The Ripple Effects of Global Tax Reform on the U.S. Economy*

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Abstract

This paper develops a quantitative general-equilibrium model to analyze the macroeconomic implications of a global minimum corporate income tax for the U.S. economy. This policy has been widely adopted by some of the United States' most important trade partners, including the European Union and Japan, under a landmark international agreement spearheaded by the OECD and the G20, but the United States itself has not yet implemented it. This inaction poses questions about the policy's potential macroeconomic impact given the United States's status as the domicile of the world's largest multinational enterprises (MNEs) and its position as the global economic leader. Our model features heterogeneous firms that make endogenous decisions about exporting, multinational production, and profit shifting, as well as a detailed representation of MNE-related provisions of the U.S. tax code, including the GILTI provision of the 2017 Tax Cuts and Jobs Act (TCJA). Through a series of counterfactual analyses, we quantify the macroeconomic consequences of TCJA's MNE-related provisions, the unilateral implementation of a global minimum corporate income tax by the U.S.'s main trading partners, and the interaction between these effects. Additionally, we evaluate the potential effects of the U.S. adopting such a policy. Our findings shed light on the complex dynamics at play and offer critical insights into the potential paths forward for U.S. policy in the context of global tax reform.

Keywords: Multinational enterprise; intangible capital; profit shifting; corporate taxation; TCJA; GILTI; global minimum corporate income tax; pillar two.

JEL Codes: **E6**, **F23**, **H25**, **H3**

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1 Introduction

In October 2021, 136 countries representing 90 percent of the world's GDP, signed a landmark agreement orchestrated by the OECD and G20 governments that aims to curtail profit shifting by multinational enterprises (MNEs). The agreement introduces two significant policy changes, or "pillars."[1] The first pillar involves revenue-based profit allocation, assigning the rights to tax a portion of an MNE's profits to the countries in which it operates in proportion to their shares of the MNE's global sales. The second pillar is a global minimum corporate income tax that requires all corporate income to be taxed at no less than 15 percent, irrespective of where it is earned.

Since the agreement's inception, the proposal has gained momentum globally, with numerous countries committing to implementing Pillar Two within the next year.[2] For instance, in December 2022, the Council of the European Union (EU) approved a directive requiring EU countries to implement Pillar Two by the end of 2023. This directive is expected to trigger widespread implementation worldwide.[3]

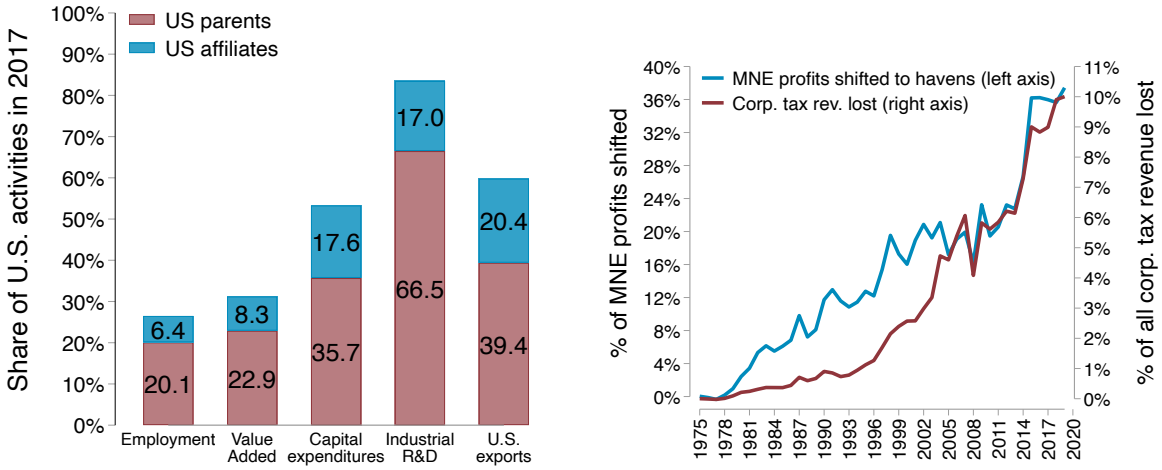
However, the United States, home to some of the largest and most economically important MNEs, has made little progress toward adopting the OECD proposal. This raises critical questions about how global corporate income tax reform in the rest of the world will affect the U.S. economy. How will U.S.-based MNEs, which are few in number but account for large shares of U.S. economic activity as shown by Figure 1, respond as foreign economies adjust? Similarly, how will the U.S. operations of foreign MNEs, which also play important roles in the U.S. economy, change? How will existing U.S. tax provisions, particularly those introduced by the Tax Cuts and Jobs Act in 2017 (TCJA) to address profit shifting, modulate these effects? What will be the macroeconomic consequences of these firm-level responses?

We address these questions by building upon the framework developed in Dyrda, Hong, and Steinberg (2022) and Dyrda, Hong, and Steinberg (2024) (collectively referred to DHS henceforth). The DHS framework, grounded in the tradition of international macroeconomics literature, is a general-equilibrium environment featuring heterogeneous firms that synthesizes key concepts from Helpman, Melitz, and Yeaple (2004) and McGrattan and Prescott (2009). It offers a comprehensive model for analyzing MNEs' decisions about the extensive and intensive margins of

[1] The press statement and a description of these pillars can be found here.

[2] Pillar Two Country Tracker, developed by PricewaterhouseCoopers, provides the status of Pillar Two implementation in different countries and regions. The tracker can be foundhere.

[3] See the press statement of the Council of the EU here.



(a) MNEs in the U.S. Economy

(b) Profit Shifting and Lost Revenues

Figure 1: Dominance of the MNEs in the U.S. economy and MNEs profit shifting.

production, as well as the effects of international profit shifting corporate tax policy on these decisions.

In the DHS framework, several "productive" regions are each home to a representative household, a large number of firms, and a government. These regions are characterized by differences in population, total factor productivity, trade and foreign direct investment (FDI) costs, and corporate income tax rates. Firms within each region choose where to export, where to establish foreign subsidiaries, the amount of labor and tangible capital to employ in both the parent division and each foreign subsidiary, the amount of intangible capital production in the parent division, and how much of the parent division's profits to shift abroad.

Intangible capital plays a pivotal role in the DHS framework. It is nonrival and can therefore be utilized simultaneously across all of an MNE's divisions. According to transfer-pricing rules, each of an MNE's affiliates pays a licensing fee for the right to use intangible capital. These licensing fees are paid to whichever division owns the intangible capital, and MNEs can transfer ownership from the parent division to foreign affiliates by paying a convex cost (accountants, lawyers, transfer-pricing analysts, et cetera). This channel is how MNEs in our model shift profits to lower-tax countries. In addition to a low-tax productive region to which MNEs based in higher-tax countries can shift profits, the model also includes an "unproductive" tax haven, inhabited only by a representative household and a government, where no economic activity occurs. In the Dyrda et al. (2024) version of the DHS model, we introduce an international externality

in intangible investment, whereby an increase in intangible investment by foreign MNEs that operate in a country makes the investments of domestic firms in that country more efficient. This assumption is consistent with empirical evidence documented by Javorcik (2004) and many others. As we show in this paper, this externality plays an important role in how global corporate tax reform would affect the U.S. economy.

In this paper, we extend the DHS framework to accurately reflect the intricacies of the U.S. tax code, particularly the provisions of the 2017 Tax Cuts and Jobs Act (TCJA) that were designed to address profit shifting. The TCJA reduced the statutory federal tax rate for all corporations from 35 percent to 21 percent, but also changed from a worldwide tax system to a territorial tax system. Under the previous worldwide system, foreign income was taxed at the domestic rate of 35 percent upon repatriation, with credits available for taxes paid abroad. Under the new territorial system, foreign corporate income is permanently exempt from U.S. taxation, albeit with certain measures to protect the U.S. tax base. One of the most important base-protection measures in the TCJA is the Global Intangible Low-Taxed Income (GILTI) provision, which imposes a 10.5 percent minimum tax on profits earned abroad that exceed a pre-defined "normal" return. This provision is thus similar to a milder version of Pillar Two, and one of the objectives of this paper is to compare and contrast the effects of these two policies, as well as the potential effects of implementing Pillar Two on top of GILTI.

We discipline the model's parameters to accurately reflect a wide array of micro- and macroeconomic data, encompassing aspects of production, trade, multinational activity, and notably, profit shifting. We categorize the world into four distinct regions: the first region (LT) comprises low-tax countries with diversified economies, including Ireland, Switzerland. The second region (TH) includes "true" tax havens such as the Caribbean, the Channel Islands, and other small economies heavily reliant on profit shifting where MNEs do not engage in meaningful amounts of productive activity. The remaining regions are delineated as the United States (US), Europe excluding the low-tax countries (EU), and the rest of the world (RW).

Our calibration emphasizes the key role multinational enterprises (MNEs) play within the U.S. economy and the global influence of U.S.-based MNEs. Despite their relatively small number, MNEs contribute to more than 30 percent of value added, account for over a quarter of employment, and are responsible for more than half of capital expenditures in the US. This significant impact positions MNEs in the upper echelon of the firm-size distribution. Our model endogenously reproduces this selection pattern, ensuring a realistic representation of MNEs' fundamental role in both the U.S. and global economies.

The calibrated model serves as our measurement device, enabling us to perform a series of counterfactual experiments to investigate the impacts of various components of the current U.S. tax system and potential reforms. First, we explore the introduction of a global minimum corporate income tax in regions outside the United States to gauge how the U.S. economy might respond to tax reforms initiated by foreign governments. Second, we study the effects of the TCJA's GILTI provision and compare them to what would happen if the United States unilaterally implemented Pillar Two. Third, we study worldwide adoption of a global minimum corporate income tax, both in the United States and abroad. Finally, we repeat each of these experiments in a version of the model without an intangible investment spillover externality to gauge the importance of this mechanism.

Our main findings are as follows. First, a global minimum corporate income tax adopted by other regions would have significant macroeconomic consequences for the United States. In fact, it would reduce U.S. GDP more than the GDP of other high-tax countries in Europe and the rest of the world. The economic mechanism behind this ripple effect is the FDI spillover externality. The reform would reduce intangible investment of MNEs based outside of the United States, which in turn would reduce the ability of U.S.-based firms to create their own intangible capital. In the absence of this externality, the reform would barely affect the U.S. economy at all.

Second, GILTI has similar effects on profit shifting by U.S.-based MNEs as Pillar Two would have. Both policies would also reduce the incentive for these MNEs to invest in intangible capital. However, there is an important difference: GILTI also increases the incentive for these MNEs to invest in tangible capital in their foreign subsidiaries as explained by Chodorow-Reich, Smith, Zidar, and Zwick (2023), and this actually increases their incentive to invest in intangible capital at home. Quantitatively, the second effect is stronger than the first, and consequently, GILTI increases U.S. GDP whereas Pillar Two would reduce it. Additionally, the outsize importance of U.S.-based MNEs for other regions' economies means that implementing Pillar Two in the United States would have significant ripple effects abroad; output in the rest of the world would fall more than U.S. output. Again, this ripple effect would be weaker in the absence of the spillover externality.

Third, worldwide adoption of Pillar Two would would reduce global GDP substantially, but the effect would be about three times smaller in the absence of FDI spillovers. When both the United States and the rest of the world adopt this policy, these spillovers create a cycle of ripple effects that dramatically magnify the economic impact: U.S.-based MNEs reduce intangible investment, which makes the investments of other countries' MNEs less effective, which in turn makes the

former's investments less effective as well, and so on.

2 Related literature

This paper contributes to several strands of literature in international economics, public finance, and macroeconomics. The first strand of literature focuses on evaluating the expected and actual effects of the TCJA's various provisions. Initial studies in this area have primarily used calibrated models to predict the TCJA's outcomes, with significant contributions from Barro and Furman (2018), Slemrod (2018), Gale, Gelfond, Krupkin, Mazur, and Toder (2019), Clausing (2020b), and Auerbach (2018), which discuss the expected economic impacts. Further empirical investigations by Garcia-Bernardo, Jansky, and Zucman (2023) and Chodorow-Reich, Smith, Zidar, and Zwick (2023) examine the TCJA's effect on profit shifting and investment behaviors, utilizing aggregate data, public filings, and administrative tax data to assess the legislation's wider economic effects. Our contribution to this strand of literature involves situating the analysis of the TCJA within a multicountry, general equilibrium model that incorporates a diverse range of firm behaviors, including decisions related to exporting and foreign direct investment (FDI). This methodological approach enables a comprehensive evaluation of the TCJA, encompassing both the direct and indirect influences on investment in tangible and intangible assets, and offers a detailed examination of the reform's extensive impact on both the domestic and international economic environments.

The second strand of literature this paper engages with revolves around the measurement of profit shifting, its macroeconomic implications, and the activities of multinational enterprises (MNEs) in this domain. Guvenen, Mataloni, Rassier, and Ruhl (2022) estimate that 38 percent of U.S. MNEs' foreign income results from profit shifting and argue that this income should be re-attributed to the domestic GDP. Similarly, Tørsløv, Wier, and Zucman (2022) find comparable levels of profit shifting on a global scale. Clausing (2020a) further concludes that profit shifting could reduce U.S. corporate tax revenues by up to a third, highlighting the significant fiscal implications of these practices.[4]

In the realm of macroeconomic research, our work in Dyrda, Hong, and Steinberg (2022) introduces a general equilibrium framework with heterogeneous firms to analyze the macroeconomic consequences of profit shifting and the effectiveness of policies designed to mitigate it. A

[4] Blouin and Robinson (2020) and Clausing (2020a) discuss the methodological challenges in estimating profit shifting's magnitude. Bolwijn, Casella, and Rigo (2018) and Crivelli, De Mooij, and Keen (2015) examine the impact of profit shifting on tax revenues in developing countries. Comprehensive reviews of the profit-shifting literature and its findings can be found in Dowd, Landefeld, and Moore (2017), Clausing (2016), and OECD (2015).

companion paper, Dyrda et al. (2024), explores the optimal design of the international corporate tax regime within a cooperative framework. Our contribution to this literature extends the framework developed in DHS in three significant ways. First, we integrate tangible capital into the model, which is essential for a quantitative analysis of the TCJA's provisions. Second, we detail the U.S. tax code and the TCJA provisions related to MNEs with precision. Most critically, we enhance the complexity of the firm's decision-making process by including endogenous decisions regarding the scale of retained earnings. This addition transforms the firm's problem into a dynamic one, significantly increasing the model's complexity and offering a more nuanced understanding of MNEs' responses to tax policies and their broader economic impacts.

Another strand emphasizes the role of nonrival intangible capital in shaping the aggregate effects of foreign direct investment (FDI). McGrattan and Prescott (2009) build a neoclassical growth model in which the representative multinational invests in intangible capital that can be used simultaneously to produce output at home and abroad, and show that this channel substantially increases the gains to openness to FDI.[5] McGrattan and Waddle (2020) use a multi-country version of this model to study the macroeconomic consequences of FDI restrictions caused by Brexit. We synthesize these two approaches by developing a model in which heterogeneous firms choose where to export, where to establish foreign affiliates, and how much to invest in nonrival intangible capital. On top of this new framework, we incorporate our theory of profit shifting, allowing firms to additionally choose whether to establish affiliates in a tax haven and how much intangible capital to shift. All this is done in the context of instiutional framework of the U.S. economy.

3 Quantitative model

The quantitative model builds closely on the version of the DHS framework in Dyrda et al. (2024). The parts of the model that are the same as in that paper are described briefly, with more attention paid to the TCJA-related changes. Time is discrete and indexed by $t = 1, 2, \ldots$. There are I regions indexed by i and j, each populated by a representative household, a measure of heterogeneous firms, and a government. Regions differ in population, total factor productivity, trade and FDI costs, and corporate income taxes. Households choose consumption, labor supply,

[5] McGrattan and Prescott (2010) show that nonrival intangible capital also has important measurement implications. Specifically, they show that it accounts for the high profitability of foreign subsidiaries of U.S. MNEs relative to U.S. subsidiaries of foreign MNEs. This helps explain why U.S. net foreign payments are positive despite the United States' negative current account and net foreign asset position—nonrival intangible capital is Hausmann and Sturzenegger (2007)'s "dark matter."

tangible investment, and bond holdings. Firms decide the following: where to export and where to open foreign subsidiaries; how much labor to hire and tangible capital to rent in the parent division and each subsidiary; and how much intangible capital to produce in the parent division. As in McGrattan and Prescott (2009). intangible capital is nonrival and is used simultaneously in all of a firm's divisions, both foreign and domestic.

Multinational firms (firms with foreign affiliates) use transfer pricing to allocate the costs of producing intangible capital across their foreign affiliates in proportion to the scale at which these affiliates use this capital. Affiliates license the right to use intangible capital from the division that owns this capital, and MNEs can shift profits by selling their intangible capital to affiliates in lower-tax regions. We denote the region with the lowest corporate income tax rate by LT. Additionally, there is an unproductive tax haven that is populated by a representative household and a government, labeled as TH, where no economic activity takes place. MNEs based in high-tax regions can transfer their intangible capital rights to either the low-tax region or the tax haven, provided that they have established affiliates there.

Throughout this section, we use capitals to denote aggregate variables and lower-cases to denote microeconomic firm-level variables. We omit time subscripts where appropriate for brevity.

3.1 Economic environment

Households. Each region i has a representative household with preferences over sequences of consumption, $\{C_{it}\}_{t=0}^{\infty}$, and labor supply, $\{L_{it}\}_{t=0}^{\infty}$, given by

$$\sum_{t=0}^{\infty} \beta^t \left[\log\left(\frac{C_{it}}{N_i}\right) + \psi_i \log\left(1 - \frac{L_{it}}{N_i}\right)\right]. \tag{1}$$

Households choose consumption, labor supply, tangible investment, $\{X_{it}\}_{t=0}^{\infty}$, and internationally-traded bonds, $\{B_{it+1}\}_{t=0}^{\infty}$ to maximize utility subject to a sequence of budget constraints,

$$P_{it}[(1+\tau_{ict})C_{it} + K_{it+1} - (1-\delta)K_{it}] + P_{bt}B_{it+1} = (1-\tau_{i\ell t})\, W_{it}L_{it} + R_{it}K_{it} + B_{it} + D_{it}, \tag{2}$$

taking the wage, W_{it}, the labor income tax rate, $\tau_{i\ell t}$, the rental rate, R_{it}, the bond price, P_{bt}, and dividends, D_{it}, as given.

Final goods. Each region has a nontradable final good that is used by households and the government for consumption. It is a constant-elasticity-of-substitution aggregate of differentiated

intermediate goods from different source countries,

$$Q_{it} = \left[\sum_{j=1}^{J} \int_{\Omega_{jit}} q_{jit}(\omega)^{\frac{\rho-1}{\rho}} d\omega \right]^{\frac{\rho}{\rho-1}}, \tag{3}$$

where $q_{jit}(\omega)$ is the quantity of intermediate variety ω from region j, Ω_{jit} is the set of intermediate goods from j available in i (determined by firms' exporting and FDI decisions specified later), and ρ is the elasticity of substitution between varieties. The demand curve for each variety can be written as

$$p_{jit}(\omega) = P_{it} Q_{it}^{\frac{1}{\rho}} q_{jit}(\omega)^{-\frac{1}{\rho}}. \tag{4}$$

The aggregate price index is

$$P_{it} = \left[\sum_{j=1}^{J} \int_{\Omega_{jit}} p_{jit}(\omega)^{1-\rho} d\omega \right]^{\frac{1}{1-\rho}}. \tag{5}$$

Production. The production technology for intermediate goods uses labor and tangible capital, which are rival, and intangible capital, which is nonrival. Each intermediate variety ω is produced by a specific firm. The production technology for a firm from i operating in j with productivity $a(\omega)$, intangible capital $z_t(\omega)$, tangible capital $k_{ijt}(\omega)$, and labor $\ell_{ijt}(\omega)$ is

$$y_{ijt}(\omega) = \sigma_{ij} A_j a(\omega) z_t(\omega)^{\phi} k_{ijt}(\omega)^{\alpha} \ell_{ijt}(\omega)^{1-\phi-\omega}. \tag{6}$$

The parameters of this technology are as follows. A_j is region j's aggregate total factor productivity. ϕ is the share of intangible capital and α is the share of tangible capital. $\sigma_{ij} \in [0,1]$ represents a technological FDI barrier as in McGrattan and Waddle (2020); we assume no barriers in domestic production, i.e., $\sigma_{ii} = 1$.

Research and development. Intermediate-good firms hire workers in their home regions to produce intangible capital. To capture the possibility of productivity spillovers in FDI, which have been documented by Javorcik (2004) and several other papers, we assume that a country's intangible-capital production technology depends on the intangible capital of foreign MNEs that operate in that country. We use the same spillover specification as Dyrda et al. (2024). A firm based in region i associated with variety ω that hires $\ell_{it}^{z}(\omega)$ R&D workers produces $z_t(\omega)$ units

of intangible capital given by

$$z_t(\omega) = A_i \ell_{it}^z(\omega) \left[\sum_{j \neq i} \int_{\Omega_{jit}} z_{jt}(\omega') \, \mathrm{d}\omega' \right]^{\upsilon}. \tag{7}$$

The parameter υ governs the strength of the spillover externality. If $\upsilon = 0$, there is no externality. The larger υ is, the more effect foreign MNEs' R&D decisions have on domestic firms' ability to produce intangible capital.

Trade and FDI. Firms can sell their products for free in the domestic market but accessing foreign markets is costly. Firms from region i pay a fixed cost κ_i^X to export and a fixed cost κ_i^F to produce locally in a foreign region. These costs are paid on a per-destination basis and are denominated in units of the home country's labor. There is also a variable exporting cost ξ_{ij} modeled as an iceberg cost. We denote a firm's set of export destinations by $J_{it}^X(\omega) \subseteq I \setminus \{i\}$ and its set of FDI destinations by $J_{it}^F(\omega) \subseteq I \setminus \{i\}$. Given these sets, the firm's resource constraints are:

$$y_{iit}(\omega) = q_{iit}(\omega) + \sum_{j \in J_{it}^X(\omega)} \xi_{ij} q_{ijt}(\omega) \tag{8}$$

$$y_{ijt} = \hat{q}_{ijt}(\omega), \; j \in J_{it}^F(\omega) \tag{9}$$

where $q_{ijt}(\omega)$ and $\hat{q}_{ijt}(\omega)$ represent exports and locally-produced products, respectively.

Transfer pricing and profit shifting. Each of a firm's affiliates pays a licensing fee for the right to use the firm's intangible capital. The licensing fee paid by the affiliate in j of a firm based in i is $\vartheta_{ijt}(\omega) z_{it}(\omega)$, where $\vartheta_{ijt}(\omega)$ is the firm's marginal revenue product of intangible capital in j. We define $\nu_{it}(\omega) z_{it}(\omega) \equiv \sum_{j \in J_{it}^F(\omega) \cup \{i\}} \vartheta_{ijt}(\omega) z_{it}(\omega)$ as the total amount of licensing fees paid across all of the firm's divisions, including the licensing fee the parent corporation "pays" itself. Firms shift profits by selling the rights to collect these licensing fees to their affiliates in the low-tax productive region (LT) and/or the unproductive tax haven (TH), provided that the fixed costs to establish these affiliates have been paid. These sales incur costs $\mathcal{C}\left(\lambda_{i,j,t}(\omega)\right) \psi_{i,j}$, where $\mathcal{C}(\lambda) = \lambda - (1-\lambda)\log(1-\lambda)$. See Dyrda et al. (2022) for a detailed treatment of our theory of profit shifting.

3.2 Corporate profits

Before describing the corporate tax system, it is helpful to define the profits earned by each of a firm's subsidiaries. In what follows, we drop time subscripts for notational brevity. We also suppress dependence of a firm's choices on its variety ω, expressing these objects instead as functions of its productivity and intangible capital; firms with the same values of a and z make the same choices regardless of which varieties they produce.

Domestic division. The pre-tax profits of a firm's domestic division are given by

$$\begin{aligned}\pi_{ii}(a,z;J_X) =& p_{ii}(q_{ii})q_{ii} + \sum_{j\in J_X} p_{ij}(q_{ij})q_{ij} + \sum_{j\in J_F}(1-\lambda_{LT}-\lambda_{TH})\vartheta_{ij}(z)z \\ & - W_i\left(\ell_{ii} + \frac{z}{A_i} + \sum_{j\in J_X}\kappa_{iX} + \sum_{j\in J_F}\kappa_{iF} + \kappa_{i,TH}\mathbb{1}_{\{\lambda_{TH}>0\}}\right) - \delta P_i k_i \\ & - W_i\left[\mathcal{C}_{i,TH}(\lambda_{TH}) + \mathcal{C}_{i,LT}(\lambda_{LT})\right]\nu_i(z)z - (\lambda_{TH}+\lambda_{LT})\vartheta_{ii}(z)z - r_i k_i.\end{aligned} \tag{10}$$

The first line contains revenues from sales and licensing the portion of intangible capital that is not transferred to the low-tax region or the tax haven. The second line contains labor costs of domestic production workers, workers hired to set up export relationships and foreign affiliates, and depreciation expenses. The last line contains labor costs of workers hired to engage in profit shifting, licensing fees paid to the low-tax region and the tax haven, and capital expenditures net of depreciation.

High-tax affiliates. The pre-tax profits of a firm's foreign affiliates in high-tax regions are simply revenues minus wages, capital costs, and licensing fees:

$$\pi_{ij}(a,z) = p_{ij}(\hat{q}_{ij})\hat{q}_{ij} - W_j\ell_j - \delta P_j k_j - \vartheta_{ij}(z)z - r_j k_j,\ j\in J_F\setminus\{LT\}. \tag{11}$$

Note that these do not depend on the decisions the firm makes about profit shifting.

Low-tax affiliate. The pre-tax profits of a firm's affiliate in the low-tax region are

$$\begin{aligned}\pi_{i,LT}(a,z;J_X) =& p_{i,LT}(\hat{q}_{i,LT})\hat{q}_{i,LT} + \sum_{j\in J_F\cup\{i\}\setminus\{LT\}}\lambda_{LT}\vartheta_{ij}(z)z \\ & - W_{LT}\ell_{LT} - \delta P_{LT}k_{LT} - (1-\lambda_{LT})\vartheta_{i,LT}(z)z - r_{LT}k_{LT}.\end{aligned} \tag{12}$$

The first line includes revenues from sales and licensing fees generated by the portion of intangible capital that is transferred to this affiliate. The second line includes labor and capital costs, and licensing fees paid on the portion of intangible capital that is retained by the parent.

Tax-haven affiliate. The pre-tax profits of a firm's affiliate in the tax-haven region, which only include licensing fees, are

$$\pi_{i,TH}(a,z) = \sum_{j \in J_F \cup \{i\}} \lambda_{TH} \vartheta_{ij}(z) z. \tag{13}$$

3.3 The TCJA's GILTI provision

The 2017 Tax Cuts and Job Act (TCJA) introduces several rules for the taxation of multinational enterprises. We focus our analysis on the global intangible low-taxed income (GILTI) provision, which is designed to discourage businesses from shifting easily movable intangible assets to low-tax jurisdictions for the purpose of profit shifting.

Consider a U.S.-based MNE with a subsidiary in region j. Its net tested income (NTI) is defined as its total revenue net of deductible expenses (wages, depreciation, and licensing fees):

$$\pi_{ij}^{NTI} = p_{ij}(\hat{q}_{ij})\hat{q}_{ij} - W_j \ell_{ij} - \delta P_j k_{ij}. \tag{14}$$

Its GILTI tax base is calculated as $\chi^{GILTI} = 50\%$ of its NTI less the Qualified Business Asset Investment (QBAI) deduction, which is defined as $\chi^{QBAI} = 10\%$ of the subsidiary's tangible assets:

$$\pi_{ij}^{GILTI} \equiv \chi^{GILTI} \times \left(\pi_{ij}^{NTI} - \chi^{QBAI} \times P_j k_{ij} \right), \tag{15}$$

The MNE's potential GILTI tax liability is then given by

$$T_{ij}^{GILTI} \equiv \tau_i \times \pi_{ij}^{GILTI}. \tag{16}$$

This tax liability is partially offset by a credit for the corporate taxes that the subsidiary pays to its host country. Deemed paid foreign taxes (DPFT) under GILTI are calculates as $\chi^{DPFT} = 80\%$ of the local taxes paid on NTI:

$$T_{ij}^{DPFT} \equiv \chi^{DPFT} \times \tau_j \times \pi_{ij}^{NTI}. \tag{17}$$

However, the foreign tax credit is limited by the fact that some of the MNE's expenses in the

United States are required to be allocated to foreign income. The model analogue of these expenses are the fixed entry costs κ_i^F to set up a foreign subsidiaries. Thus, we subtract those expenses from the GILTI tax base to define deemed foreign income (DFI):

$$\pi_{ij}^{DFI} \equiv \pi_{ij}^{GILTI} - \kappa_{ij} \tag{18}$$

The foreign tax credit limitation (FTCL) is then calculated as

$$T_{ij}^{FTCL} \equiv \tau_i \times \pi_{ij}^{DFI}, \tag{19}$$

and the foreign tax credit itself is calculated as

$$T_{ij}^{FTC} \equiv \min\left(T_{ij}^{DPFT}, T_{ij}^{FTCL}\right). \tag{20}$$

Putting these definitions together, the additional tax that must be paid to the U.S. government on top of the local paid by the foreign subsidiary, referred to as residual U.S. Tax (RT), is calculated as

$$T_{ij}^{RT} \equiv T_{ij}^{GILTI} - T_{ij}^{FTC}. \tag{21}$$

This additional tax liability is paid by the MNE's parent corporation to the U.S. government (not the government of region j).

Foreign Derived Intangible Income (FDII). Foreign Derived Intangible Income (FDII) is a special earnings category that comes from the sale of products related to intellectual property. FDII provides a tax deduction of income that belongs to this category, which lowers the effective tax rate to 13.125%. Thus, FDII aims to increase the incentive of U.S. MNEs to keep the property right and related income of their intellectual properties in the U.S.

Consider the headquarter corporation of a U.S. MNE. The calculation of FDII starts with the determination of Deemed Eligible Income and Foreign-Derived Deduction Eligible Income (FDDEI) of the company:

$$\begin{aligned}
\pi_{ii}^{DEI} &\equiv \sum_{j \in J_X \cup \{i\}} p_{ij} q_{ij} + \varphi \lambda_i z_i \sum_j \vartheta_{ij}(z_i) + (1-\lambda_i) z_i \sum_{j \neq i} \vartheta_{ij}(z_i) \\
\pi_{ii}^{FDDEI} &\equiv \sum_{j \in J_X} p_{ij} q_{ij} + \varphi \lambda_i z_i \sum_j \vartheta_{ij}(z_i) + (1-\lambda_i) z_i \sum_{j \neq i} \vartheta_{ij}(z_i)
\end{aligned} \tag{22}$$

where DEI includes all income of the headquarter corporation and FDDEI includes income from goods exports, sales of the intangible capital, and licensing fee receipts from foreign subsidiaries. The firm's FDII is then calculated as the foreign derived income minus $\chi^{QBAI} = 10\%$ of the Qualified Business Asset Investment (QBAI) portion for the purpose of foreign income, given by

$$\pi_{ii}^{FDII} \equiv \pi_{ii}^{FDDEI} - \chi^{QBAI} \times p_i k_{ii} \times \frac{\pi_{ii}^{FDDEI}}{\pi_{ii}^{DEI}}. \tag{23}$$

This company would then be allowed to deduct $\chi^{FDII} = 37.5\%$ of its FDII against its taxable income. The remaining portion is taxed at the U.S. corporate tax rate. So the FDII dedeuction is

$$\hat{T}_{ii}^{FDII} \equiv \tau_i \times \left(1 - \chi^{FDII}\right) \times \pi_{ii}^{FDII}. \tag{24}$$

Base Erosion and Anti-abuse Tax (BEAT). The Base Erosion and Anti-abuse Tax (BEAT) works as a 10% minimum tax for MNEs that pay "base erosion payments" to foreign-related entities. BEAT applies to both U.S. MNEs and foreign MNEs that have U.S. subsidiaries. The BEAT applies only to large multinational enterprises, those with gross receipts of more than $500 million. It also applies only to a corporation that makes more than 3 percent of its total deductible payments to foreign affiliates. And it is also designed to discourage U.S. and foreign MNEs from shifting profits out of the U.S.

Consider the MNE with its parent division located in a jurisdiction j with a subsidiary in the U.S., denoted by i. As with GILTI, define the MNE's net taxable income in the U.S. as $\pi_{ji}^{NTI} \equiv \pi_{ji}$. The "base erosion payments" are this corporationâs payments to a foreign subsidiary based in another country. In our case, it is the licensing fee paid to the tax haven for U.S. MNEs and the full licensing fee for foreign subsidiaries operating in the U.S.

$$\pi_{ii}^{BEAT} \equiv \lambda_i \cdot \vartheta_{ii}(z_i) z_i \tag{25}$$

$$\pi_{ji}^{BEAT} \equiv \vartheta_{ji}\left(z_j\right) z_j, \ \forall j \neq i. \tag{26}$$

Then, the BEAT modified taxable income (MTI) is $\pi_{ji}^{MTI} \equiv \pi_{ji}^{NTI} + \pi_{ji}^{BEAT}$. The BEAT works as a minimum tax: firms pay BEAT to the extent it exceeds its ordinary corporate tax liability, T_{ij}. The BEAT tax liability is then

$$T_{ji}^{BEAT} \equiv \max\left(\tau_i^{BEAT} \times \left(\pi_{ji}^{NTI} + \pi_{ji}^{BEAT}\right) - T_{ij}, 0\right) \tag{27}$$

where $\tau_i^{BEAT} = 10\%$ and will increase to 12.5% in 2026.

3.4 Global profit maximization

The objective of a firm in the model is to maximize its global after-tax profits, which are rebated to the firm's owners (the consumer in the firm's home region) as a dividend. Before stating the firm's problem formally, we explain how this dividend is computed.

It is useful to first define after-tax operating profits at the division level, which we denote by $\hat{\pi}$:

$$\hat{\pi}_{ii}(a,z;J_X) = (1-\tau_i)\left(p_{ii}(q_{ii})q_{ii} + \sum_{j\in J_X} p_{ij}q_{ij} - W_i\ell_{ii} - \delta P_i k_{ii}\right) - r_i k_{ii}, \tag{28}$$

and

$$\hat{\pi}_{ij}(a,z) = (1-\tau_j)(p_{ij}(\hat{q}_{ij})\hat{q}_{ij} - W_j\ell_{ij} - \delta P_j k_{ij}) - r_j k_{ij}. \tag{29}$$

Note that, consistent with standard accounting practices, depreciation on tangible capital is tax-deductable but other tangible-capital costs are not.

We can then express the global dividend of a U.S.-based MNE as

$$\begin{aligned}
d_i(a;J_X,J_F) = {} & \hat{\pi}_{ii}(a,z;J_X) + (1-\tau_i)\left[(1-\lambda_{LT}-\lambda_{TH})\sum_{j\in J_F}\vartheta_{ij}(z) - (\lambda_{LT}+\lambda_{TH})\vartheta_{ii}(z)\right]z \\
& + \hat{\pi}_{iLT}(a,z) + (1-\tau_{LT})\left[\lambda_{LT}\sum_{j\in J_F\cup\{i\}\setminus\{LT\}}\vartheta_{ij}(z) - (1-\lambda_{LT})\vartheta_{iLT}(z) - \varphi_{LT}\lambda_{LT}\nu_i(z)\right]z \\
& + (1-\tau_{TH})\left[\lambda_{TH}\sum_{j\in J_F\cup\{i\}}\vartheta_{ij}(z) - \varphi_{TH}\lambda_{TH}\sum_{j\in J_F\cup\{i\}}\vartheta_{ij}(z)\right]z \\
& + \sum_{j\in J_F}\hat{\pi}_{ij}(a,z) \\
& - (1-\tau_i)W_i\left[\ell^z + \sum_{j\in J_X}\kappa_i^X + \sum_{j\in J_F}\kappa_i^F + \mathbb{1}_{\{\lambda_{TH}>0\}}\kappa_i^{TH} + \left(\mathcal{C}_{i,LT}(\lambda_{LT}) + \mathcal{C}_{i,TH}(\lambda_{TH})\right)\nu_i(z)z\right] \\
& - \sum_{j\in J_F} T_{ij}^{RT}(a,z) - T_{iLT}^{RT}(a,z) - T_{iTH}^{RT}(a,z)
\end{aligned} \tag{30}$$

The dividend of an MNE based in one of the other regions is similar, except that the terms in the last line, which are are related to the GILTI provision, are zero.

The firm's objective is to maximize its dividend payout defined in (30) by choosing the fol-

lowing objects: where to export and open foreign affiliates, J_X and J_F; how much intangible capital to produce, z; how much local labor and tangible capital to hire in each of its divisions, $\boldsymbol{\ell} = (\ell_{ij})_{j\in I}$ and $\boldsymbol{k} = (k_{ij})_{j\in I}$; how much to sell to each of its markets through exporting and/or FDI, $\boldsymbol{q} = (q_{ij}, \hat{q}_{ij})_{j\in I}$; and how much of its intangible capital property rights to shift, $\boldsymbol{\lambda} = (\lambda_{LT}, \lambda_{TH})$. We denote the firm's policy functions by $z_{it}(a)$, $J_{iXt}(a)$, $J_{iFt}(a)$, $\boldsymbol{\ell}_t(a)$, $\boldsymbol{k}_t(a)$, $\boldsymbol{q}_{it}(a)$, $\boldsymbol{p}_{it}(a)$, $\boldsymbol{\lambda}_t(a)$, and $\vartheta_{it}(a)$. Note again that all firms with the same productivities will make the same choices, regardless of which variety they produce.

3.5 Aggregation and accounting measures

We revert to expressing firms' choices as functions of their varieties (ω) for notational brevity in defining national accounting measures and other macroeconomic aggregates.

Gross domestic product. Nominal GDP in each region i is the total value of goods produced by domestic firms and local affiliates of foreign MNEs:

$$GDP_{it} = \sum_{j=1}^{I} \int_{\omega\in\Omega_j, i\in J_{Ft}(\omega)} p_{jit}(\omega) q_{jit}(\omega)\, d\omega. \tag{31}$$

We compute real GDP by deflating by the consumer price index P_{it} defined in (5).

Goods trade. Aggregate exports and imports of goods are given by

$$EX_{it}^G = \sum_{j\neq i} \int_{\Omega_i} p_{ijt}(\omega)\left(1+\xi_{ij}\right) q_{ijt}(\omega)\, d\omega, \tag{32}$$

$$IM_{it}^G = \sum_{j\neq i} \int_{\Omega_j} p_{jit}(\omega)\left(1+\xi_{ji}\right) q_{jit}(\omega)\, d\omega. \tag{33}$$

where ξ_{ji} is the bilateral trade cost from region j to region i.

Services trade. Intangible capital licensing fees enter the national accounts as net exports of intellectual property services. High-tax regions' services trade flows are given by

$$EX_{it}^S = \sum_{j\neq i} \int_{\Omega_i} \left[1-\lambda_{LT,t}(\omega)-\lambda_{TH,t}(\omega)\right] \vartheta_{ijt}(\omega) z_{it}(\omega)\, d\omega, \tag{34}$$

$$IM_{it}^S = \sum_{j\neq i} \int_{\Omega_i} \left[\lambda_{LT,t}(\omega)+\lambda_{TH,t}(\omega)\right] \vartheta_{ijt}(\omega) z_{it}(\omega)\, d\omega + \sum_{j\neq i} \int_{\Omega_j} \vartheta_{jit}(\omega) z_{it}(\omega)\, d\omega. \tag{35}$$

The low-tax region's services trade flows are

$$EX^S_{LT,t} = \sum_{j \neq i} \int_{\Omega_i} \left[1 - \lambda_{TH,t}(\omega)\right] \vartheta_{ijt}(\omega) z_{it}(\omega)\ d\omega + \sum_{j \neq i} \int_{\Omega_j} \lambda_{LT,t} \vartheta_{jit}(\omega) z_{it}(\omega)\ d\omega, \tag{36}$$

$$IM^S_{LT,t} = \sum_{j \neq i} \int_{\Omega_i} \lambda_{TH,t}(\omega) \vartheta_{ijt}(\omega) z_{it}(\omega)\ d\omega + \sum_{j \neq i} \int_{\Omega_j} \left[1 - \lambda_{LT,t}(\omega)\right] \vartheta_{jit}(\omega) z_{it}(\omega)\ d\omega. \tag{37}$$

We can also write the tax haven's services exports as

$$EX^S_{TH,t} = \sum_{j=1}^{I} \int_{\Omega_j} \lambda_{TH,t} \vartheta_{jit}(\omega) z_{it}(\omega)\ d\omega. \tag{38}$$

Net factor receipts and payments. Net factor receipts from (payments to) are the sum total of the dividends paid by foreign subsidiaries of domestic multinationals (domestic subsidiaries of foreign multinationals):

$$NFR_{it} = \sum_{j \neq i} \int_{\Omega_i} d_{ijt}(\omega)\ d\omega, \tag{39}$$

$$NFP_{it} = \sum_{j \neq i} \int_{\Omega_j} d_{jit}(\omega)\ d\omega \tag{40}$$

where $d_{ijt}(\omega)$ is defined in (30).

Measuring profit shifting. Following Dyrda et al. (2022), we define $\tilde{\pi}_{ijt}(\omega)$ as the profits a firm would have reported in region j if it did not shift profits, holding fixed all of its other policy functions. Then, we can define the profits shifted out of region j by firm ω as

$$ps_{ijt}(\omega) = \tilde{\pi}_{ijt}(\omega) - \pi_{ijt}(\omega). \tag{41}$$

When $ps_{ijt}(\omega) > 0$, this indicates that the firm would book more profits in region j in the absence of profit shifting, i.e., the firm has shifted profits away from region j. Aggregating firm-level shifted profits yields the total profits shifted out of region j:

$$PS_{jt} = \sum_{i=1}^{I} \int_{\Omega_i} ps_{ijt}(\omega)\ d\omega. \tag{42}$$

3.6 Market clearing and equilibrium

In equilibrium, the government's budget constraint must be satisfied, the markets for labor, capital, and final goods must be satisfied, and the balance of payments must hold in each productive region.

Government budget constraint. Government spending, G_i, must equal revenue from labor income taxes and corporate taxes:

$$P_{it}G_{it} = \tau_{i\ell t}W_{it}L_{it} + \sum_{j=1}^{I}\int_{\Omega_j} T_{jit}(\omega)\ d\omega \tag{43}$$

where we define T_{jit} as total tax liabilities that an MNE based in region j pays in region i. For corporations in the U.S., we have

$$T_{iit}(\omega) = \tau_{it}\pi_{iit}(\omega) + \sum_{j\in J_F\cup TH} T^{RT}_{ijt}(\omega), \tag{44}$$

$$T_{jit}(\omega) = \tau_{it}\pi_{jit}(\omega),\ j \neq i. \tag{45}$$

For corporations in other non-U.S. regions, we have

$$T_{jit}(\omega) = \tau_i\pi_{jit}(\omega),\ \forall j \tag{46}$$

Government consumption, G_i, is an exogenous parameter that we set equal to total tax revenues in our calibration and hold fixed in our counterfactual experiments.

Labor market. Labor demand comes from four sources: production of intermediate goods; production of intangible capital; fixed costs of exporting and setting up foreign affiliates; and the costs of transferring intangible capital. The labor market clearing condition can be written as

$$\begin{aligned} L_{it} = &\sum_{j=1}^{I}\int_{\Omega_j} \ell_{jit}(\omega)\ d\omega + \int_{\Omega_i}\left[\ell^z_{it}(\omega) + \sum_{j\in J_{Xt}(\omega)}\kappa_{iX} + \sum_{j\in J_{Ft}(\omega)}\kappa_{iF} + \mathbb{1}_{\{\lambda_{TH,t}(\omega)>0\}}\kappa_{i,TH}\right] d\omega \\ &+ \int_{\Omega_i}\left[\mathcal{C}_{i,TH}(\lambda_{TH,t}(\omega)) + \mathcal{C}_{i,LT}(\lambda_{LT,t}(\omega))\right]\nu(\omega)z_{it}(\omega)\ d\omega. \end{aligned} \tag{47}$$

Capital market. The capital market clearing condition is

$$K_{it} = \sum_{j=1}^{I} \int_{\Omega_j} k_{jit}(\omega)\, d\omega. \tag{48}$$

Final goods market. Final goods market clearing requires that production of final goods equals the sum of private consumption, public consumption, and investment in each region:

$$Q_{it} = C_{it} + G_i + X_{it}. \tag{49}$$

Balance of payments. Each region's balance of payments must hold:

$$EX_{it}^G + EX_{it}^S - IM_{it}^G - IM_{it}^S + NFR_{it} - NFP_{it} = P_{bt}B_{it+1} - B_{it}. \tag{50}$$

Competitive equilibrium. Given a set of parameters, an equilibrium in our model is a sequence of bond prices, $\{Q_t\}_{t=0}^{\infty}$, a sequence aggregate prices and quantities for each region, $\{W_{it}, P_{it}, C_{it}, L_{it}\}_{t=0}^{\infty}$, and a sequence of firm-level policy functions for each region, $\{J_{iXt}(\omega), J_{iFt}(\omega), z_{it}(\omega), \boldsymbol{\ell}_{it}(\omega), \boldsymbol{k}_{it}(\omega)\boldsymbol{q}_{it}(\omega), \boldsymbol{p}_{it}(\omega), \boldsymbol{\pi}_{it}(\omega), \boldsymbol{\lambda}_{it}(\omega)\}_{t=0}^{\infty}$, that satisfy

1. the representative household's utility maximization problem (1)–(5);
2. the firm's profit-maximization problem (30);
3. the labor market clearing condition (47);
4. the capital market clearing condition (48);
5. the government's budget constraint (43); and
6. the balance of payments (50).

A stationary equilibrium is a competitive equilibrium in which the objects listed above are constant over time. In this paper, we restrict attention to stationary equilibria in which all regions have balanced current accounts, i.e., $B_{it+1} = 0$ for all i.

4 Effects of GILTI vs. Pillar Two on profit shifting

Before taking the model to the data and discussing our quantitative results, we analytically characterize the effects of a global minimum corporate income tax on profit shifting and compare them with the effects of the GILTI provision. In Dyrda et al. (2022), we show that without a global minimum corporate income tax or GILTI, the profit-maximizing amount of profit shifting is given by

$$\lambda_{ijt}(\omega) = 1 - \exp\left[\frac{1}{\varphi_{ij}} \frac{(\tau_i - \tau_j)}{W_i(1-\tau_i)}\right], j \in \{LT, TH\}. \tag{51}$$

This expression says that a firm based in high-tax region i will sell more intangible capital to profit shifting destination j if the domestic corporate tax rate, τ_i, is higher, the profit-shifting destination's corporate tax rate, τ_j, is lower, or the cost of shifting profits to that destination, φ_{ij}, is lower.

It is straightforward to show that with a global minimum corporate tax rate of $\underline{\tau}$, the solution to the firm's problem becomes

$$\lambda_{ijt}(\omega) = 1 - \exp\left[\frac{1}{\varphi_{ij}} \frac{(\tau_i - \max(\underline{\tau}, \tau_j))}{W_i(1-\tau_i)}\right], j \in \{LT, TH\}. \tag{52}$$

This illustrates how such a policy reduces profit shifting. If the profit-shifting destination's tax rate is lower than the global minimum tax rate, then the firm will act as if the former is equal to the latter. The higher the minimum tax rate, the less intangible capital the firm will shift to region j, regardless of that region's statutory tax rate.

Under the GILTI provision, the profit-maximizing solution for $\lambda_{jt}(\omega)$ is

$$\lambda_{ijt}(\omega) = 1 - \exp\left[\frac{1}{\varphi_{ij}} \frac{(1-\chi^{GILTI})\tau_i - (1-\chi^{DPFT})\tau_j}{W_i(1-\tau_i)}\right], j \in \{LT, TH\}. \tag{53}$$

This expression is decreasing in the size of the GILTI tax base, which is governed by χ^{GILTI}, and decreasing in the size of the credit for foreign taxes paid, which is governed by χ^{DPFT}. It should be clear that for any global minimum tax rate $\underline{\tau}$, one can find values of χ^{GILTI} and χ^{DPFT} that yield the same solution for $\lambda_{ijt}(\omega)$. In this sense, the two policies are substitutes in terms of their effects on profit shifting. Thus, while the U.S. government may be unlikely to implement Pillar Two, the GILTI provision of the TCJA may actually have similar effects.

However, the implications for firms' production decisions are not equivalent. In Dyrda et al.

(2022) we show that intangible investment is increasing in $\lambda_{ijt}(\omega)$, which implies that a global minimum corporate income tax reduces the profit-maximizing level of intangible investment. While this effect applies to GILTI as well, there is another offsetting effect. As explained by Chodorow-Reich et al. (2023), the QBAI deduction creates an incentive for MNEs to increase tangible investment in their foreign subsidiaries to reduce the GILTI tax base. This increase in tangible investment raises an MNE's global marginal revenue product of intangible capital, which in turn raises the profit-maximizing level of intangible investment. In our quantitative analysis below, we show that the QBAI effect dominates the first effect: on net, GILTI increases MNEs' intangible investment and ultimately the level of aggregate output in the United States. As we will show, this makes GILTI a more effective way of raising corporate tax revenue than Pillar Two.

5 Calibration

We use the same calibration strategy as in Dyrda et al. (2024). First, we partition to world into five regions: the United States (NA), Europe (EU), the low-tax region (LT), the tax haven (TH), and the rest of the world (RW). The low-tax region includes includes Belgium, Ireland, Hong Kong, the Netherlands, Singapore, and Switzerland. The tax-haven region includes several small European countries and territories like Cyprus and the Isle of Man, as well as a number of Caribbean countries like the Bahamas and the Cayman Islands. second, we compute region-level data on production, trade, FDI, and profit shifting by aggregating or averaging country-level data as appropriate. Third, we choose parameter values so that the model matches these data. The key parameters and the data moments that discipline them are listed below and the values are shown in Table 1.

- Population (N_i): Taken directly from the data.
- Corporate tax rates (τ_i): From Tørsløv et al. (2022).
- Labor income tax rates (τ_i^ℓ): Set to 22.4% based om McGrattan and Waddle (2020).
- Aggregate TFP (A_i): Identified by real GDP per capita.
- Utility weight on leisure (ψ_i): Identified by labor supply, which is set to one-third of the population.
- Intangible share (ϕ): Identified by the intangible income share of foreign MNEs' local affiliates.

- Trade costs (κ_i^F and ξ_{ij}): Identified by the export participation rate and bilateral trade flows.
- FDI costs (κ_i^F and σ_i): Identified by the share of firms that are MNEs and the GDP share of foreign MNEs' local affiliates.
- Profit-shifting costs ($\kappa_{i,TH}$, $\psi_{i,LT}$, and $\psi_{i,TH}$): Identified by the share of firms with affiliates in the tax-haven region, and aggregate profits shifted to the low-tax region and tax-haven region, respectively.
- Spillover parameter (υ): Identified by the ffect of FDI on domestic firms' productivity as estimated by Javorcik (2004).

6 Results

Having explained the model and its calibration, we now proceed to explain the results of our experiments. First, we study the effects of a global minimum corporate income tax in all regions of the world economy except for the United States, which we view as the most likely outcome moving forward. Second, we study the effects of the GILTI provision, which we have argued is similar to a weaker version of a global minimum tax in the United States, and compare the former to the latter. Third, we study the effects of a global minimum corporate income tax in all regions of the world economy, including the United States. We conduct two versions of each exercises: in our baseline model with spillovers, and in an alternative model without spillovers. As we will see, spillovers play a crucial role in creating what we call ripple effects: large responses in one region to a tax reform in other regions.

6.1 Pillar Two implementation outside the United States

We first study the effects of a global minimum corporate income tax rate of 15% as prescribed by Pillar Two in all productive regions of the world economy except for the United States (EU, LT, and RW). Table 2 shows the results of this experiment, with the results from the baseline model with spillovers shown in panel (a) and the results from the no-spillover model shown in panel (b).

The direct effects of this reform are seen primarily in the behavior of MNEs based in Europe and the rest of the world. Profit shifting in these regions falls dramatically, by 71% in Europe and 76% in the rest of the world, and tax revenues in these regions rise commensurately. At the same time, faced with higher effective tax rates on their intangible income, MNEs based in these

Table 1: Calibration

Statistic or parameter value	US	Europe	Low-tax	RoW	Tax haven
(a) Assigned parameters and target moments					
Population (NA = 100)	100	137	17	2,041	–
Real GDP (NA = 100)	100	98	18	383	–
Corporate tax rate (%)	21.0	17.3	11.4	17.4	3.3
Foreign MNEs' VA share (%)	11.12	19.82	28.73	9.55	–
Total lost profits ($B)	143	216	–	257	–
Lost profits to TH (%)	66.4	44.5	–	71.1	–
Imports from... (% GDP)					
North America	–	1.54	0.33	8.92	–
Europe	1.01	–	2.99	8.24	–
Low tax	1.49	12.43	–	7.89	–
Row	2.36	3.70	0.59	–	–
(b) Calibrated parameter values					
TFP (A_i)	1.00	0.76	1.19	0.24	–
Prod. dispersion (η_i)	4.74	4.75	5.23	4.59	–
Utility weight on leisure (ψ_i)	1.41	1.43	1.43	1.42	–
Fixed export cost (κ_i^X)	3.8e-3	7.5e-3	2.0e-3	3.1e-2	–
Variable FDI cost (σ_i)	0.44	0.54	0.51	0.54	–
Fixed FDI cost (κ_i^F)	2.33	3.02	0.91	16.0	–
Cost of shifting profits to LT (ψ_{iLT})	2.59	0.43	–	3.29	–
Cost of shifting profits to TH (ψ_{iTH})	2.17	1.39	–	2.42	–
Fixed FDI cost to TH (κ_i^{TH})	0.10	0.10	–	0.90	–
Variable export cost (ξ_{ij}) from ...					
North America	–	3.09	3.31	1.75	–
Europe	2.09	–	1.73	1.33	–
Low tax	2.20	1.57	–	1.53	–
RoW	2.24	2.59	3.07	–	–

Notes: Population and real GDP from World Bank WDI. Corporate tax rate from Tørsløv et al. (2022). Foreign MNEs' VA share from OECD AMNE database. Fractions of firms with foreign affiliates from Compustat. Lost profits from Tørsløv et al. (2022). Imports/GDP from WIOD. Dashes (–) represent "not applicable."

regions reduce intangible investment substantially, by about half a percent in the case of Europe and about a fifth of a percent in the rest of the world. This reduces the output of these MNEs in their respective home regions, ultimately dragging down aggregate output in these regions by about 0.05% each.

In the baseline model, this reform also has large indirect effects in equilibrium—what we

Table 2: Macroeconomic effects of global minimum corporate income tax outside United States

Region	Lost profits (benchmark = 1)	Corp. tax rev. (% chg.)	Value added (% chg.)				Intangible capital (% chg.)		
			Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
(a) Baseline model									
USA	1.00	-0.03	-0.09	-0.08	-0.08	-0.16	-0.05	-0.09	-0.05
Europe	0.29	2.92	-0.05	0.02	-0.13	-0.03	-0.39	0.01	-0.43
Rest of world	0.24	1.30	-0.06	-0.03	-0.08	-0.09	-0.20	-0.03	-0.21
Low tax	0.56	-6.68	0.00	0.31	0.04	-0.51	0.14	0.36	0.11
(b) No spillovers									
USA	1.00	-0.01	-0.00	0.00	0.01	-0.07	0.02	0.00	0.02
Europe	0.29	2.97	0.01	0.07	-0.08	0.05	-0.34	0.07	-0.38
Rest of world	0.24	1.32	0.01	0.04	-0.02	0.01	-0.13	0.05	-0.15
Low tax	0.56	-6.64	0.10	0.42	0.16	-0.45	0.26	0.49	0.23

Notes: Lost profits are measured relative to the status quo. Note that for the low-tax region, lost profits are negative in both the benchmark equilibrium and in the policy counterfactuals, i.e., profits are shifted inward to the low-tax region. A number less than one indicates a drop in profits shifted to the low-tax region.

refer to as ripple effects—in the United States. In fact, aggregate output in the United States falls by almost twice as much as in Europe and the rest of the world. This is driven by a reduction in intangible investment across all U.S. firms, even though none of these firms are directly affected by the reform. Comparing panel (a) with panel (b), we can see that this ripple effect is driven by the FDI spillover externality. In the baseline model with a spillover, the reduction in intangible investment by MNEs from Europe and the rest of the world makes U.S. firms less effective at doing their own intangible investment, because these foreign MNEs have large presences in the U.S. economy. In the no-spillover model, although these MNEs reduce intangible investment by a very similar amount as in the baseline, there is essentially no effect on U.S. firms' intangible investments or the U.S. economy as a whole. Thus, these spillovers play a crucial role in transmitting the effects of the reform in to the United States.

There is also a ripple effect on the low-tax productive region. Firms based in this region actually increase their intangible investment due a decline in input costs triggered by a reduction in labor demand from MNEs based in Europe and the rest of the world. In the model without spillovers, the increase in domestic firms' output approximately offsets the decline in the output of foreign MNEs' affiliates, resulting in essentially no change in aggregate output. In the model with spillovers, though, output in the low-tax region falls, both because this region's firms become less

effective at producing intangible capital, but also because of the response of U.S.-based MNEs, who account for an outsize fraction of low-tax region output.

6.2 GILTI vs. Pillar Two in the United States only

Next, we study the effects of the GILTI provision of the TCJA, and compare them to the effects of a global minimum corporate income tax implemented unilaterally by the United States. Table 3 compares outcomes in the calibrated model versus a counterfactual where the GILTI provision is removed from the U.S. tax code. As in the previous exercise, panel (a) shows results in the baseline model and panel (b) shows results in the model without spillovers. However, the effects are essentially the same in both cases so we discuss only the baseline results.

Consistent with our theoretical analysis above, the GILTI provision reduces profit shifting by U.S.-based MNEs by 16%, which increases U.S. tax revenues about 1%. The macroeconomic effect in the United States is positive but small. This is the result of two countervailing forces. On the one hand, GILTI reduces the effective after-tax rate of return on intangible income, which reduces the incentive for these MNEs to invest in intangible capital as in Dyrda et al. (2022). On the other hand, GILTI increases tangible investment in foreign subsidiaries as described by Chodorow-Reich et al. (2023). This second effect increases the marginal product of intangible capital in these subsidiaries, and because intangible capital is nonrival, this in turn increases the after-tax return on intangible investment. Quantitatively, the second channel is slightly stronger than the first, leading to a small increase in intangible investment by U.S. MNEs in equilibrium. In the case of GILTI, there is a ripple effect in other regions regardless of the presence of spillovers: aggregate output rises in Europe, the rest of the world, and the low-tax region in both versions of the model. This is because the effects of GILTI on the foreign subsidiaries of U.S. MNEs operate primarily through the tangible investment channel described by Chodorow-Reich et al. (2023), rather than the nonrivalrly of intangible capital described by Dyrda et al. (2022). One other interesting finding concerns the low-tax region, where the total amount of profits shifted in does not change at all. This is because profit shifting among U.S. firms falls, but the quantity of profits shifting by MNEs based in Europe and the rest of the world rises due to the positive ripple effects.

Table 4 shows the effects of introducing a global minimum tax in the United States but not in the other regions. Lost profits fall by 53%, more than three times the effect of the GILTI provision. Thus, in terms of profit shifting, it is indeed the case that GILTI acts like a partial substitute for Pillar Two. Interestingly, despite the much larger drop in profit shifting, a global minimum tax in the United States increases corporate tax revenue only slightly more than the GILTI provision,

1.12% vs. 1.01%. This is because output in the United States falls under the global minimum tax. The reason is that unlike GILTI, the global minimum tax unambiguously reduces the incentives of U.S. MNEs to invest in intangible capital. Thus, GILTI appears to be a superior way to increase corporate tax revenue.

Table 3: Macroeconomic effects of the GILTI provision

Region	Lost profits (benchmark = 1)	Corp. tax rev. (% chg.)	Value added (% chg.)				Intangible capital (% chg.)		
			Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
(a) Baseline model									
USA	0.84	1.01	0.02	0.03	0.01	0.03	0.03	0.02	0.03
Europe	1.00	0.00	0.02	0.02	0.02	0.01	-0.00	0.00	-0.00
Rest of world	1.00	0.00	0.02	0.02	0.02	0.01	0.00	0.00	0.00
Low tax	1.00	-0.02	0.07	0.11	-0.02	0.09	-0.02	0.05	-0.03
(b) No spillovers									
USA	0.84	1.01	0.02	0.03	0.01	0.03	0.03	0.02	0.03
Europe	1.00	0.00	0.02	0.02	0.02	0.01	-0.00	0.00	-0.00
Rest of world	1.00	-0.00	0.01	0.02	0.02	0.01	-0.00	0.00	-0.00
Low tax	1.00	-0.03	0.07	0.12	-0.02	0.09	-0.02	0.06	-0.03

Notes: Lost profits are measured relative to the model without GILTI. Note that for the low-tax region, lost profits are negative in both the benchmark equilibrium and in the policy counterfactuals, i.e., profits are shifted inward to the low-tax region. A number less than one indicates a drop in profits shifted to the low-tax region.

The ripple effects of a global minimum corporate tax in the United States are quite large. In fact, in the baseline model output falls more in Europe and the rest of the world than in the United States. This mirrors the result from Section 6.1 where we saw that a global minimum tax in other regions has larger macro effects in the United States. Spillovers play a smaller role in the ripple effects here, however; even in the model without spillovers output in Europe and the rest of the world declines substantially. The reason for this difference is the outsize importance of U.S.-based MNEs in these countries, relative to the importance of foreign MNEs in the United States. The drop in U.S. MNEs' intangible investment caused by a global minimum tax in the United States materially reduces output in Europe and the rest of the world regardless of the presence of spillovers. In the baseline model, the ripple effects are amplified because the spillovers cause MNEs in these regions to do less intangible investment themselves. Nevertheless, it is clear that spillovers play a larger role in inward ripple effects on the U.S. economy caused by reforms in other regions than outward ripple effects on other regions caused by U.S. reforms.

Table 4: Macroeconomic effects of global minimum corporate income tax in United States only

Region	Lost profits (benchmark = 1)	Corp. tax rev. (% chg.)	Value added (% chg.)				Intangible capital (% chg.)		
			Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
(a) Baseline model									
USA	0.47	1.12	-0.05	-0.01	-0.09	-0.06	-0.25	0.05	-0.28
Europe	1.00	-0.03	-0.09	-0.08	-0.08	-0.11	-0.02	-0.02	-0.01
Rest of world	1.00	-0.02	-0.11	-0.11	-0.11	-0.10	-0.04	-0.05	-0.04
Low tax	0.94	-0.97	-0.01	0.16	-0.08	-0.23	0.02	0.17	0.00
(b) No spillovers									
USA	0.47	1.13	-0.04	-0.00	-0.08	-0.01	-0.25	0.06	-0.27
Europe	1.00	-0.01	-0.06	-0.06	-0.05	-0.07	0.01	0.00	0.01
Rest of world	1.00	-0.01	-0.06	-0.06	-0.05	-0.08	0.00	0.00	0.00
Low tax	0.94	-0.94	0.02	0.18	-0.05	-0.19	0.04	0.20	0.02

Notes: Lost profits are measured relative to the status quo. Note that for the low-tax region, lost profits are negative in both the benchmark equilibrium and in the policy counterfactuals, i.e., profits are shifted inward to the low-tax region. A number less than one indicates a drop in profits shifted to the low-tax region.

6.3 Worldwide Pillar Two implementation

We now study the effects of implementing a global minimum corporate income tax in all productive regions: the United States, Europe, the rest of the world, and the low-tax region. Table 5 shows the results.

The overall effect on profit shifting is impressive. Lost profits in the three high-tax regions fall by the same amounts as described in the previous exercises above: 53% for the United States as in Section 6.2, and 71% and 76% respectively for Europe and the rest of the world as in Section 6.1. Profits shifted inward to the low-tax region fall by a full 50%. However, there are also large macroeconomic effects. Output falls in all four productive regions and global GDP falls by about 0.16%. Comparing panels (a) and (b), we see that these macro effects are driven even more strongly by the FDI spillover externality than in the previous exercises. Intangible investment by MNEs in all three high-tax productive regions declines even in the absence of this externality, which means that in its presence there is a large self-reinforcing effect on worldwide intangible investment efficiency.

Table 5: Macroeconomic effects of worldwide global minimum corporate income tax

Region	Lost profits (benchmark = 1)	Corp. tax rev. (% chg.)	Value added (% chg.)				Intangible capital (% chg.)		
			Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
(a) Baseline model									
USA	0.47	1.09	-0.15	-0.10	-0.17	-0.23	-0.30	-0.04	-0.33
Europe	0.29	2.89	-0.14	-0.07	-0.21	-0.15	-0.41	-0.02	-0.45
Rest of world	0.24	1.28	-0.19	-0.17	-0.20	-0.19	-0.24	-0.10	-0.25
Low tax	0.50	-7.65	-0.10	0.26	-0.02	-0.71	0.16	0.38	0.13
(b) No spillovers									
USA	0.47	1.13	-0.04	0.00	-0.08	-0.08	-0.23	0.07	-0.25
Europe	0.29	2.96	-0.05	0.01	-0.13	-0.02	-0.33	0.07	-0.38
Rest of world	0.24	1.32	-0.06	-0.04	-0.07	-0.06	-0.12	0.03	-0.14
Low tax	0.50	-7.58	0.04	0.40	0.14	-0.61	0.31	0.55	0.28

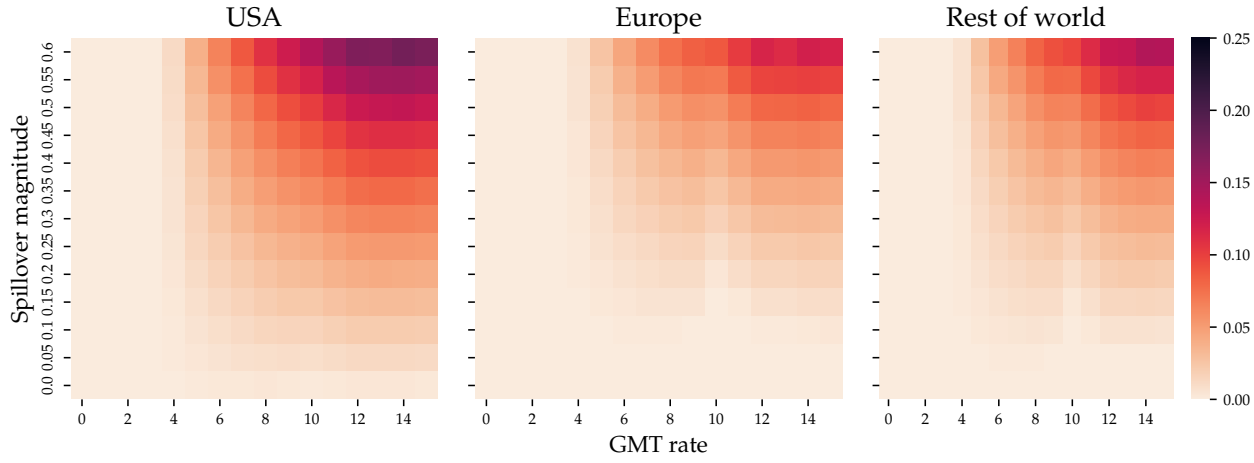
Notes: Lost profits are measured relative to the status quo. Note that for the low-tax region, lost profits are negative in both the benchmark equilibrium and in the policy counterfactuals, i.e., profits are shifted inward to the low-tax region. A number less than one indicates a drop in profits shifted to the low-tax region.

6.4 Sensitivity to spillover intensity

Our results indicate that the cross-country ripple effects of anti-profit-shifting tax reforms are driven in part by an externality associated with foreign direct investment, whereby R&D efforts of foreign MNEs make local firms' efforts more effective. Here, we study the sensitivity of our results to the strength of this externality.

Figure 2 shows how the results Pillar Two implementation outside of the United States vary with the strength of the spillover. Each panel in the figure shows how the effect on a given region's GDP changes as the spillover parameter, v, varies. We also allow the global minimum tax rate to vary to investigate whether there are any nonlinearities with associated with the policy stringency, and how these potential nonlinearities interact with the spillover. When there are no spillovers, the macro effects are mild regardless off the minimum tax rate. When there are weak spillovers, the macro effects emerge gradually as the minimum tax rate rises. But when there are strong spillovers, the macro effects emerge in a highly nonlinear way once the minimum tax rate passes about seven percent, especially in the United States. Interestingly, the macroeconomic effects of this reform are always larger in the United States than in Europe and the rest of the world, regardless of the parameter configuration.

Figure 2: Effects of Pillar Two implementation outside the United States vs. spillover strength

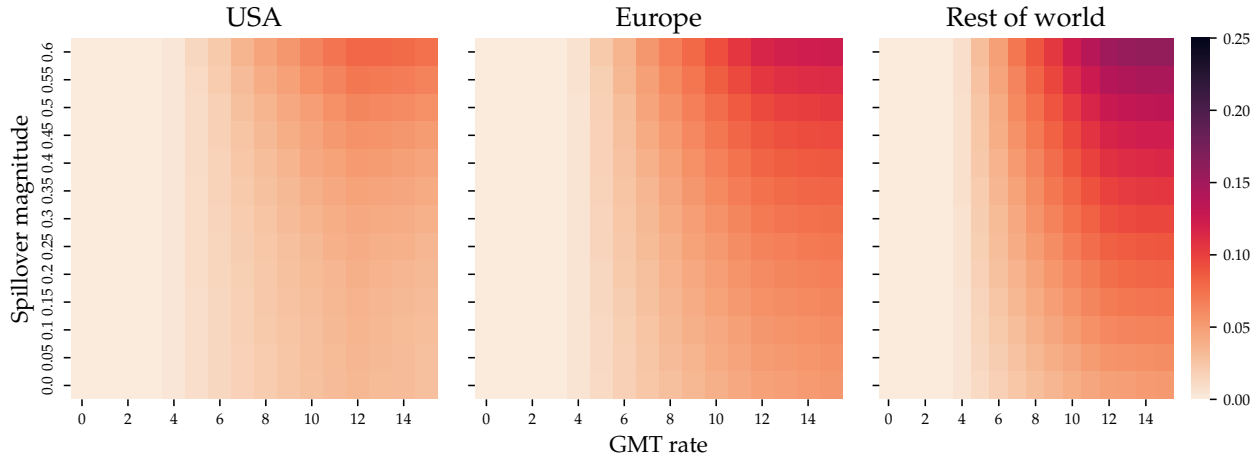


Notes: Figure shows effects of Pillar Two implementation by all regions except the United States on real GDP. x-axis in each figure is the global minimum tax rate. y-axis is the value of the spillover parameter v. Color in each cell indicates percent decline in real GDP.

Figure 3 shows how the results of unilateral Pillar Two implementation by the United States only vary with the strength of the spillover. The graph has the same structure as the previous one. When the spillover is weak, the macro effects are similar in Europe and the rest of the world. When the spillover is strong, the effects are much larger in the latter, although there is less nonlinearity than in the previous experiment. Here, the effects are always smallest in the United States regardless of the parameter configuration, which highlights once again the outsized importance of U.S.-based MNEs in other regions' economies.

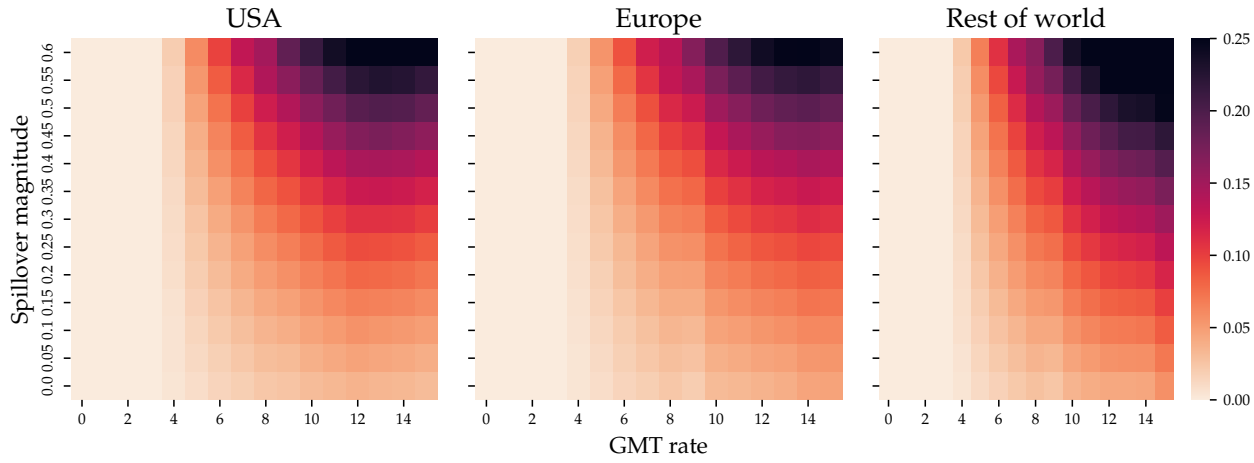
Finally, Figure 4 shows how the results of worldwide Pillar Two implementation vary with the strength of the spillover. There is a very clear interaction between the strength of the spillover and the stringency of the policy. When spillovers are weak, the macro effects are fairly small in all regions, although very high minimum tax rates still noticeably reduce output in the rest of the world. When spillovers are moderate (as in the calibration), material macro effects emerge gradually when the minimum tax rate passes 9–10%. When spillovers are strong, there is a very sharp nonlinearity when the minimum tax rate passes 7%, after which substantial GDP losses begin to show. The effects are more evenly distributed across the world economy in this case than in the previous two cases.

Figure 3: Effects of Pillar Two implementation in U.S. only vs. spillover strength



Notes: Figure shows effects of Pillar Two implementation by United States only on real GDP. x-axis in each figure is the global minimum tax rate. y-axis is the value of the spillover parameter v. Color in each cell indicates percent decline in real GDP.

Figure 4: Effects of worldwide Pillar Two implementation vs. spillover strength



Notes: Figure shows effects of Pillar Two implementation by all regions on real GDP. x-axis in each figure is the global minimum tax rate. y-axis is the value of the spillover parameter v. Color in each cell indicates percent decline in real GDP.

7 Conclusion

We have used a quantitative general-equilibrium model to conduct a comprehensive exploration of the potential consequences of the global corporate tax reform initiatives spearheaded by the OECD and G20. Our findings indicate that if other countries implement a global minimum

corporate income tax, the largest macroeconomic effects would actually be felt in U.S. economy. Conversely, if the United States were to implement such a policy unilaterally, the largest economic effects would be felt abroad. There are two key forces driving these surprising results: (i) the outsized importance of U.S.-based multinational enterprises in the economies of both the United States as well as other countries; and (ii) the positive externalities associated with foreign direct investment, which brings new technologies that make domestic firms more productive. These two forces combine to create what we have called "ripple effects" that transmit the effects of tax reforms in one region to other regions' economies.

In addition to underscoring the critical role of U.S. MNEs in the global economy, our analysis also highlights the intricate interplay between domestic tax provisions, such as the GILTI provision of the 2017 Tax Cuts and Jobs Act, and international tax reforms. More broadly, we contribute to the literature by providing a valuable methodological framework for policymakers and scholars alike to understand the broader economic consequences of tax policy changes and the strategic responses of multinational corporations within the evolving global tax landscape.

References

Auerbach, A. J. (2018): "Measuring the Effects of Corporate Tax Cuts," Journal of Economic Perspectives, 32, 97–120.

Barro, R. J. and J. Furman (2018): "Macroeconomic Effects of the 2017 Tax Reform," Brookings Papers on Economic Activity, 49, 257–345.

Blouin, J. and L. A. Robinson (2020): "Double Counting Accounting: How Much Profit of Multinational Enterprises Is Really in Tax Havens?" SSRN Scholarly Paper ID 3491451, Social Science Research Network, Rochester, NY.

Bolwijn, R., B. Casella, and D. Rigo (2018): "Establishing the baseline: estimating the fiscal contribution of multinational enterprises," Transnational Corporations, 25, 111–143.

Chodorow-Reich, G., M. Smith, O. Zidar, and E. Zwick (2023): "Tax Policy and Investment in a Global Economy," .

Clausing, K. A. (2016): "The Effect of Profit Shifting on the Corporate Tax Base in the United States and Beyond," National Tax Journal, 69, 905–934.

——— (2020a): "How Big Is Profit Shifting?" SSRN Scholarly Paper ID 3503091, Social Science Research Network, Rochester, NY.

——— (2020b): "Profit Shifting Before and After the Tax Cuts and Jobs Act," National Tax Journal.

Crivelli, E., R. A. De Mooij, and M. M. Keen (2015): Base erosion, profit shifting and developing countries, International Monetary Fund.

Dowd, T., P. Landefeld, and A. Moore (2017): "Profit Shifting of U.S. Multinationals," Journal of Public Economics, 148, 1–13.

Dyrda, S., G. Hong, and J. B. Steinberg (2022): "A Macroeconomic Perspective on Taxing Multinational Enterprises," University of Toronto Working Paper 731.

——— (2024): "Optimal Taxation of Multinational Enterprises: A Ramsey Approach," Journal of Monetary Economics, 141, 74–97.

Gale, W., H. Gelfond, A. Krupkin, M. J. Mazur, and E. Toder (2019): "Effects of the Tax Cuts and Jobs Act: A Preliminary Analysis," National Tax Journal, 71, 589–612.

Garcia-Bernardo, J., P. Jansky, and G. Zucman (2023): "Did the Tax Cuts and Jobs Act Reduce Profit Shifting by US Multinational Companies?" SSRN, available at SSRN: https://ssrn.com/abstract=4554525 or http://dx.doi.org/10.2139/ssrn.4554525.

Guvenen, F., J. Mataloni, Raymond J., D. G. Rassier, and K. J. Ruhl (2022): "Offshore Profit Shifting and Aggregate Measurement: Balance of Payments, Foreign Investment, Productivity, and the Labor Share," American Economic Review, 112, 1848–84.

Hausmann, R. and F. Sturzenegger (2007): "The Missing Dark Matter in the Wealth of Nations and its Implications for Global Imbalances," Economic Policy, 22, 469–518.

Helpman, E., M. J. Melitz, and S. R. Yeaple (2004): "Export versus FDI with heterogeneous firms," American Economic Review, 94, 300–316.

Javorcik, B. S. (2004): "Does foreign direct investment increase the productivity of domestic firms? In search of spillovers through backward linkages," American Economic Review, 94, 605–627.

McGrattan and E. C. Prescott (2010): "Technology Capital and the US Current Account," American Economic Review, 100, 1493–1522.

McGrattan, E. R. and E. C. Prescott (2009): "Openness, technology capital, and development," Journal of Economic Theory, 144, 2454–2476.

McGrattan, E. R. and A. Waddle (2020): "The Impact of Brexit on Foreign Investment and Production," American Economic Journal: Macroeconomics, 12, 76–103.

OECD (2015): Measuring and Monitoring BEPS, Action 11 - 2015 Final Report.

Slemrod, J. (2018): "Is This Tax Reform, or Just Confusion?" Journal of Economic Perspectives, 32, 73–96.

Tørsløv, T., L. Wier, and G. Zucman (2022): "The Missing Profits of Nations," The Review of Economic Studies.