

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

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2024 SED Annual Meeting, Barcelona | June 29, 2024

# Motivation

## *Introduction*

Multinational Enterprises (MNEs) shift large portions of their profits to tax havens, reducing tax revenues in their home countries by hundreds of billions of dollars per year

- Tørsløv et al. (2022): 36% of global MNE profits shifted to tax havens
- OECD: \$240 bn. (10%) of global corporate tax revenues lost annually

In October 2021, 136 countries representing 90% of global GDP signed onto historic policy framework designed by OECD/G20 to address profit shifting

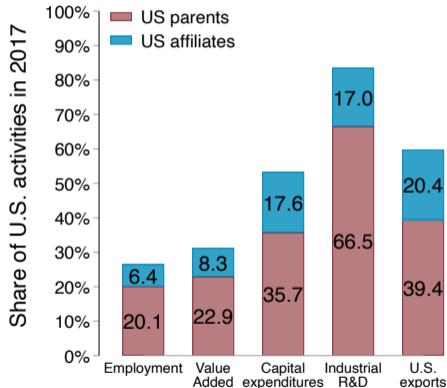
- Pillar 1: Sales-based allocation of profit taxation rights
- Pillar 2: Global minimum corporate income tax (GMT)

Since then:

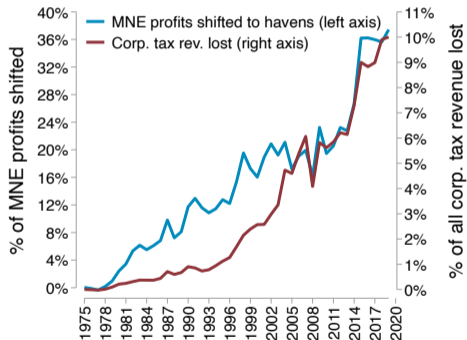
- EU has implemented GMT starting from January 1, 2024
- Many countries followed, e.g. Australia, South Korea, Japan
- No progress on either pillar in the US; home to the largest share of MNEs globally

# Importance of MNEs and profit shifting in the United States

## Introduction



(a) Importance of MNEs



(b) Rise of profit shifting

# What we do

## *Introduction*

1. Develop a quantitative framework to study the effects of the GMT on the US economy.
  - Incorporate profit shifting through transfer of the property rights to intangible capital
  - Incorporate MNEs related provisions introduced by the Tax Cuts and Jobs Act (TCJA) and their interactions with the profit shifting
  - Incorporate spillovers associated with intangible capital production technology
2. Conduct a series of experiments:
  - All but US introduce GMT: with and without spillovers
  - Only US introduces GMT: with and without spillovers
  - All including US introduce GMT: with and without spillovers
  - The macro effects of TCJA's provisions applying to MNEs

# Key takeaways

## Introduction

1. Local corporate income tax reforms can have global, **ripple macroeconomic effects**:
  - The channel is through nonrival intangible capital and spillovers
  - Other countries introduce GMT: negative effect for the US
  - US introducing GMT: negative effect for the US and everyone else
  
2. Contrast with GILTI provision of TCJA
  - Similar effects on profit shifting as GMT, but smaller ripple effect
  - Negative effects on intangible investment offset by positive effects on tangible investment in foreign subsidiaries; consistent with **Chodorow-Reich et.al. (2024)**
  - Net effect is small gain in global output. Amplified by spillovers.

# The Model

# Environment overview

- Standard multi-country GE model:
  - Five regions: US, Europe, Rest of the World, Low Tax (LT), Tax Haven (TH)
  - Representative consumers with standard preferences choosing consumption, labor and tangible investment.
  - Aggregator: nontradable final goods
  - Tradable, country-specific intermediate goods
  - Governments collect corporate tax revenues and rebate it back to the consumers.
- Add multinational enterprises:
  - Intangible capital as in (**McGrattan and Prescott (2009; 2010)**) with spillover externality
  - Theory of transfer pricing and profit shifting as in (**Dyrda et al. (2022)**)
  - Detailed representation of the MNE-related provisions of TCJA

# Intermediate Goods Producers: Technology

- Each productive region  $i$  has a unit measure  $\Omega_i$  of firms that compete monopolistically.
- A firm from region  $i$  produces in any productive region  $j$  according to:

$$y_{ij} = \sigma_{ij} A_j a (N_j z)^\phi k_j^\alpha \ell_j^\gamma.$$

where  $z$  is **nonrival**, within MNE, intangible capital,  $\sigma_{ij} \in [0, 1]$  are FDI barriers (McGrattan and Prescott, 2010) and  $a$  is idiosyncratic productivity.

- The firm's resource constraints:

$$y_{ii} = q_{ii} + \sum_{j \in J_X} \xi_{ij} q_{ij}^X,$$

$$y_{ij} = q_{ij}, \quad j \in J_F,$$

where

- $\xi_{ij}$ : iceberg transportation cost for each unit of goods shipped abroad.
- $q_{ij}^X$ : exported goods
- $q_{ii}$ : goods that are produced and consumed in the same location
- $J_X \subseteq I \setminus \{i\}$ : set of export destinations,  $J_F \subseteq I \setminus \{i\}$ : set of regions with foreign affiliates



# Production of Intangible Capital

- The intangible capital  $z$  is produced according to:

$$z_i = aA_i l_i^z \cdot \left( \sum_{j \neq i} \int_{\Omega_{ji}} z_j(\omega) d\omega \right)^\nu$$

where

- $l_i^z$ : the measure of R&D workers
  - $\sum_{j \neq i} \int_{\Omega_{ji}} z_j(\omega) d\omega$ : the total amount of foreign intangible capital used in country  $i$
  - $\nu$ : spillover elasticity
- Empirical evidence on significant backward spillovers to upstream industries: **Javorcik (2004)**, forward spillovers to downstream industries: **Liu (2008)**

## Stage 2: Operating pre-tax profits

- The domestic parent corporation's profits are

$$\pi_i^D(a, z; J_X) = \max_{q_{ii}, \{q_{ij}^X\}_{j \in J_X}, \ell_i, k_i} \left\{ p_{ii}(q_{ii})q_{ii} + \sum_{j \in J_X} p_{ij}(q_{ij}^X)q_{ij}^X - W_i \ell_i - \delta P_i k_i \right\}$$
$$\text{s.t. } q_{ii} + \sum_{j \in J_X} \xi_{ij} q_{ij} = y_{ii}$$

- Foreign subsidiaries' profits are

$$\pi_{ij}^F(a, z) = \max_{q_{ij}, \ell_j, k_j} p_{ij}(q_{ij})q_{ij} - W_j \ell_j - \delta P_j k_j, \quad j \in J_F.$$

## Stage 1: Locations, intangible capital and profit shifting.

MNE maximizes dividends:

$$d_i(a) = \max_{z, J_X, J_F, \lambda \in \Gamma} \left\{ (1 - \tau_i)\pi_{ii} + \sum_{j \in J_F \setminus \{LT\}} (1 - \tau_j)\pi_{ij} + (1 - \tau_{LT})\pi_{i,LT} \mathbf{1}_{\{LT \in J_F\}} \right. \\ \left. + (1 - \tau_{TH})\pi_{i,TH} \mathbf{1}_{\{\lambda_{TH} > 0\}} - T_i^{GILTI} \mathbf{1}_{\{i=US\}} - \sum_{j \in J_F \cup \{i\}} r_j k_j \right\}$$

subject to

$$\Gamma = \{ \lambda \in [0, 1]^2 : \lambda_{LT} + \lambda_{TH} \leq 1 \}.$$

where:

- $\lambda = (\lambda_{LT}, \lambda_{TH})$ : shares of rights to intangible capital sold to LT and TH
- $\pi_{ii}$ : taxable profits of the parent division
- $\pi_{ij}$ : taxable profits of affiliates in other high-tax regions
- $\pi_{i,LT}$ : taxable profits of the low-tax affiliate
- $\pi_{i,TH}$ : taxable profits of the tax-haven affiliate
- $T_i^{GILTI}$ : Global Intangible Low-Taxed Income tax liability for the U.S. MNEs

# Taxable profits: parent division

$$\begin{aligned}
 \pi_{ii} = & \pi_i^D(a, z; J_X) - W_i \overbrace{\left( l_i^z + \sum_{j \in J_X} \kappa_{ij}^X + \sum_{j \in J_F} \kappa_{ij}^F + \kappa_{iTH} 1_{\{\lambda_{TH} > 0\}} \right)}^{\text{Costs of intangible capital production and fixed costs}} \\
 & + \overbrace{(\varphi_{iLT} \lambda_{LT} + \varphi_{iTH} \lambda_{TH}) \nu_i(z) z}^{\text{Proceeds from selling } z} + \overbrace{\sum_{j \in J_F} (1 - \lambda_{LT} - \lambda_{TH}) \vartheta_{ij}(z) z}^{\text{Licensing fee receipts}} - \overbrace{(\lambda_{LT} + \lambda_{TH}) \vartheta_{ii}(z) z}^{\text{Licensing fee payments}} \\
 & - \overbrace{W_i \mathcal{C}_i(\lambda_{LT}, \lambda_{TH}) \nu_i(z) z}^{\text{Cost of transferring } z}.
 \end{aligned}$$

where:

- $\kappa_i^X$ : a fixed cost to export domestically produced goods
- $\kappa_i^F$ : a fixed cost to open a foreign affiliate and produce locally
- $\vartheta_{ij}(z) z \equiv \phi p_{ij} y_{ij} / z$ : licensing fee of a subsidiary in region  $j$
- $\nu_i(z) z \equiv \sum_{j \in J_F \cup \{i\}} \vartheta_{ij}(z) z$ : total amount of licensing fees across the conglomerate
- $\varphi_{iLT}, \varphi_{iTH}$ : markdowns (mispricing) on selling rights to intangible capital

# Taxable profits: foreign subsidiaries, LT and TH

- Foreign subsidiary  $j$ :

$$\pi_{i,j} = \pi_{ij}^F(a, z) - \underbrace{\vartheta_{ij}(z)z}_{\text{Licensing fee}}$$

- Low Tax (LT) region:

$$\pi_{i,LT} = \pi_{i,LT}^F(a, z) - \underbrace{\varphi_{iLT}\lambda_{LT}\nu_i(z)z}_{\text{Cost of buying } z} + \overbrace{\sum_{j \in J_F \cup \{i\} \setminus \{LT\}} \lambda_{LT}\vartheta_{ij}(z)z}^{\text{Licensing fee receipts}} - \underbrace{(1 - \lambda_{LT})\vartheta_{iLT}(z)z}_{\text{Licensing fee payment}}$$

- Tax Haven (TH) :

$$\pi_{i,TH} = \underbrace{\sum_{j \in J_F \cup \{i\}} \lambda_{TH}\vartheta_{ij}(z)z}_{\text{Licensing fee receipts}} - \underbrace{\varphi_{iTH}\lambda_{TH}\nu_i(z)z}_{\text{Cost of buying } z}$$

# Global intangible low-taxed income (GILTI)

- The GILTI tax base

$$\pi_{US}^{GILTI} \equiv \underbrace{\theta^{GILTI}}_{\substack{\text{tax base adjustment} \\ \theta^{GILTI} = 50\%}} \times \sum_j \left( \pi_{USj} - \underbrace{\theta^{QBAI} \times P_j k_j}_{\substack{\text{tax exemption for} \\ \text{tangible assets base} \\ \text{with } \theta^{QBAI} = 10\%}} \right)$$

- GILTI tax liability paid by the U.S. shareholders:

$$T_{US}^{GILTI} \equiv \underbrace{\tau_{US} \times \pi_{US}^{GILTI}}_{\substack{\text{U.S. tax rate} \\ \text{applied to GILTI base}}} - \min \left\{ \underbrace{\theta^{DPFT} \times \sum_j (\tau_j \times \pi_{USj})}_{\substack{\text{Deemed paid foreign taxes (DPFT)} \\ \text{where } \theta^{DPFT} = 80\%}}, \underbrace{\tau_{US} \times \left( \pi_{US}^{GILTI} - \sum_j x_{USj} \right)}_{\substack{\text{Foreign tax credit limitation} \\ x_{USj}: \text{U.S. expenses allocated} \\ \text{to the subsidiary in } j}} \right\}$$

# GILTI and share of shifted property rights $\lambda_{LT}$

Impose the cost function  $\mathcal{C}(\lambda) = \lambda + (1 - \lambda) \log(1 - \lambda)$  per unit value of  $z$  transferred. Then:

- Without GILTI:

$$\lambda_{LT} = 1 - \exp\left(\frac{(\tau_{US} - \tau_{LT})(1 - \varphi_{LT})}{(1 - \tau_{US})W_{US}}\right)$$

→  $\lambda_{LT}$  ↘ in LT tax rate  $\tau_{LT}$

→  $\lambda_{LT}$  ↘ in mispricing the intangible capital  $\varphi_{LT}$

- With GILTI:

$$\lambda_{LT} = 1 - \exp\left(\frac{((1 - \theta^{GILTI})\tau_{US} - (1 - \theta^{DPFT})\tau_{LT})(1 - \varphi_{LT})}{(1 - \tau_{US})W_{US}}\right)$$

→  $\lambda_{LT}$  ↘ in the GILTI tax base adjustment  $\theta^{GILTI}$

→  $\lambda_{LT}$  ↗ in how much GILTI rules allow for deducting foreign tax payments  $\theta^{DPFT}$

# Global Minimum Corporate Income Tax (GMT) in the Model

- If firm from  $i$  reports profits in  $j$  with  $\tau_j < \tau_{GMT} = 15\%$ , then  $i$  taxes these profits at rate  $\tau_{GMT} - \tau_j$
- Does not require tax havens to change their tax rates or affect their tax revenues (unless firms react by shifting fewer profits). Parent corporate in  $i$  just pays larger tax bill.
- Share of shifted property rights:

$$\lambda_i = 1 - \exp\left(\frac{(\tau_i - \max(\tau_{GMT}, \tau_{LT}))(1 - \varphi_{LT})}{(1 - \tau_i) W_i}\right)$$

- Additional revenue for  $i$  is

$$\tilde{R}_i = \sum_{j=1}^N \int_{\Omega_i} \max[(\tau_{GMT} - \tau_j), 0] \pi_j(\omega) d\omega$$



# Experiments

# GMT: All regions except US (with spillovers)

## Experiments

Region	Lost profits (benchmark = 1)	Corp. tax rev. (% chg.)	Value added (% chg.)			Intangible capital (% chg.)			
			Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
USA	1.00	-0.03	-0.09	-0.08	-0.08	-0.16	-0.05	-0.09	-0.05
Europe	0.29	2.92	-0.05	0.02	-0.13	-0.03	-0.39	0.01	-0.43
Rest of world	0.24	1.30	-0.06	-0.03	-0.08	-0.09	-0.20	-0.03	-0.21
Low tax	0.56	-6.68	0.00	0.31	0.04	-0.51	0.14	0.36	0.11

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Domestic MNEs in Europe and Rest of the World reduce their intangible capital.

# GMT: All regions except US (with spillovers)

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Low tax	0.56	-6.68	0.00	0.31	0.04	-0.51	0.14	0.36	0.11

The opposite is true for the LT region. MNEs there benefit from cheaper inputs.

# GMT: All regions except US (with spillovers)

## Experiments

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			Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
USA	1.00	-0.03	-0.09	-0.08	-0.08	-0.16	-0.05	-0.09	-0.05
Europe	0.29	2.92	-0.05	0.02	-0.13	-0.03	-0.39	0.01	-0.43
Rest of world	0.24	1.30	-0.06	-0.03	-0.08	-0.09	-0.20	-0.03	-0.21
Low tax	0.56	-6.68	0.00	0.31	0.04	-0.51	0.14	0.36	0.11

Profits flow back to Europe and RoW. Corporate tax revenues rise in EU and RoW, fall in LT.

# GMT: All regions except US (with spillovers)

## Experiments

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Europe	0.29	2.92	-0.05	0.02	-0.13	-0.03	-0.39	0.01	-0.43
Rest of world	0.24	1.30	-0.06	-0.03	-0.08	-0.09	-0.20	-0.03	-0.21
Low tax	0.56	-6.68	0.00	0.31	0.04	-0.51	0.14	0.36	0.11

The negative effects ripple to the US economy through the FDI spillovers.

# GMT: All regions except US (without spillovers)

## Experiments

Region	Lost profits (benchmark = 1)	Corp. tax rev. (% chg.)	Value added (% chg.)			Intangible capital (% chg.)			
			Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
USA	1.00	-0.01	-0.00	0.00	0.01	-0.07	0.02	0.00	0.02
Europe	0.29	2.97	0.01	0.07	-0.08	0.05	-0.34	0.07	-0.38
Rest of world	0.24	1.32	0.01	0.04	-0.02	0.01	-0.13	0.05	-0.15
Low tax	0.56	-6.64	0.10	0.42	0.16	-0.45	0.26	0.49	0.23

# GMT: All regions except US (without spillovers)

## Experiments

Region	Lost profits (benchmark = 1)	Corp. tax rev. (% chg.)	Value added (% chg.)			Intangible capital (% chg.)			
			Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
USA	1.00	-0.01	-0.00	0.00	0.01	-0.07	0.02	0.00	0.02
Europe	0.29	2.97	0.01	0.07	-0.08	0.05	-0.34	0.07	-0.38
Rest of world	0.24	1.32	0.01	0.04	-0.02	0.01	-0.13	0.05	-0.15
Low tax	0.56	-6.64	0.10	0.42	0.16	-0.45	0.26	0.49	0.23

Similar impact in Europe, RoW and LT on intangible capital, lost profits and tax revenues.



# GMT: All regions except US (without spillovers)

## Experiments

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			Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
USA	1.00	-0.01	-0.00	0.00	0.01	-0.07	0.02	0.00	0.02
Europe	0.29	2.97	0.01	0.07	-0.08	0.05	-0.34	0.07	-0.38
Rest of world	0.24	1.32	0.01	0.04	-0.02	0.01	-0.13	0.05	-0.15
Low tax	0.56	-6.64	0.10	0.42	0.16	-0.45	0.26	0.49	0.23

Without spillovers almost no impact on the US.

# The macro effect (?) of GILTI.

## Experiments

Region	Lost profits (benchmark = 1)	Corp. tax rev. (% chg.)	Value added (% chg.)			Intangible capital (% chg.)			
			Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
USA	0.84	1.01	0.02	0.03	0.01	0.03	0.03	0.02	0.03
Europe	1.00	0.00	0.02	0.02	0.02	0.01	-0.00	0.00	-0.00
Rest of world	1.00	0.00	0.02	0.02	0.02	0.01	0.00	0.00	0.00
Low tax	1.00	-0.02	0.07	0.11	-0.02	0.09	-0.02	0.05	-0.03

# The macro effect (?) of GILTI.

## Experiments

Region	Lost profits (benchmark = 1)	Corp. tax rev. (% chg.)	Value added (% chg.)			Intangible capital (% chg.)			
			Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
USA	0.84	1.01	0.02	0.03	0.01	0.03	0.03	0.02	0.03
Europe	1.00	0.00	0.02	0.02	0.02	0.01	-0.00	0.00	-0.00
Rest of world	1.00	0.00	0.02	0.02	0.02	0.01	0.00	0.00	0.00
Low tax	1.00	-0.02	0.07	0.11	-0.02	0.09	-0.02	0.05	-0.03

The macro effects of GILTI per se are limited. Two counteracting forces.

# The macro effect (?) of GILTI.

## Experiments

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Rest of world	1.00	0.00	0.02	0.02	0.02	0.01	0.00	0.00	0.00
Low tax	1.00	-0.02	0.07	0.11	-0.02	0.09	-0.02	0.05	-0.03

GILTI dampens the after-tax rate of return on intangible investment ...

# The macro effect (?) of GILTI.

## Experiments

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Rest of world	1.00	0.00	0.02	0.02	0.02	0.01	0.00	0.00	0.00
Low tax	1.00	-0.02	0.07	0.11	-0.02	0.09	-0.02	0.05	-0.03

... but incentivizes tangible investment abroad. The second channel together with spillovers dominates.

# GMT: All regions including US (with spillovers)

## Experiments

Region	Lost profits (benchmark = 1)	Corp. tax rev. (% chg.)	Value added (% chg.)			Intangible capital (% chg.)			
			Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
USA	0.47	1.09	-0.15	-0.10	-0.17	-0.23	-0.30	-0.04	-0.33
Europe	0.29	2.89	-0.14	-0.07	-0.21	-0.15	-0.41	-0.02	-0.45
Rest of world	0.24	1.28	-0.19	-0.17	-0.20	-0.19	-0.24	-0.10	-0.25
Low tax	0.50	-7.65	-0.10	0.26	-0.02	-0.71	0.16	0.38	0.13

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## Experiments

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Europe	0.29	2.89	-0.14	-0.07	-0.21	-0.15	-0.41	-0.02	-0.45
Rest of world	0.24	1.28	-0.19	-0.17	-0.20	-0.19	-0.24	-0.10	-0.25
Low tax	0.50	-7.65	-0.10	0.26	-0.02	-0.71	0.16	0.38	0.13

With the US on board GMT and spillovers reduce global output across the world, through reduction of intangible capital.

# GMT: All regions including US (with spillovers)

## Experiments

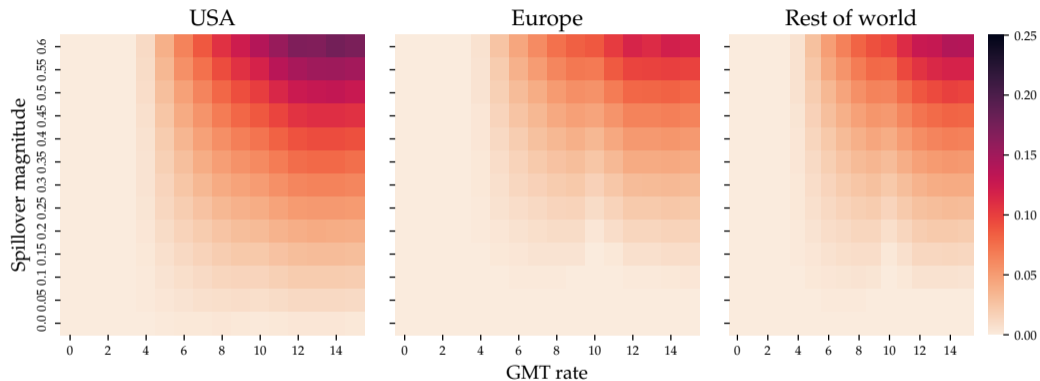
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Low tax	0.50	-7.65	-0.10	0.26	-0.02	-0.71	0.16	0.38	0.13

Though it curbs profit shifting significantly and brings back revenues to high tax jurisdictions.



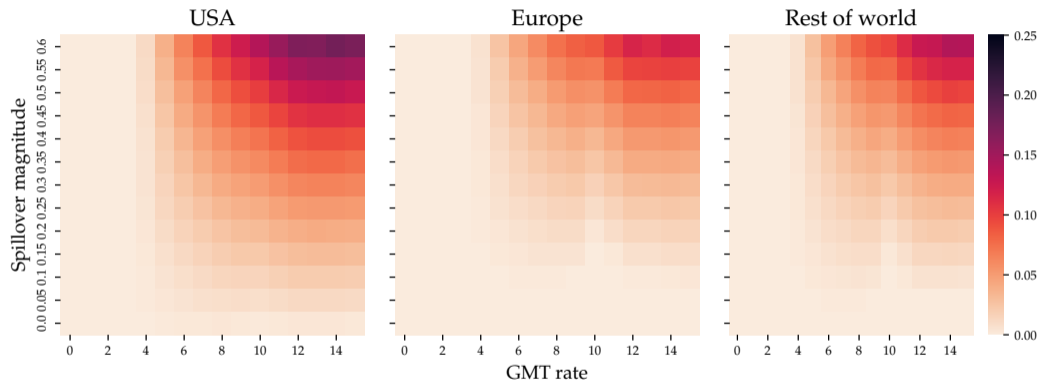
# Real GDP Change: All but US introduce GMT

## Experiments



# Real GDP Change: All but US introduce GMT

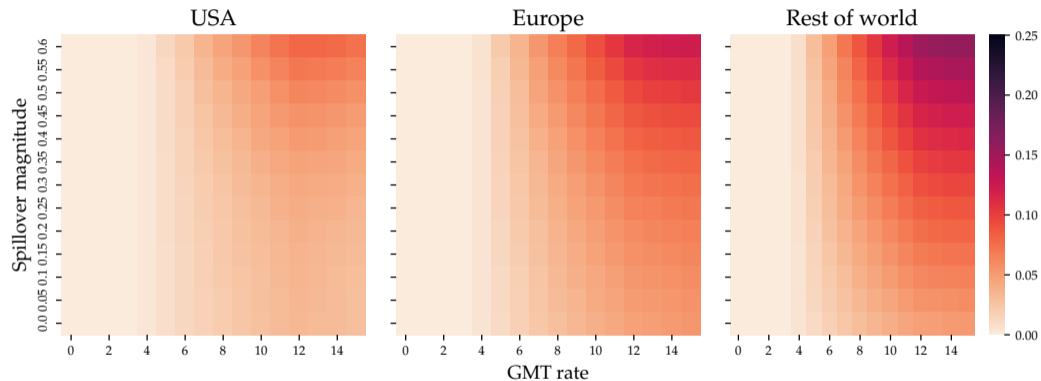
## Experiments



The larger the spillovers the more the negative effect ripples through to the US economy.

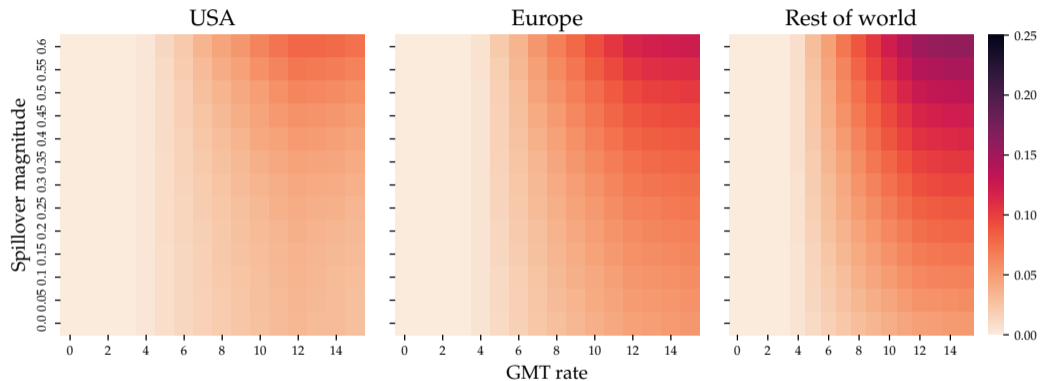
# Real GDP Change: US only introduces GMT

## Experiments



# Real GDP Change: US only introduces GMT

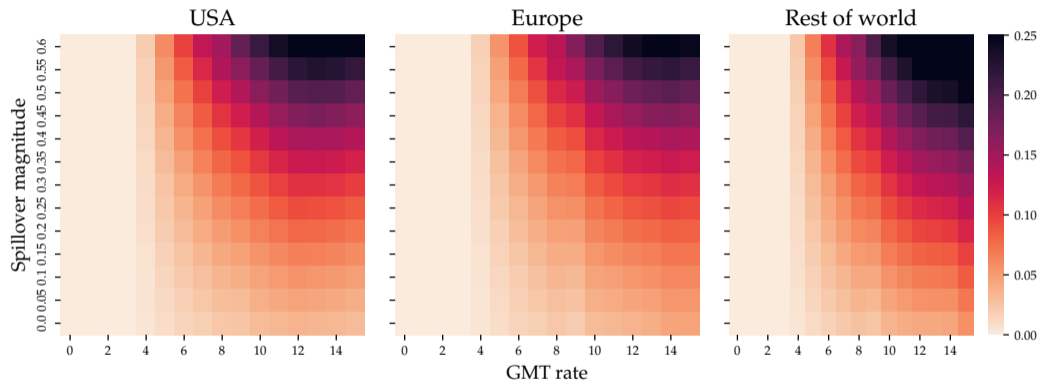
## Experiments



The effect is actually stronger than if US would unilaterally introduce GMT.

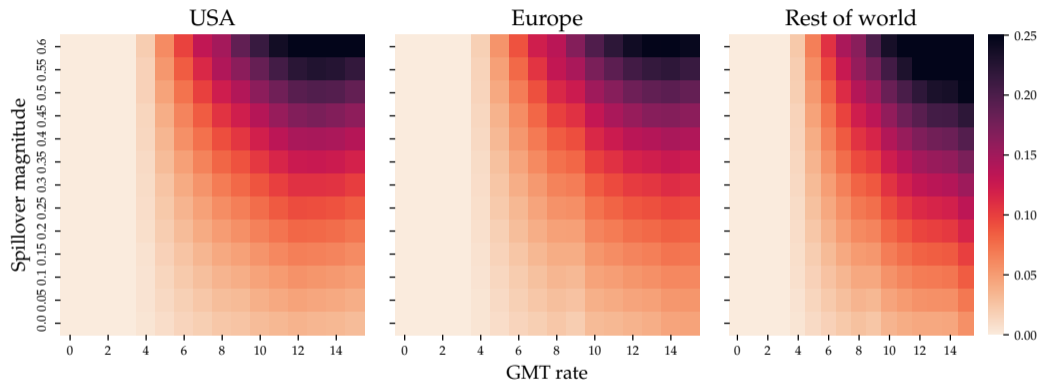
# Real GDP Change: All regions including US introduce GMT

## Experiments



# Real GDP Change: All regions including US introduce GMT

## Experiments



Spillovers amplify the effects of the GMT across the world.

# Conclusions

1. Corporate tax reforms have **ripple macro effects** in modern economy due to importance of nonrival intangible capital, profit shifting and spillovers.
2. Even if the US abstains from GMT implementation it will still experience its negative impact **without curbing profit shifting** and increasing tax revenues.
3. GILTI had **limited macroeconomic impact** due to counteracting investment incentives.

Additional Slides



# Households: preferences and budgets

- In each region  $i$  representative household solves:

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

where  $C_{it}$  is consumption,  $L_{it}$  is labor supply.

- Budget constraint:

$$P_{it}[C_{it} + X_{it}] + P_{bt}B_{it+1} = W_{it}L_{it} + R_{it}K_{it} + B_{it} + D_{it} + T_{it},$$

where  $X_{it}$  is tangible investment and  $B_{it+1}$  are internationally-traded bonds,  $D_{it}$  dividends of MNEs headquartered in  $i$ , and  $T_{it}$  are lump sum transfers.

The law of motion for tangible capital:

$$K_{it+1} = (1 - \delta)K_{it} + X_{it},$$

# Final Goods Producers

In each region  $i$  representative final-good producer that combines domestic and foreign products into a nontradable aggregate:

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

where  $q_{jit}(\omega)$  is the quantity of variety  $\omega$  from region  $j$ ,  $\Omega_{jit}$  is the set of goods from  $j$  available in  $i$  (determined by firms' exporting and FDI decisions specified later).

The aggregate price index is:

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

# Aggregation and accounting measures: GDP and Goods trade

- Gross domestic product:

$$GDP_i = \sum_{j=1}^I \int_{\omega \in \Omega_j, i \in J_F(\omega)} p_{ji}(\omega) y_{ji}(\omega) d\omega.$$

- Goods trade:

$$EX_i^G = \sum_{j \neq i} \int_{\Omega_i} p_{ij}^X(\omega) (1 + \xi_{ij}) q_{ij}^X(\omega) d\omega,$$

$$IM_i^G = \sum_{j \neq i} \int_{\Omega_j} p_{ji}^X(\omega) (1 + \xi_{ji}) q_{ji}^X(\omega) d\omega.$$

# Aggregation and accounting measures: Services trade

- High-tax regions' services:

$$EX_i^S = \sum_{j \neq i} \int_{\Omega_i} [1 - \lambda_{LT}(\omega) - \lambda_{TH}(\omega)] \vartheta_{ij}(\omega) z(\omega) d\omega + \int_{\Omega_i} \varphi_i (\lambda_{LT}(\omega) + \lambda_{TH}(\omega)) \nu_i(\omega) z(\omega) d\omega$$

$$IM_i^S = \sum_{j \neq i} \int_{\Omega_i} [\lambda_{LT}(\omega) + \lambda_{TH}(\omega)] \vartheta_{ij}(\omega) z(\omega) d\omega + \sum_{j \neq i} \int_{\Omega_j} \vartheta_{ji}(\omega) z(\omega) d\omega.$$

- The low-tax region's services:

$$EX_{LT}^S = \sum_{j \neq i} \int_{\Omega_i} [1 - \lambda_{TH}(\omega)] \vartheta_{ij}(\omega) z(\omega) d\omega + \sum_{j \neq i} \int_{\Omega_j} \lambda_{LT} \vartheta_{ji}(\omega) z(\omega) d\omega,$$

$$IM_{LT}^S = \sum_{j \neq i} \int_{\Omega_i} \lambda_{TH}(\omega) \vartheta_{ij}(\omega) z(\omega) d\omega + \sum_{j \neq i} \int_{\Omega_j} [1 - \lambda_{LT}(\omega)] \vartheta_{ji}(\omega) z(\omega) d\omega +$$

$$\sum_{j \neq i} \int_{\Omega_j} \varphi_j \lambda_{LT}(\omega) \nu_j(\omega) z(\omega) d\omega.$$

# Market clearings

- Labor market:

$$\begin{aligned}
 L_i = & \underbrace{\sum_{j=1}^I \int_{\Omega_j} \ell_{ji}(\omega) d\omega}_{\text{goods production}} + \underbrace{\int_{\Omega_i} l_i^z d\omega}_{z \text{ production}} + \underbrace{\int_{\Omega_i} \left( \sum_{j \in J_X(\omega)} \kappa_i^X + \sum_{j \in J_F(\omega)} \kappa_i^F + 1_{\{\lambda_{TH}(\omega) > 0\}} \kappa_i^{TH} \right) d\omega}_{\text{fixed costs}} \\
 & + \underbrace{\int_{\Omega_i} C_i(\lambda_{LT}, \lambda_{TH}) \nu(\omega) z(\omega) d\omega}_{\text{costs of shifting } z}.
 \end{aligned}$$

- Capital market:

$$K_i = \sum_{j=1}^I \int_{\Omega_j} k_{ji}(\omega) d\omega$$

- Government budget constraint:

$$T_i = \tau_i \sum_{j=1}^I \int_{\Omega_j} \pi_{ji}(\omega) d\omega.$$

# Market clearings

- Balance of payments:

$$EX_i^G + EX_i^S - IM_i^G - IM_i^S + NFR_i - NFP_i = 0.$$

where:

$$NFR_i = \sum_{j \neq i} \int_{\Omega_i} (1 - \tau_j) \pi_{ij}(\omega) d\omega,$$

$$NFP_i = \sum_{j \neq i} \int_{\Omega_j} (1 - \tau_i) \pi_{ji}(\omega) d\omega.$$

are net factor receipts from (payments to) foreigners.

Taking the Model to the Data

# Calibration

## *Taking the Model to the Data*

Aggregate countries into 5 regions:

- High-tax regions: United States (US), Europe (EU), Rest of the World (RW)
- Profit-shifting destinations identified by Tørsløv et al. (2022) split into
  - Low tax (LT): Belgium, Switzerland, Netherlands, Ireland etc.
  - Tax haven (TH): Antigua, Aruba, the Bahamas, Barbados etc.
  - US, EU, and RW firms can shift profits to LT and/or TH (after paying fixed FDI costs)

Discipline for key parameters:

- TFP ( $A_i$ ) and prod. dispersion ( $\sigma_a$ ): GDP and firm size dist.
- Intangible share ( $\phi$ ): Foreign MNEs' intangible share
- Trade costs ( $\kappa^X, \xi$ ): Num. exporters, trade flows
- FDI costs ( $\kappa^F, \sigma$ ): Num. MNEs, foreign MNEs' VA shares
- Corporate tax rates ( $\tau$ ): taken from Tørsløv et al. (2022)
- Markdowns ( $\varphi_i$ ): Lost profit estimates from Tørsløv et al. (2022)
  - Lost profits/GDP: 0.6% for US, 1.4% for EU, 0.7% for RoW.



# Calibration: Region-specific target moments

## Taking the Model to the Data

Statistic or parameter value	US	Europe	Low-tax	RoW	Tax haven
<i>(a) Assigned parameters and target moments</i>					
Population (NA = 100)	100	137	17	2,041	–
Real GDP (NA = 100)	100	98	18	383	–
Corporate tax rate (%)	21.0	17.3	11.4	17.4	3.3
Foreign MNEs' VA share (%)	11.12	19.82	28.73	9.55	–
Total lost profits (\$B)	143	216	–	257	–
Lost profits to TH (%)	66.4	44.5	–	71.1	–
Imports from... (% GDP)					
North America	–	1.54	0.33	8.92	–
Europe	1.01	–	2.99	8.24	–
Low tax	1.49	12.43	–	7.89	–
Row	2.36	3.70	0.59	–	–
<i>(b) Calibrated parameter values</i>					
TFP ( $A_i$ )	1.00	0.76	1.19	0.24	–
Prod. dispersion ( $\eta_i$ )	4.74	4.75	5.23	4.59	–
Utility weight on leisure ( $\psi_i$ )	1.41	1.43	1.43	1.42	–

# Measuring profit shifting in the model

## Taking the Model to the Data

- The profits shifted out of region  $j$  by firm  $\omega$  is

$$ps_{ij}(\omega) = \tilde{\pi}_{ij}(\omega) - \pi_{ij}(\omega).$$

where  $\tilde{\pi}_{ij}$  are the profits a firm would have reported in region  $j$  if it did not shift profits.

- Aggregating firm-level shifted profits yields the total profits shifted out of region  $j$ :

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

- $\tilde{\pi}_{ijt}(\omega)$  can be computed in PE (calibration) or in GE (experiments).

# Validation

## Taking the Model to the Data

Simulate at the model generated data the following

$$\log \pi_i^k(\omega) = \beta_0 + \beta_\ell \log \ell_i^k(\omega) + \beta_z \log z^k(\omega) - \beta_\tau \hat{\tau}_i^k + \epsilon_i^k(\omega)$$

- $\hat{\tau}_i^k$ : tax differential between an MNE's home region and LT or TH.
- $\beta_\tau$ : percentage change in reported profit in response to a one-percentage-point change in the tax differential between the home country and a tax haven
- $k$ : the index of the counterfactual economy

# Additional Validation

## *Taking the Model to the Data*

### 1. Share of corporate income taxes paid by foreign MNEs

Source	NA	EU	LT	RW
Data	16.65	41.58	72.40	16.32
Model	24.40	40.56	73.30	18.54

### 2. Global MNE spending on profit-shifting employees

- Tørsløv et al. (2020): \$25 billion
- Model: \$75 billion