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

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Abstract

We study how domestic and international corporate tax reforms interact to shape investment, profit shifting, and macroeconomic outcomes. We combine new firm-level evidence with a quantitative general-equilibrium model that embeds the key provisions of the 2017 U.S. Tax Cuts and Jobs Act (TCJA)—including GILTI and FDII—together with the institutional design of the OECD's global minimum tax (GMT). The model captures two central forces: the non-rivalry of intangible capital, which links multinational R&D decisions across borders, and the mobility of intellectual property ownership, which allows firms to reallocate profits across jurisdictions. We show that the TCJA boosted U.S. tangible and intangible investment (by 3.1% and 1.7%, respectively) and raised GDP by 0.8%, but at the cost of increasing profit shifting slightly and reducing corporate tax revenues by more than one third. By contrast, GMT implemented abroad without U.S. adoption feeds back into the U.S. economy through inward spillovers, reducing intangible investment and GDP by about 0.1% each, while reallocating tax revenues toward adopting jurisdictions. Taken together, our results demonstrate the bidirectional nature of corporate tax reforms: domestic changes propagate globally through multinational firms, and international reforms reverberate back into the U.S. economy, shaping the allocation of capital and tax revenues worldwide.

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

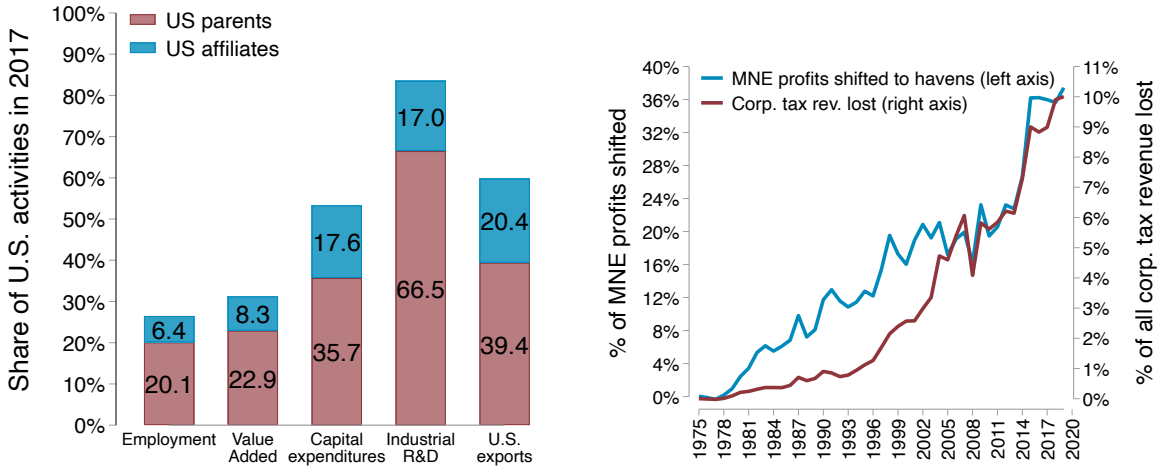
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The international corporate tax landscape is undergoing a profound transformation. In 2017, the United States moved from a worldwide to a largely territorial system of corporate taxation as part of the Tax Cuts and Jobs Act (TCJA), with new provisions aimed at discouraging profit shifting and encouraging firms to retain ownership of their intangible capital at home. These changes reshaped not only the incentives of U.S. multinationals domestically, but also had important spillover effects on investment and tax bases abroad. At the same time, the rest of the world has since advanced a different reform: the OECD's global minimum tax, which sets a floor on the taxation of multinational profits and is now being adopted across Europe and beyond. Although the United States has not implemented this policy, it cannot remain insulated from it. Because U.S. multinationals account for a large share of domestic output, employment, and research and development—see Figure 1—the global minimum tax feeds back into the U.S. economy by raising effective tax rates on American firms' foreign affiliates and by reallocating tax revenues toward adopting jurisdictions. This paper studies these effects in tandem, asking how the domestic reforms of 2017 and the international reforms now unfolding interact to shape U.S. as well as global investment, tax revenues, and broader macroeconomic outcomes.

In this paper, we combine empirical analysis with structural modeling to address these questions. We first provide new evidence on how the 2017 U.S. reform affected the investment and production decisions of U.S. multinationals, using a difference-in-differences design that compares more and less exposed firms. We then develop a quantitative general-equilibrium model with heterogeneous firms, profit shifting, and multinational production that embeds both the key provisions of the TCJA and the institutional design of the global minimum tax. This framework allows us to move from firm-level responses to aggregate outcomes and, crucially, to capture the bidirectional nature of these reforms: the spillover of U.S. policy changes to the rest of the world and the feedback of international reforms into the U.S. economy.

Our analysis delivers three main sets of results. First, using firm-level data we provide new empirical evidence on the effects of the 2017 U.S. reform. We show that U.S. multinationals more exposed to the reform increased both tangible and intangible investment, albeit increasing tangible investment significantly more, pointing to a reallocation within firms' capital portfolios. Second, our model analysis highlights the economic mechanisms that transmit changes in effective tax rates into real and financial choices. Because intangible capital is non-rival and intellectual property ownership is mobile, policies such as GILTI, FDII, and the global minimum tax alter the incentives to shift profits, invest in tangible capital, and expand intangible capital in systematically different ways. Third, our quantitative results show that these provisions matter not only domestically



(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

but also internationally: the TCJA reshaped outcomes abroad through the outward spillovers of U.S. multinationals, while the global minimum tax affects the United States even without adoption through inward spillovers. Together, these findings underscore the bidirectional nature of corporate tax reforms and the importance of analyzing domestic and international provisions *jointly*.

We begin by documenting the firm-level effects of the 2017 reform using U.S. publicly traded firms from Compustat. Our empirical strategy exploits cross-sectional variation in how much individual firms' effective tax rates fell after the reform. Using a difference-in-differences design with a continuous treatment, we compare more and less exposed U.S. multinationals before and after 2017. This approach allows us to isolate the causal impact of the reform from common shocks affecting all firms.

The evidence shows a reallocation within firms' capital portfolios: although firms that experienced larger tax cuts increased both tangible and intangible investment, the increase in tangible investment is relatively greater. We also find some preliminary evidence of a reallocation in sales activity from domestic to foreign operations. This evidence motivates our model analysis, which is designed to capture and aggregate these firm-level responses into macroeconomic consequences.

While the empirical analysis reveals important firm-level patterns, reduced-form methods alone cannot disentangle the effects of specific provisions of the TCJA on multinational behavior, nor can they capture how these provisions scale up to aggregate outcomes. Nor can they provide counterfactuals for policies not adopted in the United States, such as the global minimum tax. To

address these gaps, our key contribution is to develop a structural macroeconomic framework that embeds the institutional details of the TCJA—most importantly the provisions on Global Intangible Low-Taxed Income (GILTI) and Foreign-Derived Intangible Income (FDII)—together with the design of the global minimum tax and its rule priority. The model links these provisions to macro-relevant outcomes through two central mechanisms: the non-rivalry of intangible capital, which allows intellectual property created at headquarters to be deployed worldwide, and the mobility of intellectual property ownership, which enables firms to reallocate profits across jurisdictions by adjusting transfer prices. In isolation, we find that GILTI and FDII both reduce profit shifting but operate differently on investment: GILTI curbs intangible investment while encouraging tangible investment abroad through its deduction for foreign assets, whereas FDII strengthens incentives to hold intangible capital at home by lowering the U.S. tax rate on foreign-derived income. The global minimum tax likewise reduces profit shifting and, through its substance-based carve-outs, encourages tangible and payroll investment in low-tax affiliates. When combined, the interaction of these provisions is non-trivial: GILTI and GMT act as substitutes, both raising the effective tax floor on foreign affiliates, while FDII and GMT are complements, jointly reinforcing the incentive to keep intangible capital in the United States. This framework therefore clarifies not only the isolated channels at work, but also how domestic and international reforms reinforce or offset one another.

At the heart of the model is the link between changes in effective tax rates and multinational firms' allocation decisions. Because intangible capital is non-rival, once produced at headquarters it can be deployed simultaneously in all affiliates. The location of the ownership of that intellectual property, however, is mobile: firms can reallocate it across jurisdictions by selling IP rights internally and manipulating transfer prices, thereby shifting taxable income without moving real production. Policies such as GILTI, FDII, and the GMT work precisely by altering the tax wedge between the U.S. parent and low-tax affiliates. A higher effective tax rate abroad, or a lower rate at home, reduces the incentive to shift profits, leading to a lower share of intangible income booked outside the U.S. In turn, lower profit shifting affects intangible investment: when less of the return to new IP can be sheltered in low-tax jurisdictions, the incentive to expand intangible capital for tax purposes diminishes. At the same time, provisions that allow deductions for tangible capital or payroll (QBAI under GILTI, carve-outs under GMT) reduce the user cost of real investment in the targeted locations, raising demand for tangibles and labor. In this way, changes in effective tax rates translate mechanically into decisions about profit shifting, tangible capital, and intangible investment, and ultimately into macroeconomic outcomes such as GDP and tax revenues.

The key advantage of our structural model is that it allows us to move beyond qualitative mechanisms and generate quantitative predictions about the magnitudes of tax reform impacts. This is our unique contribution: ours is the first framework detailed enough to embed the institutional specifics of both the TCJA and the global minimum tax, and rich enough to deliver macro-relevant numbers. Two headline findings illustrate the value of this approach. First, the TCJA substantially boosted investment in the United States, raising tangible and intangible capital by about 3.1 and 1.7 percent, respectively, and lifting GDP by 0.8 percent, but at the cost of increasing profit shifting slightly and reducing corporate tax revenues by more than a third. These changes did not stop at U.S. borders: investment abroad also rose, with GDP increasing by 0.1 percent in Europe, 0.2 percent in the rest of the world, and 0.6 percent in the low-tax region, reflecting the outward spillovers of U.S. reform. Second, when the global minimum tax is implemented abroad while the United States does not adopt it, the U.S. economy is nonetheless affected. Intangible investment falls by about 0.1 percent and GDP declines by 0.1 percent, a larger contraction than in Europe (−0.03 percent) or the rest of the world (−0.06 percent), highlighting the inward spillovers of foreign reforms. Meanwhile, the low-tax region expands its real activity as carve-outs reward tangible and payroll investment. These magnitudes underscore the bidirectional nature of corporate tax reforms: the TCJA transmitted outward to the world economy, while the global minimum tax feeds back into the United States despite non-adoption. By quantifying these effects, we provide the first clear measurement of how U.S. tax policy and global reforms interact in shaping investment, tax revenues, and othe macro outcomes.

At a deeper level, our analysis highlights two fundamental mechanisms through which corporate tax reforms reshape the global economy. The first is the non-rivalry of intangible capital: once created, intellectual property can be used simultaneously across a multinational's global network, so changes in one jurisdiction's tax regime alter the productivity and investment incentives of firms everywhere. The second is the mobility of profit through the relocation of intangible ownership: by shifting intellectual property across borders, multinationals can reallocate taxable income without relocating real activity. Taken together, these forces explain why the TCJA and the global minimum tax have consequences that extend well beyond their statutory borders. They also underscore why the interaction between domestic and international reforms is central: policies that compress profit-shifting margins or change the tax treatment of intangibles reverberate globally, shaping investment patterns, tax revenues, and growth in ways that only a model with explicit intangibles and cross-border shifting can capture.

1 Empirical Analysis

1.1 Data

Our primary dataset is the Compustat North America database, which includes most publicly listed and some large private U.S. firms, from 2012 to 2022.[1] We utilize the Annual Fundamentals dataset to extract consolidated, firm-level balance sheet and income statement information. Specifically, we obtain information on industry, domestic and foreign sales, net tangible assets and investment, net intangible assets, R&D expenditures, and total tax liabilities. We only use the domestic version of the dataset, which has been standardized across firms and years for comparability.

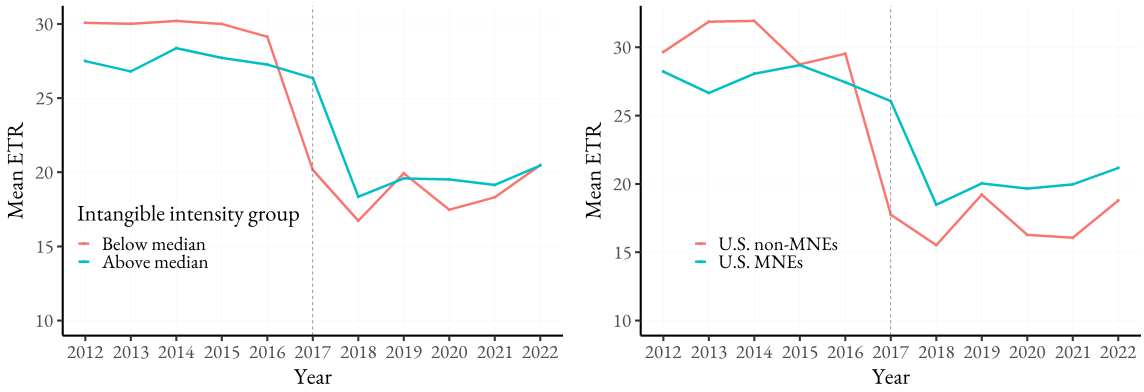
To measure the extent of multinational production, we use a linked database combining Compustat data with firm-level disclosures from the U.S. Securities and Exchange Commission (SEC), accessed through Wharton Research Data Services (WRDS). By the SEC rules, public firms in the U.S. are required to disclose the country of incorporation and ownership structure for subsidiaries in which they hold at least a 10% ownership stake. Given our focus on how the TCJA influences firms' global investment and production decisions, we limit our sample to multinational enterprises that report having foreign subsidiaries.

Under the Generally Accepted Accounting Principles (GAAP), reported intangible assets in the balance sheet reflect only externally acquired assets, as internally incurred expenses on intangibles are not capitalized. To measure firm-level intangible assets properly, we follow Peters and Taylor (2017) and construct a measure of internal intangible assets by capitalizing R&D expenditures using the perpetual-inventory method.[2] We then combine this internally-generated intangible capital measure with the balance-sheet measure to construct our preferred measure for total intangible assets at the firm level. Accordingly, we compute intangible investment as the change in total intangible assets that we construct.

[1] In ongoing work, we alternatively use Bureau van Dijk Orbis data for a more comprehensive, global sample.

[2] We also create a version of internal intangible capital by additionally capitalizing 30% of the Selling, General and Administrative expenses as in Eisfeldt and Papanikolaou (2013). The results using this alternative measure are similar.

Figure 2: ETRs by intangible intensity and MNE status



(a) By pre-TCJA intangible intensity

(b) By MNE status

Notes: These figures plot the US GAAP ETR, defined as the ratio of total taxes, inclusive of both foreign and domestic taxes, to pre-tax income for a balanced panel of Compustat firms from 2012 to 2022. To construct pre-TCJA intangible intensity groups, we first compute the firm-level average intangible intensity, weighted by total assets, using data from 2010 to 2013. We then use the (unconditional) median to create the "high" and "low" intangible intensity groups. We characterize U.S. MNE and non-MNEs using the presence of "significant" non-U.S. subsidiaries for Compustat firms incorporated in the U.S.

1.2 US GAAP Effective Tax Rate

Table 1: Summary statistics for GAAP ETR

	Mean	SD	Min	P25	P50	P75	Max
Pre-TCJA 5-year average	0.31	0.10	0.00	0.27	0.33	0.37	0.74
Post-TCJA 5-year average	0.22	0.10	0.00	0.18	0.22	0.26	0.88
Change from 2015-16 to 2018-19	-0.08	0.11	-0.33	-0.15	-0.10	-0.03	0.29

Notes: This table presents the (unweighted) mean GAAP ETR pre-TCJA from 2012 to 2016 and post-TCJA, from 2018 to 2022 for our panel of Compustat firms from 2012 to 2022.

Table 1 shows that the 5-year average GAAP ETR declined from 0.31 to 0.22, representing an average decrease of 8 percentage points following the implementation of the TCJA. Most Compustat firms predictably saw a falling ETR after the TCJA, although some firms did see an increase in their ETR. We primarily exploit the variation in this ETR change as our firm-level measure of TCJA exposure.

To illustrate further heterogeneity in this exposure, we plot the US GAAP ETR, stratified by

pre-TCJA intangible intensity and MNE status, over time. Less intangible-intensive firms have higher mean ETRs before 2017, with the mean ETR gap considerably shrinking after the TCJA reform. More intangible-intensive firms have a considerably higher mean ETR in 2017, as these firms are more likely to be subject to the one-tax repatriation tax on accumulated foreign earnings. U.S. MNEs vs. non-MNEs display similar dynamics over the sample period, in part because of the overlap between high intangibles-intensive firms and MNE status.

1.3 Regression analysis

To assess the impact of TCJA across firms, we run the following regression that closely follows Chodorow-Reich, Smith, Zidar, and Zwick (2023):

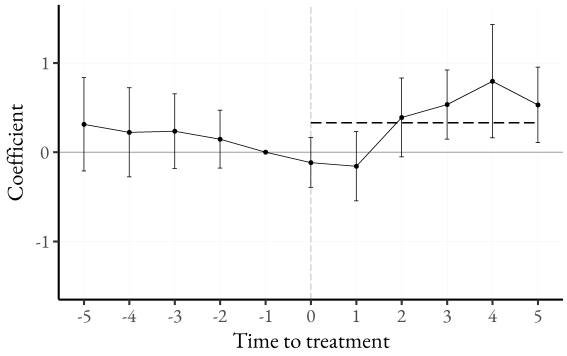
$$y_{it} = \sum_{\tau=-5}^{5} \beta_\tau \Delta ETR_{2016\to2018,i} \times \mathbb{1}_{\{t-2017=\tau\}} + \alpha_i + \gamma_{n(i)t} + \epsilon_{it} \tag{1}$$

where y_{it} is the (logged) outcome variable, $\Delta ETR_{2016\to2018,i}$ captures firm-level exposure to TCJA; β_τ captures the firm-level effect of $\Delta ETR_{2016\to2018,i}$ across the years; α_i is the firm fixed effect; $\gamma_{n(i)t}$ is the year fixed effect which is interacted with the industry n for firm i; and, ϵ_{it} is the idiosyncratic error term. We follow Wagner, Zeckhauser, and Ziegler (2020) in measuring the firm-level (recurring) exposure to TCJA using the firm-level change in the US GAAP effective tax rate (ETR) from 2016 to 2018. The outcome variable we examine include logged tangible and intangible investment, as well as log domestic and total pre-tax income[3]. By interacting the year FE with industry, operationalized using North American Industry Classification System (NAICS) 2-digit codes, we allow for industry-varying time paths and use variation in ETR change within industry. Although soaking up between-industry variation in ETR changes comes at the cost of some precision, this specification provides a stronger control for confounding trends. β_τ is the parameter of interest in equation (1): it can be interpreted as the semi-elasticity of the respective outcome variable in period τ with respect to the ETR.

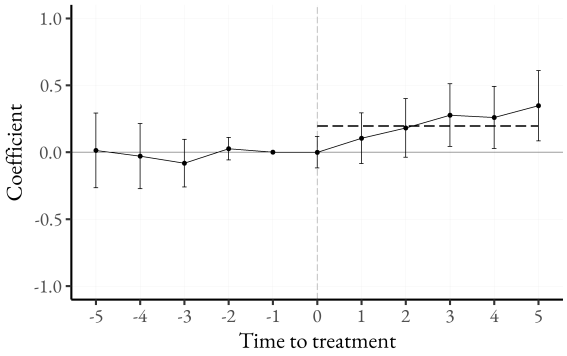
We present the parameter estimates of β_τ in Figure 3. The results show that a greater exposure to the TCJA for U.S. MNEs, captured by a larger reduction in ETR, is associated with increases in tangible and intangible investment, as well as foreign sales. The effects on the tangible and intangible investment are statistically significant at the 95% confidence level in most years and relatively stable over time. Averaging across the post-TCJA years, a ten-percentage-point decrease in ETR is associated with a 4.2% increase in tangible investment and a 2.3% increase in intangible invest-

[3]Note that exports from the headquarter are included in domestic sales.

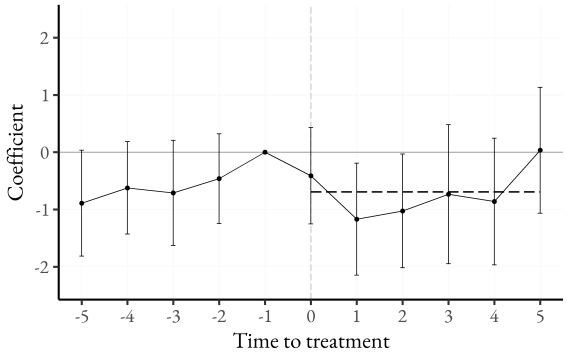
Figure 3: The effect of TCJA on investment and sales



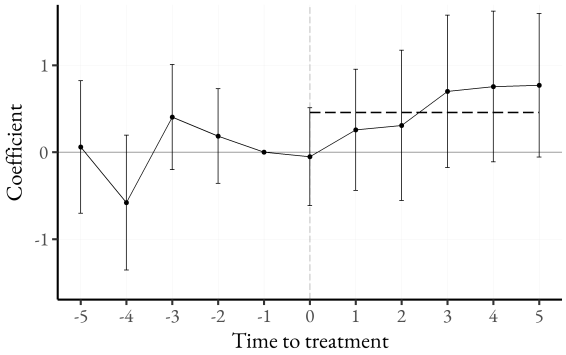
(a) Tangible investment



(b) Intangible investment



(c) Domestic sales



(d) Foreign sales

Notes: These figures plot the estimated dynamic effects, along with 95% confidence intervals, of the TCJA for tangible investment, intangible investment, domestic sales, and foreign sales of equation.

ment, both statistically significant at the 95% significance level. For reference, as noted in Table 1, the mean (unweighted) ETR change for the analysis sample from 2016 to 2018 was a decrease of 8 percentage points. A similar decrease is associated with a 5.5% statistically insignificant increase in foreign sales. In contrast, ten-percentage-point decrease in ETR is associated with a 7.5% decrease in domestic sales (statistically significant at the 90% significance level). This dampening effect on domestic sales dissipates after 2019.[4] In sum, firms with a larger decrease in ETR from the TCJA do not appear to have statistically significant total sales.

[4]The breakdown of sales by geographic region is noisily measured in the Compustat data, however, and the confidence intervals for the sale outcomes are somewhat wide. In ongoing work, we augment this with Geographic Segments data to characterize the effect on export sales.

The statistically insignificant estimates for years prior to 2017 indicate that the firms with differential exposure to TCJA did not preemptively adjust their strategies prior to the reform. This is partly due to the unexpected nature of the TCJA. The bill was introduced in early November 2017 and signed into law by President Trump on December 22, 2017. In addition, prior to its passage, there was significant uncertainty about whether a major tax reform would be enacted at all. These features of the reform give firms little time to anticipate or react to its provisions before its implementation.

These empirical results are consistent with our expectations. For tangible investment, our estimate of a positive effect of TCJA is consistent with Chodorow-Reich et al. (2023). The foreign provisions of TCJA, especially GILTI, incentivized tangible investment abroad. The finding for intangible investment suggests complementarity between tangible and intangible capital. Moreover, the effect on both tangible and intangible investment takes a couple years after the TCJA to materialize, suggesting a role for adjustment frictions.

In summary, our empirical analysis reveals that TCJA has significant effects on the investment and production activities of MNEs. However, the empirical analysis is limited in several ways in its assessment of the aggregate impacts of the TCJA. First, the empirical results inform the *relative* effect on firms with different exposure to TCJA, yet they do not shed light on the *absolute* effect of the policy. Second, it does not address how the TCJA affects the global economy through important general equilibrium effects, including its impacts through trade and FDI linkages and technology spillovers of intangible investment. To study these important questions, we introduce a quantitative model in the next section.

2 Model

Our model builds closely on our previous work in Dyrda, Hong, and Steinberg (2024a) and Dyrda, Hong, and Steinberg (2024b). 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, 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 that choose to establish foreign affiliates in equilibrium) 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.

This paper's modeling contribution relative to our previous work is a careful treatment of how the 2017 Tax Cuts and Jobs Act (TCJA) changed corporate taxation in the United States, particularly for multinational enterprises. We focus on the four key changes described above: the reduction in the statutory tax rate; the shift from worldwide to territorial taxation; the global intangible low-taxed income (GILTI) provision; and the Foreign Derived Intangible Income (FDII) provision.

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.

2.1 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

$$\sum_{t=0}^{\infty} \beta^t \left[\log\left(\frac{C_{it}}{N_i}\right) + \psi_i \log\left(1 - \frac{L_{it}}{N_i}\right) \right]. \tag{2}$$

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,

$$P_{it}[(1+\tau_{ict})C_{it} + K_{it+1} - (1-\delta)K_{it}] + P_{bt}B_{it+1} = (1-\tau_{i\ell t})\, W_{it}L_{it} + R_{it}K_{it} + B_{it} + D_{it}, \tag{3}$$

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 in-

termediate goods from different source countries,

$$Q_{it} = \left[\sum_{j=1}^{J} \int_{\Omega_{jit}} q_{jit}(\omega)^{\frac{\varrho-1}{\varrho}} d\omega \right]^{\frac{\varrho}{\varrho-1}}, \tag{4}$$

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

$$p_{jit}(\omega) = P_{it} Q_{it}^{\frac{1}{\varrho}} q_{jit}(\omega)^{-\frac{1}{\varrho}}. \tag{5}$$

The aggregate price index is

$$P_{it} = \left[\sum_{j=1}^{J} \int_{\Omega_{jit}} p_{jit}(\omega)^{1-\varrho} d\omega \right]^{\frac{1}{1-\varrho}}. \tag{6}$$

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

$$y_{ijt}(\omega) = \sigma_{ij} A_j a(\omega) z_t(\omega)^{\phi} k_{ijt}(\omega)^{\alpha} \ell_{ijt}(\omega)^{1-\phi-\omega}. \tag{7}$$

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. (2024b). 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

$$z_t(\omega) = A_i \ell_{it}^z(\omega) \left[\sum_{j \neq i} \int_{\Omega_{jit}} z_{jt}(\omega') \, \mathrm{d}\omega' \right]^{\upsilon}. \tag{8}$$

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:

$$y_{iit}(\omega) = q_{iit}(\omega) + \sum_{j \in J_{it}^X(\omega)} \xi_{ij} q_{ijt}(\omega) \tag{9}$$

$$y_{ijt} = \hat{q}_{ijt}(\omega), \; j \in J_{it}^F(\omega) \tag{10}$$

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, Hong, and Steinberg (2022) for a detailed treatment of our theory of profit shifting.

Profit shifting and transfer pricing in an example. Profit shifting in our framework operates through the reallocation of intellectual property (IP) and the associated flows of licensing fees across affiliates of the multinational. Figure 4 illustrates the basic mechanism with a U.S.-

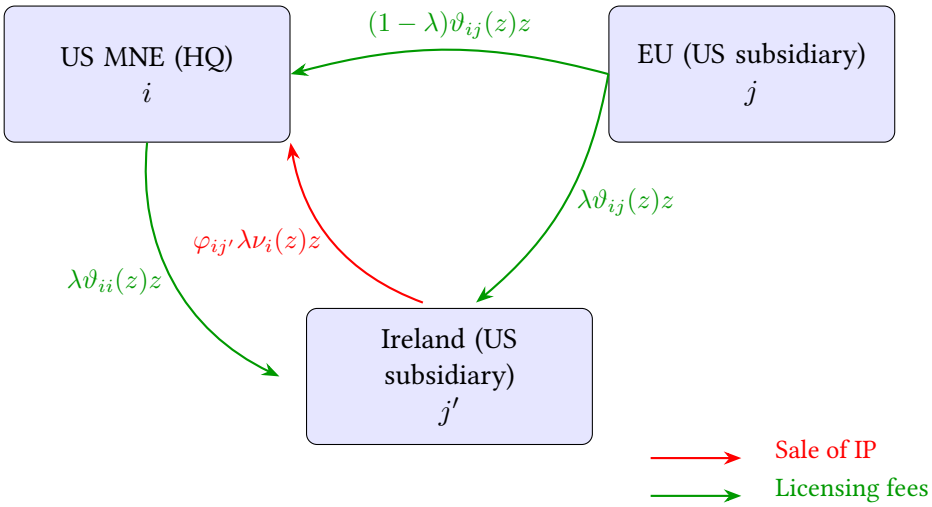


Figure 4: IP sales and licensing fees flows in the model-3 region example.

headquartered multinational i, which owns two foreign subsidiaries: one in the European Union j and one in Ireland j'. The U.S. parent sells part of its IP to the low-tax affiliate in Ireland (red arrow). The transaction is priced at $\varphi_{ij'}\lambda\nu_i(z)z$, where λ denotes the fraction of IP shifted, $\nu_i(z)$ the marginal revenue product of the technology, and $\varphi_{ij'} < 1$ a markdown factor capturing the ability to transfer IP at below arm's-length value. This intragroup sale effectively moves intangible capital out of the U.S. tax base and into the Irish affiliate.

Once the IP is booked in Ireland, the U.S. headquarters and the European subsidiary must pay licensing fees to the Irish affiliate in order to use the transferred technology (green arrows). The EU affiliate remits $(1-\lambda)\vartheta_{ij}(z)z$ on the fraction of IP it retains, and $\lambda\vartheta_{ij}(z)z$ on the portion shifted to Ireland. Similarly, the U.S. headquarters pays $\lambda\vartheta_{ii}(z)z$ to access the IP now located in Ireland. These royalty flows shift the associated profits from high-tax jurisdictions (U.S. and EU) to the low-tax affiliate. The overall effect is that a share λ of the intangible income is stripped out of the U.S. and EU tax bases and recorded in Ireland, lowering the group's global effective tax burden prior to the introduction of the global minimum tax.

2.2 Corporate profit maximization

Before describing the corporate tax system in detail, it is helpful to define the profits earned by each of a firm's subsidiaries and the general structure of the firm's profit-maximization problem. 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

$$\begin{aligned}\pi_{ii}(a,z;J_X) =& p_{ii}(q_{ii})q_{ii} + \sum_{j\in J_X} p_{ij}(q_{ij})q_{ij} + \sum_{j\in J_F}(1-\lambda_{LT}-\lambda_{TH})\vartheta_{ij}(z)z \\ & -W_i\left(\ell_{ii} + \frac{z}{A_i} + \sum_{j\in J_X}\kappa_{iX} + \sum_{j\in J_F}\kappa_{iF} + \kappa_{i,TH}\mathbb{1}_{\{\lambda_{TH}>0\}}\right) - \delta P_i k_i \\ & -W_i\left[\mathcal{C}_{i,TH}(\lambda_{TH}) + \mathcal{C}_{i,LT}(\lambda_{LT})\right]\nu_i(z)z - (\lambda_{TH}+\lambda_{LT})\vartheta_{ii}(z)z - r_i k_i.\end{aligned} \tag{11}$$

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:

$$\pi_{ij}(a,z) = p_{ij}(\hat{q}_{ij})\hat{q}_{ij} - W_j\ell_j - \delta P_j k_j - \vartheta_{ij}(z)z - r_j k_j,\ j\in J_F\setminus\{LT\}. \tag{12}$$

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

$$\begin{aligned}\pi_{i,LT}(a,z;J_X) =& p_{i,LT}(\hat{q}_{i,LT})\hat{q}_{i,LT} + \sum_{j\in J_F\cup\{i\}\setminus\{LT\}}\lambda_{LT}\vartheta_{ij}(z)z \\ & -W_{LT}\ell_{LT} - \delta P_{LT}k_{LT} - (1-\lambda_{LT})\vartheta_{i,LT}(z)z - r_{LT}k_{LT}.\end{aligned} \tag{13}$$

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

$$\pi_{i,TH}(a,z) = \sum_{j \in J_F \cup \{i\}} \lambda_{TH} \vartheta_{ij}(z) z. \tag{14}$$

Firm's problem. The objective of a firm is to maximize its worldwide after-tax profits. The firm chooses export destinations (J_X), FDI destinations (J_F), the scale of production in each location (k, ℓ), intangible investment (z), and profit shifting ($\lambda_{LT}, \lambda_{TH}$). The firm's problem can be succinctly written as

$$\max_{J_X, J_F, (k_j, \ell_j)_{j \in J_F \cup \{i\}}, z, \lambda_{LT}, \lambda_{TH}} \left\{ \pi_{ii} - T_{ii} + \sum_{j \in J_F} (\pi_{ij} - T_{ij}) + \mathbb{1}_{\{\lambda_{TH} > 0\}} \pi_{i,TH} - T_{i,TH} \right\}, \tag{15}$$

where T_{ij} denotes the firm's tax liability in jurisdiction j, which we elaborate more on below. The appendix contains a detailed description of the analytical solution to the firm's problem.

2.3 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:

$$P_{it} G_{it} = \tau_{i\ell t} W_{it} L_{it} + \sum_{j=1}^{I} \int_{\Omega_j} T_{jit}(\omega) \, d\omega \tag{16}$$

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

$$T_{iit}(\omega) = \tau_{it} \pi_{iit}(\omega) + \sum_{j \in J_F \cup TH} T_{ijt}^{RT}(\omega), \tag{17}$$

$$T_{jit}(\omega) = \tau_{it} \pi_{jit}(\omega), \; j \neq i. \tag{18}$$

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

$$T_{jit}(\omega) = \tau_i \pi_{jit}(\omega), \; \forall j \tag{19}$$

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

$$L_{it} = \sum_{j=1}^{I} \int_{\Omega_j} \ell_{jit}(\omega)\, d\omega + \int_{\Omega_i} \left[\ell_{it}^z(\omega) + \sum_{j \in J_{Xt}(\omega)} \kappa_{iX} + \sum_{j \in J_{Ft}(\omega)} \kappa_{iF} + \mathbb{1}_{\{\lambda_{TH,t}(\omega) > 0\}} \kappa_{i,TH} \right] d\omega$$
$$+ \int_{\Omega_i} \left[\mathcal{C}_{i,TH}(\lambda_{TH,t}(\omega)) + \mathcal{C}_{i,LT}(\lambda_{LT,t}(\omega)) \right] \nu(\omega) z_{it}(\omega)\, d\omega. \tag{20}$$

Capital market. The capital market clearing condition is

$$K_{it} = \sum_{j=1}^{I} \int_{\Omega_j} k_{jit}(\omega)\, d\omega. \tag{21}$$

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:

$$Q_{it} = C_{it} + G_i + X_{it}. \tag{22}$$

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

$$EX_{it}^G + EX_{it}^S - IM_{it}^G - IM_{it}^S + NFR_{it} - NFP_{it} = P_{bt} B_{it+1} - B_{it}. \tag{23}$$

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 (2)–(6);
2. the firm's profit-maximization problem (15);
3. the labor market clearing condition (20);

4. the capital market clearing condition (21);

5. the government's budget constraint (16); and

6. the balance of payments (23).

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.

2.4 Pre-TCJA corporate tax system

Prior to the TJCA, the United States had a worldwide tax system under which firms were taxed on their foreign affiliates' earnings as well as their domestic profits. We describe this system in detail in appendix. The essence is that a U.S.-based multinational paid the U.S. corporate tax rate τ_{US} on domestic earnings π_{ii} and foreign earnings $\sum_{j \in J_F} \pi_{ij} + \pi_{i,TH}$, but received a tax credit for taxes paid to foreign governments, $\sum_{j \in J_F} \tau_j \pi_{ij} + \tau_{TH} \pi_{i,TH}$. One complication is that only repatriated foreign earnings were reinvested abroad were taxed; foreign earnings that firms claimed to be "permanently or indefinitely" reinvested abroad were not subject to U.S. taxation. Modeling endogenous earnings repatriation is beyond the scope of this paper, as it would require explicitly taking a stand on firms' expectations about future tax reforms, especially dividend repatriation tax holidays.[5]

We assume for simplicity that under the pre-TCJA system, U.S.-based firms repatriate a fraction ι of their foreign earnings. Under this assumption, we can write the domestic tax liability of a U.S. firm as

$$T_{ii} = \tau_i \pi_{ii} + \iota \left[\sum_{j \in J_F} (\tau_i - \tau_j) \pi_{ij} + (\tau_i - \tau_{TH}) \pi_{i,TH} \right]. \tag{24}$$

In our calibration, we choose the U.S. tax rate, τ_i, and the repatriation fraction, ι, to match the effective tax rates of U.S. MNEs and non-MNEs during the pre-TCJA period. See section X below for more details.

[5]Several empirical papers (see, for e.g., Clemons and Kinney (2009); Brennan (2010)) have studied repatriating behavior and expectations of future tax relief after the American Jobs Creation Act (AJCA) of 2004, a one-time tax holiday which allowed repatriation of foreign profits at the reduced maximum effective tax rate of 5.25% instead of the normal 35% corporate tax rate, to show that U.S. MNEs had higher permanently reinvested foreign earnings and deferred repatriation after the AJCA. Moreover, U.S. MNEs exhibited accelerated foreign cash holdings in response to legislative signals and proposals of a repatriation tax, such as in late-2008 and 2011 (De Simone, Piotroski, and Tomy, 2019).

2.5 Corporate taxation under the TCJA

The 2017 Tax Cuts and Job Act (TCJA) cut the corporate tax rate dramatically, but also introduced several rules that changed how U.S. multinationals' income, especially their intangible income, is taxed. We focus on three key rules. First, the shift from the worldwide system described above to a territorial tax system where foreign earnings are no longer taxed in the United States. Second and third, the global intangible low-taxed income (GILTI) and Foreign Derived Intangible Income (FDII) provisions, which were both designed to encourage U.S. MNEs to retain ownership of intangible capital at home.

Global Intangible Low-Taxed Income (GILTI). 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):

$$\pi_{ij}^{NTI} = p_{ij}(\hat{q}_{ij})\hat{q}_{ij} - W_j \ell_{ij} - \delta P_j k_{ij}. \tag{25}$$

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:

$$\pi_{ij}^{GILTI} \equiv \chi^{GILTI} \times \left(\pi_{ij}^{NTI} - \chi^{QBAI} \times P_j k_{ij}\right), \tag{26}$$

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

$$T_{ij}^{GILTI} \equiv \tau_i \times \pi_{ij}^{GILTI}. \tag{27}$$

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:

$$T_{ij}^{DPFT} \equiv \chi^{DPFT} \times \tau_j \times \pi_{ij}^{NTI}. \tag{28}$$

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):

$$\pi_{ij}^{DFI} \equiv \pi_{ij}^{GILTI} - \kappa_{ij} \tag{29}$$

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

$$T_{ij}^{FTCL} \equiv \tau_i \times \pi_{ij}^{DFI}, \tag{30}$$

and the foreign tax credit itself is calculated as

$$T_{ij}^{FTC} \equiv \min\left(T_{ij}^{DPFT}, T_{ij}^{FTCL}\right). \tag{31}$$

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

$$T_{ij}^{RT} \equiv T_{ij}^{GILTI} - T_{ij}^{FTC}. \tag{32}$$

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:

$$\begin{aligned}
\pi_{ii}^{DEI} &\equiv \sum_{j \in J_X \cup \{i\}} p_{ij} q_{ij} + \varphi \lambda_i z_i \sum_j \vartheta_{ij}(z_i) + (1-\lambda_i) z_i \sum_{j \neq i} \vartheta_{ij}(z_i) \\
\pi_{ii}^{FDDEI} &\equiv \sum_{j \in J_X} p_{ij} q_{ij} + \varphi \lambda_i z_i \sum_j \vartheta_{ij}(z_i) + (1-\lambda_i) z_i \sum_{j \neq i} \vartheta_{ij}(z_i)
\end{aligned} \tag{33}$$

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

$$\pi_{ii}^{FDII} \equiv \pi_{ii}^{FDDEI} - \chi^{QBAI} \times p_i k_{ii} \times \frac{\pi_{ii}^{FDDEI}}{\pi_{ii}^{DEI}}. \tag{34}$$

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

$$\hat{T}_{ii}^{FDII} \equiv \tau_i \times \left(1 - \chi^{FDII}\right) \times \pi_{ii}^{FDII}. \tag{35}$$

2.6 Global Minimum Tax (GMT): Model Implementation

We implement the OECD/GloBE[6] minimum-tax regime at the affiliate-by-jurisdiction level and assign top-up revenues according to the standard rule priority QDMTT $\rightarrow$ IIR $\rightarrow$ UTPR:

- Qualified Domestic Minimum Top-Up Tax (QDMTT) — the source jurisdiction j has the first taxing right to levy a top-up that brings the affiliate's jurisdictional effective tax rate up to the global minimum, using the same GloBE base and carve-outs. If applied, QDMTT preempts the other rules for that affiliate.
- Income Inclusion Rule (IIR) — if no QDMTT is applied in j, the parent jurisdiction i collects the top-up on the low-taxed income of its foreign affiliate $(i \rightarrow j)$, computed on the same base/ETR, and books the revenue in i.
- Undertaxed Profits Rule (UTPR) — if neither QDMTT nor IIR applies, jurisdictions that implement UTPR collect the residual top-up by denying deductions or via equivalent charges. The revenue is allocated across adopting jurisdictions using substance weights (employment and tangible assets); we denote the weight for jurisdiction r by w_{ir}.

To illustrate, Figure 5 uses a three-region example with a U.S. parent i and two affiliates: an EU subsidiary j and an Irish subsidiary j'. The notation and implementation extend directly to arbitrary parents and host jurisdictions.

GloBE base, effective rate, and top-up need. Let π_{ij} denote pre-tax profits of affiliate $(i \rightarrow j)$, with local tax liability $T_{ij}^{\text{loc}} = \tau_j \pi_{ij}$. Let $W_j \ell_{ij}$ be payroll and $P_j k_{ij}$ the replacement cost of tangible

[6] GloBE = Global Anti–Base Erosion rules under Pillar Two.

assets. With carve-out factors $(\chi_{\text{GMT},L}, \chi_{\text{GMT},K})$, define the carve-out and the GloBE-style base:

$$\text{CO}_{ij} \equiv \chi_{\text{GMT},L}\, W_j \ell_{ij} + \chi_{\text{GMT},K}\, P_j k_{ij}, \tag{36}$$

$$\Pi_{ij}^{G} \equiv \max\{\, 0,\ \pi_{ij} - \text{CO}_{ij} \,\}. \tag{37}$$

The jurisdictional effective tax rate used for GMT is

$$\tau_{ij}^{\text{eff}} \equiv \begin{cases} \dfrac{T_{ij}^{\text{loc}}}{\Pi_{ij}^{G}}, & \Pi_{ij}^{G} > 0, \\ \text{undefined (no top-up)}, & \Pi_{ij}^{G} = 0, \end{cases} \tag{38}$$

and the top-up need (the dollar amount that would bring the rate up to τ^{GMT}) is

$$\widehat{T}_{ij} \ \equiv\ \Big(\tau^{\text{GMT}} - \tau_{ij}^{\text{eff}}\Big)_{+}\, \Pi_{ij}^{G}, \qquad (x)_{+} \equiv \max\{x, 0\}. \tag{39}$$

Affiliates with $\Pi_{ij}^{G} = 0$ or $\tau_{ij}^{\text{eff}} \geq \tau^{\text{GMT}}$ have $\widehat{T}_{ij} = 0$.

Rule priority and residualization. Let the adoption sets be $\mathcal{J}^{\text{QDMTT}}$ (source jurisdictions with QDMTT), $\mathcal{I}^{\text{IIR}}$ (parents with IIR), and $\mathcal{J}^{\text{UTPR}}$ (jurisdictions applying UTPR). With $\mathbf{1}\{\cdot\}$ the indicator function, the collected top-ups are layered as:

$$\begin{aligned} T_{ij}^{\text{QDMTT}} &\equiv \mathbf{1}\{j \in \mathcal{J}^{\text{QDMTT}}\}\, \widehat{T}_{ij}, \\ \bar{T}_{ij}^{(1)} &\equiv \widehat{T}_{ij} - T_{ij}^{\text{QDMTT}} = \big(1 - \mathbf{1}\{j \in \mathcal{J}^{\text{QDMTT}}\}\big)\, \widehat{T}_{ij}, \\ T_{i}^{\text{IIR}}(ij) &\equiv \mathbf{1}\{i \in \mathcal{I}^{\text{IIR}}\}\, \bar{T}_{ij}^{(1)}, \\ \bar{T}_{ij}^{(2)} &\equiv \bar{T}_{ij}^{(1)} - T_{i}^{\text{IIR}}(ij) = \big(1 - \mathbf{1}\{j \in \mathcal{J}^{\text{QDMTT}}\}\big)\big(1 - \mathbf{1}\{i \in \mathcal{I}^{\text{IIR}}\}\big)\, \widehat{T}_{ij}. \end{aligned} \tag{40}$$

The residual $\bar{T}_{ij}^{(2)}$ is allocated across UTPR jurisdictions by substance weights $\{w_{ir}\}_{r \in \mathcal{J}^{\text{UTPR}}}$ that sum to one:

$$T_{r}^{\text{UTPR}}(ij) \equiv \mathbf{1}\{r \in \mathcal{J}^{\text{UTPR}}\}\, w_{ir}\, \bar{T}_{ij}^{(2)}, \qquad \sum_{r \in \mathcal{J}^{\text{UTPR}}} w_{ir} = 1. \tag{41}$$

By construction, $T_{ij}^{\text{QDMTT}} + T_{i}^{\text{IIR}}(ij) + \sum_{r \in \mathcal{J}^{\text{UTPR}}} T_{r}^{\text{UTPR}}(ij) = \widehat{T}_{ij}$.

Revenue assignment and budgets. Let R_r^{GMT} denote GMT revenue accruing to jurisdiction r. For any host j and parent i,

$$R_j^{\text{GMT}} = \sum_i T_{ij}^{\text{QDMTT}} + \sum_i \sum_m T_j^{\text{UTPR}}(im), \tag{42}$$

$$R_i^{\text{GMT}} = \sum_j T_i^{\text{IIR}}(ij) + \sum_m T_i^{\text{UTPR}}(im), \tag{43}$$

i.e., source countries collect QDMTT on their affiliates and any UTPR shares if they adopt UTPR; parent countries collect IIR and, if applicable, UTPR shares. Government budget constraints are augmented by R_r^{GMT} in addition to pre-existing tax revenues, and rebates follow the baseline incidence assumptions of the model.

Three-region illustration. Figure 5 considers a U.S. parent i with an EU affiliate j and an Irish affiliate j'. After computing the carve-out–adjusted base Π_{ir}^G, the effective rate τ_{ir}^{eff}, and the top-up need $\widehat{T}_{ir}$ for each affiliate, collection for $(i \to j')$ follows the rule priority: (i) if Ireland applies QDMTT and $\widehat{T}_{ij'} > 0$, then $T_{ij'}^{\text{QDMTT}} = \widehat{T}_{ij'}$ and nothing remains; (ii) otherwise, if the U.S. applies IIR, the parent collects $T_i^{\text{IIR}}(ij') = \widehat{T}_{ij'}$; (iii) otherwise, any residual is collected under UTPR by adopting jurisdictions in proportion to substance weights, e.g. with the EU as sole adopter $T_j^{\text{UTPR}}(ij') = w_{ij}\,\widehat{T}_{ij'}$. Edge cases are straightforward: if $\Pi_{ij'}^G \leq 0$ or $\tau_{ij'}^{\text{eff}} \geq \tau^{\text{GMT}}$, then $\widehat{T}_{ij'} = 0$ and no rule is triggered. The EU affiliate $(i \to j)$ is assessed independently on its own base and rate.

3 Impact of GILTI, FDII, and GMT on macro outcomes

Before turning to the model's general-equilibrium quantification, we discuss the qualitative effects of the MNE-related provisions we have incorporated into our framework in partial equilibrium at the firm level. GILTI, FDII, and the GMT are all designed to reduce profit shifting, indeed they all have that effect. As we describe below, this has the direct effect of reducing intangible investment of MNEs in the affected jurisdiction. However, these provisions can also affect tangible investment, both at home and abroad, which indirectly affects the return to intangible investment through the nonrivalry channel. In some cases, the direct and indirect effects operate in the same direction, whereas in others they oppose one another. In turn, the ultimate effect on intangible investment indirectly alters the marginal product of domestic tangible investment, which can again amplify or attenuate the direct effect. Table 2 below summarizes these direct and indirect effects.

Table 2: Directional effects of TCJA provisions and GMT on U.S. outcomes (policy in isolation).

		Direct		Indirect	
Policy	**Profit shifting** λ	**Tangible inv.** k	**Intangible inv.** z	**Tangible inv.** k	**Intangible inv.** z
GILTI	$\downarrow$	$-$	$\downarrow$	?	$\uparrow$
FDII	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$
GMT	$\downarrow$	$-$	$\downarrow$	?	$\uparrow$

Notes: All three provisions reduce the incentive to shift profits by compressing the U.S.–foreign tax wedge, which implies they all have a negative direct effect on intangibles. GILTI boosts tangible investment in low-tax affiliates through its QBAI deduction, which has the indirect effect of increasing intangible investment. The indirect effect on domestic tangible investment can be positive or negative, depending on whether intangible investment ultimately rises or falls. FDII increases the effective tax rate on domestic tangibles, which directly lowers tangible investment and reinforces the direct effect on intangibles. GMT's substance-based carve-outs operate similarly to the GILTI QBAI deduction, raising tangible investment in low-tax jurisdictions and thus indirectly raising intantible investment.

3.1 Profit shifting

We adopt the cost-of-shifting specification $\mathcal{C}(\lambda) = \lambda + (1-\lambda)\log(1-\lambda)$. Under this cost, the optimal share of shifted IP income to a low-tax affiliate LT is

$$\lambda = 1 - \exp\left(-\frac{(\tau_p - \tau_{LT}^{\text{eff}})(1-\varphi_{LT})}{(1-\tau_p)W_{US}}\right), \tag{44}$$

where τ_p is the parent's effective rate, τ_{LT}^{eff} the affiliate's effective rate, W_{US} the unit cost of shifting, and φ_{LT} the markdown on IP sales. The wedge $(\tau_p - \tau_{LT}^{\text{eff}})$ therefore determines the incentive to shift profits.

In the absence of special provisions, the effective rate in the low-tax affiliate is simply its statutory tax rate, τ_{LT}, and the profit shifting share is

$$\lambda^{\text{Base}} = 1 - \exp\left(-\frac{(\tau_{US} - \tau_{LT})(1-\varphi_{LT})}{(1-\tau_{US})W_{US}}\right).$$

With the introduction of GILTI, however, half of the foreign affiliate's income is included in the U.S. base and credits are limited to 80 percent of foreign taxes. This raises the effective tax rate on the low-tax affiliate to $(1-\chi_{\text{GILTI}})\tau_{US} + (1-\chi_{\text{FTC}})\tau_{LT}$, where $\chi_{\text{GILTI}} = 0.5$ and $\chi_{\text{FTC}} = 0.8$. The profit shifting share becomes

$$\lambda^{\text{GILTI}} = 1 - \exp\left(-\frac{\tau_{US} - \big((1-\chi_{\text{GILTI}})\tau_{US} + (1-\chi_{\text{FTC}})\tau_{LT}\big)}{(1-\tau_{US})W_{US}}(1-\varphi_{LT})\right).$$

FDII operates on the parent side by lowering the effective U.S. tax rate on foreign-derived re-

turns. If χ_{FDII} is the deduction rate and FDR is the share of foreign-derived income, the parent's effective rate is reduced to $(1-\chi_{\text{FDII}}FDR)\tau_{US}$, and the shifting margin becomes

$$\lambda^{\text{FDII}} = 1 - \exp\left(-\frac{((1-\chi_{\text{FDII}}FDR)\tau_{US} - \tau_{LT})(1-\varphi_{LT})}{(1-(1-\chi_{\text{FDII}}FDR)\tau_{US})W_{US}}\right).$$

Finally, the global minimum tax replaces the affiliate's statutory rate τ_{LT} with the floor τ_{GMT}. The profit shifting share is then

$$\lambda^{\text{GMT}} = 1 - \exp\left(-\frac{(\tau_{US} - \tau_{\text{GMT}})(1-\varphi_{LT})}{(1-\tau_{US})W_{US}}\right).$$

All three provisions therefore reduce the incentive to shift profits, but they do so in different ways: GILTI raises the effective tax rate on low-taxed foreign income, FDII lowers the parent's effective rate on foreign-derived income, and GMT directly floors the tax rate of the low-tax affiliate.

3.2 Tangible investment

Tangible investment decisions depend on the user cost of capital. Optimal tangible investment in affiliate j satisfies

$$k_{ij} = \Xi_{ij}^{k} \cdot R_j^{-\frac{1+(\alpha+\phi)(\varrho-1)}{1+\phi(\varrho-1)}}, \tag{45}$$

where R_j is the user cost of capital in region j and Ξ_{ij}^{k} is the marginal product. The direct effects of these tax provision only affect the former. Under GILTI, the QBAI deduction of 10 percent of tangible assets reduces the residual U.S. levy on tangible capital abroad, lowering the effective user cost of k_{ij} in low-tax affiliates. This increases tangible investment in these affiliates but has no direct effect on domestic tangible investment. FDII works by providing a tax deduction for income that is deemed to be intangible and foreign-derived. As can be seen in (34) and (35), domestic tangible capital reduces the size of this deduction by shrinking the fraction of income that is deemed to be intangible. This has the effect of increasing the user cost of domestic tangible capital. The magnitude of this effect is increasing in the share of income that is foreign-derived, either from exporting or foreign affiliate sales, which means that firms that rely more heavily on these activities are the most impacted. Note that this channel also affects non-MNE exporting firms. Under GMT, substance-based carve-outs reduce the top-up base directly: $\partial\widehat{T}_{ij}/\partial k_{ij} = -\chi_{\text{GMT},K}P_j$ and $\partial\widehat{T}_{ij}/\partial \ell_{ij} = -\chi_{\text{GMT},L}W_j$. This lowers the user cost of both tangible capital and payroll in affiliates where the top-up binds.

These provisions can also have indirect effects on the marginal product term Ξ_{ij}^k that operate through the intangible investment decision, which we describe below. These effects can either attenuate or amplify the direct effect, depending on whether intangible investment goes in the same direction as the user cost. In the case of GILTI, where there is no direct effect on domestic tangible investment through the user cost, the only effect is the indirect effect.

3.3 Intangible investment

Holding other margins of adjustment constant, the direct effect on intangible investment follows directly from the dependence of z on the shifting margin. In the firm's optimality condition, intangible investment is given by

$$z = z^{NS} \cdot \Big(1 + W_{US}[\lambda \mathcal{C}'(\lambda) - \mathcal{C}(\lambda)]\Big)^{\frac{\gamma+\rho-\rho\gamma}{\alpha+\gamma+\rho(1-\phi-\gamma)}}, \tag{46}$$

where $\frac{\partial z}{\partial \lambda} > 0$ and z^{NS} is intangible investment in the absence of profit shifting. A lower value of λ reduces the purely tax-motivated component of intangible investment. GILTI and GMT achieve this by raising the effective tax rate faced by foreign affiliates, while FDII does so by lowering the effective parent rate on foreign-derived returns.

Intangible investment is also affected indirectly by other adjustment margins, especially the response of tangible investment. For example, when a firm's tangible investment increases in response to a drop in the user cost of tangible capital, the marginal product of intangible capital also increases. In some cases, tax provisions that make profit shifting, and thus intangible investment, less attractive also make tangible investment more attractive, and quantitatively the indirect effect from the latter channel can be stronger than the direct effect from the former. Importantly, these indirect effects can work across, not just within, national boundaries. For example, the direct effect oG GILTI is to reduce intangible investment of U.S. MNEs. At the same time, however, GILTI also increases tangible investment in these MNEs' foreign affiliates, which increases the marginal product of their intangible investments. In our model, the second effect is slightly stronger than the first, leading MNEs to do slightly more intangible investment in the presence of GILTI than in its absence.

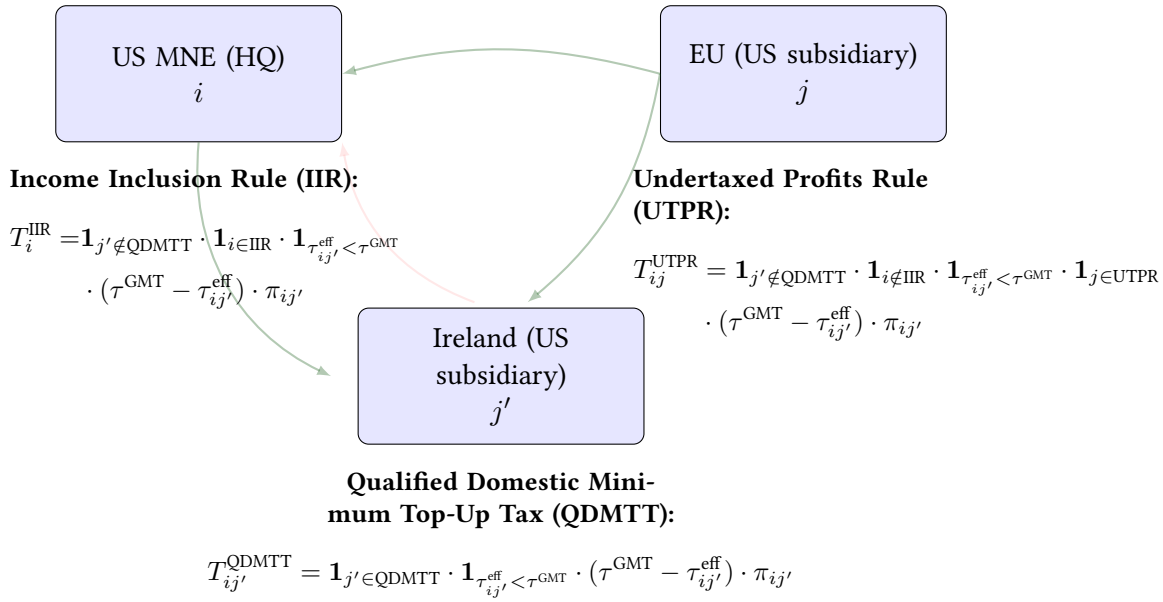


Figure 5: Global Minimum Tax (GMT) in the model-3 region example.

3.4 Interactions between GILTI, FDII, and GMT

The effects of these provisions in combination depend on how they alter the effective tax rates entering the profit-shifting condition. In the general case, the parent's effective rate is

$$\tau_p^\star = (1 - \chi_{\text{FDII}} FDR)\, \tau_{US},$$

which incorporates the FDII deduction, while the effective rate of the low-tax affiliate is

$$\tau_{LT}^\star = \max\{\tau_{LT} + \rho_{ij}^{RT},\ \tau_{\text{GMT}}\},$$

where $\rho_{ij}^{RT} = T_{ij}^{RT}/\pi_{ij}^{NTI}$ is the residual U.S. levy under GILTI and τ_{GMT} is the minimum rate under the global minimum tax. The profit-shifting share is therefore

$$\lambda^{\text{Both}} = 1 - \exp\left(-\frac{(\tau_p^\star - \tau_{LT}^\star)(1 - \varphi_{LT})}{(1 - \tau_p^\star) W_{US}}\right). \tag{47}$$

Expression (47) shows that the combined impact of the three provisions is not simply additive. GILTI and GMT both raise the effective tax rate on low-tax affiliates, and thus enter $\tau_{LT}^\star$ as alternative floors. In practice, whichever of the two is higher will bind, so GILTI and GMT are substitutes in their effect on profit shifting. By contrast, FDII lowers the parent's effective rate $\tau_p^\star$, which works

in the same direction as the higher floor on the affiliate side. FDII and GMT are therefore complements: when the minimum tax binds abroad, the lower U.S. rate on foreign-derived returns further compresses the wedge, reinforcing the incentive to keep intangible capital at home.

The implications for investment follow directly. A lower λ reduces the tax-driven component of intangible investment, while the QBAI deduction under GILTI and the substance-based carve-outs under GMT reduce the user cost of tangibles and payroll. As a result, when GILTI and GMT operate together, the incentives for tangible investment abroad are reinforced, but the margins for intangible expansion are curtailed. When FDII and GMT are combined, the result is a further shift of intangible capital toward the U.S. parent. Taken together, these interactions clarify why the overall impact of domestic and international reforms cannot be inferred from their isolated effects: some provisions offset one another, while others reinforce each other's effects on the allocation of capital and profits.

Table 3: Interactions of TCJA provisions and GMT on U.S. outcomes.

Combination	**Qualitative outcome**
GILTI + GMT	Profit shifting: Substitutes — both raise affiliate ETRs; the higher of (GILTI residual, GMT floor) binds $\Rightarrow \lambda \downarrow$. U.S. investment: $k \downarrow$ (QBAI + carve-outs shift tangibles abroad); $z \downarrow$ (smaller tax-driven return).
FDII + GMT	Profit shifting: Complements — GMT raises affiliate rate while FDII lowers parent rate $\Rightarrow \lambda \Downarrow$. U.S. investment: $k \uparrow$ (lower domestic user cost under FDII); $z \uparrow$ (stronger incentive to retain IP at home).
GILTI + FDII	Profit shifting: Orthogonal — GILTI acts on affiliates (via inclusion/QBAI), FDII on parent rate; both reduce λ. U.S. investment: k mixed (QBAI tilts k abroad; FDII raises k at home); z mixed (FDII $\uparrow$, GILTI $\downarrow$).

Notes: "Affiliate ETR" denotes the effective tax rate faced by low-tax subsidiaries. GILTI imposes a residual inclusion (with QBAI), GMT floors affiliate ETRs and adds substance carve-outs, and FDII lowers the effective U.S. rate on foreign-derived income. "Substitutes" indicates that GILTI and GMT both act on the affiliate side, so the binding floor is the higher of the two; "complements" indicates that FDII (parent side) and GMT (affiliate side) jointly compress the wedge.

Table 3 summarizes how the provisions interact when implemented jointly. GILTI and the global minimum tax are substitutes, since both operate by raising the effective tax rate on low-tax affiliates. In practice the binding floor is whichever regime imposes the higher rate, so combining the two does not multiply their effect on profit shifting but rather shifts real activity abroad through QBAI and carve-outs, reducing domestic tangibles and dampening intangible investment. By contrast, FDII and the global minimum tax are complements: the former lowers the effective U.S. rate on foreign-derived income while the latter raises the affiliate rate, so together they com-

press the wedge on both sides. This joint effect reinforces the incentive to retain intangibles at home and modestly increases domestic tangible investment. Finally, GILTI and FDII affect different margins—GILTI through the taxation of foreign affiliates and FDII through the taxation of the U.S. parent—so their effects are largely orthogonal. In combination they both reduce profit shifting, but with mixed consequences for the allocation of real and intangible investment across jurisdictions. Taken together, these interactions show that the aggregate impact of domestic and international reforms cannot be inferred from their isolated effects, as some provisions reinforce one another while others substitute for each other's role.

4 Calibration

The starting point for our calibration strategy is the approach described in Dyrda et al. (2024b). 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 compute firm-level moments from U.S. data, primarily COMPUSTAT. Fourth, 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 4.

- Population (N_i): Taken directly from the data.
- 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.

- Corporate tax rates (τ_i): For non-U.S. regions, taken from Tørsløv, Wier, and Zucman (2022). For the United States, measured directly from COMPUSTAT data.
- Repatriation share (ι): Identified by the difference in effective tax rates for MNEs vs. non-MNEs.
- 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).

The key difference between the calibration in this paper and those in our previous work is that we calibrate the pre-TCJA version of the model where the United States has a worlwide corporate tax system. This allows us to validate our calibration by evaluating the combined effects of the TCJA reforms, and contribute to the literature by analyzing the effects of each of these reforms in isolation.

5 Effects of the TCJA

Having described the model and its calibration, we turn now to our quantitative experiments. In the first set of experiments, we study the effects of the TCJA. We first evaluate the effect of the reform in its entirety, and then we then shut down the provisions that affect MNEs' intangible income (GILTI and FDII) to measure their contributions to the overall impact. We conduct each experiment twice: 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. Tables 5 and 6 show the results.

Panel (a) in table 5 shows the macroeconomic effects of the TCJA in our baseline model. In the United States, both tangible and intangible investment rise substantially (3.1 and 1.7 percent, respectively), leading to an increase in GDP of 0.8 percent. Profit shifting increases slightly relative to the pre-TCJA baseline and corporate taxes fall by more than a third. The reason that profit shifting increases despite the introduction of the GILTI and FDII provisions is the shift from worldwide to territorial taxation. On its own, this dramatically reduces the effective tax rate that U.S.-based MNEs pay on their income in the low-tax and tax-haven regions, which increases the incentive for these MNEs to shift profits, and GILTI and FDII are not quite powerful enough to counteract this

Table 4: 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	–
Effective CIT rate (%)	26.7	17.3	11.4	17.4	3.3
Effective CIT rate for MNEs (26.2%)	–	–	–	–	
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	0.75	1.19	0.24	–
Prod. dispersion (η_i)	4.74	4.75	5.23	4.59	–
Utility weight on leisure (ψ_i)	1.47	1.46	1.45	1.45	–
Intangible share (ϕ)	0.10	0.10	0.10	0.10	–
R&D spillover (ν)	0.40	0.40	0.40	0.40	–
Fixed export cost (κ_i^X)	3.2e-3	6.7e-3	1.8e-3	2.7e-2	–
Variable FDI cost (σ_i)	0.44	0.54	0.51	0.54	–
Fixed FDI cost (κ_i^F)	1.96	2.70	0.82	13.4	–
Repatriation share (ι)	0.76	–	–	–	–
Cost of shifting profits to LT (ψ_{iLT})	1.01	0.43	–	3.19	–
Cost of shifting profits to TH (ψ_{iTH})	0.72	1.35	–	2.25	–
Fixed FDI cost to TH (κ_i^{TH})	0.23	0.10	–	0.85	–
Variable export cost (ξ_{ij}) from …					
North America	–	3.04	3.25	1.72	–
Europe	2.14	–	1.73	1.34	–
Low tax	2.27	1.57	–	1.55	–
RoW	2.29	2.58	3.06	–	–

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. Effective tax rates for U.S. from Compustat. Lost profits and non-U.S. effective tax rates from Tørsløv et al. (2022). Imports/GDP from WIOD. Dashes (–) represent "not applicable."

effect. In the other regions, investment also increases, especially in intangible capital, leading to smaller but still sizeable increases in output.

Table 5: Macro effects of TCJA

Region	Lost profits	CIT rev.	GDP	Tangible capital	Intangible capital
Baseline model					
(a) All TCJA provisions					
USA	6.49	-37.06	0.80	3.10	1.72
Europe	-0.08	0.48	0.11	0.40	0.82
Rest of world	-0.08	0.38	0.19	0.29	0.83
Low tax	8.10	1.02	0.61	3.51	0.34
(b) No GILTI					
USA	78.59	-38.24	0.54	3.05	0.67
Europe	0.07	0.39	-0.18	0.39	0.83
Rest of world	-0.00	0.34	-0.20	0.27	0.70
Low tax	6.82	1.40	-0.14	0.61	1.11
(c) No FDII					
USA	26.82	-36.43	3.16	8.04	2.76
Europe	-0.23	0.69	1.36	0.43	0.79
Rest of world	-0.20	0.55	1.53	0.32	0.93
Low tax	13.27	2.11	1.82	3.52	0.15
(d) No MNE provisions					
USA	100.50	-37.84	2.88	7.99	1.74
Europe	-0.10	0.60	1.04	0.41	0.76
Rest of world	-0.12	0.51	1.14	0.30	0.79
Low tax	11.91	2.46	1.06	0.62	0.92
No spillovers					
(e) All TCJA provisions					
USA	6.51	-37.15	0.33	3.06	1.34
Europe	-0.09	0.21	-0.25	0.35	0.49
Rest of world	-0.07	0.24	-0.32	0.23	0.35
Low tax	7.99	0.67	0.24	3.47	-0.01
(f) No GILTI					
USA	78.64	-38.30	0.10	3.03	0.29
Europe	0.06	0.21	-0.43	0.35	0.59
Rest of world	0.02	0.25	-0.49	0.23	0.41
Low tax	6.73	1.17	-0.40	0.59	0.84
(g) No FDII					
USA	26.91	-36.57	2.65	8.01	2.39
Europe	-0.26	0.32	0.85	0.36	0.35
Rest of world	-0.19	0.36	0.80	0.24	0.25
Low tax	13.12	1.64	1.34	3.47	-0.24
(h) No MNE provisions					
USA	100.64	-37.94	2.42	7.96	1.38
Europe	-0.11	0.33	0.68	0.36	0.44
Rest of world	-0.11	0.37	0.63	0.24	0.31
Low tax	11.80	2.12	0.70	0.59	0.60

Notes: All columns report percent changes relative to the pre-TCJA status quo.

Table 6: Decomposition of TCJA effects by firm type

Region	Value added				Tangible capital				Intangible capital		
	Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
Baseline model											
(a) All TCJA provisions											
USA	0.80	0.49	-0.17	0.48	3.10	1.76	0.17	1.16	1.72	0.04	1.68
Europe	0.11	-0.13	-0.01	0.25	0.40	-0.12	-0.00	0.52	0.82	-0.01	0.83
Rest of world	0.19	-0.03	0.07	0.15	0.29	-0.07	0.02	0.33	0.83	0.02	0.81
Low tax	0.61	-0.70	-0.22	1.53	3.51	-0.60	-0.15	4.26	0.34	-0.19	0.53
(b) No GILTI											
USA	0.54	0.45	-0.36	0.44	3.05	1.82	0.07	1.16	0.67	0.06	0.61
Europe	-0.18	-0.24	-0.11	0.17	0.39	-0.12	0.01	0.50	0.83	-0.02	0.85
Rest of world	-0.20	-0.19	-0.13	0.12	0.27	-0.08	0.02	0.33	0.70	0.00	0.70
Low tax	-0.14	-0.37	-0.08	0.31	0.61	-0.25	-0.00	0.86	1.11	-0.05	1.17
(c) No FDII											
USA	3.16	1.13	1.57	0.47	8.04	3.17	3.86	1.01	2.76	0.04	2.72
Europe	1.36	0.37	0.48	0.51	0.43	-0.10	-0.01	0.53	0.79	0.01	0.78
Rest of world	1.53	0.27	0.99	0.27	0.32	-0.30	0.28	0.34	0.93	-0.07	1.00
Low tax	1.82	-0.18	0.09	1.91	3.52	-0.59	-0.17	4.28	0.15	-0.18	0.33
(d) No MNE provisions											
USA	2.88	1.08	1.37	0.43	7.99	3.21	3.76	1.01	1.74	0.05	1.69
Europe	1.04	0.24	0.36	0.43	0.41	-0.11	0.00	0.51	0.76	-0.00	0.76
Rest of world	1.14	0.36	0.55	0.24	0.30	-0.06	0.02	0.33	0.79	0.02	0.77
Low tax	1.06	0.15	0.23	0.68	0.62	-0.24	-0.02	0.88	0.92	-0.04	0.96
No spillovers											
(e) All TCJA provisions											
USA	0.33	0.30	-0.38	0.41	3.06	1.76	0.17	1.13	1.34	0.01	1.33
Europe	-0.25	-0.26	-0.14	0.15	0.35	-0.12	-0.01	0.48	0.49	-0.04	0.54
Rest of world	-0.32	-0.23	-0.19	0.10	0.23	-0.08	0.00	0.32	0.35	-0.03	0.38
Low tax	0.24	-0.83	-0.31	1.38	3.47	-0.57	-0.15	4.19	-0.01	-0.24	0.23
(f) No GILTI											
USA	0.10	0.27	-0.56	0.40	3.03	1.81	0.07	1.15	0.29	0.02	0.27
Europe	-0.43	-0.32	-0.20	0.10	0.35	-0.12	0.01	0.47	0.59	-0.04	0.63
Rest of world	-0.49	-0.30	-0.26	0.08	0.23	-0.09	0.01	0.31	0.41	-0.03	0.44
Low tax	-0.40	-0.46	-0.15	0.21	0.59	-0.23	0.00	0.82	0.84	-0.09	0.93
(g) No FDII											
USA	2.65	0.93	1.34	0.37	8.01	3.17	3.86	0.97	2.39	0.00	2.39
Europe	0.85	0.19	0.29	0.37	0.36	-0.11	-0.01	0.48	0.35	-0.04	0.39
Rest of world	0.80	0.22	0.36	0.22	0.24	-0.07	-0.00	0.32	0.25	-0.02	0.27
Low tax	1.34	-0.34	-0.03	1.71	3.47	-0.56	-0.16	4.19	-0.24	-0.23	-0.01
(h) No MNE provisions											
USA	2.42	0.89	1.16	0.36	7.96	3.21	3.76	0.99	1.38	0.01	1.36
Europe	0.68	0.12	0.23	0.33	0.36	-0.11	-0.00	0.47	0.44	-0.04	0.48
Rest of world	0.63	0.15	0.29	0.20	0.24	-0.08	0.00	0.32	0.31	-0.02	0.33
Low tax	0.70	0.03	0.14	0.53	0.59	-0.22	-0.01	0.82	0.60	-0.09	0.69

Notes: "Total" columns report percent changes relative to pre-TCJA status quo. Other columns report changes in percentage points relative to the pre-TCJA total for that category; other columns in each category sum to the total percent change.

Panel (a) in table 6 shows the effects on different groups of firms. In the United States, the TCJA leads to a reallocation of resources away from domestic MNEs. All U.S.-based firms invest more in both types of capital, but the increase in tangible investment is more than ten times greater for non-MNEs. Additionally, foreign MNEs' tangible investments in the U.S. grow dramatically due to the more favorable tax treatment. This causes labor to reallocate away from domestic MNEs, and their output actually falls slightly. In other regions, domestic firms (both MNEs and non-MNEs) produce less; the increase in aggregate output is driven entirely by foreign (i.e., American) MNEs. The drop in output of domestic firms in other regions is due to the fact that the large increase in demand for tangible capital in the United States pushes the real interest rate upward, making investment more expensive in other regions whose tax rates have not changed.

Panel (e) in each table shows the effects of the TCJA without spillovers. While the effects are similar to the baseline results for the United States, the outcome for other regions is striking: output now falls dramatically rather than rising. There are two reasons for this. First, intangible investment of U.S. MNEs rises less, which means their foreign affiliates' output rises less. Second, intangible investment of firms in other regions rises much less (in the case of MNEs) or falls much more (in the case of non-MNEs), amplifying the effects of the increase in capital costs on tangible investment. Thus, in the model without spillovers, the main effect of the TCJA is to pull tangible investment to the United States from the rest of the world (similar to what would happen a standard international real business cycle model), whereas in the baseline model, R&D productivity increases enough in the rest of the world to offset this effect.

5.1 Effects of GILTI

Panel (b) in tables 5 and 6 shows how the TCJA would have affected the global economy if the reform did not include the GILTI provision. For the United States, the macroeconomic consequences would be similar but profit shifting would increase dramatically. It is important to note that this would have only a modest effect on corporate income tax revenues, which would decline by 38.2 percent versus 37.1 percent under the full TCJA. Clearly, the drop in the overall effective tax rate is far more impactful for the government budget than the small number of MNEs that shift profits. Qualitatively, the effect of GILTI on tangible investment is positive, consistent with Chodorow-Reich et al. (2023), but fairly small.

For the rest of the world, GILTI has material macroeconomic consequences. Without GILTI, the TCJA would have caused output in other regions to fall, rather than rise. There are two reasons for this. First, output of U.S. MNEs' foreign affiliates in these regions rises less because GILTI provides

an incentive for tangible investment abroad as described by Chodorow-Reich et al. (2023). Note that this incentive directly affects these foreign affiliates' tangible investment, but also indirectly affects U.S. MNEs' intangible investment, which increases by almost 2/3 less in this version of the TCJA. Second, the drop in U.S. MNEs' intangible investment generates fewer spillovers in the rest of the world, leading firms in these regions, especially non-MNEs, to do less intangible investment themselves. Consequently, output of domestic firms in these regions falls more than in the full version of the TCJA.

5.2 Effects of FDII

Panel (c) in tables 5 and 6 shows how the TCJA would have affected the global economy if the reform did not include the FDII provision. For the United States, the main effect of FDII is on investment, both tangible and intangible, which would both rise by 150 percent more than in the full TCJA analysis. The difference is most pronounced for U.S.-based MNEs, but investment of non-MNEs also rises significantly. This is driven by the fact that even though the FDII provision is intended to provide a tax deduction, it also actually raises the after-tax marginal cost of domestic tangible capital, and this distortion is increasing in the fraction of a firm's income that is foreign-derived. Our results indicate that FDII incents MNEs and non-MNE exporters to invest substantially less in tangible capital. This has the effect of reducing the marginal after-tax return to intangible investment, and this effect dominates the direct effect of the tax deduction (which increases this return). FDII also reduces profit shifting, but much less than GILTI. Without the FDII provision, the TCJA would increase U.S. lost profits by about a quarter, a third of the increase in the TCJA without GILTI.

The other regions in the economy are also hurt by the FDII provision, especially in the baseline model with spillovers. In equilibrium, the large increase in output in the United States in the absence of FDII increases demand for MNEs and exporting firms in the other regions, inducing these firms to invest more and ultimately produce more at home as well. This effect is observed even in the model without spillovers, indicating that the increase in U.S. demand in the absence of FDII would outweigh the investment-pull effect that reduces investment in the rest of the world under the full TCJA.

5.3 Effects of GILTI and FDII combined

Panel (d) in tables 5 and 6 shows the effects of a version of the TCJA without either the two profit-shifting provisions. In this scenario, profit shifting would double, indicating that these provisions'

effects are largely orthogonal and do not amplify or attenuate each other. The effects on investment and output would be similar in all regions to the effects without FDII, which is not surprising given the relative magnitudes of the two provisions' effects on these margins.

6 Effects of a global minimum corporate tax

Our second set of experiments focuses on the effects of a global minimum corporate income tax (GMT). While the most likely version of this policy is implementation in all regions of the world economy except for the United States, we also study the effects of a GMT in the United States alone and a worldwide GMT. Again, we conduct two versions of each exercise: in our baseline model with spillovers and in the no-spillover alternative. Here, spillovers create even larger ripple effects. Here, we conduct these exercises starting from the TCJA equilibrium, which is the current status quo.

6.1 GMT 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). Tables 7 and 8 show 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).

Table 7: Macroeconomic effects of GMT outside United States

Region	Lost profits	CIT rev.	GDP	Tangible capital	Intangible capital
(a) Baseline model					
USA	-0.04	-0.33	-0.10	0.00	-0.09
Europe	-73.00	3.18	-0.03	0.00	-0.47
Rest of world	-80.28	1.55	-0.06	-0.01	-0.24
Low tax	-39.82	5.75	0.01	1.33	0.70
(b) No spillovers					
USA	-0.05	-0.29	0.00	0.01	-0.00
Europe	-73.01	3.24	0.04	0.01	-0.41
Rest of world	-80.29	1.59	0.02	0.00	-0.17
Low tax	-39.84	5.73	0.16	1.32	0.87

Notes: All columns report percent changes relative to the TCJA equilibrium.

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 73% in Europe and 80% 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 regions

Table 8: Effects of GMT outside of US on factor allocations

Region	Value added				Tangible capital				Intangible capital		
	Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
(a) Baseline model											
USA	-0.10	-0.04	-0.05	-0.02	0.00	0.01	0.00	-0.01	-0.09	-0.01	-0.09
Europe	-0.03	0.02	-0.05	0.01	0.00	0.03	-0.04	0.01	-0.47	0.00	-0.47
Rest of world	-0.06	-0.00	-0.04	-0.02	-0.01	0.02	-0.02	-0.01	-0.24	-0.00	-0.24
Low tax	0.01	0.10	-0.55	0.46	1.33	0.20	-0.88	2.01	0.70	0.10	0.60
(b) No spillovers											
USA	0.00	0.00	0.00	-0.00	0.01	0.01	0.00	-0.00	-0.00	0.00	-0.00
Europe	0.04	0.04	-0.03	0.03	0.01	0.03	-0.04	0.02	-0.41	0.01	-0.42
Rest of world	0.02	0.03	-0.01	-0.00	0.00	0.02	-0.01	-0.01	-0.17	0.01	-0.18
Low tax	0.16	0.17	-0.50	0.49	1.32	0.19	-0.88	2.01	0.87	0.12	0.75

Notes: "Total" columns report percent changes relative to TCJA equilibrium. Other columns report changes in percentage points relative to the TCJA equilibrium for that category; other columns in each category sum to the total percent change.

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 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 GMT in the United States only

It is extraordinarily unlikely that the United States would implement a global minimum tax on its own without the rest of the world, but this scenario still provides a useful illustration of the potential for such policies to create cross-country ripple effects. Tables 9 and 10 show the results of this experiment, both with and without spillovers as before.

Table 9: Macroeconomic effects of GMT in United States only

Region	Lost profits	CIT rev.	GDP	Tangible capital	Intangible capital
(a) Baseline model					
USA	-70.06	2.06	-0.16	-0.01	-0.61
Europe	0.03	-0.08	-0.21	-0.01	-0.04
Rest of world	0.01	-0.05	-0.27	-0.01	-0.11
Low tax	-14.84	-2.68	-0.23	-0.18	0.11
(b) No spillovers					
USA	-70.09	2.10	-0.12	-0.01	-0.59
Europe	0.03	-0.02	-0.13	-0.00	0.02
Rest of world	0.01	-0.02	-0.13	-0.00	0.01
Low tax	-14.82	-2.61	-0.15	-0.18	0.17

Notes: All columns report percent changes relative to the TCJA equilibrium.

Table 10: Effects of GMT in United States only on factor allocations

	Value added				Tangible capital				Intangible capital		
Region	Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
(a) Baseline model											
USA	-0.16	-0.02	-0.12	-0.02	-0.01	0.04	-0.05	0.00	-0.61	0.01	-0.61
Europe	-0.21	-0.08	-0.08	-0.06	-0.01	0.00	0.00	-0.02	-0.04	-0.01	-0.03
Rest of world	-0.27	-0.11	-0.13	-0.02	-0.01	-0.00	-0.00	-0.01	-0.11	-0.01	-0.10
Low tax	-0.23	-0.02	-0.02	-0.19	-0.18	0.07	0.04	-0.28	0.11	0.02	0.10
(b) No spillovers											
USA	-0.12	-0.01	-0.10	-0.00	-0.01	0.04	-0.05	0.01	-0.59	0.01	-0.60
Europe	-0.13	-0.05	-0.05	-0.03	-0.00	0.00	0.00	-0.01	0.02	0.00	0.02
Rest of world	-0.13	-0.05	-0.06	-0.02	-0.00	0.00	0.00	-0.01	0.01	0.00	0.01
Low tax	-0.15	0.01	-0.00	-0.16	-0.18	0.06	0.03	-0.27	0.17	0.02	0.14

Notes: "Total" columns report percent changes relative to TCJA equilibrium. Other columns report changes in percentage points relative to the TCJA equilibrium for that category; other columns in each category sum to the total percent change.

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.

6.3 Worldwide GMT

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. Tables 11 and 12 shows the results.

Table 11: Macroeconomic effects of worldwide GMT

Region	Lost profits	CIT rev.	GDP	Tangible capital	Intangible capital
(a) Baseline model					
USA	-70.08	1.82	-0.27	-0.01	-0.69
Europe	-72.99	3.08	-0.25	-0.01	-0.51
Rest of world	-80.28	1.50	-0.33	-0.02	-0.36
Low tax	-54.64	2.36	-0.22	1.16	0.82
(b) No spillovers					
USA	-70.11	1.89	-0.11	-0.00	-0.59
Europe	-73.00	3.21	-0.10	0.00	-0.39
Rest of world	-80.29	1.56	-0.11	-0.00	-0.16
Low tax	-54.65	2.44	0.01	1.16	1.06

Notes: All columns report percent changes relative to the TCJA equilibrium.

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: 70% for the United States as in Section 6.2, and 73% and 80% 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 55%. However, there are also large macroe-

Table 12: Effects of worldwide GMT on factor allocations

Region	Value added				Tangible capital				Intangible capital		
	Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
(a) Baseline model											
USA	-0.27	-0.07	-0.16	-0.04	-0.01	0.04	-0.05	-0.01	-0.69	-0.00	-0.69
Europe	-0.25	-0.06	-0.13	-0.05	-0.01	0.03	-0.04	-0.00	-0.51	-0.00	-0.51
Rest of world	-0.33	-0.11	-0.18	-0.04	-0.02	0.01	-0.02	-0.02	-0.36	-0.01	-0.35
Low tax	-0.22	0.08	-0.57	0.27	1.16	0.27	-0.84	1.73	0.82	0.12	0.70
(b) No spillovers											
USA	-0.11	-0.01	-0.10	-0.01	-0.00	0.04	-0.05	0.01	-0.59	0.01	-0.60
Europe	-0.10	-0.01	-0.08	-0.01	0.00	0.03	-0.04	0.01	-0.39	0.01	-0.40
Rest of world	-0.11	-0.02	-0.07	-0.02	-0.00	0.02	-0.01	-0.01	-0.16	0.01	-0.17
Low tax	0.01	0.18	-0.50	0.33	1.16	0.26	-0.84	1.74	1.06	0.15	0.91

Notes: "Total" columns report percent changes relative to TCJA equilibrium. Other columns report changes in percentage points relative to the TCJA equilibrium for that category; other columns in each category sum to the total percent change.

conomic effects. Output falls in all four productive regions and global GDP falls by almost 0.3%. 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.

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.

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