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Sebastian Dyrda
Guangbin Hong
Muhammad Ali Sajid
Joseph B. Steinberg

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ABSTRACT

We study the cross-country effects of corporate tax reforms in a fragmented global tax regime. Using firm-level evidence on the 2017 U.S. Tax Cuts and Jobs Act (TCJA) and a quantitative general-equilibrium model, we illustrate how multinational enterprises (MNEs) propagate local policy shocks globally. Our framework emphasizes two properties of intangible capital: nonrivalry and mobile ownership. The TCJA generated positive outward ripple effects through two channels. First, it boosted U.S. MNEs' intangible investment, raising output at their foreign subsidiaries. Second, it raised tangible investment by the U.S. subsidiaries of foreign MNEs, inducing their foreign parents to expand intangible investment at home. Conversely, a Global Minimum Tax (GMT) that allows low-tax jurisdictions to impose top-up taxes on U.S. MNEs' affiliate earnings generates negative inward ripple effects on GDP and tax revenue for the United States. These findings illustrate that there is no such thing as a purely domestic corporate tax policy.

Sebastian Dyrda
University of Toronto
sebastian.dyrda@utoronto.ca

Muhammad Ali Sajid
University of Toronto
ali.sajid@mail.utoronto.ca

Guangbin Hong
Michigan State University
honggua2@msu.edu

Joseph B. Steinberg
University of Toronto
Department of Economics
and NBER
joseph.steinberg@utoronto.ca

1 Introduction

The international corporate tax landscape is being reshaped by two distinct efforts to curb profit shifting by multinational enterprises (MNEs). In 2017, the United States replaced its worldwide corporate tax system with the largely territorial framework introduced by the Tax Cuts and Jobs Act (TCJA), including new provisions intended to discourage profit shifting and encourage firms to retain intangible capital at home. Since then, the European Union and other major economies have begun implementing the OECD's Global Minimum Tax (GMT), which establishes a multilateral floor on the taxation of multinational profits. This paper studies how multinational production networks propagate the macroeconomic effects of these two regimes across borders, creating cross-country "ripple effects."

Our findings are asymmetric across the two reforms. The TCJA is broad, with some provisions that apply to all firms and others that specifically target multinationals. It generates large increases in domestic investment and output, and material ripple effects abroad. The GMT is narrower, applying only to large multinationals. In adopting regions, it sharply reduces profit shifting and raises corporate tax revenue, at the cost of modest output losses. Its effects on the United States depend on whether U.S. MNEs fall within its reach. When low-tax jurisdictions levy top-up taxes on these firms' foreign affiliates, the GMT propagates to the United States through their global production networks to slightly reduce U.S. output; a complete exemption, by contrast, leaves U.S. output unchanged. Despite these differences, once scaled by the changes in average effective tax rates induced by each reform, their domestic and cross-border output effects are of comparable magnitude.

Our laboratory is a general-equilibrium model of multinational production, nonrival intangible capital, and profit shifting, building on Dyrda, Hong, and Steinberg (2024a,b). Heterogeneous firms, headquartered in different regions, pay fixed costs to export, open foreign subsidiaries, and establish affiliates in profit-shifting destinations. Following McGrattan and Waddle (2020), they accumulate intangible capital at home and combine it with tangible capital and labor wherever they operate. Intangible capital is nonrival: the same stock can be used simultaneously by all of a multinational's divisions. Profit shifting operates through transferring the ownership of this capital to low-tax affiliates, as in Dyrda et al. (2024a). Regional tax reforms that change local investment and tax revenue can propagate across borders through these multifaceted multinational production networks.

A central methodological contribution is our detailed mapping of the specific details of the institutional tax environment into our model. We account for the TCJA's shift from worldwide

to territorial taxation, its more generous depreciation allowance, and its anti-profit-shifting measures; the GMT's rule hierarchy; and the "substance-based" provisions of both regimes that provide deductions for meaningful economic activity in low-tax jurisdictions. Our results show that these details matter, particularly for the TCJA where the overall net effect is far smaller than the individual provisions' separate effects.

Our model is calibrated to match micro and macro data on production, trade, FDI, and profit shifting from 2014–2016, before the TCJA was enacted. Starting from this pre-TCJA benchmark equilibrium, we first introduce the TCJA, building it up one provision at a time until we arrive at the full suite of policy reforms it contained. The first provision is the shift from worldwide to territorial taxation, which effectively reduced the tax rate U.S.-based MNEs paid on their foreign earnings. The second provision is a reduction in the statutory corporate tax rate, which benefits all firms operating within the United States—both domestic firms and local affiliates of foreign MNEs. The third is an increase in "bonus depreciation" that allows all firms to immediately deduct most tangible investments made in the United States. Fourth is the Global Intangible Low-Taxed Income (GILTI) rule, which makes profit shifting more expensive by introducing a minimum tax on intangible income booked in low-tax jurisdictions. Fifth is the Foreign-Derived Intangible Income (FDII) rule, which incentivizes MNEs to shift intangible assets back to the United States by subsidizing intangible income associated with exporting.

We find that the TCJA substantially boosted U.S. investment, raising tangible and intangible capital by 7.0 percent and 2.1 percent, respectively, and lifting GDP by 2.1 percent. However, this expansion came at a cost: corporate tax revenues fell by more than a third, despite the fact that the share of U.S. MNEs' profits that are shifted to tax havens fell by about 4 percentage points. Other regions were also materially affected: U.S. MNEs expanded both at home and abroad, increasing GDP in Europe by 0.2 percent and the rest of the world by 0.1 percent. The shift to a territorial system, the statutory tax cut, and the increase in bonus depreciation all stimulate the U.S. economy, each boosting U.S. GDP by as much as 1.2 percent in isolation. FDII reduces U.S. output by almost 0.5 percent by discouraging U.S. exporters and MNEs from investing in domestic tangible capital. The international ripple effects are driven primarily by the territorial system, which encourages U.S. MNEs to invest more in tangible capital abroad and in intangible capital at home.

Next, we study the effects of a GMT implemented in the rest of the world, starting from the TCJA equilibrium. A GMT that completely exempts U.S. MNEs reduces intangible investment by 2.2 percent in Europe and 1.5 percent in the rest of the world, lowering output in these regions by 0.4 percent and 0.3 percent, respectively, with no discernible impact on the U.S. economy. By contrast, when the GMT applies to U.S. MNEs' foreign incomes as well as those of MNEs based

in signatory regions—consistent with the Side-by-Side (SbS) agreement the OECD reached with the United States—the effects in other regions are about the same as before, but U.S. GDP now falls by 0.02 percent. Although the overall effects of the GMT are modest compared to those of the TCJA, they should be interpreted relative to the size of the underlying tax changes. The TCJA reduced effective corporate tax rates by about six percentage points for firms operating in the United States, whereas the GMT raises taxes only for a narrow subset of MNEs that shift profits to low-tax jurisdictions; the average effective tax-rate change for MNEs headquartered in affected regions is only a few basis points. Viewed on a per-tax-point basis, the GMT therefore generates sizable effects, both within and across borders.

We validate the model's predictions using firm-level evidence from the TCJA. Using a panel of U.S. firms from Compustat, we exploit cross-firm variation in exposure to the reform, measured by a simulated tax change that depends only on each firm's pre-reform characteristics, which allows us to isolate ex-ante exposure to the reform from endogenous ex-post responses. Firms receiving larger tax cuts increase both tangible and intangible investment, with a stronger response in the former. We also find that U.S. MNEs reduce profit shifting relative to non-U.S. MNEs following the reform. The results of our modeling exercises are consistent with both pieces of evidence. The model's predicted 7.0 percent increase in aggregate tangible capital is also close to the 6.4 percent estimated by Chodorow-Reich, Smith, Zidar, and Zwick (2026), even though the two papers use vastly different modeling approaches; whereas they discipline their model using estimates from administrative data of firm-level investment responses following the TCJA's implementation, we calibrate our model by matching only moments from public data for the pre-TCJA economy. That the two approaches generate such similar results validates our model as a reliable laboratory for evaluating large-scale tax reforms.

2 Related literature

This paper contributes to several strands of literature in international economics, public finance, and macroeconomics. The first strand of literature focuses on evaluating the expected and actual effects of the TCJA tax reform. Initial studies in this area have primarily used calibrated models to predict the TCJA's outcomes, with significant contributions from Auerbach (2018), Barro and Furman (2018), and Clausing (2020), which discuss the expected economic impacts. Subsequent empirical investigations by Kopp, Leigh, Mursula, and Tambunlertchai (2019), Chodorow-Reich et al. (2026), Clausing (2024), and Santacreu and Stewart (2024) find that the TCJA generated substantial and heterogeneous reductions in effective tax rates across U.S. firms and modest and uneven effects on real activity, including investment, employment, and profit-shifting behavior, particularly

along intangible-related margins. On the global minimum tax, which took effect in 2024, Contreras, Hugger, and Zawisza (2026) find early evidence that it raises the effective tax rates of in-scope multinationals but has not yet had a significant effect on their investment or employment.

The closest paper in this strand is Chodorow-Reich et al. (2026), who use administrative tax data to estimate firm-level responses to the TCJA and discipline a model of U.S. firms' domestic and foreign tangible investment. Our framework incorporates a broader set of international margins: multiple non-U.S. regions linked in global general equilibrium, allowing us to quantify effects on adopting and non-adopting economies; nonrival intangible capital; and heterogeneous firms with endogenous export, foreign-affiliate, and profit-shifting decisions. Our microfounded profit-shifting mechanism links the ownership and licensing of intangible capital to tangible and intangible investment, while foreign MNEs operating in the United States create an additional channel through which domestic and foreign tax reforms affect the U.S. economy. Although Chodorow-Reich et al. (2026) show in their appendices how nonrival intangible capital and profit shifting can be added separately to their user-cost framework, they do not jointly incorporate these margins into their quantitative analysis. We also model the GMT and its interaction with TCJA provisions, particularly GILTI.

The second strand studies profit shifting: its measurement (Guvenen, Mataloni, Rassier, and Ruhl, 2022; Tørsløv, Wier, and Zucman, 2023; Delis, Delis, Laeven, and Ongena, 2024), effects on firm behavior (Hines and Rice, 1994; Suárez Serrato, 2018; Bilicka, Devereux, and Güçeri, 2024; Altshuler, Boller, Roberts, and Suárez Serrato, 2025), and aggregate implications (Dyrda, Hong, and Steinberg, 2024a). Our earlier work Dyrda et al. (2024a) develops a micro-founded theory of shifting via transfer pricing of intangible capital, building on the insight of Hong and Smart (2010) that shifting can improve welfare by relieving real distortions in high-tax countries, and studies the GMT within this framework. This paper extends that work in four ways. First, we map the U.S. tax code, including the TCJA's MNE provisions, into the model and quantify the effects of both reforms. Second, we add tangible capital, allowing us to quantify how the reforms' tangible-capital carve-outs affect investment. Third, we show that the GMT's effects on the United States depend on whether U.S. MNEs are exempt or face top-up taxes in low-tax countries; our earlier work considered only a hypothetical GMT with full U.S. participation. Fourth, we provide empirical evidence on the TCJA's effects on U.S. firms' tangible and intangible investment and profit shifting.

More broadly, we contribute to the literature that emphasizes the role of nonrival intangible capital in shaping the aggregate effects of foreign direct investment (McGrattan and Prescott, 2009; Alviarez, Cravino, and Ramondo, 2023; McGrattan and Waddle, 2020). Specifically, McGrattan and Prescott (2009) build a neoclassical growth model in which the representative multinational in-

vests in intangible capital that can be used simultaneously to produce output at home and abroad, and show that this channel substantially increases the gains to openness to FDI. We build on this framework by allowing heterogeneous firms to choose export destinations, foreign affiliate locations, and intangible investment, while additionally incorporating a theory of profit shifting through tax-haven affiliates and endogenous relocation of intangible assets. Recent work by LaBelle, Martin, and Santacreu (2025) provides complementary evidence using global patent transfers, documenting how statutory tax differentials shape the international allocation of intangible assets and royalty income. The paper is also related to the quantitative multinational-production models of Ramondo (2014) and Ramondo and Rodríguez-Clare (2013), which analyze firms' trade-offs between exporting and affiliate production.

3 Institutional background

We begin with a brief description of the changes to the U.S. corporate tax system under the TCJA and the changes to the rest of the world's tax system under the OECD's GMT, with a particular focus on how these reforms affected multinational corporations. The appendix contains a detailed description of how we map the provisions of these reforms into our model.

3.1 The Tax Cuts and Jobs Act

The Tax Cuts and Jobs Act (TCJA) of 2017 substantially cut taxes for all U.S. firms. Prior to the TCJA, the United States had a progressive corporate tax system, with rates ranging from 15 percent on income below $50 thousand to 35 percent on income above $10 million. Under the TCJA, all U.S. corporate income is now taxed at a flat 21 percent. The TCJA also provided a large tax deduction for tangible investment. Previously, firms could deduct 50 percent of the cost of eligible capital from their income in the year that capital was purchased.[1] The TCJA boosted this "bonus depreciation" rate to 100 percent.[2]

The TCJA also made several important changes to the way that U.S.-based MNEs are taxed on their foreign income. Before 2017, the income generated by U.S. MNEs' foreign affiliates was taxed by the U.S. government—at the higher statutory rates that applied under the old system—when that income was repatriated. The TCJA shifted to a territorial system under which repatriated foreign earnings are largely exempt from U.S. taxation.[3] Alongside this shift, two new provisions to com-

[1] Qualifying property comprises depreciable assets with a recovery period of twenty years or less, such as equipment, machinery, and software, and excludes structures. Tangible capital installed abroad by foreign subsidiaries of U.S.-based MNEs is ineligible; bonus depreciation applies to domestic investment only.

[2] The increase in bonus depreciation under the TCJA was initially temporary and scheduled to phase out starting in 2023, but the One Big Beautiful Bill Act (OBBBA) of 2025 made the increase permanent.

[3] As part of the transition to the territorial system, the TCJA also implemented a one-time repatriation tax on U.S.

bat international profit shifting were introduced: Global Intangible Low-Taxed Income (GILTI) and Foreign-Derived Intangible Income (FDII).[4] GILTI levies a minimum tax of 10.5 percent on intangible income booked in foreign subsidiaries.[5] FDII subsidizes income associated with exporting that is generated by intangible assets deployed domestically by taxing this income at 13 percent—eight percentage points below the new flat statutory rate.[6] The intention of FDII is to incentivize U.S. firms to retain intangible-related income within the U.S. and to serve foreign markets by exporting rather than multinational production, but it has an unintended perverse side effect: each unit of tangible capital installed domestically reduces the FDII subsidy (Clausing, 2024).

We first provide evidence on how the TCJA changed firms' tax burdens and shifted profits. We use Compustat, which reports firm-level financial statement data for U.S.-listed companies, including income tax expense, pre-tax income, and the foreign subsidiaries a firm discloses. We describe the sample construction in detail in the appendix. We measure a firm's tax burden with the average effective tax rate (AETR), its total worldwide income tax expense divided by its worldwide pre-tax income, aggregated across profitable firm-years so that firms are weighted by pre-tax income. We report the AETR separately for MNEs and non-MNEs and classify a firm as an MNE if it reports non-U.S. subsidiaries together with foreign pre-tax income or foreign taxes. For shifted profits, we take firm-year estimates from Delis et al. (2024), who infer them from a firm's reported profits and the semi-elasticity of those profits with respect to the tax differential between the firm and its foreign affiliates, and merge these estimates into our Compustat sample.

Table 1 shows that both effective tax rates and shifted profits declined sharply following the TCJA. Panel (a) shows that the average AETR of U.S. firms falls by 6.0 percentage points after the reform. Before the TCJA, U.S. MNEs had a slightly lower AETR than U.S. non-MNEs. The TCJA lowers the MNE rate by 8.0 percentage points, almost double the decline of 4.1 percentage points for non-MNEs, so the gap between the two groups widens. This asymmetry is consistent with the territorial shift, which lowers the tax on U.S. MNEs' foreign income and thus benefits

MNEs' accumulated foreign earnings, levied at 15.5 percent on cash and 8 percent on illiquid assets.

[4]The TCJA also introduced the Base Erosion and Anti-Abuse Tax (BEAT), which penalizes large MNEs that shift profits via deductible payments to foreign affiliates. Due to its narrow scope and coverage, it is far less important compared to GILTI and FDII. According to the IRS, total paid BEAT tax in 2018 was less than 1% of GILTI tax and 4% of FDII credits. When we incorporated BEAT into our quantitative model, we found no firm was subject to it in equilibrium.

[5]Intangible income is defined as residual earnings in excess of Qualified Business Asset Investment (QBAI), a deemed "normal" 10 percent return on tangible capital. When GILTI was enacted in 2017, it initially applied to all income of U.S. multinationals, but in 2020, the U.S. Treasury revised the rule by creating the high-tax exclusion (HTE), which excludes foreign income taxed at 90 percent or more of the U.S. corporate rate from GILTI. We apply the updated HTE rule when introducing GILTI in the model.

[6]As with GILTI, FDII defines intangible income as the residual in excess of the 10-percent QBAI return on tangible capital.

Table 1: Average effective tax rates and profit shifting before and after the TCJA

	Pre-TCJA (2014–2016)	Post-TCJA (2018–2020)	Change
(a) Average AETR (%)			
All firms	25.8	19.8	−6.0
U.S. non-MNEs	26.0	21.9	−4.1
U.S. MNEs	25.6	17.6	−8.0
(b) Profit shifting by U.S. MNEs			
Aggregate profits shifted (billions of 2009 $)	234	123	−47.4
Average share of profits shifted (%)	7.6	5.1	−2.5

Notes: (a) Average GAAP AETR (total worldwide tax expenses over pre-tax income) weighted by pre-tax income. (b) Two measures of profit shifting by U.S. MNEs from Delis et al. (2024): aggregate shifted profits in billions of dollars, and unweighted average ratio of shifted profits to pre-tax income. First and second columns report averages over 2014–2016 and 2018–2020, respectively. Last column reports changes between first two columns in percentage points for all rows except aggregate shifted profits, where change is in percent.

them disproportionately. Panel (b) shows that profit shifting by U.S. MNEs falls sharply: aggregate shifted profits decline by more than 40 percent, and the shifted-profit share, defined as shifted profits over pre-tax income, falls by 2.5 percentage points. This is consistent with GILTI and the territorial shift curbing the incentive to book income in low-tax jurisdictions.

3.2 Global Minimum Tax

The OECD/G20 Inclusive Framework on Base Erosion and Profit Shifting (BEPS) proposed several rules to combat international profit shifting by MNEs, but the most well-known is Pillar Two, commonly known as the global minimum tax (GMT), which establishes a minimum effective tax rate of 15 percent.[7] The primary enforcement mechanism is the Income Inclusion Rule (IIR), under which an MNE's home country collects a "top-up" tax on any foreign income that is taxed below the 15-percent minimum. Participating countries may also impose a Qualified Domestic Minimum Top-Up Tax (QDMTT), allowing them to collect the top-up on low-taxed local MNE income without raising taxes on non-multinational firms. As a backstop, the GMT also introduces the Undertaxed Profits Rule (UTPR), which enables third countries where the MNE operates to deny deductions or make adjustments to collect any remaining top-up tax if the IIR and QDMTT are not applied

[7]The framework's Pillar One is a rule to reallocate the rights to tax a portion of an MNE's income to participating jurisdictions in proportion to their shares of that firm's sales, but adoption has been far slower and more politically complex than with the GMT. We study the effects of this rule, and the combination of both pillars, in Dyrda et al. (2024a).

by the home or host country. The GMT provides limited relief for subsidiaries with real activity in low-tax jurisdictions through the Substance-Based Income Exclusion (SBIE), which excludes a share of tangible assets and payroll from the eligible tax base: initially 8 percent of tangible assets and 10 percent of payroll, phasing down to 5 percent for each by 2033. Subsidiaries in true tax havens whose presence is largely an accounting fiction are taxed more heavily.[8]

Over 140 countries have committed to implementing the GMT, although most have yet to fully do so.[9] However, the United States has not agreed to participate, and moreover, U.S. MNEs are largely exempt under the OECD's Side-by-Side Agreement (SbS) with the United States. Under the SbS, neither the IIR nor the UTPR applies to U.S. MNEs operating in low-tax jurisdictions. This agreement was reached in part because the United States unilaterally implemented its own anti-profit-shifting measure under the TCJA, namely GILTI. U.S.-based MNEs are not exempt from the QDMTT, but top-up taxes can only be levied on U.S. MNEs under this rule on the difference between the GILTI rate of 10.5 percent and the 15-percent GMT rate. Still, this means that the latter is likely to be the relevant marginal tax rate on U.S. MNEs' investments in low-tax jurisdictions going forward.

4 Model

Our model builds closely on our previous work in Dyrda et al. (2024a) and Dyrda et al. (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

[8] Our model draws this distinction by including two regions where MNEs based in high-tax countries can open subsidiaries and shift profits: a low-tax productive region that includes countries like Ireland and Singapore, as well as a tax-haven region that includes countries like Bermuda and the Cayman Islands.

[9] See PwC's Pillar 2 Country Tracker

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 five key changes described above: the reduction in the statutory tax rate; the increase in bonus depreciation; the shift from worldwide to territorial taxation; the global intangible low-taxed income (GILTI) provision; and the Foreign-Derived Intangible Income (FDII) provision. We also carefully model the priority structure the GMT uses to assign the rights to levy top-up taxes, first to MNEs' home countries under the Income Inclusion Rule (IIR), then to low-tax jurisdictions themselves under the Qualified Domestic Minimum Top-Up Tax (QDMTT) rule, and finally to third countries where MNEs operate under the Undertaxed Profits Rule (UTPR).

Throughout this section, we use capital letters to denote aggregate variables and lowercase letters to denote microeconomic firm-level variables.

4.1 Economic environment

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

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

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

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

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

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

termediate goods from different source countries,

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

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

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

The aggregate price index is

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

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

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

The parameters of this technology are as follows. A_j is region j's aggregate total factor productivity. ϕ is the share of intangible capital and α is the share of tangible capital.[10] $\sigma_{ij} \in [0, 1]$ 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. 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

$$z_t(\omega) = A_i \ell_{it}^{z}(\omega). \tag{7}$$

[10]The Cobb–Douglas specification imposes a unit elasticity of substitution between intangible capital and rival inputs. Our companion paperd Dyrda, Hong, Sajid, and Steinberg (2026) exploits the nonrival nature of intangible capital to estimate an elasticity above one. Our unit-elastic benchmark therefore likely understates the effects of the tax reforms on intangible investment and the resulting global ripple effects.

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

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

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

where $q_{ijt}(\omega)$ and $\hat{q}_{ijt}(\omega)$ represent exports and locally produced products, respectively, sold by a firm headquartered in region i to region j.

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 a cost of $\psi_{i,j} \mathcal{C}\left(\lambda_{i,j,t}(\omega)\right)$ per unit of intangible-asset value, paid in units of home-country labor, where $\psi_{i,j}$ is an origin–destination-specific cost parameter. See Dyrda et al. (2024a) 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 licensing fees this generates across a multinational's affiliates. Figure 1 illustrates the mechanism for a U.S.-headquartered multinational i with 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 Irish affiliate (red arrow), priced at $\varphi_{ij'} \lambda \nu_i(z) z$, where λ is the fraction of IP shifted, $\nu_i(z)$ its marginal revenue product, and $\varphi_{ij'} < 1$ a markdown reflecting below-arm's-length transfer pricing. This intragroup sale moves intangible capital out of the U.S. tax base and into Ireland.

Once the IP is booked in Ireland, the U.S. headquarters and the EU subsidiary pay licensing fees to use it (green arrows): the EU affiliate pays $(1-\lambda)\vartheta_{ij}(z) z$ on the IP it retains and $\lambda \vartheta_{ij}(z) z$ on the

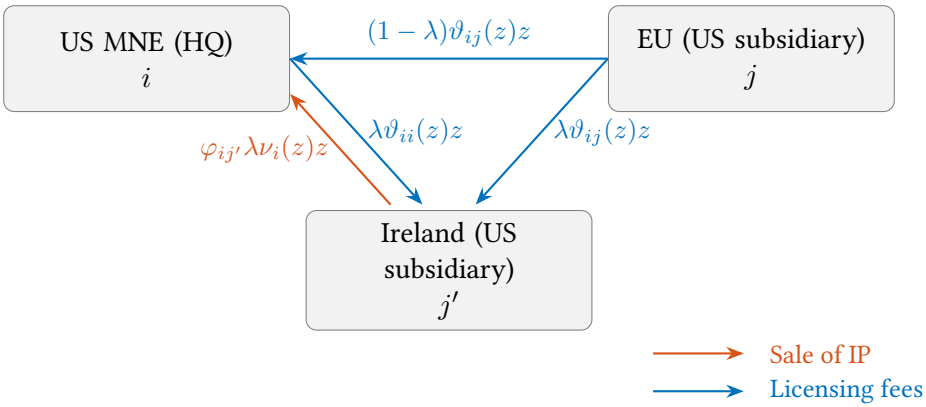


Figure 1: IP sales and licensing fee flows in a three-region version of the model.

shifted portion, while the U.S. parent pays $\lambda\vartheta_{ii}(z)z$ to access the IP now located in Ireland. These royalty flows shift the associated profits from the high-tax U.S. and EU jurisdictions to Ireland. The net effect is that a share λ of intangible income is stripped from the U.S. and EU tax bases and recorded in Ireland, lowering the group's global tax burden.

4.2 Corporate profit maximization

Before describing the corporate tax system in detail, it is helpful to define the pre-tax 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

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

The first line contains revenues from sales, licensing fees on the portion of intangible capital not transferred abroad, and the proceeds from selling the transferred intangible capital to the low-tax and tax-haven affiliates. 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:

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

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

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

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

The first line includes revenues from sales and licensing fees generated by the portion of intangible capital that is transferred to this affiliate. The second line includes labor and capital costs, and licensing fees paid on the portion of intangible capital that is owned outside the low-tax region.

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

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

Taxable income. Corporate taxes are levied on taxable income, which differs from pre-tax profits because the rental cost of tangible capital is not deductible from the tax base. The standard assumption in macro public-finance is that this cost is fully taxed (see, e.g. McGrattan and Waddle, 2020). We depart from this assumption by explicitly introducing bonus depreciation, which was an important component of TCJA to incentivize capital investment. Bonus depreciation acts on a firm's tax liability through the non-deductible rental cost of capital: a higher expensing rate shrinks the taxed share of that cost. Taxable income in our model is defined as

$$\tilde{\pi}_{ij} = \pi_{ij} + (1-b_j)\, r_j k_{ij}, j \neq TH, \tag{14}$$

where b_j is the effective bonus depreciation rate in region j. When $b_i = 1$, the tax falls on pure profits alone and no longer affects the user cost of tangible capital at all. Since the tax-haven affiliate holds no tangible capital, its taxable income coincides with its pre-tax profits, $\tilde{\pi}_{i,TH} = \pi_{i,TH}$.

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.

4.3 Market clearing and equilibrium

In equilibrium, the government's budget constraint must be satisfied, the markets for labor, capital, and final goods must clear, 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. We will formulate the tax liabilities of corporations in the U.S. before and after the TCJA reform in Section B. For corporations in other non-U.S. regions, we have

$$T_{jit}(\omega) = \tau_i \tilde{\pi}_{jit}(\omega), \ \forall j \tag{17}$$

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

$$L_{it} = \sum_{j=1}^{I} \int_{\Omega_j} \ell_{jit}(\omega)\, d\omega + \int_{\Omega_i} \left[\ell_{it}^{z}(\omega) + \sum_{j \in J_{Xt}(\omega)} \kappa_{iX} + \sum_{j \in J_{Ft}(\omega)} \kappa_{iF} + \mathbb{1}_{\{\lambda_{TH,t}(\omega) > 0\}} \kappa_{i,TH} \right] d\omega$$
$$+ \int_{\Omega_i} \left[\mathcal{C}_{i,TH}(\lambda_{TH,t}(\omega)) + \mathcal{C}_{i,LT}(\lambda_{LT,t}(\omega)) \right] \nu(\omega) z_{it}(\omega)\, d\omega. \tag{18}$$

Capital market. The capital market clearing condition is

$$K_{it} = \sum_{j=1}^{I} \int_{\Omega_j} k_{jit}(\omega)\, d\omega. \tag{19}$$

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:

$$Q_{it} = C_{it} + G_i + X_{it}. \tag{20}$$

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

$$EX_{it}^{G} + EX_{it}^{S} - IM_{it}^{G} - IM_{it}^{S} + NFR_{it} - NFP_{it} = P_{bt} B_{it+1} - B_{it}. \tag{21}$$

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

1. the representative household's utility maximization problem (1)–(5);
2. the firm's profit-maximization problem (15);
3. the labor market clearing condition (18);
4. the capital market clearing condition (19);
5. the government's budget constraint (16);
6. the balance of payments (21).

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

4.4 Corporate tax liabilities

This subsection provides a compact characterization of firms' overall corporate tax liabilities, before and after the TCJA, and after GMT implementation. A detailed mapping of the institutional features to model parameters is provided in the appendix. Herein, we use i to denote the United States and j to denote other regions for notational brevity unless otherwise indicated, since most of the provisions we discuss below are related to the U.S. TCJA.

Pre-TCJA worldwide system. We represent the pre-TCJA worldwide tax system with deferral using a repatriation rate $\iota_j \in [0, 1]$, capturing the fraction of foreign earnings from jurisdiction j that enters the U.S. tax base in a given period. The domestic tax liability of a U.S. parent is:

$$T_{ii} = \tau_i^{pre} \tilde{\pi}_{ii} + \sum_{j \in J_F \cup \{TH\}} \iota_j \times \max\big(0, (\tau_i^{pre} - \tau_j)\tilde{\pi}_{ij}\big). \tag{22}$$

Bonus depreciation. As described above, bonus depreciation allows any business operating in the United States—including the U.S. affiliates of foreign multinationals—to immediately deduct, or "expense," a fraction of the cost of qualifying tangible investment in the year it is placed in service, rather than depreciating it over the asset's service life. Our formalization of bonus depreciation follows Barro and Furman (2018). The overall bonus depreciation rate b_i is equal to the product of the headline expensing rate e_i, and the fraction of tangible capital that is eligible for bonus depreciation, θ_i. The TCJA raised the headline rate from 50 percent to 100 percent, but also excluded rate-regulated utility property, which lowered the eligibility share from 80 percent to 66 percent according to our calculations.[11] We set $e_j = 0$ for all other regions, a normalization consistent with our calibration strategy which interprets the tax rate parameter, τ_j, for these regions as an effective, not statutory, tax rate.

[11] Qualifying property is generally depreciable property with a recovery period of twenty years or less, including equipment, machinery, certain vehicles, and off-the-shelf computer software; nonresidential structures and residential rental buildings are excluded. Under the TCJA as enacted, 100 percent bonus depreciation applied to eligible property placed in service after September 27, 2017, and before 2023, then phased down by 20 percentage points per year: 80 percent in 2023, 60 percent in 2024, 40 percent in 2025, 20 percent in 2026, and zero thereafter. However, as explained above, the OBBBA in 2025 made the 100-percent expensing rate permanent. The TCJA also expanded eligibility to certain used property, while excluding property used in regulated public utility businesses and certain floor-plan-financed property. See I.R.C. §168(k)(1), (2), (6), and (9).

TCJA: GILTI and FDII. Under the TCJA, a U.S. multinational's U.S. tax liability (where i denotes the United States) is

$$T_{ii} = \tau_i \tilde{\pi}_{ii} - \hat{T}_{ii}^{FDII} + T_{ii}^{GILTI}. \tag{23}$$

which combines (i) the tax on domestic taxable income, $\tau_i \tilde{\pi}_{ii}$, (ii) the FDII deduction, $\hat{T}_{ii}^{FDII}$, and (iii) the residual tax on foreign intangible income, T_{ii}^{GILTI}.

The FDII tax deduction depends on the MNE's foreign-derived income (i.e., its income from exporting), $\tilde{\pi}_{ii}^{FDDEI}$, and the ratio of that income to its total taxable income, $\tilde{\pi}_{ii}$. Let FDR denote this ratio. The tax value of the FDII deduction is then

$$\hat{T}_{ii}^{FDII} = \tau_i \times \chi^{FDII} \times \left(\tilde{\pi}_{ii}^{FDDEI} - \chi^{QBAI} \times p_i k_{ii} \times FDR \right), \tag{24}$$

where $\chi^{FDII} = 0.375$ is the FDII deduction rate and $\chi^{QBAI} = 0.10$ is the deemed routine return on tangible assets.[12] Notice that the deduction is increasing in the level of its foreign-derived income, but decreasing in the share of its domestic capital devoted to producing exports. This formula is intended to isolate and subsidize intangible income associated with exporting, but as explained by Clausing (2024), it also discourages domestic tangible investment, and the second effect dominates quantitatively.

The residual GILTI tax is collected on the income of an MNE's subsidiaries in the low-tax region and the tax haven, over and above the routine QBAI return on those affiliates' local tangible capital stocks:

$$T_{ii}^{GILTI} = \max \left\{ 0,\ \tau_i (1 - \chi^{GILTI}) \sum_{j \in LT,TH} \left(\tilde{\pi}_{ij} - \chi^{QBAI} P_j k_{ij} \right) - T_{ii}^{FTC} \right\}. \tag{25}$$

Here, $\chi^{GILTI} = 0.50$ is the Section 250 deduction rate and T_{ii}^{FTC} is a credit for taxes paid to the host region's government. Note that high-tax regions are excluded from GILTI in our model; this is our implementation of the high-tax exclusion that applies GILTI only to affiliates whose effective local tax rates are less than 90 percent of the U.S. rate.[13] Note also that the subsidiary's tangible investment reduces the MNE's GILTI liability, increasing the effective after-tax rate of return on this investment. This only applies in the low-tax region, of course; subsidiaries in the tax-haven region have no tangible capital at all.

[12] The QBAI base is computed under the alternative depreciation system (straight-line, IRC §168(g)), which does not incorporate bonus depreciation. Bonus depreciation therefore does not affect the QBAI calculation.

[13] EU and RW effective rates in our calibration fall slightly below this 90-percent threshold, but in the spirit of the rule we treat them as high-tax jurisdictions and assume all firms elect the exclusion. This delivers a lower bound on the effect of GILTI on tangible investment in high-tax foreign affiliates.

Global Minimum Tax (GMT). Under a global minimum tax, a multinational's foreign affiliates face a higher effective tax rate whenever their jurisdictional rate falls below the global minimum, either through a host-country Qualified Domestic Minimum Top-Up Tax (QDMTT) or, residually, through an Income Inclusion Rule (IIR) applied by the MNE's parent region. If neither the host country adopts a QDMTT nor the parent country applies an IIR, jurisdictions where the MNE has other subsidiaries can collect the top-up tax through the Undertaxed Profits Rule (UTPR).

Let i represent any generic region, j be either LT or TH, and τ_{GMT} denote the GMT rate of 15 percent. The top-up tax liability under the GMT of an MNE based in region i operating an affiliate in region j with $\tau_j < \tau_{GMT}$ is

$$T_{ij}^{top-up} = \left(\tau_{GMT} - \tau_{ij}^{eff}\right) \times \left(\tilde{\pi}_{ij} - \chi_{GMT,K} P_j k_{ij} - \chi_{GMT,L} W_j \ell_{ij}\right), \tag{26}$$

where τ_{ij}^{eff} denotes the affiliate's effective tax rate prior to the top-up and $\chi_{GMT,K}$ and $\chi_{GMT,L}$ are the SBIE carve-out rates for tangible capital and payroll, respectively. For MNEs based outside of the United States, τ_{ij}^{eff} is simply τ_j. For U.S.-based MNEs under the TCJA regime, it is the effective rate after applying GILTI.

If the host region j implements the QDMTT, that region's government collects the top-up tax. If not, the MNE's home region i collects it under the Income Inclusion Rule (IIR), provided that region participates in the GMT system. We consider two versions of the GMT in our experiments. In the first, the low-tax and tax-haven regions participate in the GMT system and thus collect top-up taxes on foreign MNEs under the QDMTT rule, but U.S.-based MNEs are completely exempt and do not pay top-up taxes at all. In the second, the low-tax region and the tax haven collect top-up taxes over and above the GILTI rate—our interpretation of the OECD's Side-by-Side (SBS) agreement with the United States. We do not implement UTPR at all; given the large number of countries outside the United States that have agreed to participate in the GMT system, this rule is unlikely to be quantitatively important. Regardless, what matters for firm decisions in our model is not who collects the top-up tax, but whether or not they have to pay it.

4.5 Firm-level mechanisms: investment and profit shifting

Before turning to the model's general-equilibrium quantification, we characterize how the TCJA and the global minimum tax affect firms' decisions in partial equilibrium. We start with the decision rules for tangible investment, intangible investment, and profit shifting. We show that tangible investment depends on the location-specific after-tax user cost of capital, intangible investment on the after-tax return on intangible capital across all of the firm's divisions, and profit shifting on the differential in effective tax rates between the parent and its low-taxed affiliates. We then discuss

how each reform affects these firm-level decisions and how the policies interact. The appendix provides formal proofs of these results.[14]

Optimal investment and profit shifting. Consider first tangible capital. Conditional on operating in location j, a firm's profit-maximizing level of tangible investment depends on the after-tax user cost of capital:

$$k_{ij} = \Xi_{ij}^{k} \cdot c_j^{-\frac{1+(\alpha+\phi)(\varrho-1)}{1+\phi(\varrho-1)}}, \tag{27}$$

where Ξ_{ij}^{k} collects all of the terms that govern the firm's marginal revenue product in region j, and c_j is the after-tax user cost of tangible capital in that region. Taxation enters this decision only through the user cost: any provision that changes the taxation of tangible-capital income in j affects k_{ij} directly only through c_j.

We turn next to profit shifting. Firms from region i with affiliates in the low-tax or tax-haven regions shift profits by relocating a share of their intangible capital, and the optimal share equates the marginal cost of shifting with the tax saved on the marginal dollar of shifted income:

$$\lambda_{ij} \;=\; (\mathcal{C}')^{-1}\left(\frac{(\tau_i - \tau_j^{eff})(1-\varphi_{i,j})}{(1-\tau_p)W_i}\right), \tag{28}$$

where τ_i is the parent's effective rate, τ_j^{eff} is the effective tax rate in the destination region $j \in \{LT, TH\}$ (which potentially depends on policies in the MNE's home country such as GILTI as well as the low-tax region's statutory tax rate), W_i is the wage in which shifting costs are paid, and $\varphi_{i,j}$ the markdown on IP sales. As in Dyrda et al. (2024a), we assume that the shifting cost $\mathcal{C}$ is increasing and convex, so λ increases in the parent–affiliate tax differential, $\tau_i - \tau_j^{eff}$.

Last, we discuss intangible investment, which is produced in the headquarters but deployed nonrivalrously in every division. The profit-maximizing level of intangible investment can be derived as

$$z_i = z_i^{NS} \cdot \underbrace{\Big(1 + W_i\big[\lambda\,\mathcal{C}'(\lambda) - \mathcal{C}(\lambda)\big]\Big)^{\phi(\varrho-1)+1}}_{\equiv\,\Lambda(\lambda)\geq 1}. \tag{29}$$

[14] These reforms also change the average tax burden on the earnings of MNEs' foreign subsidiaries, and thus also potentially affect firms' decisions to open or close these subsidiaries. However, these extensive-margin effects matter much less for macroeconomic consequences than the user-cost margin. The bulk of both tangible and intangible capital belongs to the most productive multinationals, for which the fixed cost of a foreign subsidiary is a small fraction of the after-tax profit that subsidiary generates. Only marginal entrants respond to changes in the average burden along the extensive margin, and these firms are much smaller than the "representative" multinational. The appendix derives formulas for both the average effective tax rate (AETR) and marginal effective tax rate (METR), following the framework of Devereux and Griffith (1998), under the policies in question, and shows how these policies quantitatively change both objects.

Here, z_i^{NS} is the profit-maximizing level of intangible investment in the absence of profit shifting, and $\Lambda(\lambda) \geq 1$ is increasing in λ under the assumption on $\mathcal{C}$: profit shifting raises the after-tax return on intangible capital, a result we formally prove in Dyrda et al. (2024a). Unlike tangible-investment costs, intangible-investment costs are fully tax deductible. For non-MNEs and MNEs who do not shift profits, this implies that the corporate tax rate τ_i does not affect intangible investment at all; z_i^{NS} does not depend on τ_i. For MNEs who do shift profits, though, intangible investment does respond to changes in corporate tax rates. In particular, any reduction in the tax differential $\tau_i - \tau_j^{eff}$ reduces their intangible investment, whether that reduction is caused by a drop in τ_i or an increase in τ_j^{eff}. Importantly, this means that a drop in the domestic tax rate τ_i can actually reduce intangible investment.

Finally, the tangible and intangible margins reinforce each other: intangible capital raises the marginal revenue product of tangible capital, entering (27) through Ξ_{ij}^k, and vice versa, entering (29) through z_i^{NS}. This implies that the response of intangible investment to a reform that curbs profit shifting combines this marginal-product channel with the shifting channel $\Lambda(\lambda)$, and the two can potentially oppose each other. For example, a reform that reduces the user cost of tangible capital in the MNE's home country but also makes profit shifting less attractive could potentially increase or decrease the profit-maximizing levels of both tangible and intangible investment.

Firm-level effects of the TCJA and GMT We now discuss how the different provisions of the tax reforms in question affect these firm-level decisions. The TCJA's statutory tax cut reduces the user cost of domestic tangible capital, but it also reduces the tax differential between the United States and the profit shifting destinations LT and TH. This discourages U.S.-based MNEs from profit shifting, but also reduces their intangible investment at home. Through the reinforcement margin articulated above, this partially offsets the boost in domestic tangible investment, and also reduces tangible investment abroad by U.S. MNEs' foreign affiliates.

The direct effect of the shift to a territorial system is to reduce the user cost of tangible capital for U.S.-based MNEs' foreign affiliates. Through the reinforcement channel articulated above, this also boosts the amount of intangible investment these MNEs do at home, which in turn raises their domestic tangible investment as well. Thus, this provision increases both tangible and intangible investment by U.S. firms, both at home and abroad. However, this provision also increases profit shifting by widening the gap between the U.S. tax rate and the effective rates that U.S. MNEs pay in the low-tax and tax-haven regions.

Bonus depreciation is similar to the statutory tax cut, in that its direct effect is to reduce the user cost of tangible investment in the United States. However, it does not affect the tax wedge between the United States and the profit-shifting destinations, and thus does not affect the level of

profit shifting or have the same adverse effect on intangible investment. This suggests that bonus depreciation may be a more effective investment incentive, and that it may have less potential for adverse cross-country ripple effects.

GILTI curbs profit shifting while also incentivizing tangible investment in the low-tax region. Its top-up tax narrows the parent-affiliate differential, which reduces profit shifting by U.S.-based MNEs but also discourages intangible investment. Its QBAI deduction lowers the user cost of tangible investment for the affiliates of these MNEs in the low-tax region, but the net effect on tangible investment in these affiliates is ambiguous because the top-up tax also raises that user cost.

FDII encourages firms to book intangible income in the United States but discourages domestic tangible investment by exporters. The first effect operates through a reduction in the effective tax rate on export income, including exports related to intangible capital via the licensing fees, which decreases the effective tax rate on intangible income booked at home. The second effect operates through the QBAI deduction, which raises exporters' domestic user cost, since each additional unit of domestic tangible capital shrinks the size of the deduction as discussed in (Clausing, 2024). The net effects on domestic tangible and intangible investment are potentially ambiguous.

Finally, the global minimum tax raises the tax rate on low-taxed affiliate income to the 15 percent floor. The top-up tax decreases profit shifting and lowers the return on intangible capital for firms who are subject to it. Similar to the QBAI design of GILTI, the SBIE carve-out of the global minimum tax also lowers the user cost of capital for the low-tax subsidiaries of MNEs based in high-tax regions, which is discussed in Contreras et al. (2026).

The discussion above is confined to partial-equilibrium analysis at the firm level. Our quantitative analysis measures the impact of each individual effect in isolation and measures their interactions, but also embeds these responses in general equilibrium, where changes in factor prices reallocate resources across firms and regions.

5 Quantitative analysis

Having described the model, we now turn to our quantitative experiments. We first calibrate the model to match data from the pre-TCJA period. We then evaluate the two reforms in turn, first studying the effects of the TCJA starting from our calibrated pre-TCJA baseline, and then studying the effects of a global minimum corporate tax taking the post-TCJA economy as the status quo.

5.1 Calibration

The starting point for our calibration strategy is the approach described in Dyrda et al. (2024b). First, we partition the world into five regions: the United States (NA), Europe (EU), the low-tax

Table 2: Calibration

Statistic or parameter value	US	Europe	Low-tax	RoW	Tax haven
(a) Target moments					
Tangible-capital share (α)	0.25	0.25	0.25	0.25	–
Real GDP (NA = 100)	100	98	18	383	–
Foreign MNEs' VA share (%)	11.12	19.82	28.73	9.55	–
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	–	–
GAAP EATR for U.S. non-MNEs (%)	26.0	–	–	–	–
GAAP EATR for U.S. MNEs (%)	25.6	–	–	–	–
Total lost profits (% GDP)	0.8	1.2	–	1.4	–
Lost profits to TH (%)	66.4	44.5	–	71.1	–
Chg. in agg. lost profits after TCJA (%)	-48.1%	–	–	–	–
(b) Parameter values					
Population (NA = 100)	100	137	17	2,041	–
TFP (A_i)	1.00	0.76	1.21	0.24	–
Elast. of substitution betw. varieties (ϱ)	5	5	5	5	–
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	–
Prod. dispersion (η_i)	4.69	4.72	5.19	4.56	–
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)	1.98	2.71	0.82	13.5	–
Fixed FDI cost to TH (κ_i^{TH})	0.04	0.09	–	0.85	–
Variable export cost (ξ_{ij}) from …					
North America	–	3.04	3.25	1.72	–
Europe	2.15	–	1.72	1.34	–
Low tax	2.27	1.57	–	1.55	–
RoW	2.29	2.58	3.06	–	–
Tax rate (τ_i)	28.9	17.3	11.4	17.4	3.3
High-tax repatriation share (ι_H)	0.73	–	–	–	–
Low-tax repatriation share (ι_L)	0.75	–	–	–	–
Cost of shifting profits to LT (ψ_{iLT})	1.17	0.42	–	3.19	–
Cost of shifting profits to TH (ψ_{iTH})	0.84	1.34	–	2.24	–

Notes: Population and real GDP from World Bank WDI. Corporate tax rates from Tørsløv et al. (2023). Foreign MNEs' VA share from OECD AMNE database. Fractions of firms with foreign affiliates from Compustat. Effective tax rates for U.S. firms from Compustat. Total lost profits in levels and non-U.S. effective tax rates from Tørsløv et al. (2023). Imports/GDP from WIOD. Change in U.S. lost profits after the TCJA from Panel (b) of Table 1. U.S. effective CIT rates from Panel (a) of Table 1. Dashes (–) represent "not applicable."

region (LT), the tax haven (TH), and the rest of the world (RW).[15] 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 macro and micro moments. The departure point from our previous work is that the TCJA experiment itself now plays an important role: we calibrate most of the parameters by aligning the pre-TCJA version of the model with data from before 2017, but we also target the aggregate change in lost profits after 2017. The key parameters and the data moments that discipline them are shown in Table 2.

Several sets of parameters are identified in exactly the same way as in Dyrda et al. (2024b), by aligning the pre-TCJA version of the model, where the United States has a worldwide system, to data from the relevant period. We describe these parameters and their targets only briefly:

- Population (N_i): Taken directly from the data.
- Aggregate TFP (A_i): Identified by real GDP per capita.
- Elasticity of substitution between varieties (ϱ): Set to the standard value of five.
- Utility weight on leisure (ψ_i): Set so that the employment/population ratio equals one-third in each region.
- Intangible share (ϕ): Identified by the intangible income share of foreign MNEs' local affiliates.[16]
- Trade costs (κ_i^X and ξ_{ij}): Identified by the export participation rate and bilateral trade flows.
- FDI costs (κ_i^F, $\kappa_{i,TH}$, and σ_i): κ_i^F and σ_i are identified by the share of firms that are MNEs and the GDP share of foreign MNEs' local affiliates. The fixed cost of establishing a tax-haven affiliate, $\kappa_{i,TH}$, is identified by the average employment of firms with at least one tax-haven affiliate relative to the overall average employment of all firms, computed from Compustat.
- Corporate tax rates (τ_i) for non-U.S. regions: Taken from Tørsløv et al. (2023).

[15] The low-tax region 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.

[16] We assign a common ϕ to all firms, although profit shifting is concentrated among intangible-intensive firms (Grubert, 2003). Dyrda et al. (2024a) show that the aggregate effects of the OECD tax reforms are robust to allowing for heterogeneity in ϕ. At the firm level, however, more intangible-intensive firms are more strongly affected by GILTI, FDII, and the GMT, as shown in Section 6.

- Variable profit-shifting costs ($\psi_{i,LT}$ and $\psi_{i,TH}$): Following Dyrda et al. (2024a), we assume that the profit-shifting cost function is $C(\lambda) = \psi_{i,j}\left[\lambda + (1-\lambda)\log(1-\lambda)\right]$. These origin-destination-specific variable cost parameters, $\psi_{i,LT}$ and $\psi_{i,TH}$, are identified jointly by matching, for each high-tax region, (i) total lost profits and (ii) the share of those lost profits shifted to the tax-haven region, both taken from Tørsløv et al. (2023).[17]

The remaining parameters are calibrated to match specific features in the U.S. tax code that we model for the first time in this paper. Most of these parameters, which are either new or involve new identification strategies, are additions to the phase of the calibration where we construct the pre-TCJA equilibrium. We set $e^{pre}_{US} = 0.5$ and the bonus-eligible share $\theta^{pre}_{US} = 0.80$, so that $b^{pre}_{US} = 0.40$; we explain how we compute θ^{pre}_{US} from BEA fixed-asset data in the appendix. We assume that the pre-TCJA repatriation share is the same for affiliates in all high-tax countries, $\iota_H \equiv \iota_{EU} = \iota_{RoW}$, and jointly calibrate this with the pre-TCJA U.S. tax rate parameter τ_{US} to match two targets from the pre-TCJA period: the income-weighted average EATRs for U.S. MNEs and non-MNEs, reported in Panel (a) of Table 1.[18]

The last parameter in our calibration is the pre-TCJA repatriation share for affiliates in low-tax regions, $\iota_L \equiv \iota_{LT} = \iota_{TH}$. Unlike all the other parameters, which are part of the construction of the pre-TCJA equilibrium, we calibrate this parameter during the TCJA experiment itself, to match the change in aggregate U.S. lost profits shown in Panel (b) of Table 1. Since the choice of ι_L affects the pre-TCJA equilibrium as well as the effects of the reform, this additional phase of calibration necessitates an iterative procedure: guess a value for ι_L; calibrate all the other parameters to construct the pre-TCJA equilibrium; run the TCJA experiment; update ι_L until the model matches the observed drop in aggregate lost profits.

5.2 U.S. Tax Cuts and Jobs Act (TCJA)

Our model allows us to quantify, both separately and jointly, the effects of the five central provisions of the TCJA: the shift to a territorial system, the statutory rate cut, the expansion of bonus depreciation, GILTI, and FDII. Table 3 summarizes how we implement these changes, and Figures 2–4 summarize the results of our experiment.

We model the territorial shift by setting the repatriation parameters ι_H and ι_L to zero. We implement the statutory rate cut by setting the post-TCJA tax parameter τ_{US} to match the overall

[17] Following Dyrda et al. (2024a), we set the markdown parameter on intangible-capital sales to the low-tax and tax-haven affiliates to zero, $\varphi_{i,LT} = \varphi_{i,TH} = 0$, because these parameters cannot be separately identified from the marginal-cost parameters $\psi_{i,LT}$ and $\psi_{i,TH}$.

[18] In the absence of bonus depreciation, we could simply set the U.S. tax rate parameter equal to the EATR for non-MNEs as we did in our previous work. Here, bonus depreciation introduces a wedge between the parameter τ_{US} and the measured EATR.

Table 3: Model Implementation of the TCJA Provisions

Provision	Parameter	Pre-TCJA	Post-TCJA
Territorial system	ι_H	0.73	0
	ι_L	0.75	0
Statutory rate cut	τ_{US}	0.29	0.23
Bonus depreciation	$b_{US} = \theta_{US} e_{US}$	0.40	0.66
Expensing rate	e_{US}	0.50	1.00
Eligible fraction	θ_{US}	0.80	0.66
FDII	χ^{FDII}	0	0.38
GILTI	χ^{GILTI}	1	0.50
FDII & GILTI	χ^{QBAI}	0	0.10

8.0 percentage-point decline in the income-weighted EATR of U.S. MNEs documented in Section 3. We find that this parameter falls by 6.0 percentage points. The two-percentage-point gap between these two numbers reflects the increase in the bonus depreciation rate b_{US}, which rises from 39.9 percent to 66 percent, reflecting an increase from 50 percent to 100 percent in the statutory bonus rate and a decrease in the fraction of eligible investment, from 80 percent to 66 percent.[19] We set the GILTI, FDII, and QBAI parameters directly from the tax code.

5.2.1 U.S. macroeconomic outcomes

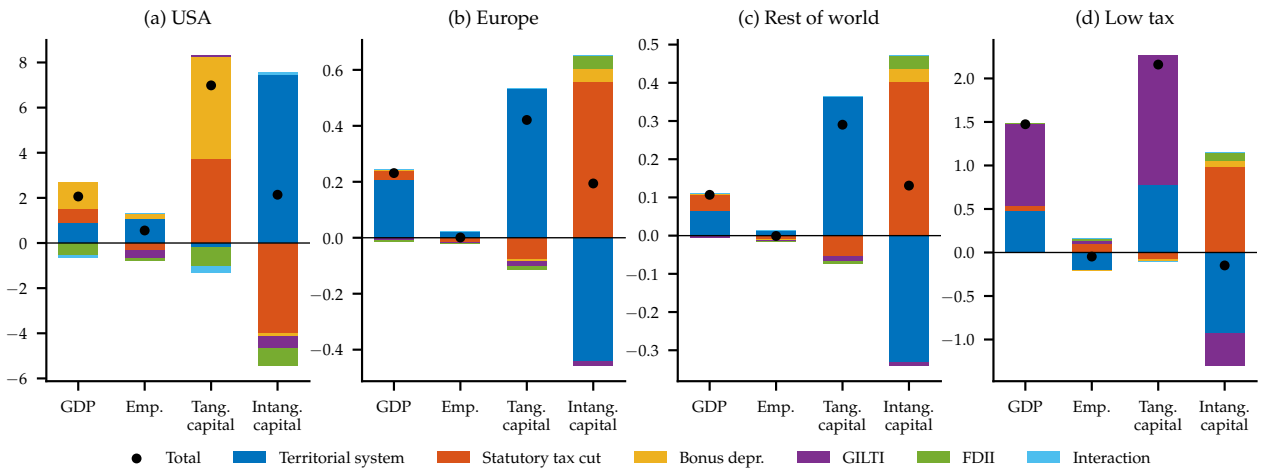
Panel (a) of Figure 2 shows the overall effects of the TCJA on U.S. GDP, employment, and tangible and intangible capital, and decomposes these effects across the reform's individual provisions. Panel (a) of Figure 3 decomposes the effects by firm type: non-MNEs, U.S.-based MNEs, and local affiliates of foreign MNEs.[20]

Shift to territorial taxation. This provision has virtually no effect on tangible capital but increases intangible capital by almost 7.5 percent, making the U.S. economy substantially more intangible-intensive and boosting GDP by almost 1 percent. This effect is attributable entirely to the behavior of U.S.-based MNEs. In our calibration, under the worldwide system a large fraction of the pre-tax profits of these MNEs' foreign subsidiaries is taxed at the U.S. statutory rate, which was higher pre-TCJA than the corporate tax rates in other regions. Under a territorial system, by contrast, these profits are taxed entirely at the lower foreign rates, which increases the after-tax

[19] The TCJA increased the bonus depreciation allowance for eligible investment, but it also made rate-regulated utility property ineligible. See the appendix for the details of these calculations.

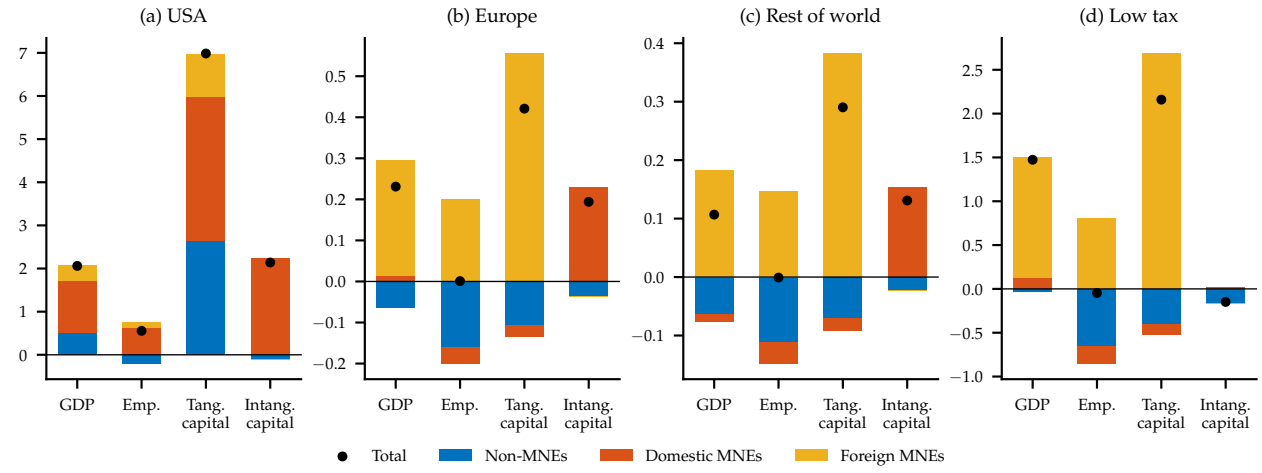
[20] See the appendix for the numerical results used to generate the figure.

Figure 2: Macro effects of TCJA decomposed by provision



Notes: Figure shows changes from pre-TCJA calibration to equilibrium with TCJA. Black dots show aggregate percent changes. Dark blue, orange, yellow, purple, and green bars show changes in percentage points resulting from territorial taxation, the statutory rate cut, increased bonus depreciation, GILTI, and FDII, respectively. The light blue bar shows the interaction between the individual provisions, measured as the difference between the black dot (overall total) and the sum of the other colored bars.

Figure 3: Macro effects of TCJA decomposed by firm type



Notes: Figure shows changes from pre-TCJA calibration to equilibrium with TCJA. Black dots show aggregate percent changes. Blue, orange, and green bars show changes in percentage points relative to the pre-TCJA total for non-MNEs, domestic MNEs, and foreign MNEs, respectively; bar values sum to aggregate percent changes.

rate of return on intangible investment.

Statutory rate cut. The rate cut produces a conventional user-cost response, raising U.S. tangible capital by about 3.75 percent and GDP by about 0.6 percent. However, it also reduces intangible

capital by 4 percent, clawing back a little less than half of the gain from shifting to a territorial system. This is due to the fact that intangible investment expenditures are fully tax-deductible. While domestic firms' intangible investment decisions are entirely unaffected by the statutory rate, the after-tax return on U.S.-based MNEs' intangible investment is increasing in the gap between domestic and foreign tax rates. This channel is explained in detail in Dyrda et al. (2024b).

Bonus depreciation. The increase in bonus depreciation adds a further 4.5 percent to tangible capital and 1.2 percent to GDP. Unlike the statutory rate cut, however, this provision has little effect on intangible investment, indicating that bonus depreciation is a more effective form of stimulating investment when both the tangible and intangible margins are considered.

GILTI. This provision reduces U.S. intangible capital by 0.5 percent but has no other material macroeconomic effects. Note that the effect on intangible investment was potentially ambiguous. On the one hand, the increase in the effective tax rate in the profit shifting destinations reduces the after-tax return on U.S. MNEs' intangible investment. On the other hand, the QBAI carve-out encourages these MNEs to expand tangible investment in the low-tax region, and through nonrivalry, this raises the desired stock of intangibles in the headquarters. The results show that the first channel dominates quantitatively.

FDII. The last TCJA provision works in the opposite direction from the others, causing the U.S. economy to contract, reducing tangible capital by about 0.9 percent, intangible capital by 0.8 percent, and GDP by about 0.5 percent. Because the FDII deduction applies only to profits above a routine return on domestic tangible assets, additional domestic capital shrinks the FDII base and reduces the value of the deduction. As discussed above, this creates a perverse disincentive for domestic investment, particularly for firms with high foreign sales shares.

Full TCJA. Combined, the five provisions increase tangible capital by about 7 percent and intangible capital by about 2.1 percent, employment by about 0.6 percent, and GDP by about 2.1 percent. Interactions among provisions are negligible for GDP, employment, and intangible capital, but reduce tangible capital by a further 0.3 percent, due to the way bonus depreciation weakens FDII's rate-cut channel.[21] Most of the overall net impact of the full suite of TCJA provisions on the U.S. economy is driven by domestic MNEs. All three types of firms expand in the United States, while

[21] Combining the two provisions, the user cost of tangible capital for a U.S. exporting parent is

$$c_i^{FDII,AD} = \left[\frac{1}{1-\tau_p^*} + b_{US}\left(1 - \frac{1}{1-\tau_p^*}\right)\right] r_i + \delta P_i + \frac{\tau_i \chi^{FDII}\left(\tilde{\pi}_{ii}^{FDDEI}/\tilde{\pi}_{ii}^{DEI}\right)\chi^{QBAI} P_i}{1-\tau_p^*},$$

where $\tau_p^* = \tau_i(1 - \chi^{FDII}\,\tilde{\pi}_{ii}^{FDDEI}/\tilde{\pi}_{ii}^{DEI})$ is the parent's effective rate after the FDII deduction. FDII operates only by lowering τ_p^*, but the effect on the first term is smallser when b_{US} is larger.

the domestic MNEs benefit the most from the TCJA due to the transition to the territorial system. In fact, the increase in intangible capital within the United States is entirely driven by the domestic MNEs.

Our aggregate results align closely with those of Chodorow-Reich et al. (2026), who study the TCJA using a general-equilibrium model calibrated to match firm-level investment responses to the reform estimated using administrative tax data. Their model predicts a 6.4 percent increase in the U.S. corporate capital stock, compared to our prediction of 7.0 percent.[22] Relative to their analysis, our contribution is to embed the tax reform in a multi-region economy with intangible capital and profit shifting, which allows us to study the global ripple effects of the TCJA beyond the U.S. border.

The model implies a semi-elasticity of capital to taxation of -1.5 for U.S. MNEs, which are most affected by the reform and most important for aggregate capital: their domestic tangible capital rises by 7.2 percent while their marginal effective tax rate falls by 4.8 percentage points.[23] This semi-elasticity sits above the range of firm-level estimates of -0.55 to -1.1 reported by de Mooij and Ederveen (2008). Two channels account for our larger number. First, the model-implied aggregate elasticity embeds the expansionary effect of the TCJA on the U.S. economy that raises capital demand. Second, the TCJA also increases U.S. MNEs' intangible investment, which raises the marginal product of tangible capital and thus tangible investment.

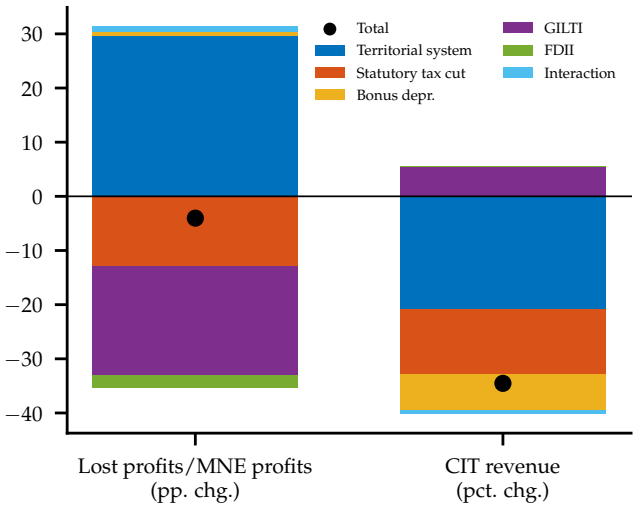
5.2.2 U.S. profit shifting and tax revenues

Figure 4 applies the same decomposition as in Figure 2 to profit shifting and U.S. corporate income tax (CIT) revenue. Under the full TCJA, lost profits fall by 4.0 percentage points as a share of total MNE profits, from 8.6 percent before the reform to 4.6 percent afterward. However, this modest overall change is the result of netting out much larger changes caused by the individual provisions, some positive and some negative. The shift to a territorial system, which eliminates U.S. taxes on profits repatriated from tax havens, boosts profit shifting by 30 percentage points. The statutory rate cut, which reduces the wedge between the U.S. tax rate and the rates in the low-tax region and tax haven, reduces profit shifting by 13 percentage points. GILTI reduces profit shifting by a further 20 percentage points, and FDII lowers it by roughly 2.5 more percentage points. Thus,

[22] The fact that the two approaches yield similar results is driven by the fact that both models feature the same long-run elasticity of tangible capital to the user cost, $1/(1-\alpha)$ where $\alpha = 0.25$. The TCJA lowers the user cost of domestic tangible capital by about 4.6 percent in our model versus 4.1 percent in theirs. Our figure is calculated by comparing the pre-TCJA user cost of tangible capital, $(1 - \tau_{US}^{pre} b_{US}^{pre}) r/(1 - \tau_{US}^{pre}) + \delta P$, with the post-TCJA FDII-inclusive user cost shown in the appendix for a representative U.S. firm at the mean foreign-derived income ratio $\mathrm{FDR} = 0.13$.

[23] The firm-type results in Figure 3 report each type's contribution to the change in aggregate capital, not the percent change in its own capital stock; the 7.2 percent figure is the latter.

Figure 4: Effects of TCJA on public finances



Notes: Figure shows changes from pre-TCJA calibration to equilibrium with TCJA. Colored bars show the changes attributable to each of the five TCJA provisions and to their interaction. The black dot shows the aggregate effect of the full TCJA.

the combined effects of the statutory rate cut and the anti-shifting provisions more than offset the territorial system's greater incentive to book profits abroad.

The picture is different for tax revenues, where most of the provisions work in the same direction. U.S. CIT revenue falls by 34.5 percent under the full TCJA in our model, close to the 38 percent decline estimated by Chodorow-Reich et al. (2026). The territorial shift and the rate cut reduce revenues by 21 percent and 12 percent, respectively, and accelerated depreciation adds another 6.7 percent drop. GILTI raises CIT revenue by 5.5 percent, while FDII has a negligible effect.

5.2.3 International ripple effects

The TCJA also produces positive macroeconomic effects in the EU and RoW, as shown in panels (b) and (c) of Figure 2. GDP rises by 0.23 percent in the former and by 0.11 percent in the latter. Tangible capital rises 2–3 times more and intangible capital by about the same amount. Notably, almost all of the growth in output and tangible capital comes from the local affiliates of U.S.-based MNEs, whose expansion crowds out domestic firms in labor and tangible capital markets.

The provision-level decomposition shows that these overall gains are driven primarily by the United States' shift to a territorial system, which provides greater incentives for U.S. MNEs to expand abroad. The statutory rate cut is the second-largest channel, operating mainly through these regions' domestic MNEs. Their U.S. affiliates expand in response to the tax cut, which incentivizes these firms to do more intangible investment, which also boosts their output at home.

The other provisions have negligible effects on output and tangible investment in the EU and RoW, and moderate effects on intangible investment. For example, accelerated depreciation raises the return to intangible investment for MNEs based in these regions by making their U.S. affiliates more tangible-capital intensive.

The low-tax region responds much more strongly, as shown in Panel (d) of Figure 2. The full TCJA raises its GDP by almost 1.5 percent and its tangible capital by about 2.2 percent. GILTI's QBAI carve-out is the central mechanism: it encourages U.S.-parented MNEs to install more tangible capital in their low-tax affiliates. Foreign MNEs account for virtually all of the GDP growth, and more than 100 percent of tangible-capital growth; domestic firms invest less as factor prices rise in equilibrium due to the increased demand from foreign MNEs' local affiliates.

Share of profits shifted. We do not directly target the share of profits shifted by U.S. MNEs shown in Figure 4; the calibration instead targets the change in aggregate lost profits. The shifted-profit share therefore provides a separate validation moment. In the model it falls from 8.6 percent before the TCJA to 4.5 percent afterward. In the data from Delis et al. (2024), it falls from an average of 7.6 percent in 2014–2016 to 5.1 percent in 2018–2020. The model thus closely reproduces both the level and the post-TCJA decline of a moment that was not directly targeted.

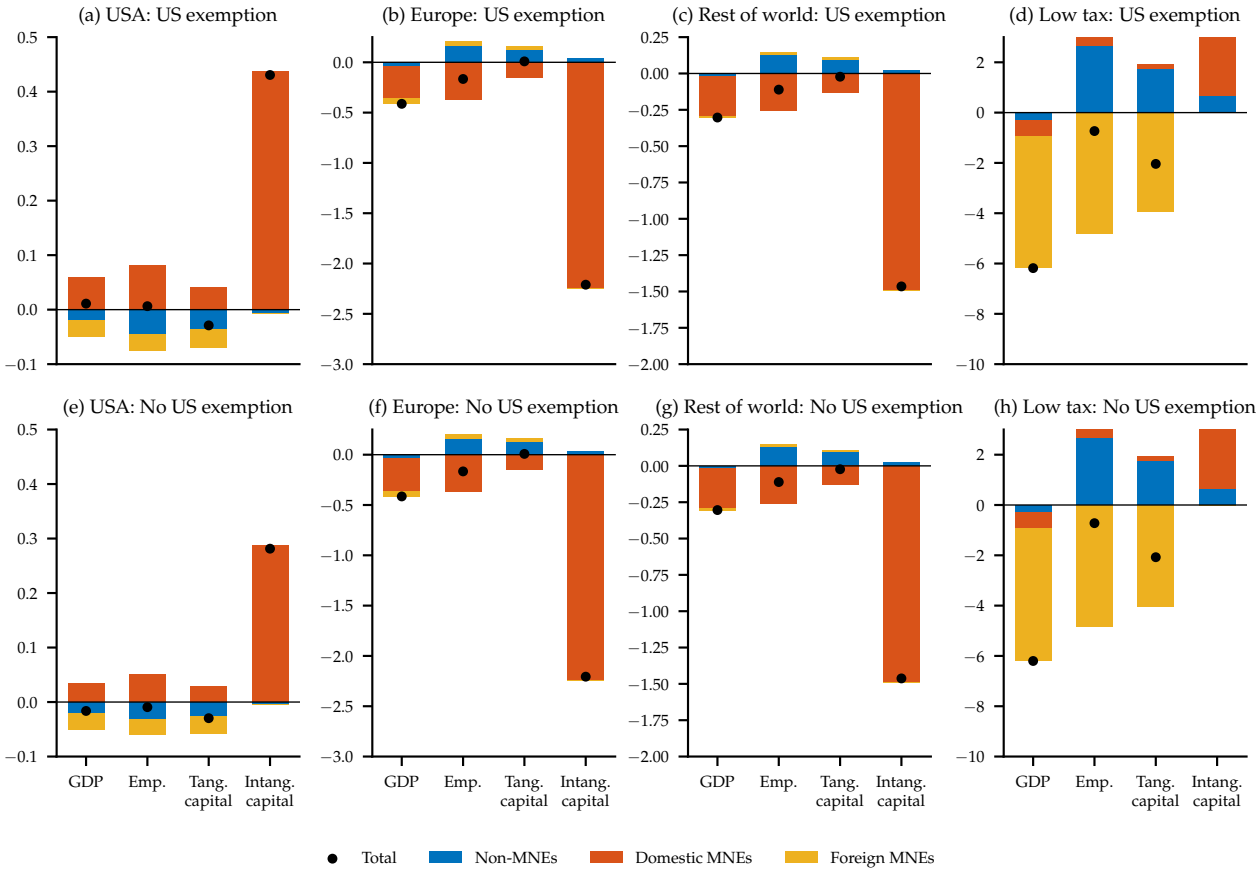
5.3 Effects of a global minimum corporate tax

We now turn to the global minimum corporate income tax (GMT), taking the post-TCJA equilibrium as the status quo. We consider two scenarios. In the first, the GMT applies only to non-U.S.-parented MNEs; U.S. MNEs are completely exempt from the GMT. In the second, low-tax and tax-haven jurisdictions also impose QDMTT top-up taxes on the local profits of U.S.-parented MNEs, which makes the GMT rate of 15 percent the relevant marginal tax rate on U.S. MNE income in these jurisdictions. This second scenario corresponds to the OECD's Side-by-Side Safe Harbour, applicable from January 1, 2026, which relieves eligible U.S. MNEs from IIR and UTPR liabilities but preserves local QDMTTs. Figures 5 and 6 report the results.

5.3.1 GMT with complete exemption for U.S. MNEs

Panels (a)–(d) of Figure 5 report the macro effects when U.S.-parented MNEs remain outside the GMT. The direct effects are concentrated in Europe and the RoW, where the minimum tax binds for their domestic MNEs. Intangible capital falls by 2.3 percent in Europe and 1.5 percent in the RoW, driving GDP declines of 0.4 percent and 0.3 percent, respectively. The low-tax region contracts dramatically. Its GDP falls by 6.2 percent and its tangible capital by 2.0 percent, although

Figure 5: Macro effects of GMT decomposed by firm type



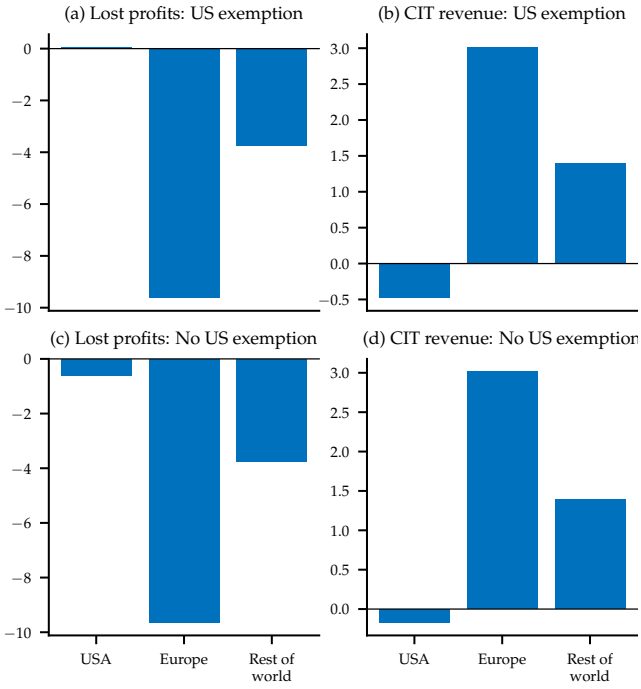
Notes: Figure shows changes from TCJA equilibrium to equilibria with different GMT configurations. First row: GMT outside the United States, including in the low-tax region and the tax haven. Second row: worldwide GMT. Black dots show aggregate percent changes. Blue, orange, and green bars show changes in percentage points relative to the initial TCJA total for non-MNEs, domestic MNEs, and foreign MNEs, respectively; bar values sum to aggregate percent changes.

intangible capital rises by 5.0 percent.[24] Foreign MNEs account for most of the output losses, indicating that the GMT's substance-based income exclusion does not make real activity in the region meaningfully more attractive relative to shifted profits.

In the aggregate, the U.S. economy expands slightly, by 0.01 percent, although this aggregate result masks a reallocation away from local affiliates of foreign MNEs toward domestic MNEs. The former contract because of the adverse effect of the GMT on their intangible capital, which makes them produce less in the U.S. market as well as at home. The latter expand because they are

[24]This is consistent with McGrattan and Waddle (2020)'s work on Brexit, which shows that FDI barriers reduce output but at the same time cause domestic firms to do more intangible investment to replace the decline in intangible capital deployed locally by foreign MNEs.

Figure 6: Effects of GMT on public finances



Notes: Figure shows changes from TCJA equilibrium to equilibria with different GMT configurations. First row: GMT outside the United States, including in the low-tax region and the tax haven. Second row: worldwide GMT. First column: changes in lost profits/total MNE profits in percentage points. Second column: percent changes in corporate tax revenues.

more competitive globally, being the only MNEs that are unencumbered by the GMT. The effects are particularly pronounced on intangible investment, where U.S. MNEs expand by more than 0.4 percent.

Panels (a)–(b) of Figure 6 reports the effects on public finances. The shifted-profit share falls by 9.6 percentage points for European MNEs and 3.8 percentage points for RoW MNEs. CIT revenue rises by 3.0 percent in Europe, 1.4 percent in the RoW, and 6.0 percent in the low-tax region. Note that the rule priority structure of the GMT allows the low-tax region to benefit from a public-finance perspective; the lost profit-shifting revenues are more than offset by QDMTT top-up taxes. The U.S. lost-profits share is largely unchanged, but U.S. CIT revenue falls by 0.5 percent because U.S. MNEs do more tangible investment in the low-tax region, which reduces their GILTI liabilities by increasing their QBAI deductions.

5.3.2 GMT where QDMTT applies to U.S. MNEs

We next allow low-tax and tax-haven jurisdictions to apply QDMTTs to U.S.-parented MNEs, following the OECD's Side-by-Side (SbS) agreement with the United States. Our interpretation of

this agreement is that GILTI remains intact and the United States continues to collect taxes on the profits U.S.-based MNEs book in these regions as specified in (25), and that these regions collect top-up taxes only on the difference between the GMT rate of 15 percent and the effective GILTI rate of $(1-\chi_{FTC})\tau_j + (1-\chi_{GILTI})\tau_{US}$, which is about 13.8 percent for the low-tax region and 12.2 percent for the tax haven. This GMT version also raises the user cost of capital for the U.S. MNEs' subsidiaries in the low-tax region because GILTI's QBAI deduction is more generous than the GMT's SBIE. The former exempts 10 percent of tangible assets from tax at the higher GILTI rate; the latter exempts a smaller base, 5 percent of tangible assets plus 5 percent of the wage bill, together about 6 percent of the capital stock at the lower GMT top-up rate.[25]

Panels (e)–(h) of Figure 5 show that extending QDMTTs to U.S. MNEs changes the macroeconomic incidence of the reform. Relative to the post-TCJA equilibrium, U.S. GDP now falls by 0.02 percent, about a twentieth of the effect in the EU and a fifteenth of the effect in the RoW region. The difference is explained entirely by a contraction among domestic MNEs, which expand less than in the first scenario, particularly in terms of intangible investment. There are two reasons for this. First, the QDMTT top-up tax raises the marginal tax rate on intangible income booked in the low-tax region and the tax haven, which reduces profit shifting. Second, the marginal effective tax rate on tangible capital installed in the low-tax region rises, as the GMT's SBIE deduction is smaller than GILTI's QBAI deduction. This reduces tangible investment in the low-tax region, which in turn further reduces the return to intangible investment at home. Europe, the RoW, and the low-tax region have the same aggregate GDP responses as in the U.S.-exempt scenario, because the contraction of U.S.-parented affiliates is offset by an expansion among domestic firms. This version of the GMT keeps the playing field more level between MNEs from different regions.

Panels (c)–(d) of Figure 6 show that removing the U.S. QDMTT exemption leads to a small reduction in the share of profits shifted by U.S. MNEs of about 0.6 percentage points, reflecting the fact that the GMT rate of 15 percent is a few percentage points higher than the effective tax rate on shifted profits under GILTI. U.S. CIT revenues still fall, albeit not as much as when the U.S. is completely exempt. Together with the macro effects in the first two panels, this indicates that while the GMT is slightly more effective at curbing profit shifting than GILTI, but slightly worse in terms of the implications for investment and output. As with the macroeconomic effects, the effects on public finances in the EU and RoW regions are largely unchanged from the first scenario.

Although the macro effects of the GMT appear small relative to the effects of the TCJA, they should be viewed relative to the scale and breadth of the reform. Whereas the TCJA reduces ef-

[25] To value the SBIE carve-out in units of tangible capital, note that $wL = \frac{1-\phi-\alpha}{\alpha} \times cK \approx 0.26K$ at $\alpha = 0.25$, $1-\phi-\alpha = 0.65$, and a user cost $c = 0.10$. The carve-out is therefore worth $0.05K + 0.05wL \approx 0.06K$.

fective tax rates of all U.S. firms by about 6 percentage points on average, the GMT only applies to multinationals, and its effect on their average effective tax rate is ten times smaller.[26] Thus, the elasticity of the ripple effects of the GMT relative to the change in taxes is actually quite large. The effect on the United States in the second scenario is the same magnitude as some estimates for other major international tax reforms that affect much larger portions of the economy; for example, Caliendo and Parro (2014) estimate that the United States gained 0.06 percent from NAFTA.

5.4 Alternative calibrations and experiments

The appendix contains several sensitivity analyses that explore how our results change under alternative calibration assumptions and experiment designs. Here, we briefly discuss these analyses and their main conclusions, and refer the reader to the appendix itself for details and numerical results.

Bonus depreciation. We calculate pre- and post-TCJA bonus depreciation rates by taking the statutory increase, from 50 percent to 100 percent, off the shelf and multiplying it by our calculation of the eligible portion of aggregate U.S. investment. We have also explored an alternative approach where we calculate the present value of the detailed IRS depreciation schedule for each asset class before aggregating, rather than simply applying a binary eligible-or-not flag. This approach yields an increase in bonus depreciation that is about a fifth of our baseline value, which changes the nature of the TCJA experiment: we need a larger cut in the tax rate parameter τ_{US} to match the same measured decline in the average EATR. Consequently, the statutory tax cut generates a larger boost in investment and output than in our baseline calibration, and the increase in bonus depreciation generates a smaller boost. However, the combined effect is slightly smaller than in the baseline, indicating that bonus depreciation is a more effective tool for growing the economy than cuts in the headline corporate tax rate.

Restoring pre-TCJA profit shifting levels under post-TCJA rules. One way to measure the tax equivalent of the TCJA provisions is to compare the overall drop in the average EATR (about 8 percentage points) with the statutory tax cut that the model requires to match that drop (about 6 percentage points). Another way is to look at firms' behavior, particularly profit shifting. Concretely, we ask: how big of a statutory tax increase would be required to restore the pre-TCJA aggregate level of profit shifting, while keeping in place the non-tax TCJA provisions (territorial system, greater bonus depreciation allowance, GILTI, and FDII)? We find that the required statutory tax hike is 11 percentage points. Given that our TCJA experiment required a tax cut of 6 percentage points, this implies that the non-tax TCJA provisions are worth about 5 percentage

[26] See our AETR and METR calculations in the appendix.

points in corporate taxes in terms of their effects on profit shifting.

Profit-shifting target. We target the profit-shifting estimates of Tørsløv et al. (2023) in our calibration, which are on the upper end of the range of the OECD's estimates of the magnitude of this phenomenon. In an alternative parameterization, we scale these estimates down by 40 percent to the lower end of that range, and calibrate the profit-shifting costs to match these scaled-down estimates. In this version of the model, both the TCJA and GMT have smaller effects, but the TCJA results change less because the most impactful provisions—the shift to a territorial system, the statutory tax cut, and the increase in bonus depreciation—are largely unrelated to profit shifting.

FDI spillover externality. In our previous work on optimal corporate tax policy Dyrda et al. (2024b), we study the role of a cross-country intangible investment externality, whereby inward FDI by foreign multinationals reduces the cost of intangible investment for domestic firms, consistent with evidence from Javorcik (2004) and others. In this version of the model, the TCJA and GMT have larger effects overall, but the international ripple effects are particularly amplified. The positive ripple effects of the TCJA on EU and RoW GDP are about four and eight times larger with a spillover externality. The negative ripple effect of a GMT on U.S. GDP is about fifty times larger.

Labor supply. Finally, we also experiment with alternative assumptions about labor supply. Our baseline model, which has log-separable preferences over consumption and leisure, is a middle ground between two extremes: inelastic labor supply and Greenwood, Hercowitz, and Huffman (1988, henceforth GHH) preferences. In the former, where labor supply is fixed, wages adjust more in equilibrium in response to shifts in labor demand; in the latter, where there are no wealth effects, wages adjust less. We find that all three specifications generate quantitatively similar results in both experiments, although the macro effects are smaller (and in some cases slightly negative) with inelastic labor and larger with GHH preferences.

6 Empirical Validation on the Effects of TCJA

We validate the model's quantitative findings using firm-level evidence on the TCJA. We leverage cross-firm variation in firms' overall exposure to the reform to test whether investment and profit shifting respond as the model predicts.[27] We do not analyze the global minimum tax empirically, given that its implementation is still ongoing.

We use a panel of U.S. firms in Compustat covering the 2012–2022 period. We classify a firm

[27] We find no evidence of an extensive-margin response in the opening or closing of foreign subsidiaries, as shown in the appendix. Firms receiving larger tax cuts did not significantly expand overseas, nor did they exit tax-avoidance jurisdictions. This pattern is consistent with the model's implication that most multinationals are inframarginal in their FDI decisions and that extensive-margin adjustment contributes little to aggregate investment.

as a multinational if (i) it reports a foreign subsidiary in the WRDS Company Subsidiary database in any of the three preceding years, and (ii) it reports nonzero foreign income or foreign taxes. This approach is designed to capture firms with substantive foreign operations rather than purely financial arrangements. Tangible investment is defined as capital expenditure net of sales of property, plant, and equipment. Intangible capital is measured following the approach of Peters and Taylor (2017), which capitalizes R&D and a share of SG&A expenditures. The appendix provides more details about our sample construction and the investment measures.

6.1 Investment responses to the TCJA

We first examine investment responses to the TCJA. We estimate an event-study specification around the reform,

$$y_{it} = \alpha_i + \gamma_{n(i)\,m(i)\,t} + \sum_{\substack{\tau=-5 \\ \tau\neq -1}}^{5} \beta_\tau \, \Delta\tau_i^{sim} \times \mathbb{1}_{\{t-2017=\tau\}} + \varepsilon_{it}, \tag{30}$$

where y_{it} is log tangible or intangible investment, α_i is a firm fixed effect, and $\gamma_{n(i)\,m(i)\,t}$ interacts industry (two-digit NAICS), pre-reform multinational status, and year, so that identification comes from within-industry, within-status variation in exposure. Regressions are weighted by pre-reform revenue and standard errors are clustered by firm. Fiscal years 2017 and 2018 are only partially treated, so we focus our attention on the response from 2019 onward.[28]

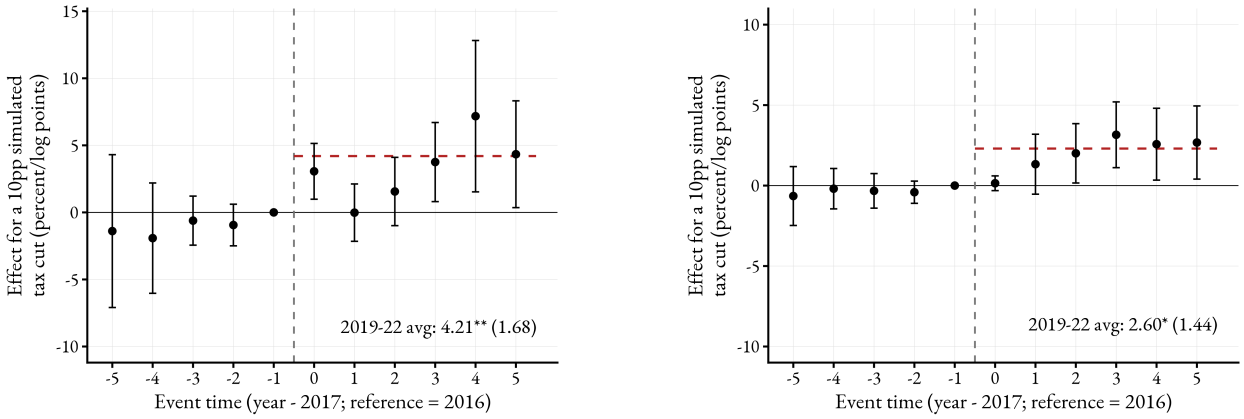
We measure each firm's exposure to the TCJA with the simulated instrument approach following Zwick and Mahon (2017). Realized changes in effective tax rates are endogenous: they reflect not only the legislated rules but also firms' responses to them. We therefore hold each firm's income-statement variables at their pre-reform (2016) values and vary only the statutory rules, defining the simulated tax change as

$$\Delta\tau_i^{sim} = \frac{T^{post}(X_{i,2016}) - T^{pre}_{i,2016}}{\pi_{i,2016}}, \tag{31}$$

where $T^{pre}_{i,2016}$ is the firm's actual 2016 tax expense and $T^{post}(X_{i,2016})$ applies the post-TCJA rate structure to its 2016 characteristics. Variation in $\Delta\tau_i^{sim}$ comes only from predetermined differences

[28] The 21 percent rate applies to taxable years beginning after December 31, 2017, and fiscal years straddling that date are taxed at a day-weighted blended rate under Section 15 of the Internal Revenue Code. Fiscal 2017 is partially treated because 100 percent bonus depreciation applies to property placed in service after September 27, 2017, and because one-time enactment effects are recognized in the reporting period containing December 22, 2017; fiscal 2018 is fully treated only for firms whose fiscal years begin on or after January 1, 2018. All firms operate entirely under the new regime from fiscal 2019 onward.

Figure 7: Effect of the TCJA on investment by U.S. firms



(a) Tangible investment

(b) Intangible investment

Notes: The figures plot the dynamic estimates $\hat{\beta}_\tau$ from equation (30), scaled to a 10-percentage-point simulated tax cut. The sample is a 2012–2022 panel of U.S. firms with positive pre-tax income in 2016. Regressions include firm and industry-by-status-by-year fixed effects, are weighted by average 2015–2016 revenue, and cluster standard errors by firm. The vertical dashed line marks 2017; the horizontal dashed red line shows the 2019–2022 average, with its standard error in parentheses. Bars show 95% confidence intervals. ***, **, and * denote significance at the 1, 5, and 10 percent levels.

in pre-reform firm characteristics, which isolates the legislated component of the reform from firms' responses. Figure 7 shows the results.

Averaging over 2019–2022, a mean change in the simulated tax measure of 10.2 percentage points is associated with a 4.2 percent increase in tangible investment and a 2.6 percent increase in intangible investment. The pre-trend estimates are jointly insignificant, indicating that more exposed firms were not on differential investment trajectories before the reform. The tangible response appears immediately after enactment, while the intangible response builds gradually, consistent with the higher costs of adjusting intangible capital. That firms with greater predicted decreases in the tax burden raise both forms of investment is consistent with our quantitative findings: in the model, the TCJA raises both tangible and intangible capital, especially for domestic MNEs whose tax burdens fall the most.

Our empirical estimates are smaller than the model-implied aggregate response, as expected. The event-study design, standard in the empirical public finance literature, identifies effects from cross-firm variation in changes in tax burdens and therefore cannot recover the effect of the reform that is common to all firms. Quantifying the overall effect, including this common component, is one of the goals and contributions of our general-equilibrium analysis.

Our estimate concerns the effect on worldwide tangible investment by a firm, obtained from

consolidated firm records in the Compustat dataset, whereas both administrative studies measure U.S. investment alone. Since the investment response abroad is weaker than at home, our estimate is likely smaller than the domestic response. In addition, our sample of large public firms also has been shown to respond less to tax incentives than the private firms behind the administrative estimates (Zwick and Mahon, 2017). On the intangible margin, Chodorow-Reich et al. (2026) report that R&D rises by about one third of the tangible response; we likewise find a smaller response of intangible investment.

In the appendix, we attempt to isolate the effects of GILTI and FDII from the overall net effect of the TCJA. We find suggestive evidence consistent with our findings: US firms with more foreign income in excess of the 10-percent QBAI allowance on foreign tangible assets see larger increases in foreign tangible investment, and firms with more export income see larger decreases in domestic tangible investment. However, it is difficult to cleanly separate the income from foreign affiliates' local operations from domestic income generated by exporting using our data without shrinking the sample to the point that the effects are statistically insignificant, so these results should be interpreted cautiously. This highlights another useful function of the model: performing counterfactual experiments to cleanly decompose the effects of the TCJA's separate provisions.

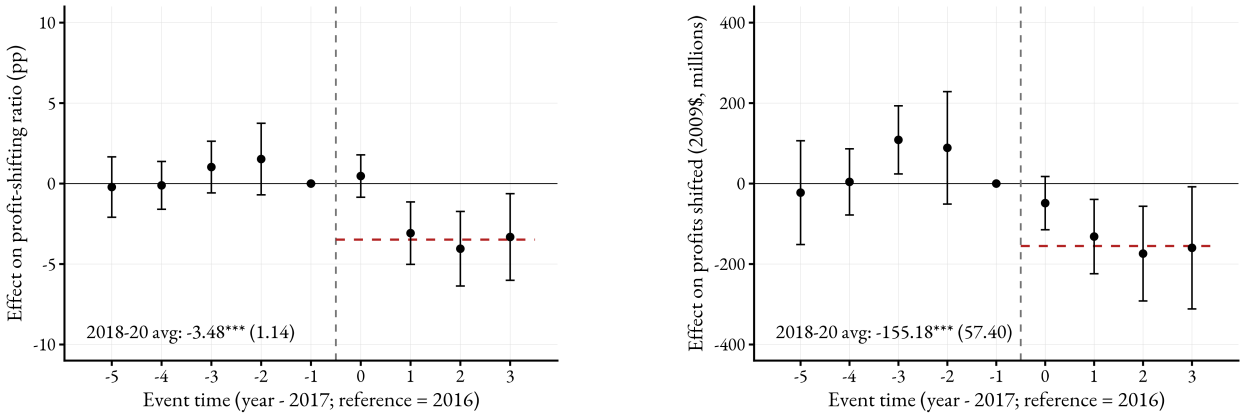
6.2 Profit shifting

Lastly, the model predicts that the TCJA reduces profit shifting by U.S. MNEs. We test this prediction with an event study that compares profit shifting by U.S. and non-U.S. MNEs.[29] This empirical design is analogous to Crawford and Markarian (2024), who estimate the investment effect of the TCJA by comparing U.S. firms to Canadian firms unaffected by the reform. To do so, we obtain the estimated MNE-level shifted profits by firm and year from Delis et al. (2024) and merge them into our Compustat sample. As in equation (30), we control for industry-year fixed effects to absorb time-varying industry-level shocks. Figure 8 shows the results.

Both the profit-shifting ratio and total profits shifted fall after the reform for U.S. MNEs relative to the foreign MNEs that operate in the United States. The pre-reform coefficients are insignificant, so the two groups were shifting profits along parallel paths before the TCJA. Averaging the effects between 2018 and 2020, U.S. MNEs reduce their shifted-profit share by about 3.5 percentage points and their total shifted profits by $155 million per year relative to the control firms. This estimated decline in the shifted-profit share is close to the 4-percentage-point decline the model predicts, which again validates the model's ability to evaluate the tax revenue effect of large corporate tax

[29] We do not use the simulated tax measure of Section 6.1 here because the separate provisions of the TCJA move profit shifting in opposite directions as we showed in our quantitative analysis. This design captures the overall net effect of the TCJA on profit shifting at the firm level.

Figure 8: Effect of the TCJA on profit shifting by U.S. MNEs



(a) Profit-shifting ratio

(b) Total profits shifted

Notes: These figures plot event-study estimates, with 95% confidence intervals, of the TCJA's effect on profit shifting by U.S. MNEs. The treatment group consists of U.S. MNEs and the control group of foreign-headquartered firms with U.S. affiliates in the Compustat sample. The dashed vertical line marks 2017, the enactment of the TCJA reform. Industry-year fixed effects are included. The outcomes are (a) the profit-shifting ratio, defined as shifted profits divided by observed profits, S_{it}/π_{it}, and (b) total profits shifted, S_{it}, both estimates are obtained from Delis et al. (2024) and go up to 2020.

reforms.

7 Conclusion

We develop and quantify a multi-country general-equilibrium model of multinational enterprises (MNEs) that jointly choose tangible and intangible investment and the location of reported profits. The framework maps detailed features of the U.S. Tax Cuts and Jobs Act (TCJA) and the OECD's Global Minimum Tax (GMT) into the firm's decision problem, allowing us to measure the effects of these policies on the economies of the implementing jurisdictions as well as their cross-border spillover effects.

Our results indicate that the TCJA raised investment and output in the United States and generated meaningful positive spillovers abroad, largely through changes in MNEs' investments and the reallocation of their activity across locations. When the GMT is implemented outside the United States and U.S.-parented MNEs remain exempt, the effects on the United States are negligible. Once U.S. MNEs become subject to the GMT under the Side-by-Side arrangement, however, U.S. GDP and tangible capital both decline. In the presence of technology externalities, whereby domestic firms benefit from intangible capital deployed locally by foreign MNEs, these international feedback effects become substantially stronger.

More broadly, our analysis underscores two lessons for policy evaluation. First, corporate tax reforms should not be assessed in isolation: in a world with globally active MNEs and intangible capital that is nonrival and highly mobile across tax jurisdictions, unilateral policy changes can transmit sizable macroeconomic effects across borders. Second, the institutional specifics of tax reforms, such as QBAI-style deductions and the GMT's SBIE carve-outs, play a material role in determining the magnitude of these spillovers; macroeconomic policy analysis needs to grapple with these specifics as well as the headline changes in statutory tax rates. Our model, and the effort of transcribing these specifics into it, together make a useful quantitative tool for evaluating a policy landscape that continues to change, including the OBBBA's changes to the TCJA provisions and the adoption of the GMT across countries.

Finally, our findings have several important implications for policymakers. First, the welfare and revenue consequences of minimum-tax regimes depend critically on both the breadth of adoption and the hierarchy and interactions between overlapping systems, such as the hierarchy of GILTI and the GMT's top-up taxes. Second, policies that primarily target reported profits can induce large real responses when they interact with investment margins that determine tax bases, especially for MNEs' intangible capital. As a result, seemingly modest reforms in terms of average effective tax-rate changes can have material macroeconomic effects. Designing anti-base-erosion rules with clear coordination rules and careful treatment of SBIE carve-outs is therefore central to limiting unintended cross-border distortions while achieving revenue objectives.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process. During the preparation of this work, the authors used Claude Code and ChatGPT Codex to assist with translating policy documents into model equations, with textual analysis of financial statements and balance-sheet information, and with copy-editing the manuscript. The authors reviewed all output of AI queries and take full responsibility for the manuscript's content.

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Appendix

A Empirics

A.1 Sample construction and descriptives

Our analysis merges several data sources at the firm-year level. Financial statement data come from the Compustat North America Fundamentals Annual database, which covers publicly traded U.S. firms from 1950 to 2024. We identify foreign subsidiaries and their locations using the WRDS Company Subsidiary database, available for 1995–2023, and supplement it with foreign pre-tax income and foreign taxes paid from Compustat to classify multinational status (Section A.2.1). Foreign sales shares come from Compustat's Geographic Segments database; because segment reporting standards changed in 1998, we sum export sales reported in domestic and foreign segments before that date and use export sales reported in domestic segments thereafter. Measures of intangible capital and investment follow Peters and Taylor (2017), as detailed in Section A.2.2.

We construct the panel in five steps. First, for firms that report under both industrial and financial-services formats in Compustat, we retain only the industrial format to avoid double counting. Second, we require a valid two-digit North American Industry Classification System (NAICS) code. Third, we restrict the sample to firm-year observations with positive net sales. Fourth, we require intangible intensity, the ratio of intangible to total capital defined in Section A.2.2, to lie within the unit interval; this eliminates observations with missing or implausible values of either intangible or physical capital. Fifth, we limit the sample period to 1995–2022, the coverage of the WRDS Company Subsidiary database.

The event studies in the main text use a balanced 2012–2022 subpanel of firms with positive pre-tax income in 2016, with regressions weighted by average 2015–2016 revenue. This yields the estimation sample of 1,867 firms (875 multinationals and 992 domestic firms) summarized below. The profit-shifting event study in the main text extends this sample to foreign-headquartered firms with U.S. affiliates, as described in Section A.2.3.

Summary statistics. Table A.1 presents summary statistics for the estimation sample, partitioned by multinational status. MNEs differ systematically from domestic firms in scale, asset composition, and tax planning. They invest more, with average log tangible investment of 3.73 versus 3.08 and log intangible investment of 4.29 versus 2.42, and operate at a much larger scale, with average sales of $6.6 billion versus $2.8 billion. They are structurally more reliant on intangible capital, with an average intangible intensity of 0.51 versus 0.33, and report a foreign sales share of 40 percent versus 3 percent. Profit-shifting opportunities are also concentrated among

multinationals: 48 percent own at least one tax-haven subsidiary, compared with 10 percent of domestic firms, and the estimated profit-shifting ratio, the fraction of observed profits attributable to shifting (Section A.2.3), is 0.13 versus 0.02.

Table A.2 documents how firm-level tax burdens changed around the reform. The average within-firm AETR falls by 8.6 percentage points between 2014–2016 and 2018–2020, but the changes are widely dispersed: the interquartile range of within-firm changes runs from -14.9 to -4.4 percentage points, and the support extends from -60.2 to $+84.9$. This dispersion reflects heterogeneous exposure to the reform's provisions and is the cross-sectional variation that our empirical design exploits. The income-weighted AETRs by multinational status that discipline the model's calibration appear in Table 1 of the main text.

To further characterize this variation and probe the identifying assumption, Table A.3 summarizes firm characteristics across quartiles of the realized change in the AETR from 2016 to 2018. Our regressions use the simulated tax change $\Delta\tau_i^{\text{sim}}$ (Section A.2.4) rather than this realized change, which partly reflects firms' endogenous responses to the reform, but the realized change offers a transparent description of how tax burdens actually shifted and a natural dimension along which to examine pre-reform behavior. Panel (A) confirms substantial variation in exposure: firms in the first quartile (Q1) saw a mean AETR reduction of 26 percentage points, while fourth-quartile (Q4) firms saw an average increase of 18 points, a difference of 44 percentage points. Panel (B) supports the identifying assumption that, absent the reform, investment trends would have been similar across groups: pre-reform growth rates (2012–2016) of tangible and intangible investment are statistically indistinguishable between Q1 and Q4 firms, with differences of 0.02 and -0.01, neither significant. Panel (C) documents level differences: firms with larger realized cuts tend to be larger, with mean log total assets of 6.4 versus 5.8, but less intangible-intensive (0.39 versus 0.46) and less likely to be multinational (42 versus 64 percent). These level differences are absorbed by the firm fixed effects in our specifications, while industry-by-status-by-year effects absorb differential sectoral trends.

A.2 Description of key variables

A.2.1 MNE identification

Our baseline measure classifies a firm as a multinational enterprise in year t if it satisfies two conditions: (i) the firm had at least one foreign subsidiary in any of the preceding three years, as recorded in the WRDS Company Subsidiary database; and (ii) the firm reported nonzero foreign pre-tax income or nonzero foreign income taxes in any of those same years. This definition extends the approach of Erel, Jang, and Weisbach (2020), who classify firms as multinationals based

Table A.1: Summary Statistics

	Full Sample	By MNE Status		
	Mean	MNEs	Non-MNEs	Diff.
Panel A: Realized Change				
ΔAETR (2016–2018)	−0.06	−0.04	−0.07	0.04***
	[0.21]	[0.21]	[0.20]	
Panel B: Outcome Variables				
Log tangible investment	3.41	3.73	3.08	0.65***
	[2.19]	[2.06]	[2.27]	
Log intangible investment	3.38	4.29	2.42	1.87***
	[2.24]	[2.03]	[2.03]	
Sales ($ millions)	4743.03	6618.90	2789.51	3829.38***
	[17457.69]	[22746.01]	[8717.57]	
Panel C: Firm Characteristics				
Log total assets	6.00	6.56	5.42	1.14***
	[2.42]	[2.16]	[2.53]	
Intangible intensity	0.42	0.51	0.33	0.19***
	[0.32]	[0.27]	[0.33]	
Foreign sales share	0.25	0.40	0.03	0.37***
	[0.28]	[0.25]	[0.15]	
Profit shifting indicator	0.41	0.66	0.14	0.51***
	[0.49]	[0.47]	[0.35]	
Panel D: Sample Composition				
Share MNE	0.47	—	—	—
	[0.50]			
Share with tax haven subsidiary	0.30	0.48	0.10	0.38***
	[0.46]	[0.50]	[0.30]	
Profit shifting ratio	0.07	0.13	0.02	0.11***
	[0.12]	[0.13]	[0.07]	
Unique firm observations	1,867	875	992	

Notes: This table presents descriptive statistics for the estimation sample (Section A.1). Panel A reports the realized change in the GAAP AETR from 2016 to 2018, shown for reference; the regressions in the main text use the simulated tax change described in Section A.2.4. Panels B and C report pre-TCJA (2012–2016) means for outcome variables and firm characteristics. Panel D reports sample composition. MNEs are firms with at least one foreign subsidiary and nonzero foreign income or taxes in the three years prior to 2017 (Section A.2.1). Intangible intensity and the profit-shifting ratio are defined in Sections A.2.2 and A.2.3, and the foreign sales share is constructed from Compustat Geographic Segments. The "Diff." column reports the difference (MNE − Non-MNE) with significance from a two-sample t-test. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table A.2: GAAP average effective tax rate (AETR): firm-level distribution

	Pre-TCJA (2014–16)	Post-TCJA (2018–20)	Change (post − pre)
Mean	31.7	23.2	−8.6
(SD)	(9.9)	(10.6)	(11.9)
P25	27.1	18.0	−14.9
Median	33.1	22.2	−10.4
P75	37.4	26.9	−4.4
Range [Min, Max]	[0.0, 77.6]	[0.0, 89.1]	[−60.2, 84.9]

Notes: GAAP average effective tax rates for firms in Compustat North America (Section A.1). A firm's annual AETR is total income tax expense over pre-tax book income, winsorized to $[0, 1]$. The pre- and post-TCJA columns are three-year firm averages over 2014–2016 and 2018–2020, omitting 2017 to exclude one-time transition effects of the reform. The table reports the distribution of equal-weighted, firm-level AETRs, with the standard deviation in parentheses below the mean and the support shown as [min, max]. The change column is the within-firm difference over firms present in both windows and so cannot be recovered by differencing the level percentiles. Income-weighted AETRs by multinational status appear in Table 1 of the main text. Levels are in percent and changes in percentage points.

solely on nonzero foreign pre-tax income; requiring documented foreign subsidiaries better captures operational foreign presence rather than purely financial arrangements. Our definition classifies approximately 30 percent of sample firms as multinationals in 2017, compared with roughly 40 percent under the Erel et al. (2020) definition. We also construct an indicator for whether a firm was ever classified as a multinational before the TCJA's enactment, which defines the pre-TCJA MNE subsamples used in the event studies. Our results are robust to two alternative definitions: a contemporaneous one, requiring a foreign subsidiary in the current year, and a sales-based one, classifying firms with more than 5 percent foreign sales as multinationals.

A.2.2 Intangible capital and investment

Intangible capital plays a central role in our analysis given its non-rival nature and mobile ownership, properties that make intangible-intensive firms particularly responsive to corporate tax incentives. Because U.S. accounting standards require most internally developed intangibles to be expensed rather than capitalized, balance-sheet intangibles understate the true stock. We therefore follow the perpetual inventory method (PIM) framework of Corrado, Hulten, and Sichel (2005), adapted to firm-level data by Eisfeldt and Papanikolaou (2013) and Peters and Taylor (2017), and define total intangible capital as the sum of externally acquired intangibles and two classes of internally created capital:

$$K_{it}^{int} = K_{it}^{ext} + K_{it}^{know} + K_{it}^{org}. \tag{A.1}$$

Externally acquired intangible capital, K_{it}^{ext}, comprises assets purchased from other en-

Table A.3: Pre-TCJA Characteristics by Realized Change in the AETR

	Quartile of ΔAETR (2016–2018)				
	Q1 (Largest cut)	Q2	Q3	Q4 (Smallest cut)	Q4−Q1
Panel A: Realized Change					
ΔAETR	−0.26	−0.12	−0.04	0.18	0.44***
Panel B: Pre-TCJA Outcome Trends (2012–2016 Growth)					
Δ Log tangible investment	0.03	0.05	0.04	0.01	0.02
Δ Log intangible investment	0.06	0.03	0.06	0.05	−0.01
Panel C: Pre-TCJA Firm Characteristics					
Log total assets	6.4	6.5	6.1	5.8	−0.6**
Intangible intensity	0.39	0.34	0.49	0.46	0.07***
Share MNE	0.42	0.44	0.60	0.64	0.22***
Foreign sales share	0.18	0.16	0.31	0.36	0.18***
Pre-TCJA AETR (2012–2016)	0.35	0.34	0.30	0.27	-0.08***
Unique firm observations	467	466	467	467	

Notes: This table compares pre-TCJA characteristics across quartiles of the realized change in the GAAP AETR from 2016 to 2018. Q1 contains firms with the largest tax cuts; Q4 contains firms with the smallest cuts or with increases. Panel A confirms substantial variation in realized exposure. Panel B reports pre-reform trends in the outcome variables; the insignificant Q4−Q1 differences support the parallel trends assumption. Panel C documents that firms with larger realized cuts tend to be larger, less intangible-intensive, less likely to be MNEs, and to have had higher pre-TCJA AETRs; these level differences are absorbed by firm fixed effects, and industry-by-status-by-year effects absorb differential sectoral trends. The Q4−Q1 column reports the difference with significance from a two-sample t-test. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

tities, such as patents, brands, and goodwill arising from acquisitions, and is measured as total intangible assets (INTAN) on the Compustat balance sheet.

Knowledge capital captures the stock of scientific and technological know-how generated through R&D and accumulates according to

$$K_{it}^{know} = (1 - \delta_{know})K_{i,t-1}^{know} + I_{it}^{know}, \tag{A.2}$$

where I_{it}^{know} is real R&D expenditure (Compustat item XRD, deflated by the CPI) and $\delta_{know} = 0.15$ following Li and Hall (2020) and the BEA standard.

Organizational capital reflects investments in firm-specific resources such as brand equity, human capital, and distribution systems. These investments are rarely capitalized on the balance sheet, so we proxy for them using Selling, General, and Administrative (SG&A) expenses. Because Compustat firms often report R&D within SG&A, we first net it out[30]:

$$\text{SG\&A}_{it}^{net} = \text{XSGA}_{it} - \text{XRD}_{it}. \tag{A.3}$$

Following Hulten and Hao (2008) and Eisfeldt and Papanikolaou (2013), we treat a fraction $\gamma = 0.30$ of these expenses as long-term investment, a rate based on Bureau of Labor Statistics estimates, and accumulate the stock as

$$K_{it}^{org} = (1 - \delta_{org})K_{i,t-1}^{org} + \gamma\,\text{SG\&A}_{it}^{net}, \tag{A.4}$$

with $\delta_{org} = 0.20$.

Intangible intensity. We measure intangible intensity as the ratio of intangible capital (INTAN+ K^{know}) to total capital, where total capital is the sum of intangible capital and gross property, plant, and equipment (PPEGT).

Investment measures. Physical investment is measured as capital expenditures (CAPX), with net physical investment subtracting sales of property, plant, and equipment (SPPE). Intangible investment follows Peters and Taylor (2017), summing R&D expenditures and the invested share of SG&A:

$$I_{it}^{intan} = \text{XRD}_{it} + 0.3 \times \text{SG\&A}_{it}^{net}. \tag{A.5}$$

[30]This adjustment is necessary because standard accounting rules allow firms to report R&D within SG&A. Peters and Taylor (2017) verify the prevalence of this practice, finding that in a random sample of 100 Compustat firms, 90 bundled R&D entirely into SG&A, while seven allocated it to Cost of Goods Sold (COGS).

A.2.3 Profit shifting

Tax haven and low-tax subsidiaries Using the WRDS Company Subsidiary database, we construct indicators for whether a firm has at least one subsidiary in a tax haven or low-tax jurisdiction, and count the number of such subsidiaries in each firm-year. The complete list of countries, taken from Tørsløv et al. (2023), is: Andorra, Anguilla, Antigua, Aruba, the Bahamas, Bahrain, Barbados, Belize, Bermuda, British Virgin Islands, Cayman Islands, Curacao, Cyprus, Gibraltar, Grenada, Guernsey, the Isle of Man, Jersey, Lebanon, Liechtenstein, Luxembourg, Malta, Marshall Islands, Mauritius, Monaco, the Netherlands Antilles, Panama, Puerto Rico, Samoa, Seychelles, Sint Maarten, St. Kitts & Nevis, St. Vincent & the Grenadines, St. Lucia, the Turks & Caicos, and Vanuatu.

Profit-shifting intensity To measure profit shifting at the firm-year level, we use the estimates of Delis et al. (2024), who work within the tax-response framework of Hines and Rice (1994) and Huizinga and Laeven (2008) but allow the semi-elasticity of reported profits to vary across firms and years. For each firm-year, they estimate by local linear regression a semi-elasticity g_{it} of reported pre-tax profits π_{it} with respect to a composite tax differential CT_{it}, the average wedge between the firm's statutory tax rate and those of its group affiliates. Observed profits then decompose into true and shifted components according to $\pi_{it} = T_{it}\, e^{g_{it} CT_{it}}$, so shifted profits are

$$S_{it} = \pi_{it} \left(\frac{g_{it} CT_{it}}{1 + g_{it} CT_{it}} \right). \tag{A.6}$$

We merge these firm-year estimates into our Compustat sample. The profit-shifting ratio, S_{it}/π_{it}, measures the fraction of observed profits attributable to shifting and is the outcome reported in Table A.1 and studied in the profit-shifting event study of the main text.

Design of the profit-shifting event study The profit-shifting event study in the main text compares U.S. MNEs with foreign-headquartered firms that have U.S. affiliates. For this exercise, we extend the sample of Section A.1 to the full Compustat North America universe, which includes foreign-headquartered firms listed in the United States. U.S. MNEs are treated from 2017, and industry-year fixed effects absorb time-varying sectoral shocks. Because the control firms' U.S. operations are also affected by the reform, through the statutory rate cut and base-broadening provisions such as the Base Erosion and Anti-Abuse Tax, the comparison identifies the differential decline in shifting by U.S. MNEs; to the extent the reform also curbed shifting by the control group, our estimates understate the TCJA's total effect on profit shifting.

A.2.4 The simulated tax change

The main text defines the simulated tax change as

$$\Delta\tau_i^{sim} = \frac{T^{post}(\mathbf{X}_{i,2016}) - T^{pre}_{i,2016}}{\pi_{i,2016}}, \tag{A.7}$$

where $T^{pre}_{i,2016}$ is the firm's actual 2016 tax expense, $T^{post}(\mathbf{X}_{i,2016})$ applies the post-TCJA rate structure to the firm's 2016 characteristics, and $\pi_{i,2016}$ is 2016 pre-tax income. Variation in $\Delta\tau_i^{sim}$ therefore comes only from ex-ante differences in pre-reform characteristics interacted with the statutory rule change. Here we detail the construction of T^{post}.

We freeze each firm's balance sheet, geographic income distribution, and asset composition at their 2016 values, prior to the drafting and enactment of the TCJA, and mechanically apply the post-reform code: T^{post} applies the 21 percent flat corporate rate to 2016 domestic income and models the GILTI regime by applying the 10.5 percent effective rate to the 2016 stock of foreign pre-tax earnings. Because firms could not have adjusted their 2016 characteristics in response to a reform not yet drafted, $\Delta\tau_i^{sim}$ captures the intention to treat of the policy and is purged of the endogenous responses, such as profit shifting or the timing of deductions, that contaminate realized post-reform tax rates.

A.3 Additional empirical results of TCJA

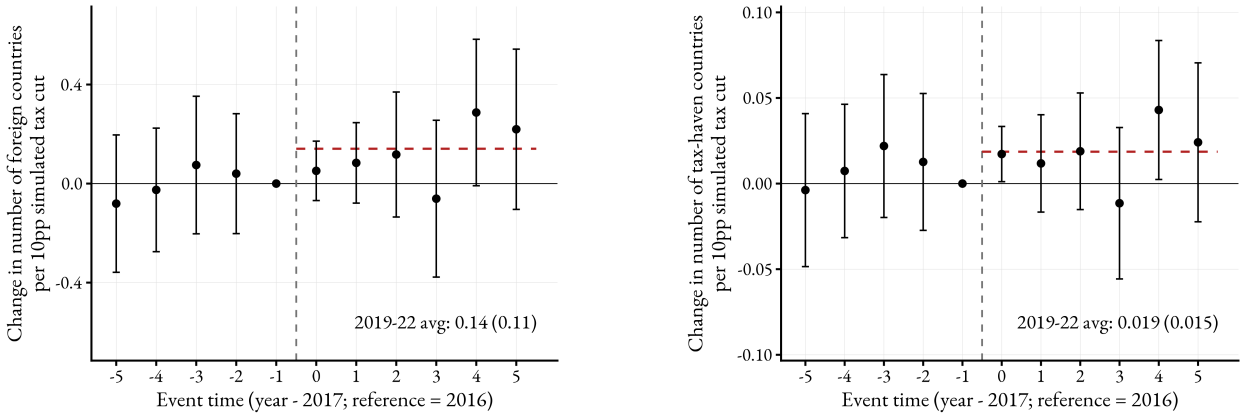
A.3.1 The extensive margin of global expansion

The model implies that the AETR channel contributes little to aggregate investment. Because the average tax burden governs whether a firm operates in a region at all, it moves capital only through entry and exit. The most productive multinationals hold the bulk of the capital and earn profits in each region that are large relative to the fixed cost of operating there, so they are inframarginal: a change in the average rate leaves their location decisions unchanged. Only much smaller marginal entrants could respond, and they account for little capital. We test this prediction by asking whether the firms that received larger tax cuts came to operate in more countries.

We measure a firm's global footprint by the number of distinct foreign countries in which it discloses a significant subsidiary under SEC Exhibit 21, and separately by the number of tax-avoidance countries. Counting countries rather than entities isolates geographic reach from the within-country proliferation of affiliates that tax and organizational structuring generates, and the disclosure threshold ensures that a country enters the count only where the firm's presence is economically material.[31] We re-estimate (30) with each country count as the outcome.

[31] Under Item 601(b)(21) of Regulation S-K, registrants may omit subsidiaries that, even considered together, would

Figure A.1: The effect of the TCJA on global expansion



(a) Foreign countries

(b) Tax-avoidance countries

Notes: These figures plot the estimated dynamic effects $\hat{\beta}_\tau$ from equation (30), scaled to a 10 percentage point simulated tax cut, with 95% confidence intervals. The outcomes are the number of distinct foreign countries in which the firm discloses a significant subsidiary under SEC Exhibit 21 and, in panel (b), the number of those countries classified as tax havens or low-tax jurisdictions. The dashed vertical line marks the onset of treatment.

Exposed firms did not expand their geographic footprint. Averaging over 2019–2022, a 10-percentage-point simulated tax cut changes the number of foreign countries of operation by 0.14, against a 2016 mean of about ten, and the number of tax-avoidance countries by 0.05, against a mean of about two. Neither effect is statistically significant, the pre-reform coefficients are flat, and restricting attention to non-haven countries yields the same null. These are precisely estimated zeros rather than uninformative ones: the point estimates bound the response to a small fraction of a single country, far from the whole-country moves that entry and exit would produce. The reform changed how much exposed firms invested but not where they operate, which is what the model implies: taxation acts on aggregate investment through the user cost of capital rather than through the average tax burden that governs entry.

A.3.2 GILTI and FDII effects on tangible capital

We empirically test the effect of GILTI and FDII on tangible investment by U.S. MNEs. We construct predetermined measures of firms' exposure to each of the two international provision of the TCJA. The measures approximate the extent to which a firm's pre-TCJA income exceeded the provisions' deemed return on tangible capital. They should be interpreted as exposure indices rather than estimates of statutory tax liabilities. Compustat foreign and domestic pretax income and book PP&E

not constitute a "significant subsidiary," a term defined in Rule 1-02(w) of Regulation S-X by a 10 percent threshold on the subsidiary's share of consolidated assets, on the parent's investment in it, or on consolidated income.

do not map directly into tested income, foreign-derived deduction-eligible income, tax-basis QBAI, foreign tax credits, expense allocations, or the limitations governing the Section 250 deduction.

Let $\overline{\pi}_i^F$ and $\overline{\pi}_i^D$ denote firm i's average foreign and domestic pretax income during 2013–2016. Let $\overline{K}_i^F$ and $\overline{K}_i^D$ denote average foreign and domestic tangible capital over the same period, and let $\overline{A}_i$ denote average consolidated assets. Our preferred measure of tangible capital is geographically disclosed net property, plant, and equipment (PP&E).

We measure exposure to GILTI as

$$B_i^G = \frac{\max\left\{0,\ \overline{\pi}_i^F - 0.10\overline{K}_i^F\right\}}{\overline{A}_i} \tag{A.8}$$

The term $0.10\overline{K}_i^F$ approximates the 10 percent deemed return on qualified business asset investment under GILTI. The measure is therefore larger for firms with substantial foreign income relative to their foreign tangible-capital stock.

To construct FDII exposure, we first calculate the firm's pre-reform foreign-sales share,

$$s_i^F = \min\left\{1,\ \max\left\{0,\ \frac{\overline{\text{Foreign Sales}}_i}{\overline{\text{Total Sales}}_i}\right\}\right\}. \tag{A.9}$$

We then define

$$B_i^F = s_i^F \frac{\max\left\{0,\ \overline{\pi}_i^D - 0.10\overline{K}_i^D\right\}}{\overline{A}_i}. \tag{A.10}$$

This measure combines domestic income in excess of the deemed return on domestic tangible capital with the share of the firm's sales directed to foreign markets. The sales-share adjustment reflects that FDII applies to foreign-derived income rather than to all domestic income.

Both measures are based exclusively on information from 2013–2016 and are therefore fixed before the enactment of the TCJA. We winsorize each continuous measure at the 1st/99th percentiles of its positive distribution while leaving genuine zeros unchanged.

Geographic PP&E from XBRL filings. We obtain our preferred tangible capital outcomes, domestic and foreign net PP&E, from geographically dimensioned XBRL disclosures in firms' annual SEC filings. Compustat's geographic segment files are the traditional source for the geographic composition of firms' assets, but their coverage of tangible assets is thin and uneven: segment-level property, plant, and equipment is available in both the pre- and post-reform periods for only about 340 firms. To expand this margin we parse the dimensional XBRL data underlying firms' 10-K filings, published in the SEC's Financial Statement and Notes data sets, and reconstruct each

firm's United States versus foreign split of property, plant, and equipment, long-lived assets, and revenue from the entity-wide geographic disclosures required under ASC 280. The resulting panel covers roughly 2,200 firms over fiscal years 2013 through 2022 and raises the number of firms with a tangible-asset split observed before and after the reform from about 340 to roughly 840. Where the two sources overlap they agree closely: implied foreign shares have a rank correlation of 0.96 with a median difference of zero. We classify a disclosure as domestic when its geographic context explicitly identifies the United States and as foreign when it identifies a non-US country, foreign region, or non-US aggregate. US territories are classified as foreign because they generally fall outside the relevant federal tax definition of the United States.

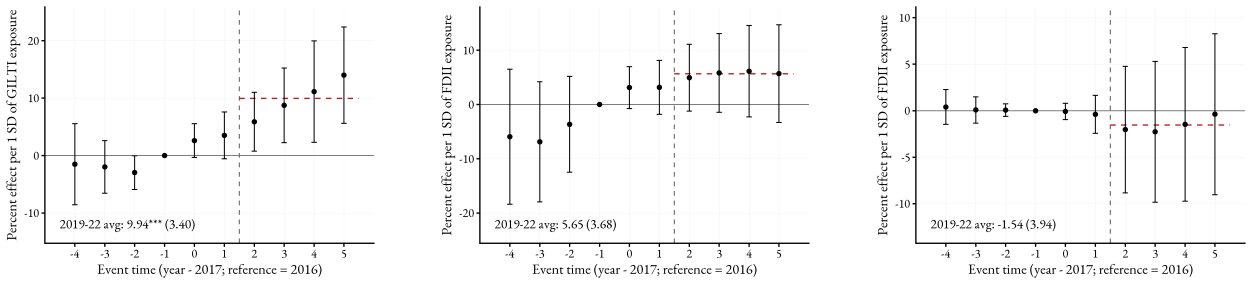
Generic labels such as "domestic" and "foreign" are potentially ambiguous for foreign private issuers, for whom "domestic" may refer to the issuer's home country. We therefore use such labels only when the disclosure clearly identifies the United States or non-US operations. Ambiguous geographic facts are excluded. Where a firm reports consolidated PP&E together with a sufficiently well-defined domestic or foreign component, we use the corresponding residual to recover the other geographic component. We discard residuals that are negative or otherwise inconsistent with the consolidated total.

This procedure assigns PP&E according to the geographic information contained in firms' financial disclosures. It does not assign capital based on the location of incorporation, headquarters, or customers. A firm can therefore report both domestic and foreign PP&E. When a filing does not provide enough information to construct a geographic split, the corresponding value is treated as missing rather than as zero. The principal outcomes are $\log(1 + \text{Domestic PP\&E})$ and $\log(1 + \text{Foreign PP\&E})$.

Separating exports from affiliate sales. The FDII exposure multiplies domestic excess income by a foreign-derived sales share proxied by foreign segment sales over total sales. Statutory FDDEI covers only US-origin exports and cross-border licensing, while the geographic sales share also counts local sales made through foreign affiliates, which generate GILTI-side income and no FDII benefit. A validation exercise shows that our foreign-derived sales share proxy from Compustat has a strong, positive correlation (+0.53) with firms' pre-TCJA stock of permanently reinvested foreign earnings (profits made by foreign subsidiaries not yet repatriated by a U.S. parent) scaled by assets, while disclosing firms' actually reported FDII deductions from 2019–2025 are virtually uncorrelated with either pre-TCJA permanently reinvested foreign earnings (-0.06) or the §965 transition tax (+0.05). The GILTI exposure suffers from a similar measurement error since it uses foreign excess income in equation (A.8) which muddles export sales with sales from foreign affiliates.

To address this contamination, we construct a firm-level measure of foreign-affiliate intensity

Figure A.2: The effect of GILTI and FDII exposure on U.S. and foreign tangible capital (PP&E)



(a) GILTI on foreign PP&E (b) FDII on U.S. PP&E (all firms) (c) FDII on U.S. PP&E (exporters)

Notes: The figures plot event-study estimates of the effect of pre-policy GILTI and FDII exposure on tangible capital. The outcome is log tangible capital, measured from geographic asset disclosures in XBRL filings, in (a) foreign jurisdictions, and at the U.S. headquarters for (b) all firms and (c) the exporters-only sample. The exposure measures, defined in the text, are 2013–2016 averages standardized to unit variance; both enter each regression jointly, interacted with year indicators, with 2016 omitted. The vertical dashed line marks 2017; the horizontal dashed red line shows the 2019–2022 average, with its standard error in parentheses. Bars show 95% confidence intervals. ***, **, and * denote significance at the 1, 5, and 10 percent levels.

from 10-K disclosures which are informative about the mode of foreign operation, and we partition the sample into groups within which the exposure measure has a more homogeneous interpretation. For each firm, we construct four proxies, each increasing in the intensity of foreign-affiliate operations: (i) permanently reinvested foreign earnings relative to total assets, disclosed in income tax footnotes, a direct measure of accumulated affiliate profits; (ii) foreign pretax income relative to foreign sales, since exporters book their income in the United States; (iii) foreign income taxes paid relative to foreign sales, and (iv) foreign tangible assets relative to foreign sales, since local production requires local plant. We assign firms a percentile rank on each proxy and split the sample into terciles using a consolidated percentile rank obtained from averaging over all proxies. We tag the top tercile of firms as affiliate-heavy and the bottom tercile as the exporters sample, which we use for Panel (c) in Figure A.2.

Results. Figure A.2 reports event-study estimates in which the two exposure measures, standardized to unit variance, enter jointly interacted with relative time indicators. Panel (a) shows that firms with greater GILTI exposure expand their foreign tangible capital after the reform: the pre-reform coefficients are flat, the response builds after 2019, and averaging over 2019-2022, a one-standard-deviation increase in the GILTI exposure raises foreign PP&E by 9.9%. This is precisely the margin that the QBAI carve-out targets, since each additional unit of foreign tangible capital raises the deemed routine return exempted from the GILTI base and thereby lowers the user cost of tangible investment in foreign affiliates. Panels (b) and (c) report the corresponding

estimates for FDII exposure and domestic tangible capital. Among all firms in panel (b), the response of U.S. PP&E is positive and statistically insignificant, reflecting the measurement problem discussed above: the foreign sales share in the FDII exposure also captures local sales made through foreign affiliates, which generates GILTI-side income and no FDII benefit. Restricting attention to exporters in panel (c), for whom the sales share more cleanly proxies foreign-derived income, firms with greater FDII exposure reduce their domestic tangible capital by 1.5% per standard deviation of exposure over 2019-2022, consistent with the carve-out raising exporters' domestic user cost because each additional unit of domestic tangible capital shrinks the deduction. The restriction shrinks the sample, however, and the estimates lose statistical significance, so we interpret this evidence as suggestive.

B Mapping Model to Internal Revenue Services Concepts

In this section, we bridge the gap between our theoretical framework and the administrative reality of the U.S. corporate tax code. We provide a detailed mapping of model variables to specific line items on IRS tax return forms for both the pre-2018 and post-2017 tax regimes.

This mapping serves two purposes. First, it validates that our definitions of tax bases—particularly for complex provisions like GILTI and FDII—adhere to the statutory formulas governing U.S. multinational enterprises. Second, it clarifies how theoretical concepts such as "profit shifting" and "intangible capital" translate into reported taxable income, foreign tax credits, and final tax liabilities.

We structure the appendix chronologically to mirror the policy transition analyzed in the paper:

- Section B.1: The pre-TCJA "Worldwide" system, characterized by deferral and the repatriation tax.
- Section B.2: The post-TCJA "Territorial" system, characterized by the participation exemption and the new intangible income provisions (GILTI and FDII).

We reference the specific IRS forms and line items (e.g., Form 1120, Form 8993) that correspond to our equations to ensure institutional precision.

B.1 Pre-TCJA "Worldwide" Tax System (2017)

In the pre-TCJA worldwide system, a U.S. parent's tax base began with its domestic profits and then added: (1) immediately taxable foreign earnings under Subpart F, (2) repatriated dividends from non-Subpart F earnings, and (3) a notional "gross-up" of foreign taxes paid on those earnings (per IRC §78).

Unlike the current regime, there was generally no dividends-received deduction (DRD) for foreign-source dividends (old IRC §245 applied only to U.S.-source dividends). Instead, the U.S. taxed this worldwide income at the statutory rate of 35% and provided relief via a Foreign Tax Credit (FTC) under IRC §902 (repealed 2017). The result was that the U.S. collected a "residual" tax whenever the foreign tax rate was lower than 35%.

We map these concepts to the **2017** versions of the relevant IRS forms:

- Form 1120 (2017): U.S. Corporation Income Tax Return.
- Form 1118 (2017): Foreign Tax Credit.
- Form 5471 (2017): Information Return of U.S. Persons With Respect to Certain Foreign Corporations.

B.1.1 Foreign Earnings of the U.S. Parent

Subpart F Inclusion Subpart F (IRC §951) is the anti-deferral regime for passive/mobile income. Pre-TCJA, a high-tax exception applied if the foreign effective rate was $\geq 90\%$ of the U.S. rate ($0.9 \times 0.35 = 31.5\%$). Define the high-tax set:

$$J_F^{HT,pre} \equiv \left\{ j \in J_{F \bigcup \{TH\}} \;\middle|\; \frac{\text{Foreign Taxes Paid}}{\tilde{\pi}_{ij}} \geq 0.315 \right\}.$$

The Subpart F set is the complement: $J_F^{SF} = J_F \setminus J_F^{HT,pre}$. The immediate Subpart F inclusion is:

$$\tilde{\pi}_{ii}^{SubF} = \sum_{j \in J_F^{SF}} \tilde{\pi}_{ij} + \tilde{\pi}_{i,TH}. \qquad \text{[Form 1120 (2017), Sch C, Line 14]}$$

Repatriated Dividends Under a static full-repatriation assumption, the U.S. parent receives dividends from the after-tax profits of high-tax (deferred) subsidiaries. Note that dividends are paid out of *after-tax* profits:

$$DIV_i = \sum_{j \in J_F^{HT,pre}} (\tilde{\pi}_{ij} - \tau_j \tilde{\pi}_{ij}). \qquad \text{[Form 1120 (2017), Sch C, Line 13]}$$

Section 78 Gross-up To claim a credit for taxes paid by the subsidiary, the U.S. parent must "gross up" its income by the amount of those taxes (effectively treating the tax payment as a deemed dividend under §78). The deemed taxes associated with *both* Subpart F inclusions and Repatriated

Dividends are:

$$T_i^{Deemed} = \sum_{j \in J_F^{SF}} \tau_j \tilde{\pi}_{ij} + \sum_{j \in J_F^{HT,pre}} \tau_j \tilde{\pi}_{ij}. \qquad \text{[Form 1118 (2017), Sch A, Col 3]}$$

The Section 78 Gross-up added to income is equal to these deemed taxes:

$$G_i = T_i^{Deemed}. \qquad \text{[Form 1120 (2017), Sch C, Line 15]}$$

Worldwide Gross Income The total income appearing on the U.S. return includes domestic profit plus the full pre-tax value of foreign earnings (cash dividends + inclusions + tax gross-up):

$$\begin{aligned} \tilde{\pi}_i^{WWGI} &= \tilde{\pi}_{ii} + \tilde{\pi}_{ii}^{SubF} + DIV_i + G_i \\ &= \tilde{\pi}_{ii} + \sum_{j \in J_F} \tilde{\pi}_{ij} + \tilde{\pi}_{i,TH}, \end{aligned} \qquad \text{[Form 1120 (2017), Pg 1, Line 10]}$$

where taxable income deducts the bonus allowance from the otherwise non-deductible rental cost of capital, $\tilde{\pi}_{ii} = \pi_{ii} + (1 - b_{US}^{pre}) r_i k_{ii}$. We describe how we calculate the bonus rate b_{US} before and after the reform in Appendix B.2.2.

B.1.2 Regular Tax Liability

Taxable Income Pre-TCJA, there was no deduction for foreign-source dividends. Thus, Taxable Income is simply the Worldwide Gross Income:

$$\tilde{\pi}_i^{TI,pre} = \tilde{\pi}_i^{WWGI}.$$

The pre-credit U.S. tax liability is:

$$T_i^{reg} = \tau_{US}^{pre} \times \tilde{\pi}_i^{TI,pre}, \qquad \text{[Form 1120 (2017), Sch J, Line 2]}$$

where $\tau_{US}^{pre} = 0.35$.

B.1.3 Foreign Tax Credit (FTC)

FTC Limitation The credit is limited to the U.S. tax that *would* be paid on the foreign-source income under IRC §904. Foreign-Source Taxable Income (FSTI) is the sum of Subpart F, Dividends,

and the Gross-up:

$$\tilde{\pi}_i^{FSTI} = \tilde{\pi}_{ii}^{SubF} + DIV_i + G_i = \sum_{j \in J_F} \tilde{\pi}_{ij} + \tilde{\pi}_{i,TH}. \qquad \text{[Form 1118 (2017), Sch B, Part II, Line 6]}$$

The limitation is:

$$FTC^{limit} = \tau_{US}^{pre} \times \tilde{\pi}_i^{FSTI}. \qquad \text{[Form 1118 (2017), Sch B, Part II, Line 10]}$$

Allowed Credit The allowed credit is the lesser of actual taxes deemed paid or the limitation:

$$FTC^{allowed} = \min\left(T_i^{Deemed},\ FTC^{limit}\right). \qquad \text{[Form 1118 (2017), Sch B, Part II, Line 13]}$$

Total U.S. Tax Liability

The final liability is the regular tax minus the allowed credit.

$$\begin{aligned} T_{US}^{Total} &= T_i^{reg} - FTC^{allowed} && \text{[Form 1120 (2017), Sch J, Line 10]} \\ &= \tau_{US}^{pre}(\tilde{\pi}_{ii} + \tilde{\pi}_i^{FSTI}) - \min\left(T_i^{Deemed},\ \tau_{US}^{pre}\tilde{\pi}_i^{FSTI}\right) \\ &= \underbrace{\tau_{US}^{pre}\tilde{\pi}_{ii}}_{\text{Tax on Domestic}} + \underbrace{\max\left(0,\ \tau_{US}^{pre}\tilde{\pi}_i^{FSTI} - T_i^{Deemed}\right)}_{\text{Residual Tax on Foreign}}. \end{aligned}$$

This equation demonstrates the pre-TCJA "top-up" mechanic: MNEs paid full U.S. tax on domestic profits, plus the difference between the U.S. rate and the foreign rate on foreign profits (if the foreign rate was lower).[32]

B.1.4 Model Implementation: The Repatriation Rate (ι)

The detailed derivation above highlights that under the pre-TCJA system, the U.S. residual tax applied only to a subset of foreign earnings: those deemed distributed under Subpart F ($\tilde{\pi}_{ii}^{SubF}$) and those voluntarily repatriated as dividends (DIV_i). The remaining active earnings could be deferred indefinitely.

To map this complex legal structure into our stationary general-equilibrium framework—without explicitly modeling the dynamic timing of repatriation decisions—we introduce a reduced-form parameter, ι. This parameter represents the *repatriation rate*, or the fraction of total foreign

[32] We abstract from the Corporate Alternative Minimum Tax (AMT), which imposed a 20% minimum tax on a broader definition of income (see IRC §55). While the TCJA repealed the Corporate AMT, its effects in the pre-TCJA period are implicitly captured in our calibration of the effective tax rate rather than explicitly modeled.

earnings ($\sum \tilde{\pi}_{ij}$) that enters the U.S. tax base in a given period, either through mandatory Subpart F inclusions or voluntary repatriation. We allow ι to vary by region to reflect the variation in the share of repatriated profits.

Substituting this parameter into the Total U.S. Tax Liability equation derived above, and assuming for tractability that the foreign tax credit limitation is calculated against this aggregate included fraction, we arrive at the reduced-form tax function used in the main text:

$$T_{ii} \approx \tau_{US}^{pre} \tilde{\pi}_{ii} + \sum_{j \in J_F \bigcup \{TH\}} \iota_j \times \max\left(0,\ (\tau_{US}^{pre} - \tau_j)\tilde{\pi}_{ij}\right). \tag{B.1}$$

Here, the term $\max(0, \tau_{US}^{pre} - \tau_j)$ captures the residual tax mechanic (regular tax minus FTC) derived in the previous subsection.

B.2 Post-TCJA "Territorial" Tax System (2018+)

The 2017 Tax Cuts and Jobs Act fundamentally shifted the U.S. from a worldwide system with deferral to a quasi-territorial system. The cornerstone of this shift is the **Participation Exemption** (IRC §245A), which allows U.S. corporations to deduct 100% of the foreign-source portion of dividends received from specified 10%-owned foreign corporations.

In the model, we implement the participation exemption implicitly: unlike the pre-TCJA framework, we do not include repatriated dividends in the U.S. tax base. Instead, U.S. taxation of foreign earnings is strictly limited to the new intangible income regimes. We match model concepts to the following forms:

1. Form 1120 (U.S. Corporation Income Tax Return)
2. Form 1118 (Foreign Tax Credit)
3. Form 8991 (BEAT)
4. Form 8992 (GILTI Inclusion)
5. Form 8993 (Section 250 Deduction)
6. Form 4562 (Depreciation and Amortization)

B.2.1 U.S. Parent Taxable Income

We begin with the pre-tax profit at the MNE level, defined as:

$$\pi_i^{MNE} \equiv \pi_{ii} + \sum_{j \in J_F} \pi_{ij} + \pi_{i,TH},$$

where π_{ii} is the parent's pre-tax profit. The object taxed by the IRS, however, is the parent's taxable income, $\tilde{\pi}_{ii}$. In IRS terminology, it corresponds to **Taxable Income Before Net Operating Loss and Special Deductions**: it includes domestic gross receipts, export income, and royalties received, net of domestic deductions, but excludes dividends and inclusions from foreign subsidiaries (which are added later via Schedule C).

We map $\tilde{\pi}_{ii}$ to Line 28 of Form 1120:

$$
\begin{aligned}
\tilde{\pi}_{ii} = & \underbrace{\sum_{j \in J_X \cup \{i\}} p_{ij} q_{ij}}_{\text{Gross Receipts (Line 1)}} + \underbrace{(\varphi_{LT}\lambda_{LT} + \varphi_{TH}\lambda_{TH}) z_i \sum_{j \in J_F \cup \{i\}} \vartheta_{ij}(z_i)}_{\text{IP Transfer Proceeds (Line 10)}} \\
& + \underbrace{(1-\lambda_i) z_i \sum_{j \in J_F} \vartheta_{ij}(z_i)}_{\text{Royalties/License Fees (Line 6)}} \\
& - \Bigg(\underbrace{W_i l + \delta P_i k}_{\text{COGS \& Deductions}} + \underbrace{b_i \, r_i k}_{\text{Bonus Depreciation}} + \underbrace{\lambda \vartheta_{ii}(z_i) z_i}_{\text{Royalties Paid}} \\
& + \underbrace{W_i \big(\mathcal{C}_{i,LT}(\lambda_{LT}) + \mathcal{C}_{i,TH}(\lambda_{TH}) \big) z_i \sum_{j \in J_F \cup \{i\}} \vartheta_{ij}(z_i)}_{\text{Cost of Profit Shifting}} \Bigg) \\
& - \underbrace{\left(\frac{W_i}{A_i} \right) z_i}_{\text{R\&D Exp (Line 26)}} - \underbrace{W_i \left(\sum_{j \in J_X} \kappa_{jX} + \sum_{j \in J_F} \kappa_{jF} \right)}_{\text{Other Deductions (Line 26)}}
\end{aligned}
\qquad \text{[Form 1120, Line 28]}
$$

This definition captures the domestic tax base prior to the application of international provisions. Note that the subset J_X appears here because exports are part of the domestic tax base, while J_F (foreign production) generally is not, except through the specific profit-shifting mechanisms detailed above. Relative to the parent's pre-tax profits (10), taxable income adds back the non-deductible rental cost of capital net of the bonus-depreciation deduction, $\tilde{\pi}_{ii} = \pi_{ii} + (1 - b_i)\, r_i k_{ii}$, consistent with (14).

B.2.2 Bonus Depreciation

Bonus depreciation (IRC §168(k)) is claimed on Form 4562 (Part II, Line 14), flows to the depreciation line of Form 1120, and reduces taxable income on Line 28. Because the allowance attaches to the vintage of investment rather than to the installed stock, it changes the timing of the depreciation deductions, not their total.

We set the U.S. bonus rate to $b_{US} = \theta_{US}\, e_{US}$, the product of the statutory headline rate e_{US}

(0.5 before the TCJA under the PATH Act, 1 under full expensing) and the eligible share θ_{US}. For the coverage rate θ_{US}, bonus depreciation covers property with a recovery period of twenty years or less (I.R.C. §168(k)(2)(A)(i)). We measure θ_{US} as the share of U.S. private nonresidential tangible investment in such property, taking investment by asset type from the BEA Fixed Asset Tables and recovery periods from the crosswalk of Zwick and Mahon (2017). This share is 0.80 before the reform. The TCJA's exclusion of regulated public-utility property and floor-plan-financing businesses (I.R.C. §168(k)(9)) lowers it to 0.66, so $b_{US}^{pre} = 0.40$ and $b_{US}^{post} = 0.66$. As a robustness check, in Section E.2 we follow Barro and Furman (2018) and construct b_{US} from the investment-weighted present value of depreciation allowances, using asset-level schedules that weight each asset by its own depreciation rate.

B.2.3 Foreign Affiliate Income (Tested Income)

To determine the inclusion amounts for GILTI, we must also define the taxable income of foreign subsidiaries, which maps to the *Earnings and Profits* (E&P) or *Tested Income* concepts found on Form 5471. As in (14), taxable income deducts local depreciation but not the rental cost of capital, so $\tilde{\pi}_{ij} = \pi_{ij} + r_j k_{ij}$ for the foreign affiliates, which receive no bonus depreciation ($b_j = 0$).

For subsidiaries in high-tax regions ($j \in J_F \setminus \{LT\}$), taxable income is local revenue less operational costs and royalty payments for the use of intellectual property (IP):

$$\tilde{\pi}_{ij} = p_{ij} q_{ij} - W_j l_j - \delta P_j k_j - \vartheta_{ij}(z_i) z_i.$$

For the subsidiary in the low-tax region (LT), the taxable-income equation accounts for the profit-shifting mechanics. This affiliate receives income from shifting IP (licensing fees from other affiliates) but pays for the acquisition of that IP (transfer pricing):

$$\tilde{\pi}_{i,LT} = p_{LT} q_{LT} - W_{LT} l_{LT} - \delta P_{LT} k_{LT} \\ \underbrace{- \varphi_{LT} \lambda_{LT} \sum_{j \in J_F \cup \{i\}} \vartheta_{ij}(z_i)}_{\text{Cost of Acquired IP}} + \underbrace{\sum_{j \in J_F \cup \{i\} \setminus \{LT\}} \lambda_{LT} \vartheta_{ij}(z_i) z_i}_{\text{Royalties Received}} - \underbrace{(1 - \lambda_{LT}) \vartheta_{i,LT}(z_i) z_i}_{\text{Royalties Paid to Parent}}.$$

Finally, the tax haven affiliate (TH) acts purely as a holding entity for shifted IP. Its income consists solely of royalties received on shifted IP, net of the transfer price paid to acquire it; because it holds no tangible capital, its taxable income coincides with its pre-tax profits:

$$\tilde{\pi}_{i,TH} = \sum_{j \in J_F \cup \{i\}} \lambda_{TH} \vartheta_{ij}(z_i) z_i - \varphi_{TH} \lambda_{TH} \sum_{j \in J_F \cup \{i\}} \vartheta_{ij}(z_i).$$

B.2.4 Global Intangible Low-Taxed Income (GILTI)

GILTI is governed by IRC §951A and computed on Form 8992. On Form 1120, the section 951A inclusion is reported on Schedule C, line 17 and is aggregated into "Dividends and inclusions" on Schedule C, line 23 (column (a)), which flows to page 1, line 4. The associated section 250 deduction is computed on Form 8993 and reported on Schedule C, line 22 (column (c)); the total of special deductions on Schedule C, line 24 (column (c)) is carried to page 1, line 29b.[33]

We construct Net Tested Income (NTI) in accordance with Form 8992, Part I. Jurisdictions whose effective tax rate is at least 90 percent of the U.S. rate fall under the high-tax exclusion of 26 CFR §1.951A-2(c)(6). Define

$$J_F^{HT} \equiv \left\{ j \in J_F \;\middle|\; \frac{T_{ij}^{loc}}{\tilde{\pi}_{ij}} \geq 0.9\,\tau_{US} \right\}.$$

Net Tested Income is then

$$\tilde{\pi}_{ii}^{NTI} = \sum_{j \in J_F \setminus J_F^{HT}} \tilde{\pi}_{ij}, \qquad \text{[Form 8992, Part I, line 3]}$$

Next, we compute the Deemed Tangible Income Return (DTIR), equal to 10% of Qualified Business Asset Investment (QBAI) across all non–high-tax foreign affiliates, as specified in IRC §951A(b)(2):

$$DTIR = \chi^{QBAI} \sum_{j \in J_F \setminus J_F^{HT}} P_j k_{ij}, \qquad \chi^{QBAI} = 0.10, \qquad \text{[Form 8992, Part II, line 2]}$$

Since the model contains no deductible interest, Net DTIR equals DTIR (Form 8992, line 5). The GILTI base (section 951A inclusion before the section 250 deduction) is therefore

$$\tilde{\pi}_{ii}^{GILTI} = \tilde{\pi}_{ii}^{NTI} - DTIR. \qquad \text{[Form 8992, Part II, line 5]}$$

The §250 deduction for GILTI (together with FDII) is computed on Form 8993 and reported on Schedule C, line 22 (column (c)). On Form 1120, the gross inclusion flows to Page 1, Line 4 (via Schedule C), while the deductible portion is reported on Page 1, Line 29b. In the model, we collapse

[33] See the official Instructions for Form 1120 (2024), especially Schedule C instructions for lines 17, 22–24, and Form 1120 page 1 lines 4 and 29b.

these steps to represent the net contribution to Taxable Income (Line 30) as:

$$\text{Net GILTI in Tax Base} \;=\; (1-\chi^{GILTI})\,\tilde{\pi}_{ii}^{GILTI} \qquad \text{[Form 1120, Line 30]}$$

where $\chi^{GILTI} = 0.50$.

Foreign Tax Credit (FTC). The Foreign Tax Credit for the GILTI basket is governed by IRC §960(d) and computed on Form 1118. First, we calculate the Deemed Paid Foreign Taxes (DPFT). Under §960(d)(1), the U.S. corporation is deemed to have paid 80% of the foreign income taxes associated with the net tested income. Aggregating across the relevant foreign affiliates:

$$T_{ii}^{DPFT} = \chi^{FTC} \sum_{j \in J_F \setminus J_F^{HT}} \tau_j \tilde{\pi}_{ij}, \qquad \chi^{FTC} = 0.80. \qquad \text{[Form 1118, Sched B, Part I]}$$

Next, we compute the Foreign Tax Credit Limitation (FTCL) under IRC §904. The limitation restricts the credit to the U.S. tax liability allocable to foreign-source taxable income. This base is the taxable GILTI inclusion net of allocated domestic expenses (modeled here as the fixed entry costs κ_{ij}^F):

$$\tilde{\pi}_{ii}^{Lim} = (1-\chi^{GILTI})\,\tilde{\pi}_{ii}^{GILTI} - \sum_{j \in J_F \setminus J_F^{HT}} \kappa_{ij}^F. \qquad \text{[Form 1118, Sched J, Part I, Line 11]}$$

The allowable Foreign Tax Credit is the lesser of the deemed paid taxes and the U.S. tax on the limitation base:

$$T_{ii}^{FTC} = \min\left(T_{ii}^{DPFT},\; \tau_{US} \times \max\left(0, \tilde{\pi}_{ii}^{Lim}\right)\right). \qquad \text{[Form 1118, Sch B, Pt II, Line 14]}$$

Finally, the residual U.S. tax liability for GILTI is the tax on the inclusion minus the allowable credit. This net liability represents the GILTI contribution to the total tax due on Form 1120 and corresponds exactly to Equation (23) in the main text:

$$T_{ii}^{GILTI} = \max\left(0,\; \tau_{US}(1-\chi^{GILTI})\tilde{\pi}_{ii}^{GILTI} - T_{ii}^{FTC}\right). \qquad \text{[Form 1120, Sch J, Line 2 – 5a]}$$

B.2.5 Foreign-Derived Intangible Income (FDII)

FDII provides a deduction for income derived from serving foreign markets and is governed by IRC §250. It is computed on Form 8993 and flows to Form 1120 alongside GILTI. The calculation proceeds in four steps: determining deduction eligible income, deemed intangible income, the

foreign-derived ratio, and finally the deduction limitation based on taxable income.

Step 1: Deduction Eligible Income (DEI) We start by defining the Deduction Eligible Income (DEI) of the U.S. parent. This corresponds to the gross income of the corporation determined without regard to certain exclusions (e.g., subpart F income, dividends from CFCs). For the model, we map this to the total net income from Form 1120, Line 28:

$$\tilde{\pi}_{ii}^{DEI} \equiv \tilde{\pi}_{ii}. \qquad \text{[Form 8993, Part I, Line 6]}$$

Step 2: Deemed Intangible Income (DII) Next, we calculate the Deemed Tangible Income Return (DTIR), which exempts a fixed return on tangible assets from the intangible income base. This equals 10% of the U.S. parent's domestic Qualified Business Asset Investment (QBAI):

$$DTIR = \chi^{QBAI} \times QBAI_i = \chi^{QBAI} \times p_i k_{ii}, \qquad \chi^{QBAI} = 0.10. \quad \text{[Form 8993, Part II, Line 7a]}$$

Subtracting this tangible return from DEI yields Deemed Intangible Income (DII):

$$\tilde{\pi}_{ii}^{DII} \equiv \tilde{\pi}_{ii}^{DEI} - DTIR. \qquad \text{[Form 8993, Part II, Line 8]}$$

Step 3: Foreign-Derived Deduction Eligible Income (FDDEI) To isolate the portion of intangible income derived from foreign markets, we calculate the ratio of foreign-derived gross receipts to total gross receipts (ρ). The numerator includes exports, royalties received from foreign affiliates, and proceeds from IP transfers. The denominator adds domestic sales and domestic IP use:

$$\begin{aligned} \rho \equiv & \quad \frac{\text{FDDEI Gross Receipts}}{\text{Total DEI Gross Receipts}} \\ = & \quad \frac{\sum_{j\in J_X} p_{ij}q_{ij} + (\varphi_{LT}\lambda_{LT} + \varphi_{TH}\lambda_{TH}) z_i \sum_{j\in J_F} \vartheta_{ij}(z_i) + (1-\lambda_i) z_i \sum_{j\in J_F} \vartheta_{ij}(z_i)}{\sum_{j\in J_X\cup\{i\}} p_{ij}q_{ij} + (\varphi_{LT}\lambda_{LT} + \varphi_{TH}\lambda_{TH}) z_i \sum_{j\in J_F\cup\{i\}} \vartheta_{ij}(z_i) + (1-\lambda_i) z_i \sum_{j\in J_F} \vartheta_{ij}(z_i)}. \end{aligned} \tag{B.2}$$

Using this ratio, we allocate deductions to the foreign activity. Note that licensing fees paid by the U.S. parent to foreign affiliates for domestic IP use are excluded here, as they relate to domestic

revenue. The FDDEI-allocated deductions are:

$$\text{Allocated Deductions} = \rho\Bigg[W_i l + \delta P_i k + \left(\frac{W_i}{A_i}\right) z + W_i\big(\mathcal{C}_{i,LT}(\lambda_{LT}) + \mathcal{C}_{i,TH}(\lambda_{TH})\big) z \sum_{j \in J_F \cup \{i\}} \vartheta_{ij}(z)\Bigg] + W_i \left(\sum_{j \in J_X} \kappa_{jX} + \sum_{j \in J_F} \kappa_{jF}\right).$$

[Form 8993, Part III, Line 18]

FDDEI is then gross receipts minus these allocated deductions:

$$\tilde{\pi}_{ii}^{FDDEI} \equiv \text{FDDEI Gross Receipts} - \text{Allocated Deductions}. \qquad \text{[Form 8993, Part III, Line 19]}$$

Step 4: FDII Calculation We determine the Foreign-Derived Ratio (FDR) and apply it to the Deemed Intangible Income to find the final FDII base:

$$FDR = \frac{\tilde{\pi}_{ii}^{FDDEI}}{\tilde{\pi}_{ii}^{DEI}}, \qquad \text{[Form 8993, Part III, Line 20]}$$

$$\tilde{\pi}_{ii}^{FDII} = FDR \times \tilde{\pi}_{ii}^{DII}. \qquad \text{[Form 8993, Part III, Line 21]}$$

Step 5: Section 250 Deduction Limitation The deduction for FDII and GILTI is limited if the sum of these inclusions exceeds the corporation's taxable income. Using inputs from Form 8992 (GILTI), we sum the components:

$$\tilde{\pi}_{ii}^{Sum} = \tilde{\pi}_{ii}^{GILTI} + \tilde{\pi}_{ii}^{FDII}. \qquad \text{[Form 8993, Part IV, Line 23]}$$

We compare this to the corporation's taxable income ($\tilde{\pi}_{ii}$). The excess amount is:

$$\tilde{\pi}^{Excess} = \tilde{\pi}_{ii}^{Sum} - \tilde{\pi}_{ii}. \qquad \text{[Form 8993, Part IV, Line 25]}$$

If $\tilde{\pi}^{Excess} > 0$, the base for the deduction must be reduced. The reduction is allocated pro-rata. For FDII:

$$R^{FDII} = \begin{cases} 0 & \text{if } \tilde{\pi}^{Excess} \leq 0, \\ \frac{\tilde{\pi}_{ii}^{FDII}}{\tilde{\pi}_{ii}^{Sum}} \times \tilde{\pi}^{Excess} & \text{if } \tilde{\pi}^{Excess} > 0. \end{cases} \qquad \text{[Form 8993, Part IV, Line 26]}$$

For GILTI:

$$R^{GILTI} = \begin{cases} 0 & \text{if } \tilde{\pi}^{Excess} \leq 0, \\ \tilde{\pi}^{Excess} - R^{FDII} & \text{if } \tilde{\pi}^{Excess} > 0. \end{cases} \qquad \text{[Form 8993, Part IV, Line 27]}$$

Step 6: Final Tax Liability The final deductions are calculated by applying the statutory rates ($\chi^{FDII} = 0.375$ and $\chi^{GILTI} = 0.50$) to the reduced bases:

$$D^{FDII} = \chi^{FDII} \times \left(\tilde{\pi}_{ii}^{FDII} - R^{FDII}\right), \qquad \text{[Form 8993, Part IV, Line 28]}$$
$$D^{GILTI} = \chi^{GILTI} \times \left(\tilde{\pi}_{ii}^{GILTI} - R^{GILTI}\right). \qquad \text{[Form 8993, Part IV, Line 29]}$$

The final Taxable Income reported on Form 1120 is the DEI plus the GILTI inclusion, minus the Section 250 deductions:

$$\tilde{\pi}_{ii}^{TI} = \tilde{\pi}_{ii}^{DEI} + \tilde{\pi}_{ii}^{GILTI} - D^{FDII} - D^{GILTI}. \qquad \text{[Form 1120, Line 30]}$$

This yields the regular tax liability (before BEAT):

$$T_{ii}^{Reg} = \tau_{US} \times \tilde{\pi}_{ii}^{TI}. \qquad \text{[Form 1120, Line 31]}$$

B.2.6 Total tax liability

Expanding terms, we can map this statutory calculation directly to the economic components presented in Equation (23) of the main text. By substituting the definitions of D^{FDII} and D^{GILTI}, and subtracting the Foreign Tax Credit (T_{ii}^{FTC}) derived in Section B.2.4, the total final tax liability T_{ii} is:

$$T_{ii} = T_{ii}^{Reg} - T_{ii}^{FTC}. \tag{B.3}$$

Substituting the components:

$$T_{ii} = \tau_{US}\tilde{\pi}_{ii}^{DEI} - \underbrace{\tau_{US}D^{FDII}}_{\hat{T}_{ii}^{FDII}} + \underbrace{\left(\tau_{US}(\tilde{\pi}_{ii}^{GILTI} - D^{GILTI}) - T_{ii}^{FTC}\right)}_{T_{ii}^{GILTI}}. \tag{B.4}$$

where:

1. $\tau_{US}\tilde{\pi}_{ii}^{DEI}$ is the baseline tax on domestic taxable income (first term of Equation (23)).
2. $\hat{T}_{ii}^{FDII} = \tau_{US}D^{FDII}$ represents the tax value of the FDII deduction, see Equation (24).

3. T_{ii}^{GILTI} represents the net residual tax on GILTI after the section 250 deduction (D^{GILTI}) and foreign tax credits, see Equation (25).

C Global Minimum Tax (GMT) Model Implementation

We implement the OECD/GloBE minimum-tax regime at the affiliate-by-jurisdiction level. This requires defining the specific tax base (GloBE income), the jurisdictional effective tax rate (ETR), and the cascading revenue assignment mechanism.

C.1 GloBE Base and Top-Up Need.

Let $\tilde{\pi}_{ij}$ denote the taxable income of an affiliate in region j owned by a parent in region i, as defined in (14), with local tax liability $T_{ij}^{\text{loc}} = \tau_j \tilde{\pi}_{ij}$. The GloBE rules allow for a substance carve-out based on payroll ($W_j \ell_{ij}$) and tangible assets ($P_j k_{ij}$). Using long-run carve-out factors $(\chi_{\text{GMT},L}, \chi_{\text{GMT},K})$ of 5%, we define the carve-out amount (CO_{ij}) and the GloBE tax base (Π_{ij}^G):

$$CO_{ij} \equiv \chi_{\text{GMT},L} W_j \ell_{ij} + \chi_{\text{GMT},K} P_j k_{ij}, \tag{C.1}$$

$$\Pi_{ij}^G \equiv \max\left(0,\ \tilde{\pi}_{ij} - CO_{ij}\right). \tag{C.2}$$

The jurisdictional effective tax rate (τ_{ij}^{eff}) is the ratio of local taxes to the GloBE base:

$$\tau_{ij}^{\text{eff}} \equiv \begin{cases} \frac{T_{ij}^{\text{loc}}}{\Pi_{ij}^G} & \text{if } \Pi_{ij}^G > 0, \\ \text{undefined} & \text{if } \Pi_{ij}^G = 0. \end{cases} \tag{C.3}$$

The total "top-up" tax required ($\widehat{T}_{ij}$) is determined by the gap between the global minimum rate ($\tau^{\text{GMT}} = 0.15$) and the effective rate:

$$\widehat{T}_{ij} \equiv \max\left(0,\ \tau^{\text{GMT}} - \tau_{ij}^{\text{eff}}\right) \times \Pi_{ij}^G. \tag{C.4}$$

If the affiliate has no excess profit ($\Pi_{ij}^G = 0$) or is already taxed above the minimum ($\tau_{ij}^{\text{eff}} \geq \tau^{\text{GMT}}$), the top-up is zero.

C.2 Rule Priority and Residualization.

The collection of the top-up tax follows a strict hierarchy of taxing rights established by the OECD Pillar Two framework. We define the three enforcement mechanisms as follows:

- **Qualified Domestic Minimum Top-Up Tax (QDMTT):** The source jurisdiction (j) has the primary right to tax its own low-taxed income to bring the effective rate up to 15%.

- **Income Inclusion Rule (IIR):** If the source jurisdiction does not levy a QDMTT, the parent jurisdiction (i) has the secondary right to collect the top-up tax on its foreign subsidiary.
- **Undertaxed Profits Rule (UTPR):** A backstop mechanism allowing other jurisdictions (r) to collect any residual top-up tax that was not collected under the QDMTT or IIR (typically via denied deductions).

To implement this, we define indicator sets for jurisdictions adopting specific rules: $\mathcal{J}^{\text{QDMTT}}$ (source jurisdictions), $\mathcal{I}^{\text{IIR}}$ (parents), and $\mathcal{J}^{\text{UTPR}}$ (backstop jurisdictions). The top-up tax is collected sequentially:

1. **QDMTT:** The host country j takes priority.

$$T_{ij}^{\text{QDMTT}} \equiv \mathbf{1}\{j \in \mathcal{J}^{\text{QDMTT}}\}\widehat{T}_{ij}. \tag{C.5}$$

2. **IIR:** Any residual amount ($\bar{T}_{ij}^{(1)}$) is collected by the parent i if it has adopted the IIR.

$$\bar{T}_{ij}^{(1)} \equiv \widehat{T}_{ij} - T_{ij}^{\text{QDMTT}}, \tag{C.6}$$

$$T_{i}^{\text{IIR}}(ij) \equiv \mathbf{1}\{i \in \mathcal{I}^{\text{IIR}}\}\bar{T}_{ij}^{(1)}. \tag{C.7}$$

3. **UTPR:** Any remaining residual ($\bar{T}_{ij}^{(2)}$) is allocated to other UTPR-adopting jurisdictions r. The allocation is based on substance weights w_{ir} (a composite of employees and assets in r).

$$\bar{T}_{ij}^{(2)} \equiv \bar{T}_{ij}^{(1)} - T_{i}^{\text{IIR}}(ij), \tag{C.8}$$

$$T_{r}^{\text{UTPR}}(ij) \equiv \mathbf{1}\{r \in \mathcal{J}^{\text{UTPR}}\}w_{ir}\bar{T}_{ij}^{(2)}, \quad \text{where} \sum_{r \in \mathcal{J}^{\text{UTPR}}} w_{ir} = 1. \tag{C.9}$$

Three-region illustration. Figure C.1 illustrates these strategic interactions using a network of a U.S. parent (i), an EU subsidiary (j), and a low-tax Irish subsidiary (j'). Suppose the Irish affiliate has an effective tax rate below the 15% minimum. Under the GMT rule priority, the allocation of the top-up tax depends on which jurisdictions have adopted the rules. First, if Ireland implements a QDMTT, it collects the top-up ($T_{ij'}^{QDMTT}$) directly; the revenue remains in Ireland, and no further tax is owed to the U.S. or the EU. However, if Ireland abstains but the U.S. has adopted the IIR, the taxing right shifts to the headquarters, and the U.S. parent pays the top-up (T_{i}^{IIR}) to the U.S. government. Finally, if neither Ireland nor the U.S. implements these rules, the EU subsidiary collects the residual top-up (T_{ij}^{UTPR}) via the UTPR. This hierarchy creates strong incentives for

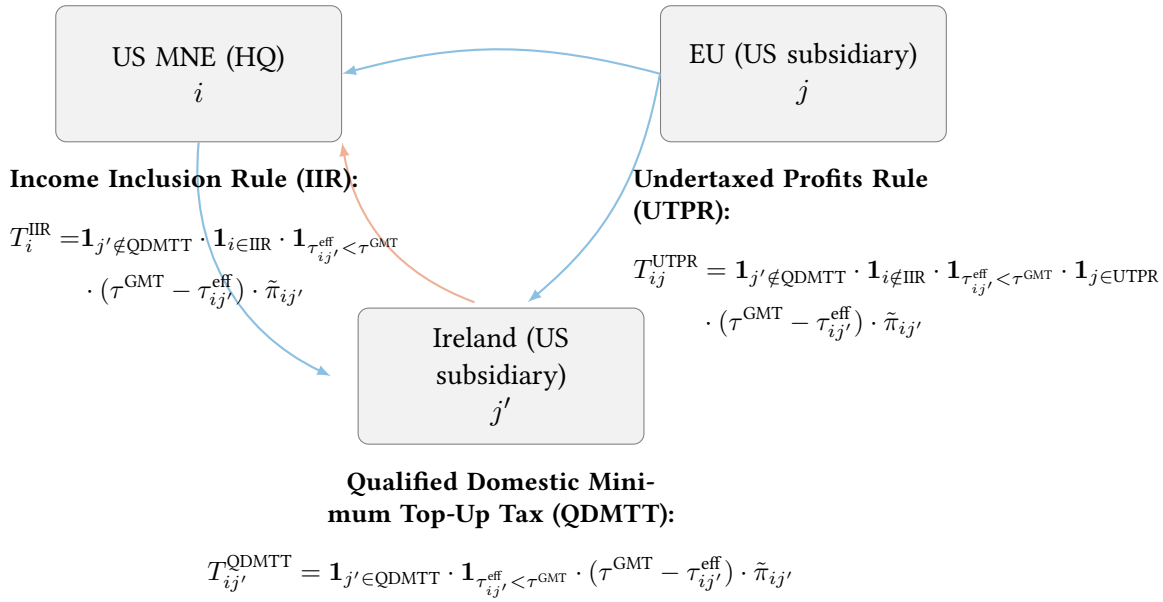


Figure C.1: Global Minimum Tax (GMT) in the three-region version of the model.

adoption: by implementing a QDMTT, a low-tax nation retains tax revenue that would otherwise flow to foreign treasuries via the IIR or UTPR.

C.3 Mapping to Model Equations

We can now explicitly derive the tax liability and revenue equations used in the main text.

Total Tax Liability of the U.S. Parent The total tax liability T_{ii} for a U.S. parent ($i = US$) consists of its domestic liability under the TCJA (including GILTI and FDII) derived in the previous section, see Equation (B.4), plus any IIR top-up taxes it must pay on its foreign subsidiaries ($j \in J_F$) derived in (C.6). Note that UTPR payments are collected by *other* governments and do not appear in the U.S. parent's liability to the U.S. government, nor do QDMTTs which are paid to foreign governments.

$$T_{ii} = T_{ii}^{TCJA} + \sum_{j \in J_F} T_i^{IIR}(ij). \tag{C.10}$$

Additional U.S. Government Revenue While the U.S. parent does not pay UTPR to the U.S., the U.S. government may act as a backup jurisdiction ($r = US$) to collect UTPR revenue from *foreign* multinational groups ($m \neq US$) operating within the United States. This revenue is defined as:

$$R_{US}^{UTPR} = \sum_{m \neq US} \sum_{j} T_{US}^{UTPR}(mj). \tag{C.11}$$

This corresponds to the aggregation of the UTPR shares allocated to the U.S. based on its share of the foreign MNE's tangible assets and employees.

D Derivation of the Quantitative Model

In this section, we derive firms' optimal decisions in the quantitative model under three tax systems: (1) pre-TCJA, (2) TCJA, and (3) TCJA and GMT. Given the set of foreign subsidiaries J_F and exporting destinations J_X, an MNE maximizes its post-tax profits:

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

where π_{ii}, π_{ij} for $j \neq TH$, and $\pi_{i,TH}$ are given by equations (10)–(13). The tax liability terms change between different tax regimes. See Dyrda et al. (2024a) for more details on the combinatorial problem of choosing J_X and J_F.

D.1 Pre-TCJA

D.1.1 Optimal decisions of U.S. MNEs

In the pre-TCJA regime, for U.S. MNEs, we have $T_{ij} = \tau_j \tilde{\pi}_{ij}$ and $T_{i,TH} = \tau_{TH} \tilde{\pi}_{i,TH}$, with taxable income $\tilde{\pi}_{ij}$ defined in (14). The total tax liability paid by the parent division, T_{ii}, is

$$T_{ii} = \tau_{US}^{pre} \tilde{\pi}_{ii} + \sum_{j \in J_F \bigcup \{TH\}} \iota_j \times \max\left(0,\ (\tau_{US}^{pre} - \tau_j)\tilde{\pi}_{ij}\right), \tag{D.2}$$

where ι represents the repatriation rate of foreign profits.

From the profit maximization problem, we can derive the optimal decisions for tangible capital, labor, R&D investment, and profit-shifting shares. At headquarters, the optimal tangible capital and labor demand are:

$$k_{ii} = \left\{ \frac{\alpha^{\varrho(\alpha+\phi)+(1-\phi-\alpha)}}{(1-\phi-\alpha)^{(1-\alpha-\phi)(1-\varrho)}} \left[\frac{(\varrho-1)}{\varrho}\right]^{\varrho} \left[P_i^{\varrho} Q_i + \sum_{j \in J_X} P_i^{\varrho} \xi_{ij}^{1-\varrho} Q_i \right] \frac{W_i^{(1-\varrho)(1-\alpha-\phi)}}{c_i^{\varrho(\alpha+\phi)+(1-\alpha-\phi)}} \left[A_i a (N_i z)^{\phi}\right]^{\varrho-1} \right\}^{\frac{1}{1-\phi+\phi\varrho}} \tag{D.3}$$

and

$$\ell_{ii} = \left\{ \frac{(1-\phi-\alpha)^{\varrho(1-\alpha)+\alpha}}{\alpha^{\alpha(1-\varrho)}} \left[\frac{(\varrho-1)}{\varrho}\right]^{\varrho} \left[P_i^{\varrho} Q_i + \sum_{j \in J_X} P_i^{\varrho} \xi_{ij}^{1-\varrho} Q_i \right] \frac{c_i^{\alpha(1-\varrho)}}{W_i^{\varrho(1-\alpha)+\alpha}} \left[A_i a (N_i z)^{\phi}\right]^{\varrho-1} \right\}^{\frac{1}{1-\phi+\phi\varrho}} \tag{D.4}$$

where we define $c_i = (1 - \tau_{US}^{pre}\, b_{US}^{pre})\, r_i / (1 - \tau_{US}^{pre}) + P_i \delta$, which reflects the pre-TCJA bonus-depreciation deduction in the U.S. tax base (Appendix B.2.2).

In the foreign subsidiaries, the optimal tangible capital and labor demand are:

$$k_{ij} = \left\{ \frac{\alpha^{\varrho(\alpha+\phi)+(1-\phi-\alpha)}}{(1-\phi-\alpha)^{(1-\alpha-\phi)(1-\varrho)}} \left[\frac{(\varrho-1)}{\varrho}\right]^{\varrho} \left[P_j^{\varrho} Q_j\right] \frac{W_j^{(1-\varrho)(1-\alpha-\phi)}}{c_j^{\varrho(\alpha+\phi)+(1-\alpha-\phi)}} \left[\sigma_{ij} A_j a \left(N_j z\right)^{\phi}\right]^{\varrho-1} \right\}^{\frac{1}{1-\phi+\phi\varrho}} \tag{D.5}$$

and

$$\ell_{ij} = \left\{ \frac{(1-\phi-\alpha)^{\varrho(1-\alpha)+\alpha}}{\alpha^{\alpha(1-\varrho)}} \left[\frac{(\varrho-1)}{\varrho}\right]^{\varrho} \left[P_j^{\varrho} Q_j\right] \frac{c_j^{\alpha(1-\varrho)}}{W_j^{\varrho(1-\alpha)+\alpha}} \left[\sigma_{ij} A_j a \left(N_j z\right)^{\phi}\right]^{\varrho-1} \right\}^{\frac{1}{1-\phi+\phi\varrho}} \tag{D.6}$$

where $c_j = \left(1-\tau_j b_j\right) r_j/(1-\tau_j) + P_j\delta$, with $b_j = 0$ in all regions other than the United States.

For the choice of profit shifting, we have

$$\begin{aligned} \lambda_{LT} &= \left(\psi_{i,LT}\mathcal{C}'_{i,LT}\right)^{-1} \left[\frac{1}{W_i} \frac{\left(\tau_{US}^{pre} - \left(\tau_{LT} + \iota_{LT}\left(\tau_{US}^{pre} - \tau_{LT}\right)\right)\right)}{1-\tau_{US}^{pre}}\right] \\ \lambda_{TH} &= \left(\psi_{i,TH}\mathcal{C}'_{i,TH}\right)^{-1} \left[\frac{1}{W_i} \frac{\left(\tau_{US}^{pre} - \left(\tau_{TH} + \iota_{TH}\left(\tau_{US}^{pre} - \tau_{TH}\right)\right)\right)}{1-\tau_{US}^{pre}}\right]. \end{aligned} \tag{D.7}$$

Lastly, for the intangible investment, we have

$$z = \left\{ \left(\frac{1-\phi+\phi\varrho}{\phi(\varrho-1)}\right) \left[\frac{\left(1-\tau_{US}^{pre}\right) W_i/A_i}{DENOM_{US}^{PRE}}\right] \right\}^{-(1-\phi+\phi\varrho)}, \tag{D.8}$$

where

$$\begin{aligned} DENOM_{US}^{PRE} = & \sum_{j\in J_F\cup\{i\}} \left(1-\tau_j-\iota_j\left(\tau_{US}^{pre}-\tau_j\right)\right)\left(\bar{R}_{ij}-\bar{C}_{ij}\right) \\ & - \sum_{j\in J_F\cup\{i\}} \left(\tau_{US}^{pre}-\tau_j-\iota_j\left(\tau_{US}^{pre}-\tau_j\right)\right)\left(\frac{\phi(\varrho-1)}{1-\phi+\phi\varrho}\right)\left(\bar{R}_{ij}-\bar{C}_{ij}\right) \\ & + \left(\tau_{US}^{pre} - \left(\tau_{LT}+\iota_{LT}\left(\tau_{US}^{pre}-\tau_{LT}\right)\right)\right)\lambda_{LT} \sum_{j\in J_F\cup\{i\}} \left(\frac{\phi(\varrho-1)}{1-\phi+\phi\varrho}\right)\left(\bar{R}_{ij}-\bar{C}_{ij}\right) \\ & - \left(\tau_{US}^{pre} - \left(\tau_{LT}+\iota_{LT}\left(\tau_{US}^{pre}-\tau_{LT}\right)\right)\right)\varphi_{i,LT}\lambda_{LT} \sum_{j\in J_F\cup\{i\}} \left(\frac{\phi(\varrho-1)}{1-\phi+\phi\varrho}\right)\left(\bar{R}_{ij}-\bar{C}_{ij}\right) \\ & + \left(\tau_{US}^{pre} - \left(\tau_{TH}+\iota_{TH}\left(\tau_{US}^{pre}-\tau_{TH}\right)\right)\right)\lambda_{TH} \sum_{j\in J_F\cup\{i\}} \left(\frac{\phi(\varrho-1)}{1-\phi+\phi\varrho}\right)\left(\bar{R}_{ij}-\bar{C}_{ij}\right) \\ & - \left(\tau_{US}^{pre} - \left(\tau_{TH}+\iota_{TH}\left(\tau_{US}^{pre}-\tau_{TH}\right)\right)\right)\varphi_{i,TH}\lambda_{TH} \sum_{j\in J_F\cup\{i\}} \left(\frac{\phi(\varrho-1)}{1-\phi+\phi\varrho}\right)\left(\bar{R}_{ij}-\bar{C}_{ij}\right) \\ & - \left(1-\tau_{US}^{pre}\right) W_i \left(\psi_{i,LT}\mathcal{C}_{i,LT}\left(\lambda_{LT}\right) + \psi_{i,TH}\mathcal{C}_{i,TH}\left(\lambda_{TH}\right)\right) \sum_{j\in J_F\cup\{i\}} \left(\frac{\phi(\varrho-1)}{1-\phi+\phi\varrho}\right)\left(\bar{R}_{ij}-\bar{C}_{ij}\right) \end{aligned} \tag{D.9}$$

and

$$\begin{aligned}
\bar{R}_{ii} = & \left[P_i Q_i^{\frac{1}{\varrho}} \bar{Q}_{ii}^{\frac{\varrho-1}{\varrho}} + \sum_{j\in J_X} P_j Q_j^{\frac{1}{\varrho}} \bar{Q}_{ij}^{\frac{\varrho-1}{\varrho}}\right] \times \left\{\left[\frac{(\varrho-1)}{\varrho}\right]^{\varrho}\left[P_i^{\varrho} Q_i + \sum_{j\in J_X} P_j^{\varrho}\xi_{ij}^{1-\varrho} Q_j\right]\right\}^{\frac{\varrho-1}{\varrho}\frac{1-\phi}{1-\phi+\phi\varrho}} \times \\
& \left(\frac{W_i}{1-\phi-\alpha}\right)^{-(\varrho-1)\frac{(1-\alpha-\phi)}{1-\phi+\phi\varrho}} \cdot \left(\frac{c_i}{\alpha}\right)^{-(\varrho-1)\frac{\alpha}{1-\phi+\phi\varrho}} \times (A_i a)^{\frac{\varrho-1}{1-\phi+\phi\varrho}} \cdot (N_i)^{\phi\frac{\varrho-1}{1-\phi+\phi\varrho}} \\
\bar{C}_{ii} = & \left[\left(\frac{(1-\phi-\alpha)^{\varrho(1-\alpha)+\alpha}}{\alpha^{\alpha(1-\varrho)}}\right)^{\frac{1}{1-\phi+\phi\varrho}} + \left(\frac{\alpha^{\varrho(\alpha+\phi)+(1-\phi-\alpha)}}{(1-\phi-\alpha)^{(1-\alpha-\phi)(1-\varrho)}}\right)^{\frac{1}{1-\phi+\phi\varrho}}\right] \times \\
& \left\{\left[\frac{(\varrho-1)}{\varrho}\right]^{\varrho}\left[P_i^{\varrho} Q_i + \sum_{j\in J_X} P_i^{\varrho}\xi_{ij}^{1-\varrho} Q_i\right] c_i^{\alpha(1-\varrho)} W_i^{(1-\varrho)(1-\alpha-\phi)}\left[A_i a\left(N_i\right)^{\phi}\right]^{\varrho-1}\right\}^{\frac{1}{1-\phi+\phi\varrho}}
\end{aligned} \tag{D.10}$$

and

$$\begin{aligned}
\bar{R}_{ij} = & \left[P_j Q_j^{\frac{1}{\varrho}}\right] \times \left\{\left[\frac{(\varrho-1)}{\varrho}\right]^{\varrho} \cdot P_j^{\varrho} Q_j\right\}^{\frac{\varrho-1}{\varrho}\frac{1-\phi}{1-\phi+\phi\varrho}} \times \\
& \left(\frac{W_j}{1-\phi-\alpha}\right)^{-(\varrho-1)\frac{(1-\alpha-\phi)}{1-\phi+\phi\varrho}} \cdot \left(\frac{c_j}{\alpha}\right)^{-(\varrho-1)\frac{\alpha}{1-\phi+\phi\varrho}} \times (A_j \sigma_{ij} a)^{\frac{\varrho-1}{1-\phi+\phi\varrho}} \cdot (N_j)^{\phi\frac{\varrho-1}{1-\phi+\phi\varrho}} \\
\bar{C}_{ij} = & \left[\left(\frac{(1-\phi-\alpha)^{\varrho(1-\alpha)+\alpha}}{\alpha^{\alpha(1-\varrho)}}\right)^{\frac{1}{1-\phi+\phi\varrho}} + \left(\frac{\alpha^{\varrho(\alpha+\phi)+(1-\phi-\alpha)}}{(1-\phi-\alpha)^{(1-\alpha-\phi)(1-\varrho)}}\right)^{\frac{1}{1-\phi+\phi\varrho}}\right] \times \\
& \left\{\left[\frac{(\varrho-1)}{\varrho}\right]^{\varrho}\left[P_j^{\varrho} Q_j\right] c_j^{\alpha(1-\varrho)} W_j^{(1-\varrho)(1-\alpha-\phi)}\left[A_j a\left(N_j\right)^{\phi}\right]^{\varrho-1}\right\}^{\frac{1}{1-\phi+\phi\varrho}}
\end{aligned} \tag{D.11}$$

D.1.2 Optimal decisions of non-U.S. MNEs

The optimal decisions of non-U.S. MNEs follow the same formulas as U.S. MNEs, with ι set to zero.

D.2 TCJA

D.2.1 Optimal decisions of U.S. MNEs

Under TCJA, the total tax liability paid by the parent division of a U.S. MNE, $i = US$, is

$$T_{ii} = \tau_i \left(\tilde{\pi}_{ii}^{DEI} + \tilde{\pi}_{ii}^{GILTI} - D^{FDII} - D^{GILTI}\right) - T_{ii}^{FTC}, \tag{D.12}$$

where each term has been defined in Section B.2. We make three simplifying assumptions when implementing GILTI and FDII: (1) for calculating the FTC of GILTI, we assume the deemed paid foreign tax (DPFT) is smaller than the foreign tax credit limit (FTCL), i.e., $T_{ii}^{DPFT} < \tau_{US}\tilde{\pi}_{ii}^{lim}$, which is also assumed in Chodorow-Reich et al. (2026); (2) for FDII, we fix the value of FDR of each firm using its value in the pre-TCJA equilibrium; (3) for the final tax deductions combining FDII and GILTI, we assume $\tilde{\pi}^{GILTI} + \tilde{\pi}^{FDII} < \tilde{\pi}_{ii}$ such that $R^{FDII} = R^{GILTI} = 0$. We also have $T_{ij} = \tau_j \tilde{\pi}_{ij}$ for $j \neq TH$ and $T_{i,TH} = \tau_{TH}\tilde{\pi}_{i,TH}$.

By plugging the tax liabilities into equation D.1, we can then solve for U.S. MNEs' optimal decisions. For the parent division, the optimal tangible capital and labor demand are:

$$k_{ii} = \left\{ \frac{\alpha^{\varrho(\alpha+\phi)+(1-\phi-\alpha)}}{(1-\phi-\alpha)^{(1-\alpha-\phi)(1-\varrho)}} \left[\frac{\varrho-1}{\varrho}\right]^{\varrho} \left[P_i^{\varrho} Q_i + \sum_{j \in J_X} \xi_{ij}^{1-\varrho} P_j^{\varrho} Q_j \right] \right.$$
$$\left. \times \left(\frac{1-\tau_p^*}{r_i^{FDII}}\right)^{1+(\alpha+\phi)(\varrho-1)} W_i^{(1-\varrho)(1-\alpha-\phi)} \left[A_i a (N_i z)^{\phi}\right]^{\varrho-1} \right\}^{\frac{1}{1-\phi+\phi\varrho}} \tag{D.13}$$

and

$$\ell_{ii} = \left\{ \frac{(1-\phi-\alpha)^{\varrho(1-\alpha)+\alpha}}{\alpha^{\alpha(1-\varrho)}} \left[\frac{\varrho-1}{\varrho}\right]^{\varrho} \left[P_i^{\varrho} Q_i + \sum_{j \in J_X} \xi_{ij}^{1-\varrho} P_j^{\varrho} Q_j \right] \right.$$
$$\left. \times \left(\frac{1-\tau_p^*}{r_i^{FDII}}\right)^{\alpha(\varrho-1)} W_i^{-(\varrho(1-\alpha)+\alpha)} \left[A_i a (N_i z)^{\phi}\right]^{\varrho-1} \right\}^{\frac{1}{1-\phi+\phi\varrho}}, \tag{D.14}$$

where we define $\tau_p^* \equiv (1 - \chi_{FDII} FDR)\, \tau_{US}$ and $r_i^{FDII} \equiv \left(1 - \tau_p^* b_{US}\right) r_i + \delta P_i \left(1 - \tau_p^*\right) + \tau_{US} \chi^{FDII} \frac{\tilde{\pi}_{ii}^{FDDEI}}{\tilde{\pi}_{ii}^{DEI}} \chi^{QBAI} P_i$, where the financing term is scaled by $\left(1 - \tau_p^* b_{US}\right)$ because bonus depreciation deducts $b_{US}\, r_i k$ from the U.S. tax base (Appendix B.2.2).

For the foreign subsidiaries in the high-tax jurisdictions, the optimal tangible capital and labor demand are the same as in the pre-TCJA regime. For the foreign subsidiaries in the low-tax jurisdictions, the optimal tangible capital and labor demand are:

$$k_{i,LT} = \left\{ \frac{\alpha^{\varrho(\alpha+\phi)+(1-\phi-\alpha)}}{(1-\phi-\alpha)^{(1-\alpha-\phi)(1-\varrho)}} \left[\frac{(\varrho-1)}{\varrho}\right]^{\varrho} \left[P_{LT}^{\varrho} Q_{LT}\right] \frac{(W_{LT})^{(1-\varrho)(1-\alpha-\phi)}}{\left(c_{LT}^{GILTI}\right)^{\varrho(\alpha+\phi)+(1-\alpha-\phi)}} \left[\sigma_{i,LT} A_{LT} a \left(N_{LT} z\right)^{\phi}\right]^{\varrho-1} \right\}^{\frac{1}{1-\phi+\phi\varrho}} \tag{D.15}$$

and

$$\ell_{i,LT} = \left\{ \frac{(1-\phi-\alpha)^{\varrho(1-\alpha)+\alpha}}{\alpha^{\alpha(1-\varrho)}} \left[\frac{(\varrho-1)}{\varrho}\right]^{\varrho} \left[P_{LT}^{\varrho} Q_{LT}\right] \frac{\left(c_{LT}^{GILTI}\right)^{\alpha(1-\varrho)}}{(W_{LT})^{\varrho(1-\alpha)+\alpha}} \left[\sigma_{i,LT} A_{LT} a \left(N_{LT} z\right)^{\phi}\right]^{\varrho-1} \right\}^{\frac{1}{1-\phi+\phi\varrho}} \tag{D.16}$$

where $c_{LT}^{GILTI} = \frac{r_{LT} + \left(1-\tau_{LT}^*\right)\delta P_{LT} - \left(1-\chi^{GILTI}\right)\tau_{US}\, \chi^{QBAI} P_{LT}}{1-\tau_{LT}^*}$ and $\tau_{LT}^* \equiv \left(1-\chi^{FTC}\right)\tau_{LT} + \left(1-\chi^{GILTI}\right)\tau_{US}$.

The optimal profit-shifting shares can be derived from

$$\frac{1}{W_i}\left[(1-\varphi_{i,LT})\left(\frac{\tau_p^* - \left(\left(1-\chi^{FTC}\right)\tau_{LT} + \left(1-\chi^{GILTI}\right)\tau_{US}\right)}{1-\tau_p^*}\right)\right] = \psi_{i,LT}\mathcal{C}'_{i,LT}(\lambda_{LT}), \tag{D.17}$$

and

$$\frac{1}{W_i}\left[(1-\varphi_{i,TH})\left(\frac{\tau_p^* - \left(\left(1-\chi^{FTC}\right)\tau_{TH} + \left(1-\chi^{GILTI}\right)\tau_{US}\right)}{1-\tau_p^*}\right)\right] = \psi_{i,TH}\mathcal{C}'_{i,TH}(\lambda_{TH}). \tag{D.18}$$

Lastly, the optimal intangible investment is:

$$z = \left\{ \left(\frac{1-\phi+\phi\varrho}{\phi(\varrho-1)} \right) \left[\frac{(1-\tau_i) W_i / A_i}{DENOM_{US}^{TCJA}} \right] \right\}^{-(1-\phi+\phi\varrho)}. \tag{D.19}$$

where $DENOM_{US}^{TCJA}$ differs from $DENOM_{US}^{PRE}$ in two ways: (1) changes in the marginal product of intangible capital due to changes in optimal tangible capital and labor demand, reflected by changes in the $\bar{R}$ and $\bar{C}$ terms, and (2) changes in the effective tax rates on intangible income. The full expression is available upon request.

D.2.2 Optimal decisions of non-U.S. MNEs

For non-U.S. MNEs, $i \neq US$, the decision rules are the same as in the pre-TCJA regime. The changes in U.S. MNEs' decisions under the TCJA affect non-U.S. MNEs' optimal decisions through general equilibrium effects on factor prices.

D.3 TCJA and GMT when the U.S. is exempt

D.3.1 Optimal decisions of U.S. MNEs

Since U.S. MNEs are exempt from the GMT, their optimal decisions follow the same formulas as in the TCJA regime.

D.3.2 Optimal decisions of non-U.S. MNEs

For non-U.S. MNEs, the optimal decisions in all high-tax-jurisdiction subsidiaries follow the same formulas as in the pre-TCJA regime. For the subsidiaries in LT, the optimal tangible capital and labor demand are affected by the GMT carve-out and become:

$$k_{i,LT} = \left\{ \frac{\alpha^{\varrho(\alpha+\phi)+(1-\phi-\alpha)}}{(1-\phi-\alpha)^{(1-\alpha-\phi)(1-\varrho)}} \left[\frac{(\varrho-1)}{\varrho} \right]^{\varrho} [P_{LT}^{\varrho} Q_{LT}] \frac{\left(\tilde{W}_{LT}^{GMT} \right)^{(1-\varrho)(1-\alpha-\phi)}}{\left(c_{LT}^{GMT} \right)^{\varrho(\alpha+\phi)+(1-\alpha-\phi)}} \left[\sigma_{i,LT} A_{LT} a \left(N_{LT} z \right)^{\phi} \right]^{\varrho-1} \right\}^{\frac{1}{1-\phi+\phi\varrho}} \tag{D.20}$$

and

$$\ell_{i,LT} = \left\{ \frac{(1-\phi-\alpha)^{\varrho(1-\alpha)+\alpha}}{\alpha^{\alpha(1-\varrho)}} \left[\frac{(\varrho-1)}{\varrho} \right]^{\varrho} [P_{LT}^{\varrho} Q_{LT}] \frac{\left(c_{LT}^{GMT} \right)^{\alpha(1-\varrho)}}{\left(\tilde{W}_{LT}^{GMT} \right)^{\varrho(1-\alpha)+\alpha}} \left[\sigma_{i,LT} A_{LT} a \left(N_{LT} z \right)^{\phi} \right]^{\varrho-1} \right\}^{\frac{1}{1-\phi+\phi\varrho}}, \tag{D.21}$$

where we can derive the effective cost terms as $c_{LT}^{GMT} \equiv \frac{r_{LT} + \left((1-\tau_{GMT})\delta - (\tau_{GMT}-\tau_{LT})\chi_{GMT,K} \right) P_{LT}}{1-\tau_{GMT}}$ and $\tilde{W}_{LT}^{GMT} \equiv \frac{1-\tau_{GMT}-(\tau_{GMT}-\tau_{LT})\chi_{GMT,L}}{1-\tau_{GMT}} W_{LT}$, respectively.

For the profit shifting shares, the decision follows the same formulas as in the pre-TCJA regime but with GMT tax rates applied to LT and TH:

$$\frac{1}{W_i} \left[(1-\varphi_{i,LT}) \left(\frac{\tau_i - \tau_{GMT}}{1-\tau_i} \right) \right] = \psi_{i,LT} \mathcal{C}'_{i,LT}(\lambda_{LT}) \tag{D.22}$$

$$\frac{1}{W_i}\left[(1-\varphi_{i,TH})\left(\frac{\tau_i-\tau_{GMT}}{1-\tau_i}\right)\right]=\psi_{i,TH}\mathcal{C}'_{i,TH}(\lambda_{TH}). \tag{D.23}$$

The intangible investment decision also follows the same formula as in the pre-TCJA regime, with $\bar{R}_{i,LT}$ and $\bar{C}_{i,LT}$ now becoming:

$$\begin{aligned}\bar{R}_{iLT}^{GMT}=&\left(\sigma_{iLT}A_{LT}a\left(N_{LT}\right)^{\phi}\right)^{\frac{\varrho-1}{1-\phi+\phi\varrho}}\cdot\left(P_{LT}Q_{LT}^{\frac{1}{\varrho}}\right)\times\left\{\left[\frac{(\varrho-1)}{\varrho}\right]^{\varrho}\left(P_{LT}^{\varrho}Q_{LT}\right)\right\}^{\frac{\varrho-1}{\varrho}\frac{1-\phi}{1-\phi+\phi\varrho}}\times\\&\left(\frac{\tilde{W}_{LT}^{GMT}}{1-\phi-\alpha}\right)^{-(\varrho-1)\frac{(1-\alpha-\phi)}{1-\phi+\phi\varrho}}\cdot\left(\frac{c_{LT}^{GMT}}{\alpha}\right)^{-(\varrho-1)\frac{\alpha}{1-\phi+\phi\varrho}}\end{aligned} \tag{D.24}$$

and

$$\begin{aligned}\bar{C}_{iLT}^{GMT}=&\left[\left(\frac{(1-\phi-\alpha)^{\varrho(1-\alpha)+\alpha}}{\alpha^{\alpha(1-\varrho)}}\right)^{\frac{1}{1-\phi+\phi\varrho}}+\left(\frac{\alpha^{\varrho(\alpha+\phi)+(1-\phi-\alpha)}}{(1-\phi-\alpha)^{(1-\alpha-\phi)(1-\varrho)}}\right)^{\frac{1}{1-\phi+\phi\varrho}}\right]\times\\&\left\{\left[\frac{(\varrho-1)}{\varrho}\right]^{\varrho}\left[P_{LT}^{\varrho}Q_{LT}\right]\left(c_{LT}^{GMT}\right)^{\alpha(1-\varrho)}\left(\tilde{W}_{LT}^{GMT}\right)^{(1-\varrho)(1-\alpha-\phi)}\left[A_{LT}a\left(N_{LT}\right)^{\phi}\right]^{\varrho-1}\right\}^{\frac{1}{1-\phi+\phi\varrho}}.\end{aligned} \tag{D.25}$$

D.3.3 TCJA and GMT in all regions

In this case, GILTI is replaced by GMT for the under-taxed profits booked by U.S. MNEs in the low-tax and tax-haven regions. Therefore, the optimal decisions of the U.S. MNEs' low-tax-region subsidiaries and the U.S. MNEs' profit-shifting shares follow the same formulas as in Section D.3.2. Optimal investment in intangible capital changes slightly because the GMT carve-out changes the marginal product of intangible capital in the low-tax region, as reflected by equations (D.24) and (D.25).

D.4 Effective tax rates: definitions and derivations

This appendix formalizes the decision margins of Section 4.5 as effective tax rates in the tradition of Devereux and Griffith (1998). We first define the tangible METR^k and the AETR, then derive, from the optimal decisions of Appendix D, how each provision moves each rate relative to the pre-TCJA benchmark. For each special provision we isolate its marginal contribution by comparing the affiliate's user cost or liability with and without it; we summarize the signs in Table D.1 and discuss them at the end of this appendix.

D.4.1 Definitions

Because taxation reaches tangible investment through the user cost alone (equation (27)), the tangible marginal effective tax rate is the wedge between c_j and the user cost that would prevail with no tax,

$$\mathrm{METR}_j^k \;=\; 1-\frac{r_j+\delta P_j}{c_j}. \tag{D.26}$$

The METR^k is a subsidiary-level object: the tangible-capital choice is made separately in each location through that location's user cost.

A foreign affiliate is established when its post-tax profit covers the fixed cost,

$$(1 - \mathrm{AETR}_{ij})\,\pi_{ij} \geq W_i \kappa_i^F, \tag{D.27}$$

where $\mathrm{AETR}_{ij} = T_{ij}/\pi_{ij}$ is the average effective tax rate, the share of the affiliate's pre-tax profit absorbed by taxation. Because it is an average over the affiliate's entire tax base, the AETR combines the taxation of tangible and intangible capital and of labor employed in that location. The corresponding intangible rate, the METR^z, is a wedge in the marginal benefit of intangible capital; we define and derive it at the end of this appendix.

D.4.2 The tangible METR^k

The tangible-capital first-order condition equates the marginal revenue product to the user cost c_j. With the no-tax user cost $c_j^0 \equiv r_j + \delta P_j$, the marginal effective tax rate is the proportional wedge

$$\mathrm{METR}_j^k = \frac{c_j^{\text{policy}} - c_j^0}{c_j^{\text{policy}}} = 1 - \frac{r_j + \delta P_j}{c_j^{\text{policy}}}. \tag{D.28}$$

With no special provision the user cost is $c_j = r_j/(1-\tau_j) + \delta P_j$, and substituting into (D.28) gives the standard tangible METR^k,

$$\mathrm{METR}_j^{k,\text{std}} = 1 - \frac{r_j + \delta P_j}{\frac{r_j}{1-\tau_j} + \delta P_j} = \frac{\tau_j\, r_j}{r_j + (1-\tau_j)\delta P_j}, \tag{D.29}$$

which is increasing in τ_j and collapses to τ_j as $\delta P_j \to 0$. Each provision moves the METR^k by reshaping c_j^{policy}.

Rate cut and territorial shift. Cutting the U.S. rate from τ_{US}^{pre} to τ_{US} lowers the financing term in $c_i = r_i/(1-\tau_{US}) + \delta P_i$ and hence the domestic METR^k. For a foreign affiliate, the pre-TCJA worldwide system added a repatriation residual $\iota_j \max\{0, \tau_{US}^{pre} - \tau_j\}$, raising the effective rate above τ_j whenever $\tau_j < \tau_{US}^{pre}$; the territorial shift removes it, lowering the effective rate to τ_j and so lowering foreign METR^ks for U.S. MNEs.

GILTI. The GILTI-modified user cost is

$$c_{LT}^{GILTI} = \frac{r_{LT} + (1-\tau_{LT}^*)\delta P_{LT} - (1-\chi^{GILTI})\tau_{US}\chi^{QBAI}P_{LT}}{1-\tau_{LT}^*}, \qquad \tau_{LT}^* \equiv (1-\chi^{FTC})\tau_{LT} + (1-\chi^{GILTI})\tau_{US}, \tag{D.30}$$

and substituting into (D.28) yields

$$\text{METR}_{LT}^{k,GILTI} = 1 - \left(r_{LT} + \delta P_{LT}\right)\frac{1-\tau_{LT}^*}{r_{LT} + (1-\tau_{LT}^*)\delta P_{LT} - (1-\chi^{GILTI})\tau_{US}\chi^{QBAI}P_{LT}}. \tag{D.31}$$

Two terms separate this from the benchmark (D.29): the GILTI inclusion net of the foreign tax credit raises the effective rate from τ_{LT} to τ_{LT}^*, shrinking the denominator and raising the METR^k, while the QBAI deduction subtracts $(1-\chi^{GILTI})\tau_{US}\chi^{QBAI}P_{LT}$ from the numerator, lowering it. The net effect on the low-tax METR^k is thus ambiguous.

FDII. The parent's user cost is $c_i^{FDII} = r_i^{FDII}/(1-\tau_p^*)$, where, from Section D.2, $\tau_p^* = (1-\chi^{FDII}FDR)\tau_{US}$ and

$$r_i^{FDII} = \left(1-\tau_p^* b_{US}\right) r_i + \delta P_i(1-\tau_p^*) + \tau_i \chi^{FDII}\frac{\tilde{\pi}_{ii}^{FDDEI}}{\tilde{\pi}_{ii}^{DEI}}\chi^{QBAI}P_i. \tag{D.32}$$

Dividing through by $1-\tau_p^*$,

$$c_i^{FDII} = \frac{\left(1-\tau_p^* b_{US}\right) r_i}{1-\tau_p^*} + \delta P_i + \frac{\tau_i \chi^{FDII}\frac{\tilde{\pi}_{ii}^{FDDEI}}{\tilde{\pi}_{ii}^{DEI}}\chi^{QBAI}P_i}{1-\tau_p^*}, \tag{D.33}$$

so FDII moves only the financing and QBAI terms. The subsidy lowers τ_p^* below τ_{US}, reducing the financing term, while the QBAI term raises the user cost; relative to the benchmark (D.32) at $\chi^{FDII} = 0$, the net effect on the domestic METR^k is ambiguous and vanishes when $FDR = 0$.

GMT. The GMT-modified user cost, derived in Section D.3, is

$$c_{LT}^{GMT} = \frac{r_{LT} + \left((1-\tau_{GMT})\delta - (\tau_{GMT}-\tau_{LT})\chi_{GMT,K}\right)P_{LT}}{1-\tau_{GMT}}, \tag{D.34}$$

with $\text{METR}_{LT}^{k,GMT} = 1 - (r_{LT} + \delta P_{LT})/c_{LT}^{GMT}$. The GMT has two components that move the user cost in opposite directions. The top-up tax lifts the affiliate's effective rate from the local rate τ_{LT} to the floor τ_{GMT}, which raises the user cost; the SBIE carve-out exempts a routine return on tangible capital from the top-up, entering through the term $-(\tau_{GMT}-\tau_{LT})\chi_{GMT,K}P_{LT}$, which lowers it. The net effect on the low-tax METR^k is therefore ambiguous.

Bonus depreciation. Bonus depreciation deducts $b_i\, r_i k$ from the tax base of any division operating in the United States, so its taxable income is $\tilde{\pi}_{ii} = \pi_{ii} + (1 - b_i)\, r_i k_{ii}$ (Appendix B.2.2). Maximizing $\pi_{ii} - \tau_i \tilde{\pi}_{ii}$ over k_{ii}, only the fraction $1 - b_i$ of the financing cost remains non-deductible, and the first-order condition equates the marginal revenue product to the user cost under bonus depreciation,

$$c_i^{AD} = \frac{(1 - \tau_i\, b_i)\, r_i}{1 - \tau_i} + \delta P_i. \tag{D.35}$$

The deduction scales the financing term by $1 - \tau_i b_i$; under full expensing, $b_i = 1$, the user cost collapses to its no-tax level $r_i + \delta P_i$. Substituting (D.35) into (D.28) gives

$$\mathrm{METR}_i^{k,AD} = 1 - \frac{r_i + \delta P_i}{c_i^{AD}} = \frac{\tau_i (1 - b_i)\, r_i}{(1 - \tau_i b_i) r_i + (1 - \tau_i)\delta P_i}. \tag{D.36}$$

Unlike GILTI, FDII, and the GMT, whose rate and carve-out components move the METR^k in opposite directions, bonus depreciation has a single component: (D.36) is strictly decreasing in b_i, equals the standard METR^k (D.29) at $b_i = 0$, and vanishes at full expensing $b_i = 1$. It moves only the U.S. METR^k, since $b_j = 0$ for foreign affiliates.

D.4.3 The AETR

The AETR is $\mathrm{AETR}_{ij} = T_{ij}/\pi_{ij}$, the liability over pre-tax profits, following the economic-profit convention of Devereux and Griffith (1998). Because the liability is assessed on taxable income, $T_{ij} = \tau_j \tilde{\pi}_{ij}$, the no-provision benchmark is $\mathrm{AETR}_j^{\text{std}} = \tau_j \tilde{\pi}_{ij}/\pi_{ij}$, slightly above τ_j: taxing the normal return to capital pushes the average rate on economic profit above the statutory rate. Each provision moves the AETR by changing this benchmark rate or by adding a term to the liability.

Rate cut and territorial shift. Under the pre-TCJA worldwide system the benchmark rate carries a repatriation residual, $\tau_j^{\text{eff},pre} = \tau_j + \iota_j \max\{0, \tau_{US}^{pre} - \tau_j\}$, so $\mathrm{AETR}_j^{pre} = \tau_j^{\text{eff},pre} \tilde{\pi}_{ij}/\pi_{ij}$. Cutting the U.S. rate lowers the domestic AETR, and the territorial shift removes the residual on U.S. MNEs' foreign affiliates, lowering their AETR by $\iota_j \max\{0, \tau_{US}^{pre} - \tau_j\}\, \tilde{\pi}_{ij}/\pi_{ij}$ to the local benchmark $\tau_j \tilde{\pi}_{ij}/\pi_{ij}$.

GILTI. For a foreign affiliate subject to the GILTI tax, the tax is levied at $\tau_{US}(1 - \chi^{GILTI})$ on tested income net of the QBAI deduction, $\tilde{\pi}_{LT} - \chi^{QBAI} P_{LT} k_{LT}$, less the foreign tax credit $\chi^{FTC} \tau_{LT} \tilde{\pi}_{LT}$ on full tested income, floored at zero:

$$\mathrm{AETR}_{LT}^{GILTI} = \frac{\tau_{LT} \tilde{\pi}_{LT}}{\pi_{LT}} + \frac{1}{\pi_{LT}} \max\Big\{0,\ \tau_{US}(1 - \chi^{GILTI})\big(\tilde{\pi}_{LT} - \chi^{QBAI} P_{LT} k_{LT}\big) - \chi^{FTC} \tau_{LT} \tilde{\pi}_{LT}\Big\}. \tag{D.37}$$

The floor gives $\mathrm{AETR}_{LT}^{GILTI} \geq \mathrm{AETR}_{LT}^{\mathrm{std}}$: the QBAI deduction and credit shrink the residual but cannot push it below the benchmark, so GILTI unambiguously raises the AETR. The QBAI deduction enters only the GILTI-tax base, not the credit base, so (D.37) keeps the two distinct.

FDII. FDII is a deduction applied at the parent rather than an additional tax floored at zero, so it can lower the parent's average rate. The parent AETR is

$$\mathrm{AETR}_i^{FDII} = \frac{\tau_{US}\tilde{\pi}_{ii}}{\pi_{ii}} - \tau_{US}\chi^{FDII}\left(\frac{\tilde{\pi}_{ii}^{FDDEI}}{\pi_{ii}} - \chi^{QBAI}\frac{P_i k_{ii}}{\pi_{ii}}FDR\right) < \frac{\tau_{US}\tilde{\pi}_{ii}}{\pi_{ii}}, \tag{D.38}$$

which equals the no-provision benchmark when the FDII base is zero and lies below it otherwise, so FDII lowers the U.S. AETR.

GMT. For the GMT, the top-up tax $(\tau_{GMT} - \tau_{LT}^{eff})$ applies to the affiliate's taxable income net of the SBIE carve-out on tangible capital and payroll, $\tilde{\pi}_{LT} - \chi_{GMT,K}P_{LT}k_{LT} - \chi_{GMT,L}W_{LT}\ell_{LT}$, again floored at zero:

$$\mathrm{AETR}_{LT}^{GMT} = \frac{\tau_{LT}\tilde{\pi}_{LT}}{\pi_{LT}} + \frac{1}{\pi_{LT}}\max\Big\{0,\ (\tau_{GMT} - \tau_{LT}^{eff})\big(\tilde{\pi}_{LT} - \chi_{GMT,K}P_{LT}k_{LT} - \chi_{GMT,L}W_{LT}\ell_{LT}\big)\Big\}, \tag{D.39}$$

so $\mathrm{AETR}_{LT}^{GMT} \geq \mathrm{AETR}_{LT}^{\mathrm{std}}$: like GILTI, the GMT unambiguously raises the AETR, since the SBIE offsets only part of the top-up.

Bonus depreciation. Bonus depreciation augments the deductible depreciation on U.S. tangible capital to $(\delta P_i + b_{US}r_i)k$ (Appendix B.2.2), reducing the tax borne by any affiliate operating in the United States—including the U.S. affiliates of foreign MNEs—and hence the U.S. AETR that governs where tangible capital is located; foreign affiliates, with $b_j = 0$, are unaffected.

D.4.4 The intangible METR^z

Intangible capital differs from tangible capital in two ways that determine the right effective-rate object. It is chosen once at the headquarters rather than location by location, and it is non-rival, so a single unit of z raises operating surplus in every division $j \in J_F \cup \{i\}$ the firm operates. The firm chooses z to maximize worldwide post-tax profit net of the development cost $W_i z/A_i$, which is deductible at the parent rate τ_i. The first-order condition equates the after-tax marginal cost to the after-tax marginal benefit,

$$\underbrace{(1-\tau_i)\frac{W_i}{A_i}}_{\text{marginal cost}} = \underbrace{\frac{\phi(\varrho-1)}{1-\phi+\phi\varrho}\frac{DENOM_i}{z}}_{\text{marginal benefit}}, \tag{D.40}$$

where the constant $\frac{\phi(\varrho-1)}{1-\phi+\phi\varrho}$ is the elasticity of each division's operating surplus with respect to z implied by the production structure, and solving (D.40) gives the representation $z = z^{NS}\Lambda(\lambda)$ of equation (29). The term $DENOM_i$, derived in Appendix D, is the firm-level marginal benefit of z: it collects the after-tax surplus that an extra unit of z generates across all divisions, so it is the natural object for the intangible effective rate, exactly as the user cost c_j is for the tangible METR^k. It has two parts,

$$DENOM_i = \underbrace{\sum_{j\in J_F\cup\{i\}} (1-\tau_{ij}^{eff})(\bar{R}_{ij}-\bar{C}_{ij})}_{\text{production return}} + \underbrace{(\tau_p-\tau_{LT}^{eff})\lambda_{LT}\,\Theta_i + (\tau_p-\tau_{TH}^{eff})\lambda_{TH}\,\Theta_i}_{\text{profit-shifting return}}, \quad \text{(D.41)}$$

where $\bar{R}_{ij}-\bar{C}_{ij}$ is the pre-tax operating surplus a unit of z produces in division j, τ_{ij}^{eff} that division's effective rate, τ_p the parent's effective rate (τ_{US}^{pre} before the reform, τ_p^* under FDII), and $\Theta_i > 0$ collects the surplus and cost terms common to the shifting components. The production return is the after-tax marginal product summed across divisions; the shifting return is the extra value of z from the IP income it lets the firm book in low-tax locations, and it is proportional to the parent–affiliate wedge.

The no-tax benchmark is obtained by setting every effective rate to zero, $\tau_{ij}^{eff} = 0$ and $\tau_p = 0$, while holding the firm's set of foreign subsidiaries J_F fixed, so that the benchmark isolates the effect of taxation on the intangible margin alone and not on the firm's location and entry decisions. The shifting return then vanishes, because each of its terms is proportional to a tax wedge, and the production return collapses to the pre-tax marginal product of z summed across divisions,

$$DENOM_i^0 \equiv \sum_{j\in J_F\cup\{i\}} \big(\bar{R}_{ij}-\bar{C}_{ij}\big). \quad \text{(D.42)}$$

This is the relevant benchmark precisely because z is non-rival: an untaxed unit benefits every division, so its marginal product is the sum across j. The intangible METR^z is then the proportional wedge between this no-tax marginal benefit and its after-tax counterpart $DENOM_i$, exactly as in (D.28) for tangible capital,

$$\mathrm{METR}_i^z = \frac{DENOM_i^0 - DENOM_i}{DENOM_i^0} = 1 - \frac{DENOM_i}{\sum_{j\in J_F\cup\{i\}}\big(\bar{R}_{ij}-\bar{C}_{ij}\big)}. \quad \text{(D.43)}$$

At zero taxes $DENOM_i = DENOM_i^0$ and $\mathrm{METR}_i^z = 0$; positive effective rates shrink the numerator and raise METR_i^z, while profit shifting adds to $DENOM_i$ and lowers it. Both forces

enter only through effective rates and the share λ; no average rate appears, so there is no behavioral role for an intangible-income AETR.

A provision affects intangible investment through two routes that are visible in (D.43). The first works through the numerator $DENOM_i$, that is, through METR_i^z: a provision changes an effective rate τ_{ij}^{eff}, either on the production return directly or through the parent–affiliate wedge $(\tau_p - \tau_{LT}^{eff})$ that determines the shifting share λ. The second works through the denominator, the pre-tax marginal product $\sum_j (\bar{R}_{ij} - \bar{C}_{ij})$: because a unit of z is more valuable where the firm holds more tangible capital, anything that moves the tangible user cost c_j moves k_{ij}, hence $\bar{R}_{ij}$, and hence the marginal product of z.

Because the two routes can move in opposite directions, a provision's net effect on z is generally ambiguous even when its effect on METR^z is signed; we trace each provision in turn.

Rate cut and territorial shift. By lowering the U.S. and foreign effective rates faced by U.S. MNEs, the rate cut and territorial shift raise tangible investment at home and abroad, which raises the marginal product of z and pushes z up. They move the parent–affiliate wedge $(\tau_p - \tau_{LT}^{eff})$ in opposite directions, however, so their effect through METR^z, and hence the net effect on z, is ambiguous.

GILTI. The GILTI tax raises τ_{LT}^{eff} on the affiliate's intangible income, which raises METR^z and lowers z; the QBAI deduction lowers c_{LT}, raising $k_{i,LT}$ and $\bar{R}_{i,LT}$, which raises the marginal product of z and pushes z up. The net effect is ambiguous.

FDII. The subsidy lowers the parent's effective rate τ_p^*, which lowers METR^z and raises z; the QBAI penalty raises the domestic user cost c_i, lowering domestic tangible capital and the marginal product of z. The net effect is ambiguous.

GMT. The top-up raises τ_{LT}^{eff}, which raises METR^z and lowers z; the SBIE carve-out lowers c_{LT}, raising the marginal product of z and pushing z up. The net effect is ambiguous.

Bonus depreciation. Bonus depreciation changes no effective rate on intangible income, so it does not enter METR^z. It lowers the U.S. user cost, raising domestic tangible capital and hence the marginal product of z, so it unambiguously raises intangible investment—the one provision with a signed effect on z, as reported in Table D.1.

D.4.5 Summary of the provisions' effects

Table D.1 summarizes the firm-level effects of the reforms. Panel A reports the tangible METR^k and the AETR by location. The statutory tax cut lowers the U.S. METR^k and AETR. The territorial shift lowers both the METR^k and the AETR faced by U.S. MNEs' foreign affiliates. Bonus

Table D.1: Effects of each provision on firm-level decisions

Panel A. Tangible capital						
	METR^k			AETR (affiliate)		
Provision	US	High-tax	Low-tax	US	High-tax	Low-tax
Territorial system	–	↓	↓	–	↓	↓
Statutory rate cut	↓	–	–	↓	–	–
Bonus depreciation	↓	–	–	↓	–	–
GILTI: tax	–	–	↑	–	–	↑
GILTI: QBAI	–	–	↓	–	–	↓
FDII: subsidy	↓	–	–	↓	–	–
FDII: QBAI	↑	–	–	↑	–	–
GMT: top-up	–	–	↑	–	–	↑
GMT: SBIE	–	–	↓	–	–	↓

Panel B. Intangible capital			
Provision	Total	METR^z	MP of z
Rate cut + territorial	?	?	↑
Bonus depreciation	↑	–	↑
GILTI	?	↑	↑
FDII	?	↓	↓
GMT	?	↑	↑

Panel C. Profit shifting	
Provision	Total
Rate cut + territorial	?
Bonus depreciation	–
GILTI	↓
FDII	↓
GMT	↓

Notes: "↑"/"↓" denotes the indicated object rising/falling, "?" a qualitatively ambiguous net effect, and "–" no direct effect; all entries are measured relative to the pre-TCJA benchmark. Bonus depreciation is a U.S.-only provision applying to short-lived tangible assets. Panel A reports the effect on the tangible METR^k and the AETR by location. Panel B reports the effect on intangible investment z, through their effects on METR^z and the marginal product of z. Panel C reports the effect on the share of intangible income shifted, λ. In Panels B and C, the "Total" column reports the total effect of each provision (on z and on λ, respectively). "Low-tax" refers to both the low-tax region and the tax haven. We assume that all MNEs apply the high-tax exclusion (HTE), which excludes profits derived in high-tax foreign jurisdictions from GILTI. See Section 4.5 for discussion and Appendix B.2.2 for the bonus-depreciation derivations.

depreciation lowers the METR^k and the AETR for parent divisions of U.S. firms and also U.S. subsidiaries of foreign MNEs (not shown in the table). Each remaining provision combines a rate component with a carve-out component: GILTI's top-up tax raises the two effective tax rates in the low-tax region while its QBAI deduction lowers them, FDII's subsidy lowers the U.S. rates while its QBAI penalty raises them, and the GMT's top-up raises the low-tax rates while its SBIE lowers

them. The net effects on the METR^k of these provisions are therefore ambiguous. The net effects on the AETR are not, as the deductions can only offset part of the added tax liabilities or subsidies.

Panel B reports the effects on intangible investment, through the effects on METR^z and the marginal product of z. Bonus depreciation is the one provision with an unambiguous sign: it does not enter the METR^z and raises the marginal product of z as U.S. tangible capital expands. For every other provision the two channels oppose each other. GILTI and the GMT raise the METR^z but also raise the marginal product of z through their carve-outs; FDII lowers the METR^z but depresses the marginal product of z through its QBAI penalty on domestic tangible capital; and the statutory tax cut and territorial shift raise the marginal product of z while moving the METR^z ambiguously. The net responses are resolved by the quantitative model.

Panel C reports the effect on profit shifting, which responds to the parent–affiliate tax differential. GILTI and the GMT raise the tax on intangible income booked in the low-tax and tax-haven regions, and FDII lowers the U.S. tax on it, so all three narrow the differential and reduce shifting. Bonus depreciation leaves the differential untouched. The statutory tax cut and the territorial shift move it in opposite directions, so their net effect is ambiguous.

D.4.6 Quantifying the reforms' effects on $METR^k$ and $AETR$

In Figures E.1 and E.2, we quantify the reforms' effects on the tangible METR^k and the AETR. For firms based in each region, we decompose the change in each rate into the contribution of every provision, separately for the firm's home division (subscript i) and its foreign divisions (subscript $-i$), with the black marker the total. Figure E.1 reports the TCJA. The home-division AETR of U.S. firms falls sharply, driven by the statutory rate cut, and the METR^k on their foreign divisions falls as the territorial shift removes the tax on repatriated profits. For firms based elsewhere, the home rates are essentially unchanged and the rates on their foreign divisions fall, reflecting the lower taxes paid by their U.S. affiliates.

GILTI changes the home-division and foreign-division AETR of U.S. firms in opposite directions. In a foreign affiliate it is a top-up tax that raises the affiliate's liability and AETR directly, largely offsetting the reduction the territorial shift delivers there. GILTI leads U.S. MNEs to book more profit at home, and because the home AETR exceeds the statutory rate only through the non-deductible return to capital, the larger profit base decreases its $AETR$. FDII, by contrast, lowers the home AETR directly, through its deduction in the domestic liability.

Figure E.2 reports the global minimum tax under two scenarios: one in which the United States remains outside the regime and one in which its firms are subject to it. In both, the top-up raises the METR^k and AETR of low-taxed foreign affiliates. When the United States is fully exempt, the

U.S. firms are almost unaffected while European and rest-of-world multinationals bear the top-up on their low-tax affiliates. When the United States is subject to the minimum tax, the METR^k on U.S. multinationals' foreign divisions rises substantially, as the GMT reaches income that GILTI shielded and its SBIE carve-out relieves the tangible return less generously than GILTI's QBAI deduction.

E Additional quantitative results and sensitivity analyses

E.1 Additional results from the baseline model

Tables E.1–E.4 show the numerical results underpinning the figures in the main text of the paper. Figures E.3–E.5 show extra results: effects of the TCJA and GMT on MNEs' average effective tax rates (AETR) and marginal effective tax rates on tangible capital (METR^k); a decomposition of the TCJA provisions' effects by firm type; and the effects of both policies on national incomes and trade variables.

Table E.1: Macro effects of TCJA provisions

Region	Lost profits/ MNE profits	CIT rev.	GDP	Emp.	Tangible capital	Intangible capital
(a) Territorial system						
USA	29.64	-20.90	0.92	1.08	-0.16	7.46
Europe	-0.02	-0.14	0.21	0.02	0.53	-0.44
Rest of world	-0.01	-0.09	0.06	0.01	0.36	-0.33
Low tax	–	9.31	0.48	-0.20	0.78	-0.93
(b) Statutory tax cut						
USA	-12.91	-11.93	0.58	-0.34	3.75	-3.99
Europe	0.05	0.24	0.03	-0.01	-0.08	0.56
Rest of world	0.01	0.24	0.04	-0.01	-0.05	0.40
Low tax	–	-4.91	0.07	0.10	-0.08	0.99
(c) More accelerated depreciation						
USA	0.73	-6.74	1.19	0.21	4.49	-0.16
Europe	0.01	0.18	0.00	-0.00	-0.01	0.05
Rest of world	0.00	0.18	0.00	-0.00	-0.00	0.03
Low tax	–	0.23	-0.00	-0.01	-0.01	0.07
(d) GILTI						
USA	-20.07	5.48	-0.00	-0.32	0.07	-0.50
Europe	-0.01	-0.02	-0.01	-0.00	-0.02	-0.01
Rest of world	-0.00	-0.02	-0.00	-0.00	-0.01	-0.01
Low tax	–	-1.67	0.93	0.04	1.48	-0.37
(e) FDII						
USA	-2.37	0.14	-0.52	-0.11	-0.89	-0.78
Europe	0.01	-0.05	-0.00	-0.00	-0.01	0.05
Rest of world	0.00	-0.05	0.00	-0.00	-0.01	0.03
Low tax	–	-0.97	0.00	0.02	-0.01	0.10
(f) Full TCJA						
USA	-4.02	-34.53	2.06	0.56	6.98	2.14
Europe	0.04	0.20	0.23	0.00	0.42	0.19
Rest of world	0.01	0.25	0.11	-0.00	0.29	0.13
Low tax	–	1.97	1.47	-0.05	2.16	-0.15

Notes: The table shows changes from pre-TCJA calibration to equilibria with one TCJA provision implemented at a time, as well as the full TCJA with all provisions. Changes in lost profits/MNE profits reported in percentage points. All other changes are in percent.

Table E.2: Effects of TCJA decomposed by firm type

Region	Value added				Emp.				Tangible capital				Intangible capital		
	Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
(a) Territorial system															
USA	0.92	-0.98	1.92	-0.02	1.08	-1.49	2.74	-0.16	-0.16	-1.42	1.40	-0.14	7.46	-0.38	7.84
Europe	0.21	-0.10	-0.10	0.41	0.02	-0.15	-0.17	0.33	0.53	-0.09	-0.09	0.71	-0.44	-0.03	-0.41
Rest of world	0.06	-0.09	-0.13	0.29	0.01	-0.09	-0.14	0.25	0.36	-0.06	-0.08	0.50	-0.33	-0.02	-0.31
Low tax	0.48	-0.22	-0.11	0.81	-0.20	-0.46	-0.29	0.55	0.78	-0.30	-0.16	1.24	-0.93	-0.12	-0.81
(b) Statutory tax cut															
USA	0.58	0.78	-0.41	0.20	-0.34	0.69	-1.21	0.18	3.75	2.09	1.11	0.56	-3.99	0.14	-4.13
Europe	0.03	0.02	0.10	-0.09	-0.01	-0.02	0.10	-0.10	-0.08	-0.02	0.05	-0.11	0.56	-0.01	0.56
Rest of world	0.04	0.02	0.10	-0.08	-0.01	-0.02	0.09	-0.07	-0.05	-0.02	0.05	-0.09	0.40	-0.00	0.41
Low tax	0.07	0.11	0.14	-0.18	0.10	0.08	0.20	-0.17	-0.08	0.05	0.10	-0.23	0.99	0.02	0.97
(c) More bonus depreciation															
USA	1.19	0.80	0.24	0.15	0.21	0.44	-0.26	0.04	4.49	2.18	1.79	0.52	-0.16	0.14	-0.30
Europe	0.00	0.00	0.01	-0.01	-0.00	-0.00	0.01	-0.01	-0.01	-0.00	0.01	-0.01	0.05	-0.00	0.05
Rest of world	0.00	0.00	0.01	-0.01	-0.00	-0.00	0.01	-0.01	-0.00	-0.00	0.01	-0.01	0.03	-0.00	0.03
Low tax	-0.00	-0.00	0.01	-0.01	-0.01	-0.01	0.01	-0.01	-0.01	-0.01	0.01	-0.01	0.07	-0.00	0.07
(d) GILTI															
USA	-0.00	0.32	-0.33	0.01	-0.32	0.35	-0.69	0.02	0.07	0.35	-0.31	0.02	-0.50	0.11	-0.62
Europe	-0.01	0.01	0.00	-0.02	-0.00	0.01	0.00	-0.02	-0.02	0.01	-0.00	-0.02	-0.01	0.00	-0.02
Rest of world	-0.00	0.01	0.00	-0.01	-0.00	0.01	0.00	-0.01	-0.01	0.00	0.00	-0.01	-0.01	0.00	-0.01
Low tax	0.93	0.06	0.08	0.79	0.04	-0.28	-0.14	0.46	1.48	-0.17	-0.07	1.71	-0.37	-0.07	-0.30
(e) FDII															
USA	-0.52	0.18	-0.71	0.00	-0.11	0.43	-0.59	0.05	-0.89	0.09	-1.01	0.04	-0.78	0.12	-0.90
Europe	-0.00	0.00	0.01	-0.02	-0.00	0.00	0.01	-0.02	-0.01	0.00	0.01	-0.02	0.05	0.00	0.05
Rest of world	0.00	0.00	0.01	-0.01	-0.00	0.00	0.01	-0.01	-0.01	0.00	0.01	-0.01	0.03	0.00	0.03
Low tax	0.00	0.02	0.01	-0.03	0.02	0.02	0.02	-0.03	-0.01	0.02	0.01	-0.03	0.10	0.01	0.09
(f) Full TCJA															
USA	2.06	0.51	1.21	0.35	0.56	-0.21	0.63	0.13	6.98	2.64	3.35	1.00	2.14	-0.10	2.24
Europe	0.23	-0.06	0.01	0.28	0.00	-0.16	-0.04	0.20	0.42	-0.11	-0.03	0.56	0.19	-0.04	0.23
Rest of world	0.11	-0.06	-0.01	0.18	-0.00	-0.11	-0.04	0.15	0.29	-0.07	-0.02	0.38	0.13	-0.02	0.15
Low tax	1.47	-0.03	0.12	1.38	-0.05	-0.65	-0.21	0.81	2.16	-0.41	-0.12	2.69	-0.15	-0.17	0.02

Notes: The table shows changes from pre-TCJA calibration to equilibrium with full TCJA. "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.

Table E.3: Macro effects of GMT

Region	Lost profits/ MNE profits	CIT rev.	GDP	Emp.	Tangible capital	Intangible capital
(a) Complete US exemption						
USA	0.07	-0.48	0.01	0.01	-0.03	0.43
Europe	-9.63	3.02	-0.41	-0.17	0.01	-2.21
Rest of world	-3.76	1.39	-0.30	-0.11	-0.02	-1.47
Low tax	–	6.02	-6.18	-0.73	-2.04	4.99
(b) US MNEs subject to QDMTT						
USA	-0.61	-0.18	-0.02	-0.01	-0.03	0.28
Europe	-9.63	3.02	-0.41	-0.17	0.01	-2.21
Rest of world	-3.76	1.39	-0.30	-0.11	-0.02	-1.46
Low tax	–	5.57	-6.20	-0.72	-2.08	5.02

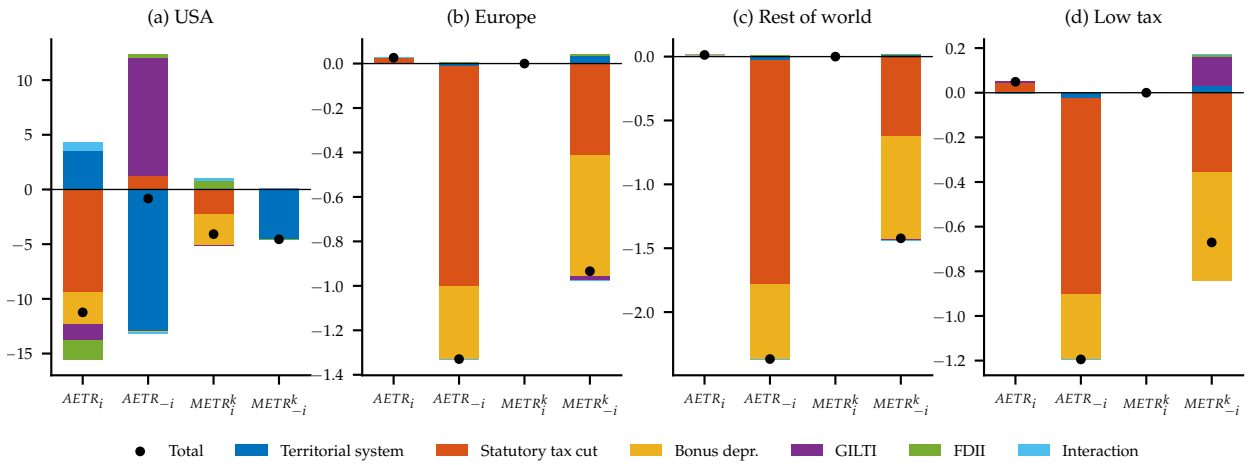
Notes: Lost profits/MNE profits reported in percentage point changes. All other variables are reported in percent changes.

Table E.4: Effects of GMT decomposed by firm type

Region	Value added				Emp.				Tangible capital				Intangible capital		
	Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
(a) Comlete US exemption															
USA	0.01	-0.02	0.06	-0.03	0.01	-0.04	0.08	-0.03	-0.03	-0.04	0.04	-0.03	0.43	-0.01	0.44
Europe	-0.41	-0.04	-0.33	-0.05	-0.17	0.16	-0.37	0.04	0.01	0.13	-0.15	0.03	-2.21	0.04	-2.25
Rest of world	-0.30	-0.02	-0.27	-0.01	-0.11	0.13	-0.26	0.02	-0.02	0.10	-0.13	0.01	-1.47	0.03	-1.49
Low tax	-6.18	-0.28	-0.67	-5.24	-0.73	2.66	1.41	-4.80	-2.04	1.76	0.17	-3.96	4.99	0.66	4.33
(b) US MNEs subject to QDMTT															
USA	-0.02	-0.02	0.03	-0.03	-0.01	-0.03	0.05	-0.03	-0.03	-0.03	0.03	-0.03	0.28	-0.01	0.29
Europe	-0.41	-0.04	-0.32	-0.05	-0.17	0.16	-0.37	0.04	0.01	0.13	-0.15	0.03	-2.21	0.04	-2.24
Rest of world	-0.30	-0.02	-0.27	-0.01	-0.11	0.13	-0.26	0.02	-0.02	0.10	-0.13	0.01	-1.46	0.03	-1.49
Low tax	-6.20	-0.27	-0.66	-5.26	-0.72	2.68	1.42	-4.82	-2.08	1.77	0.17	-4.02	5.02	0.66	4.36

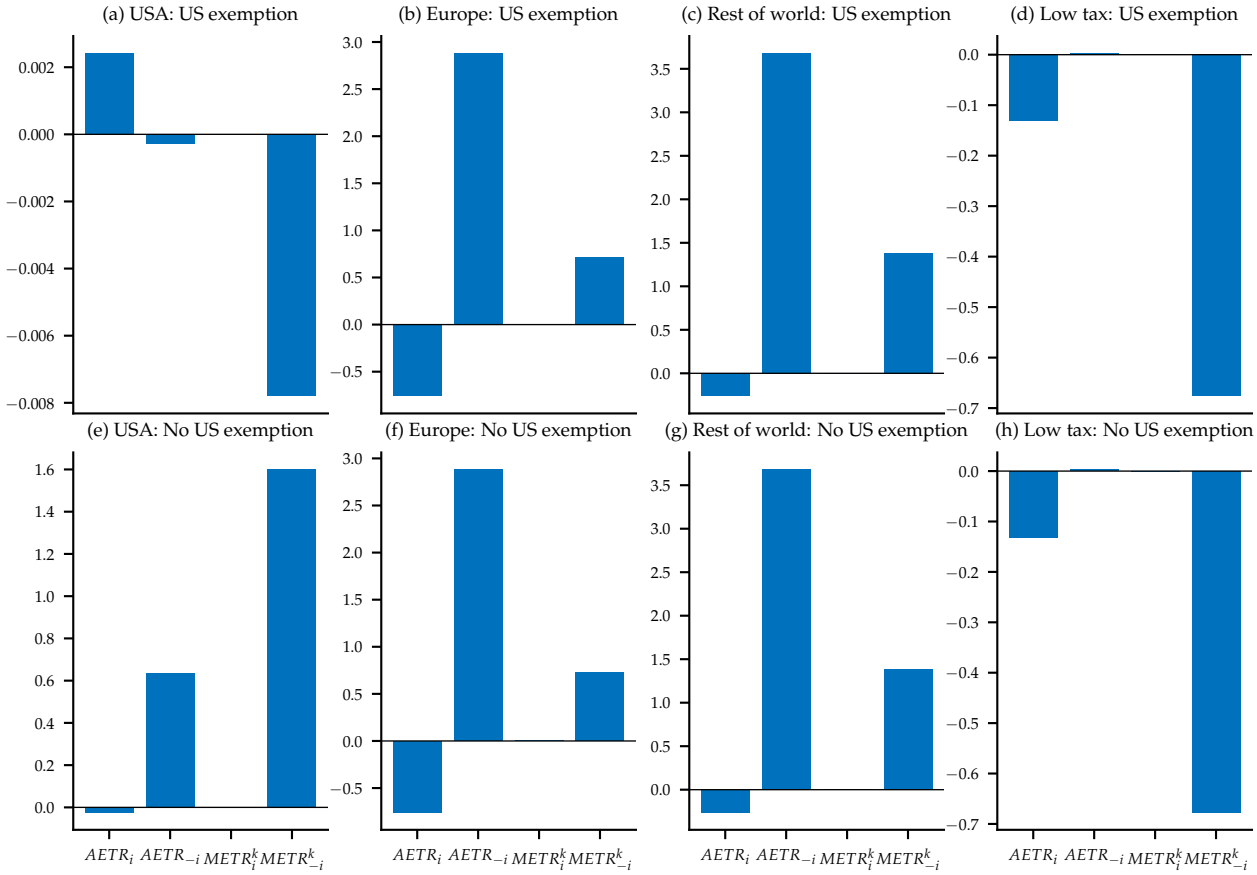
Notes: The table shows changes from the post-TCJA equilibrium to equilibria under the two GMT scenarios: adoption outside the United States (panel a) and worldwide adoption including U.S. MNEs (panel b). "Total" columns report percent changes relative to the post-TCJA status quo. Other columns report changes in percentage points relative to the post-TCJA total for that category; other columns in each category sum to the total percent change.

Figure E.1: Effects of TCJA on MNEs' AETRs and METRs



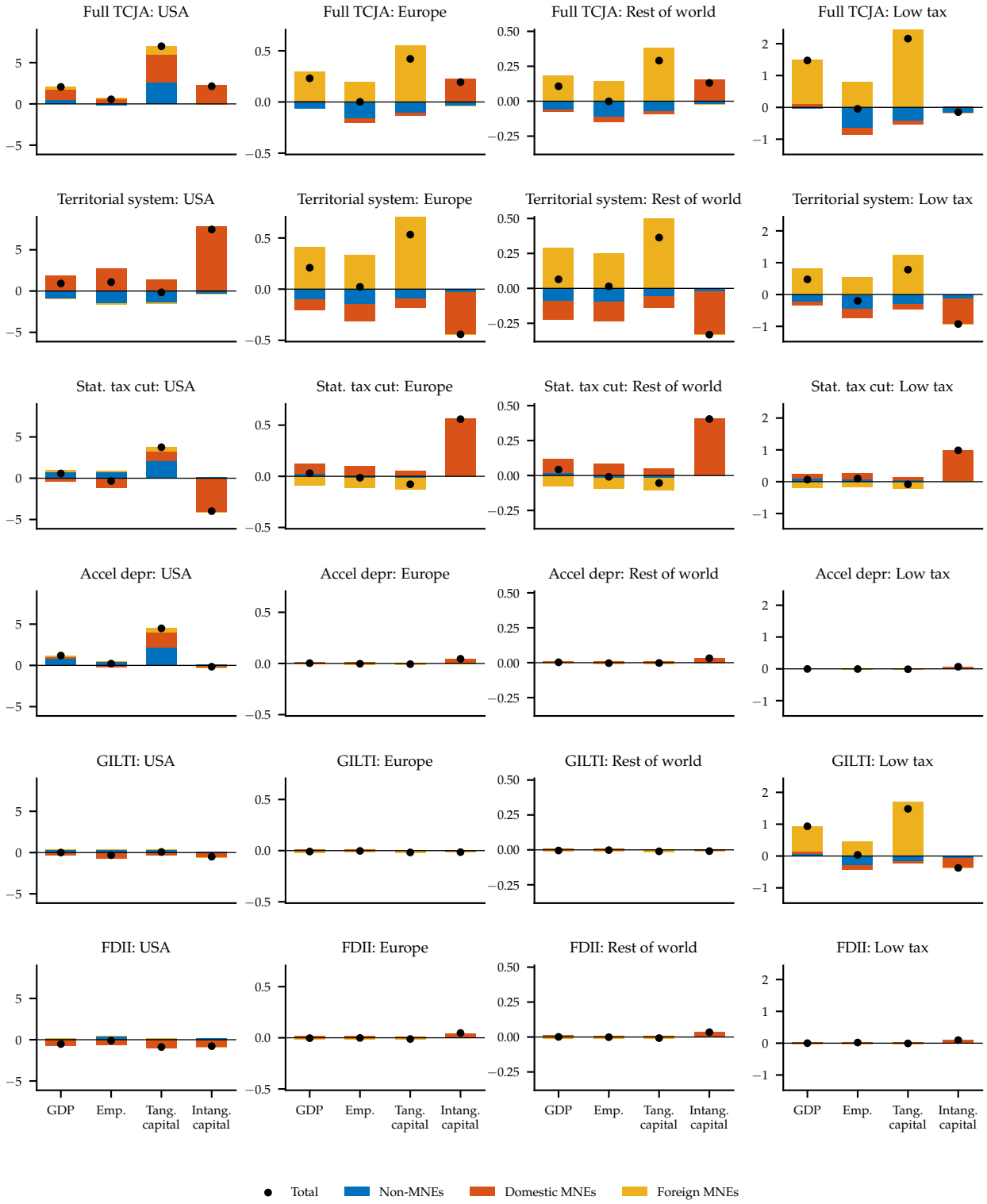
Notes: Figure shows changes from pre-TCJA calibration to equilibria with one TCJA provision implemented at a time, as well as the full TCJA with all provisions. Definitions are as follows. $AETR_i$ is the average effective tax rate on domestic profits booked in an MNE's home country. $AETR_{-i}$ is the average effective tax rate on profits booked in foreign subsidiaries, weighted by those subsidiaries' shares in the MNE's total foreign profits. $METR_i^k$ is the marginal effective tax rate on domestic tangible capital deployed in the MNE's home country. $METR_{-i}^k$ is the marginal effective tax rate on tangible capital deployed abroad by the MNE's foreign affiliates, weighted by those subsidiaries' shares in the MNE's total foreign tangible capital stock. All measures aggregated by averaging across firms, weighting by the appropriate profit or capital variable. Results shown in percentage points.

Figure E.2: Effects of GMT on MNEs' AETRs and METRs



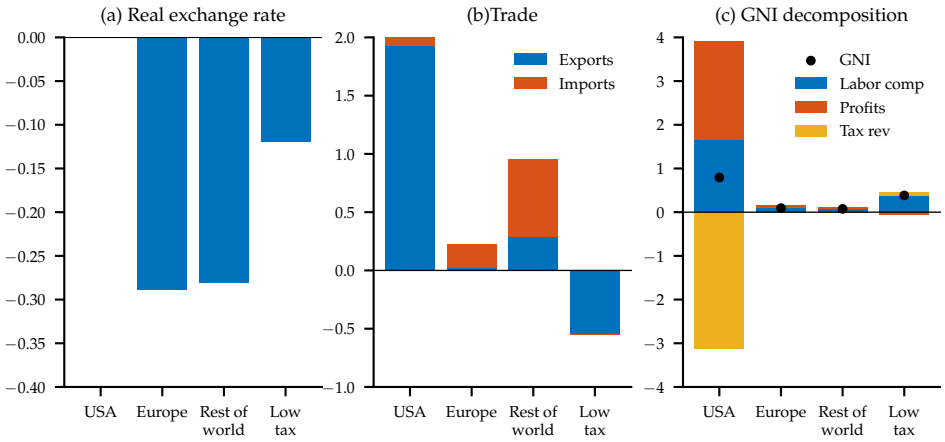
Notes: Figure shows changes from TCJA equilibrium to equilibria with different GMT configurations in baseline model. Definitions are as follows. $AETR_i$ is the average effective tax rate on domestic profits booked in an MNE's home country. $AETR_{-i}$ is the average effective tax rate on profits booked in foreign subsidiaries, weighted by those subsidiaries' shares in the MNE's total foreign profits. $METR_i^k$ is the marginal effective tax rate on domestic tangible capital deployed in the MNE's home country. $METR_{-i}^k$ is the marginal effective tax rate on tangible capital deployed abroad by the MNE's foreign affiliates, weighted by those subsidiaries' shares in the MNE's total foreign tangible capital stock. All measures aggregated by averaging across firms, weighting by the appropriate profit or capital variable. Results shown in percentage points.

Figure E.3: Effects of each TCJA provision decomposed by firm type



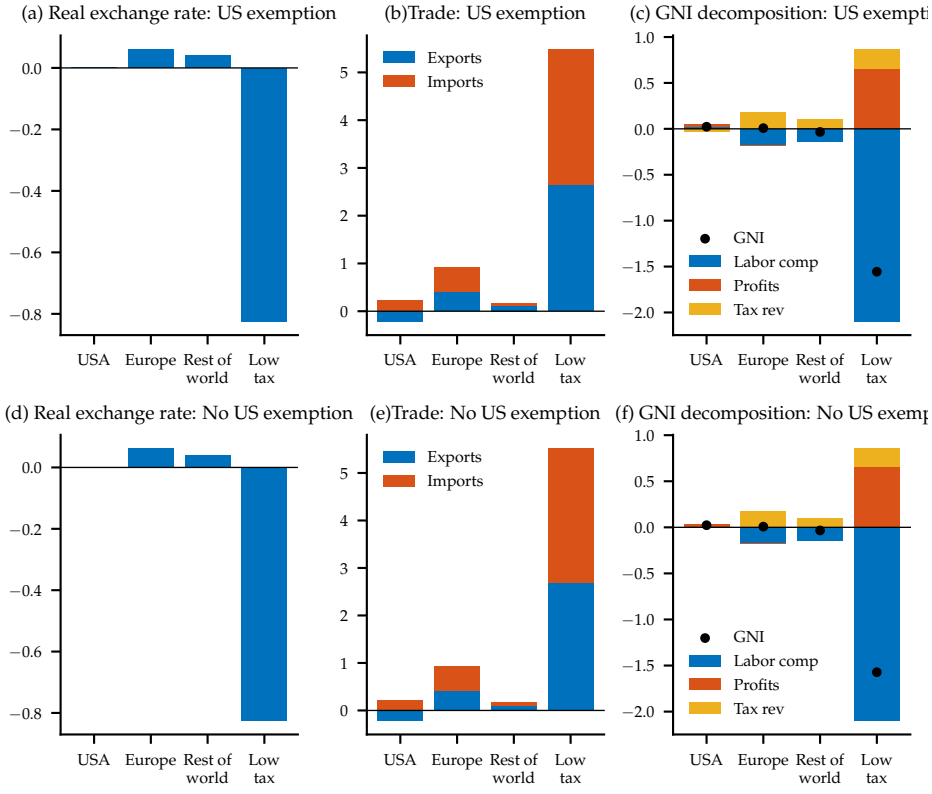
Notes: Figure shows changes from pre-TCJA calibration to equilibria with one TCJA provision implemented at a time, as well as the full TCJA with all provisions.

Figure E.4: Effects of TCJA on trade and composition of national income



Notes: Figure shows changes from pre-TCJA status quo to equilibrium with TCJA in baseline model.

Figure E.5: Effects of GMT on trade and composition of national income



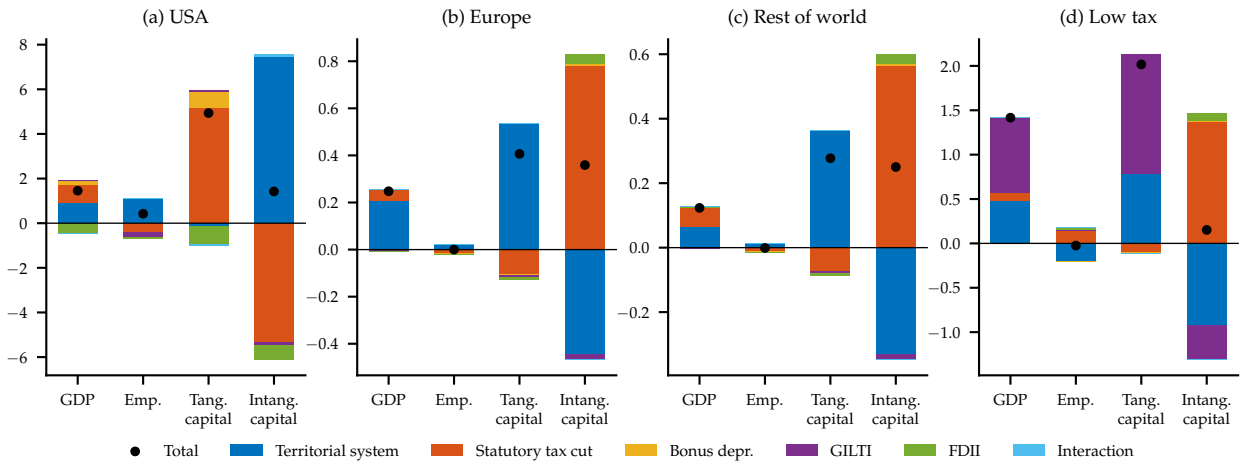
Notes: Figure shows changes from TCJA equilibrium to equilibria with different GMT configurations in baseline model.

E.2 Alternative measure of bonus depreciation

Our baseline calibration of the pre- and post-TCJA bonus depreciation rates is based on the statutory increase in the bonus depreciation allowance rate, from 50 percent to 100 percent, coupled with our own calculations of the fraction of U.S. investment that is eligible for such allowances.[34] We take boolean eligibility flags for each asset class in IRS Rev. Proc. 87-56, and then aggregate using weights taken from BEA NIPA table 5.5.5.

An alternative, far more complex, approach is to compute the present value of the U.S. tax depreciation schedule: the Modified Accelerated Cost Recovery System (MACRS, IRS Pub. 946). For each asset class, we compute the present value of depreciation deductions per dollar invested under MACRS, which yields a numeric value for each rather than simple boolean eligibility flag. Then we aggregate these values using weights from NIPA table 5.5.5 as before. This yields a smaller increase in the bonus depreciation allowance of only 5 percentage points, from 60 percent to 65 percent, a similar change to that reported by Barro and Furman (2018). Figures E.6 and E.7 show the effects of our TCJA analysis using the smaller increase in bonus depreciation implied by this alternative method.

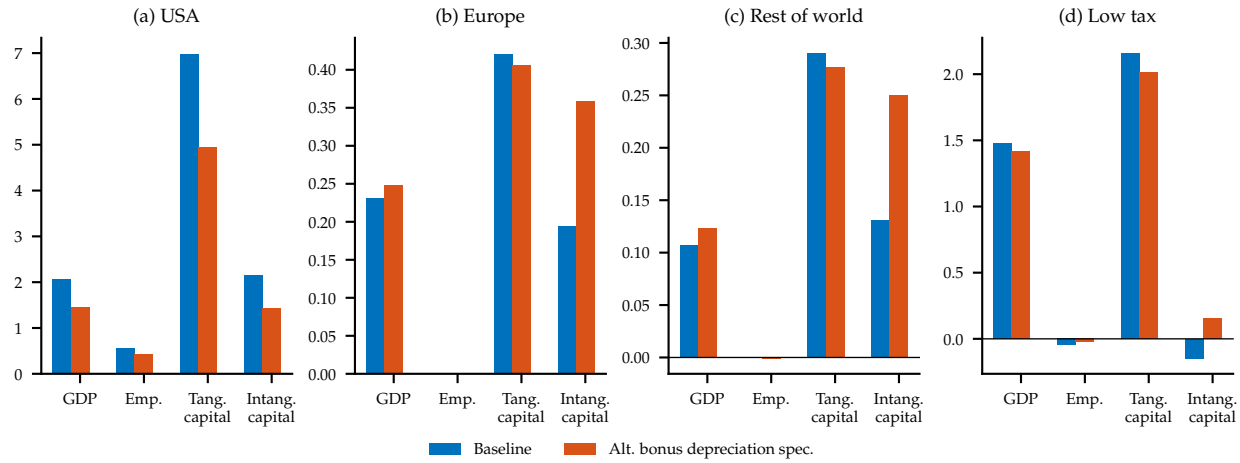
Figure E.6: Macro effects of TCJA with alternative bonus depreciation measure: by provision



Notes: Figure shows changes from pre-TCJA calibration to equilibrium with TCJA in model with alternative bonus depreciation measure. Black dots show aggregate percent changes. Dark blue, orange, and yellow, purple, and green bars show changes in percentage points resulting from the territorial taxation, the statutory rate cut, increased bonus depreciation, GILTI, and FDII, respectively. The light blue bar shows the interaction between the individual provisions, measured as the difference between the black dot (overall total) and the sum of the other colored bars.

[34] As mentioned in the text, not all types of capital are eligible; most notably, the TCJA removed eligibility for rate-regulated utility capital. This approach leads to an increase in the aggregate bonus allowance rate of 26 percentage points, from 40 percent to 66 percent.

Figure E.7: Macro effects of TCJA with alternative bonus depreciation measure: comparison with baseline model



Notes: Figure shows changes from pre-TCJA benchmark to TCJA equilibrium in baseline model versus model with alternative bonus depreciation measure.

It is important to emphasize that the nature of the experiment itself changes: with a smaller increase in bonus depreciation, a larger drop in the tax rate parameter, τ_{US}, is required to generate the observed overall decline in the average EATR faced by U.S. firms. We find that the tax rate parameter falls by 8.5 percent, rather than 6 percent in our baseline.[35] This changes the relative impact of the two provisions: the tax cut now does more work than in the baseline calibration, while the change in bonus depreciation does less work.

The aggregate response is about the same, albeit a bit smaller: the TCJA now raises US GDP by about 1.75 percent and tangible investment by about 5.5 percent. This shows that bonus depreciation is more effective in stimulating the economy than an across-the-board tax cut. This is due partly to the fact that intangible investment is already fully tax deductible in our model and is largely undistorted (at least by the overall tax parameter τ_{US}; it is distorted by the other provisions such as GILTI).

E.3 Increasing taxes to restore profit shifting while maintaining TCJA provisions

Since the TCJA changed the statutory tax rate while also making several other major changes to the U.S. tax code, one might wonder what the "tax equivalent" of those other changes is. One way to get at that question is to simply compare the change in the average EATR, which is about 8

[35]That this decline is now larger than the overall average EATR decline of 8 percent reflects the impact of other provisions, most notably FDII which increased the marginal tax rate on U.S. MNEs' tangible investment.

percentage points, with the change in the U.S. tax rate parameter τ_{US} that the model requires to match that first number, which is 6 percentage points. This approach would indicate that the tax equivalent of the other provisions is about 2 percentage points.

If one is interested in understanding the "tax equivalent" of the TCJA's effects on firm behavior, particularly profit shifting, a different approach is needed. To address this type of question, we start from the TCJA equilibrium and maintain all the TCJA provisions aside from the change in τ_{US}—the territorial system, the increase in bonus depreciation, GILTI, and FDII—and increase τ_{US} so that the aggregate level of U.S. profit shifting returns to its pre-TCJA value. We find that this exercise requires an 11-percentage-point increase in τ_{US}. Thus, in terms of the effects on profit shifting, the TCJA provisions are equivalent to a statutory tax cut of about 5 percentage points (11 minus 6), versus the lower number of 2 percent in terms of the effects on EATRs.

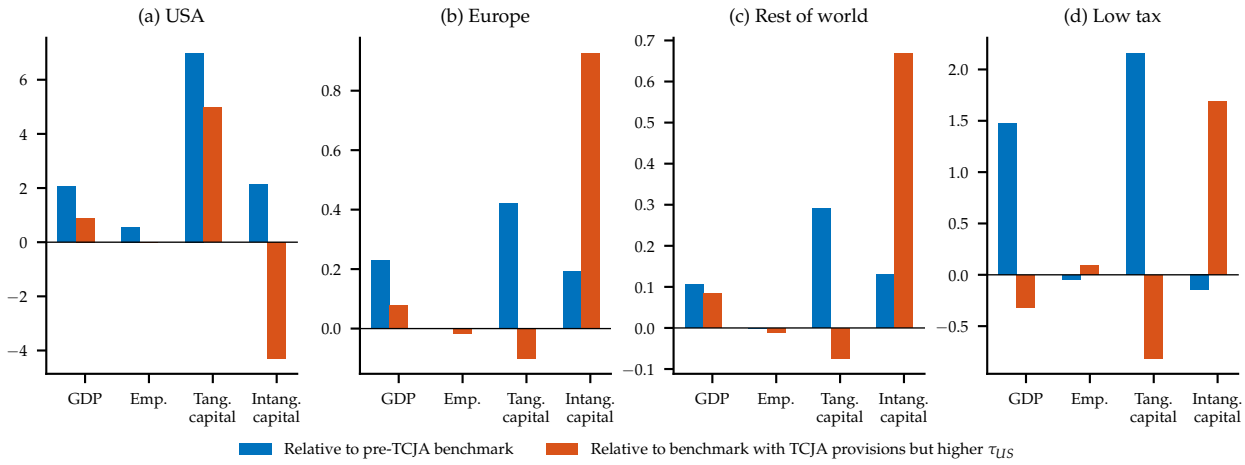
The effects of this experiment are shown in Figure E.8. What the figure shows precisely is the percent changes between two different starting points and the TCJA equilibrium. In blue, the starting point is the benchmark pre-TCJA equilibrium constructed in our calibration, where none of the TCJA provisions are implemented and the tax parameter is 6 percentage points higher. In red, the starting point is the equilibrium where all the TCJA provisions are still maintained, and the tax rate parameter rises by the 11-percentage-point figure cited above required to restore pre-TCJA profit shifting levels. Not surprisingly, the larger change in statutory rates implies larger changes in tangible investment and GDP. However, intangible investment now falls instead of rising. This is because intangible investment is fully tax deductible in our model. This implies that statutory rates have no direct effect at all on intangible investment for domestic firms, and that a larger gap between domestic and foreign tax rates actually positively impacts intangible investment for MNEs, especially those that shift profits. We explain this mechanism in detail in our previous papers Dyrda, Hong, and Steinberg (2024c) and Dyrda et al. (2024b).

E.4 Calibration based on lower aggregate shifted profits

Our baseline calibration of the profit-shifting costs $\psi_{i,LT}$ and $\psi_{i,TH}$ targets the aggregate shifted-profit estimates of Tørsløv et al. (2023), which lie at the high end of the range in the literature: they imply lost corporate income tax revenue of about ten percent of global receipts, against the four-to-ten percent range of the OECD (2015). Since the level of profit shifting governs the strength of the intangible-investment channel, we recalibrate these costs to match sixty percent of the Tørsløv et al. (2023) estimates and re-run both experiments.

Figures E.9 and E.10 compare the two reforms under the baseline and the lower-shifting calibrations. Our results are qualitatively robust: every effect, on both the directly targeted economies

Figure E.8: Macro effects of restoring pre-TCJA profit shifting level while maintaining TCJA provisions



Notes: Figure shows changes from pre-TCJA benchmark to TCJA equilibrium (baseline results; blue) versus changes from equilibrium where TCJA provisions are preserved but τ_{US} increased to restore pre-TCJA profit shifting level.

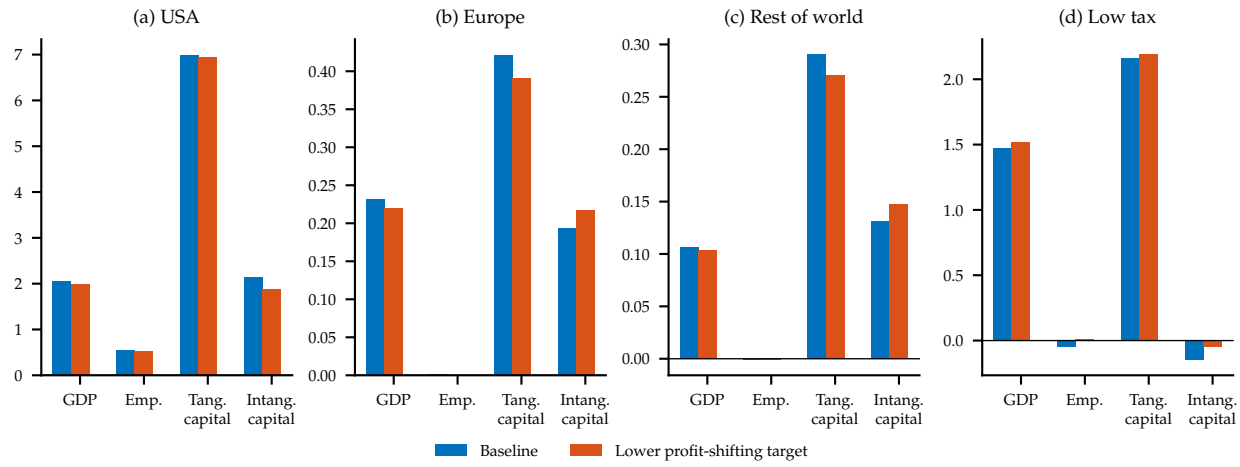
and the ripple effects abroad, is mostly quantitatively smaller, as expected, since a smaller initial level of profit shifting leaves less room for the reforms to reallocate intangible income and investment across regions. The TCJA results change by less than the GMT results, because the TCJA works mainly through the statutory rate cut and the territorial shift rather than through the transfer of intangible income, whereas the GMT acts directly on the profit-shifting margin by raising the tax on income booked in low-tax jurisdictions.

E.5 Effects of FDI externalities

We have shown that the effects of corporate tax reforms propagate across borders primarily through their impact on investment. Given the well-documented technology spillovers from foreign direct investment (FDI) on the host country (Javorcik, 2004), we now study the effects of FDI externalities in our model. As we have shown, the corporate tax reforms have significant effects on the intangible investment by MNEs across the world. These investment responses could also generate technology spillovers through multinational networks. By raising the efficiency of foreign firms' intangible investment, these spillovers would further amplify the ripple effects of tax reforms.

We follow Dyrda et al. (2024b) and model intangible spillovers as a multiplicative shifter to the efficiency of intangible investment. With spillovers, the production technology for intangible

Figure E.9: Macro effects of TCJA with lower profit-shifting calibration target



Notes: Figure shows changes from pre-TCJA benchmark to TCJA equilibrium in baseline model versus alternative calibration that targets 60% lower pre-TCJA profit shifting levels.

capital in region i is

$$z_t(\omega) = A_i \ell_{it}^z(\omega) \left[\sum_{j \neq i} \int_{\Omega_{jit}} z_{jt}(\omega') \, \mathrm{d}\omega' \right]^{\upsilon}, \tag{E.1}$$

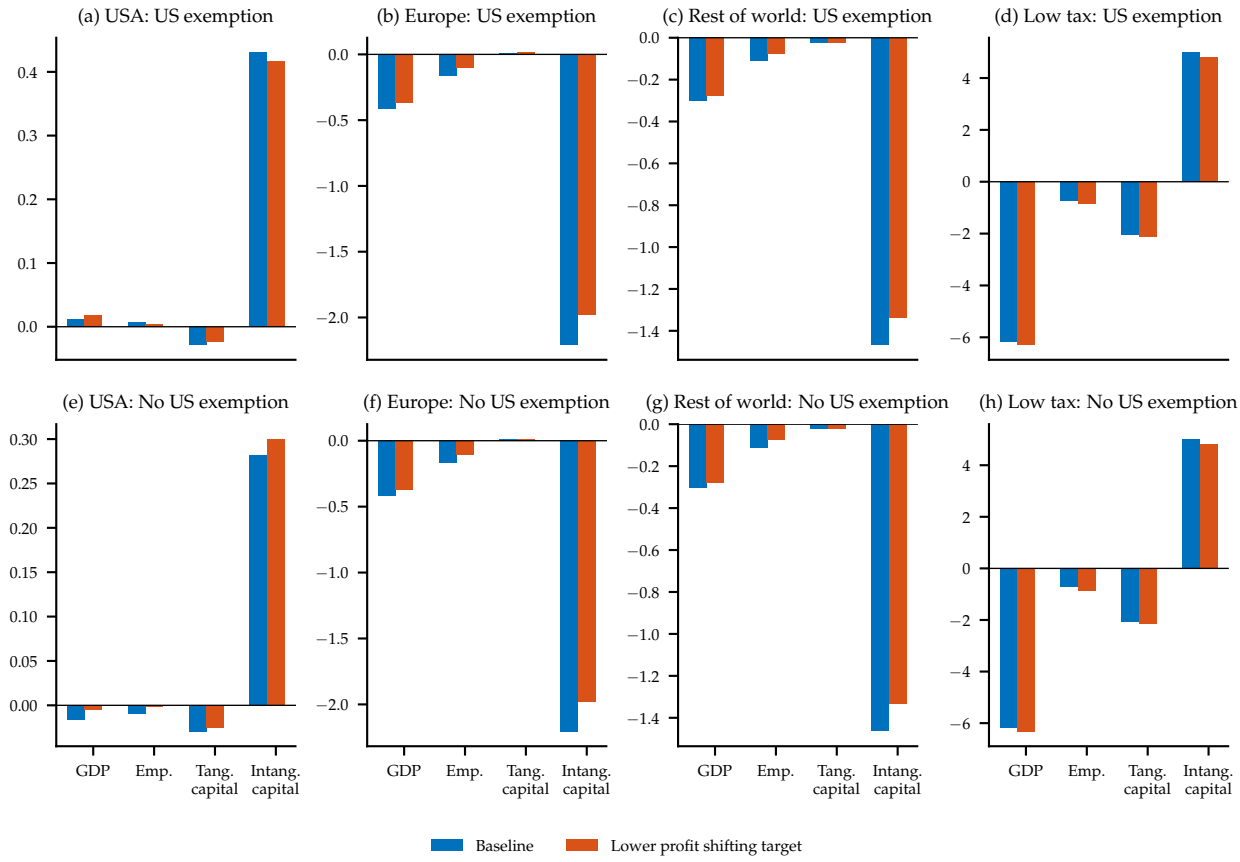
where $\sum_{j \neq i} \int_{\Omega_{jit}} z_{jt}(\omega') \, \mathrm{d}\omega'$ is total intangible capital deployed in region i, and υ governs the strength of the spillover externality. If $\upsilon = 0$, spillovers are absent. Higher values of υ imply that foreign MNEs' R&D decisions more strongly raise domestic firms' efficiency in producing intangible capital.

The results of the TCJA and GMT exercises with the FDI externality are shown in Figures E.11 and E.12. We set $\upsilon = 0.4$ following Dyrda et al. (2024b). The spillover specification amplifies the effects of both reforms, but particularly amplifies the cross-country ripple effects of the GMT. In both versions of that reform we consider, U.S. GDP falls by more than 0.6 percent, more than half the decline observed in the EU and RoW regions.

E.5.1 Alternative labor supply assumptions

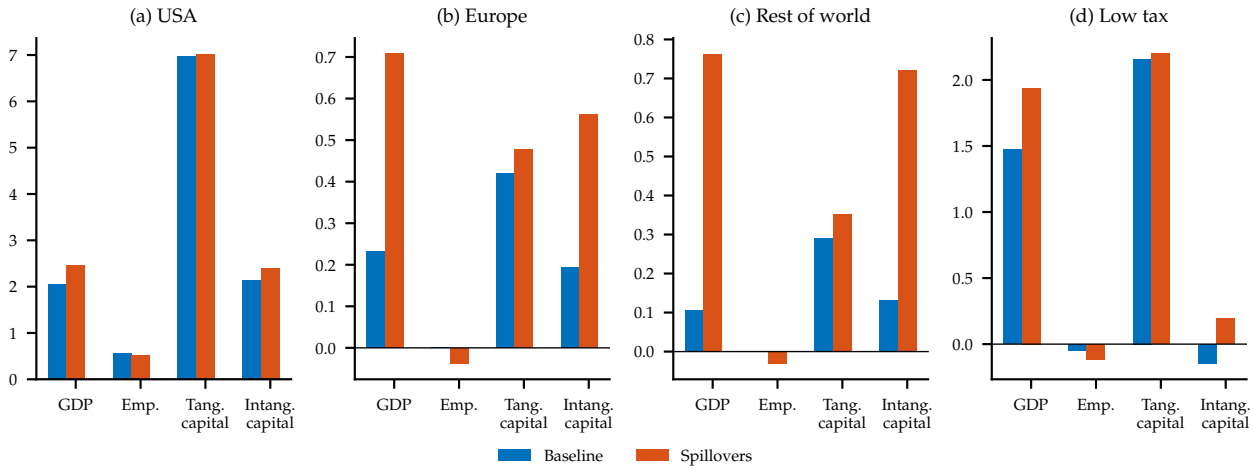
We also examine the sensitivity of our results to the modeling of labor supply. In addition to the baseline specification, we consider two alternatives: one in which labor supply is fixed, and one in which we remove the wealth effect on labor supply. Figures E.13 and E.14 report the macroeconomic effects of the TCJA and the GMT under these alternatives. The results are quantitatively similar across the three specifications, so our conclusions do not depend on the way labor supply is modeled.

Figure E.10: Effects of GMT on macro variables with lower profit-shifting calibration target



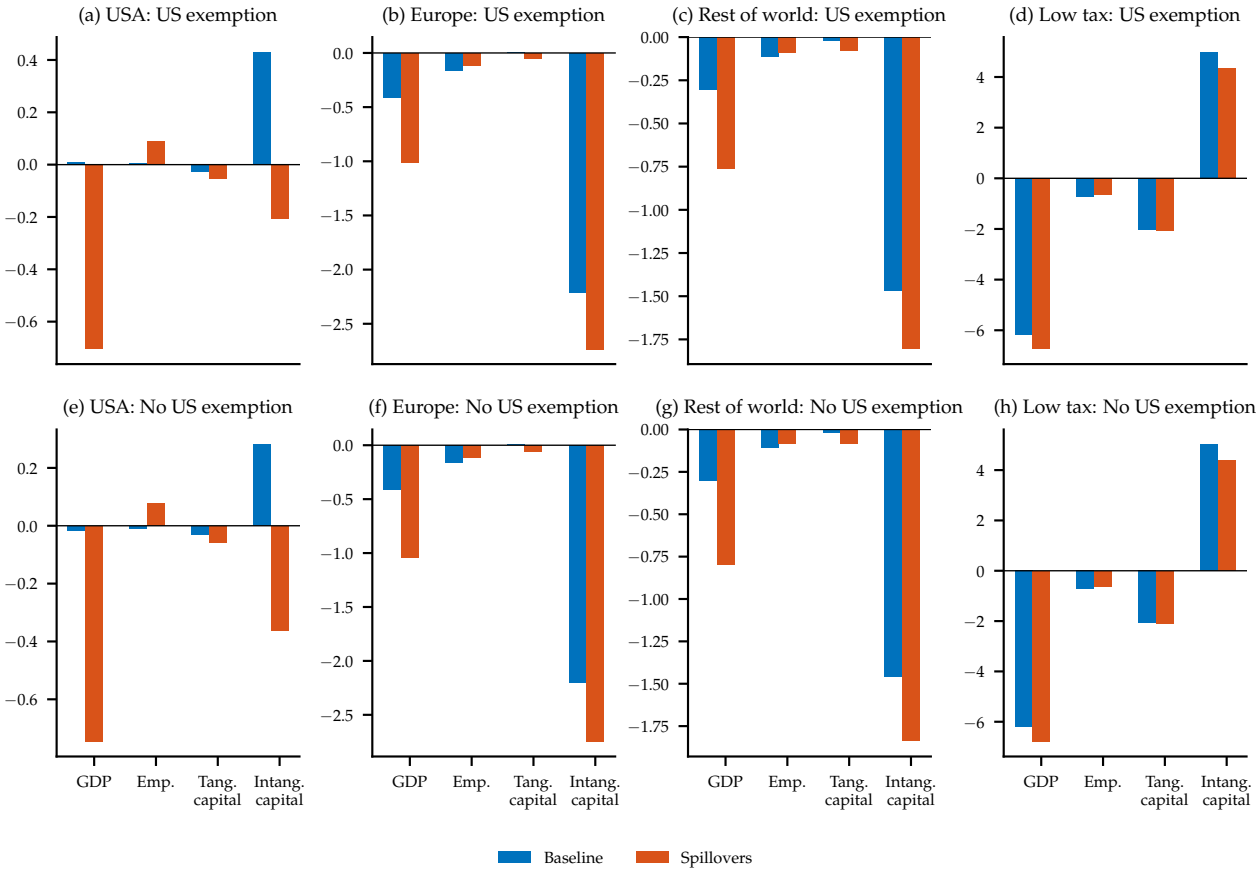
Notes: Figure shows changes from TCJA equilibrium to equilibria with different GMT configurations in baseline model versus alternative calibration that targets 60% lower pre-TCJA profit shifting levels.

Figure E.11: Macro effects of TCJA with FDI externality



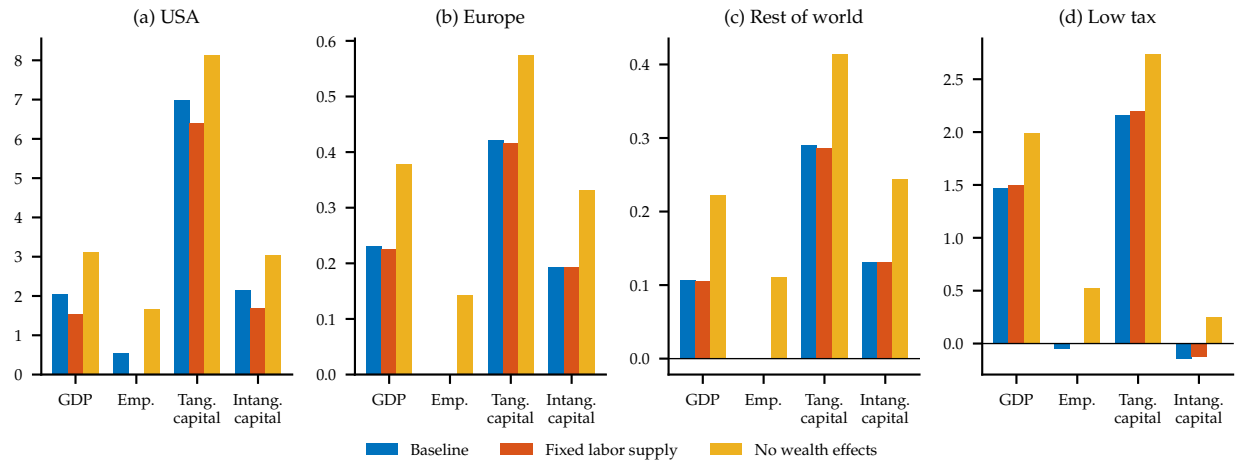
Notes: Figure shows changes from pre-TCJA calibration to equilibrium with TCJA. Blue: baseline model. Orange: model with FDI externality, where intangible capital deployed by affiliates of foreign MNEs raises domestic firms' intangible investment efficiency.

Figure E.12: Macro effects of GMT with FDI externality



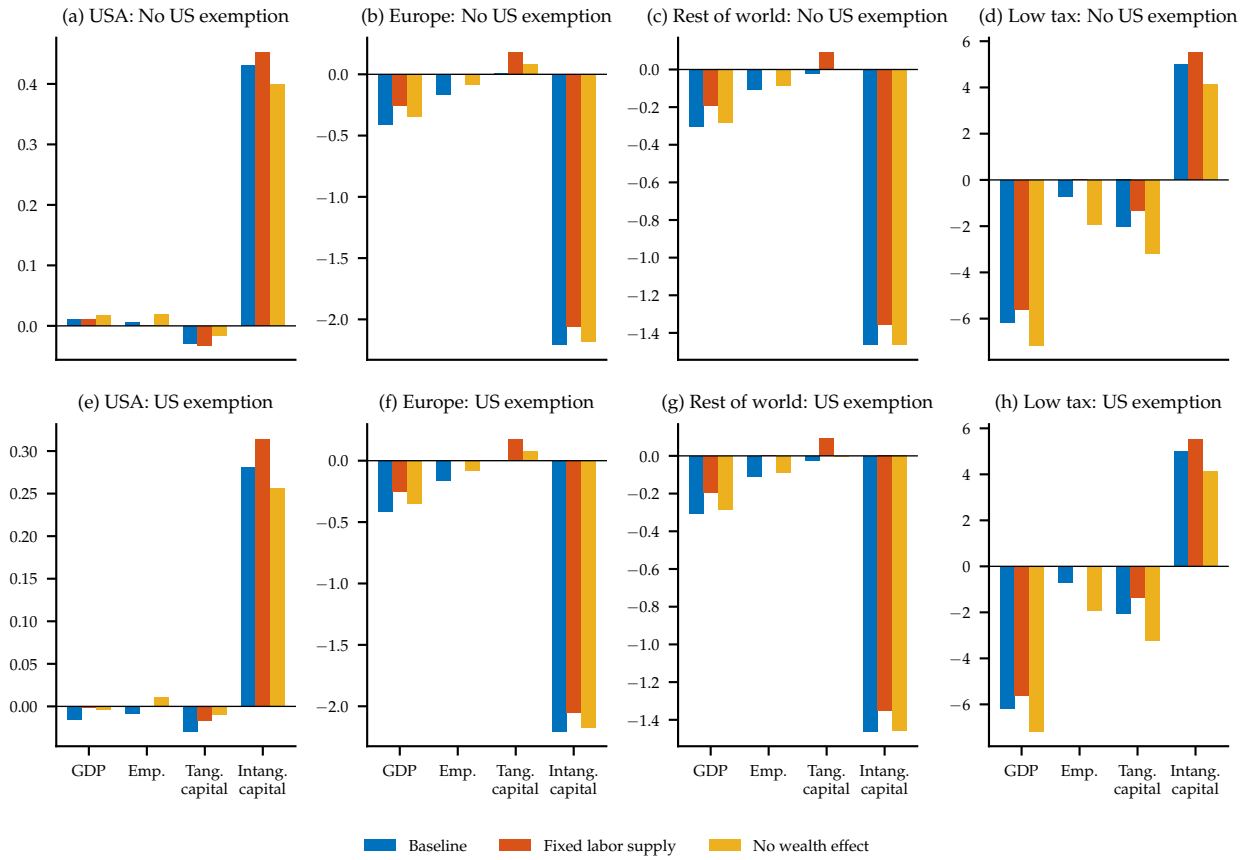
Notes: Figure shows changes from TCJA equilibrium to equilibria with different GMT configurations. First row: GMT outside of United States, including in low-tax region and tax haven. Second row: worldwide GMT. Blue bars: baseline model. Orange bars: model with FDI externality, where intangible capital deployed by affiliates of foreign MNEs raises domestic firms' intangible investment efficiency.

Figure E.13: Effects of TCJA on macro variables with alternative labor supply specifications



Notes: Figure shows changes from pre-TCJA benchmark to TCJA equilibrium under alternative labor supply specifications.

Figure E.14: Effects of GMT on macro variables with alternative labor supply specifications



Notes: Figure shows changes from TCJA equilibrium to equilibria with different GMT configurations under alternative labor supply specifications.