A Macroeconomic Perspective on Taxing Multinational Enterprises

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Motivation

Introduction

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

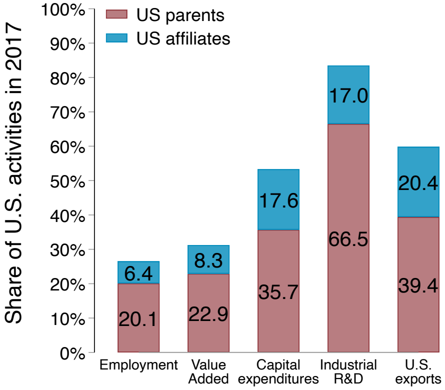
- Pillar 1: Sales-based allocation of profit taxation rights
- Pillar 2: Global minimum corporate income tax

This paper:

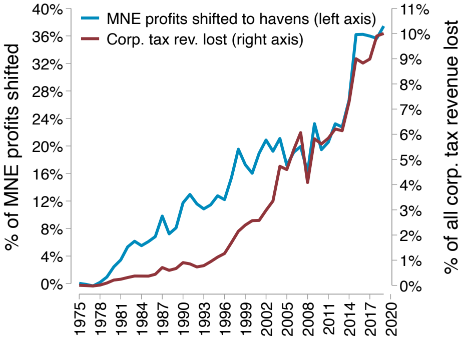
- How does profit shifting affect MNEs' production decisions at the micro level?
- What are the aggregate consequences of these micro effects?
- How will the OECD/G20 framework affect the global economy?

Importance of MNEs and profit shifting in the United States

Introduction



(a) Importance of MNEs



(b) Rise of profit shifting

Overview

Introduction

What we do

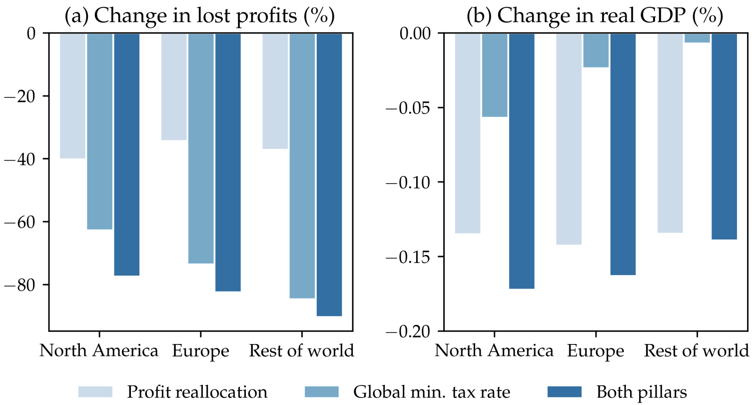
1. Develop theory of profit shifting and intangible investment
2. Embed theory in multi-country, heterogeneous-firm GE model
3. Calibrate to data on profit shifting under current international tax regime
4. Evaluate impact of OECD/G20 proposal

What we find

1. Profit shifting increases intangible investment, leading to higher output in all of an MNE's subsidiaries, both foreign and domestic
2. The OECD/G20 plan will largely eliminate profit shifting, but also reduce global output

Headline result of the paper

Introduction



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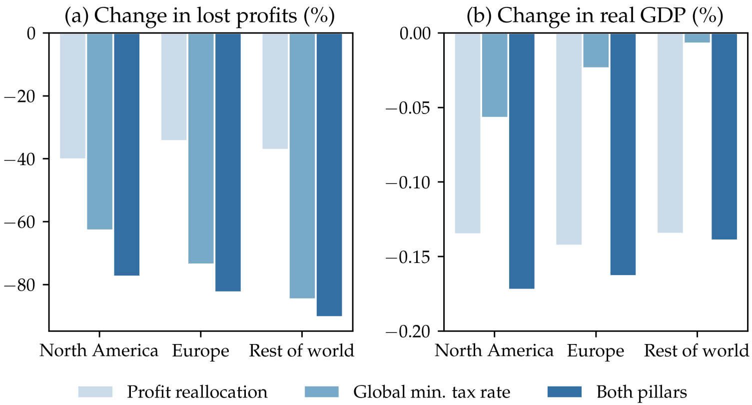
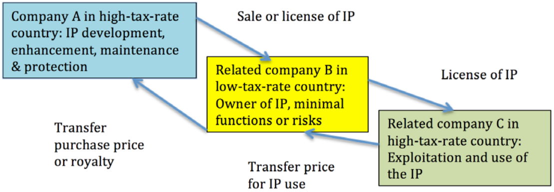


GDP losses are double that of the OECD/G20 estimates, and the rise of tax revenues is similar.

Our theory of profit shifting in brief

Introduction

- MNEs shift profits by transferring nonrival intangible capital to affiliates in tax havens
- Tax-haven affiliates charge parent (and other affiliates) licensing fees
- Empirical evidence
  - Delis et al. (2021): R&D-intensive firms shift more profits
  - Accoto et al. (2021): Profit shifters import IP services from tax havens
- End result: increases after-tax return on intangible investment



"95 percent of Apple's R&D... is conducted in the United States... [During] 2009 to 2012, ASI [Apple Ireland] paid... $5 billion to [Apple USA] as its share of the R&D costs. Over that same time period, ASI received profits of $74 billion. The difference between ASI's costs and the profits, almost $70 billion, is how much taxable income [should] have flowed to the United States."

— U.S. Senator Carl Levin, May 21, 2013

Contributions to the literature

Introduction

1. Profit shifting: Hines and Rice (1994), Suárez Serrato (2018), Delis et al. (2021), Accoto et al. (2021), Guvenen et al. (2022), Tørsløv et al. (2022)
   → Theory of profit shifting via transfer pricing of intangible capital
   → Embed in general-equilibrium model to study macro effects

2. MNEs: Helpman et al. (2004), Ellen R. McGrattan and Prescott (2009) and Ellen R. McGrattan and Prescott (2010), Tintelnot (2017), Arkolakis et al. (2018), Garetto et al. (2019), Ellen R. McGrattan and Waddle (2020)
   → Model where heterogeneous firms decide foreign affiliate locations, intangible investment, and profit shifting

3. Macro public finance: Harberger (1962), Auerbach (1983), Barro and Furman (2018), Kaymak and Schott (2018), Bhandari and Ellen R McGrattan (2020)
   → Aggregate implications of profit shifting for corporate tax reform

Theory of profit shifting

Environment: Basics

Theory of profit shifting

- MNE operates in N countries that differ in TFP (A_i), prices (p_i, w_i), corporate taxes (τ_i)
  - i: Parent division in home country
  - $j \neq i$: Foreign affiliates
  - i^*: Tax haven with $\tau_{i^*} = \min\{\tau_1, ..., \tau_N\}$
- Production technology in country j:

$$F_j(z, l_j) = A_j z^{\phi} l_j^{\gamma},$$

  - z: Non-rival intangible capital, purchased in home country
  - l_k: Rival factors, purchased locally in k
  - $\phi + \gamma < 1$: Decreasing returns to scale
- MNE's goal: maximize global after-tax profits $\sum_{j=1}^{N}(1-\tau_j)\pi_j$

Environment: Transfer pricing and profit shifting

Theory of profit shifting

- Transfer pricing:
  - Foreign affiliates pay licensing fees q_j to use intangible capital
  - Arm's-length principle: $q_j = \phi p_j \left(A_j z^{\phi-1} l_j^{\gamma}\right)$
- Profit shifting:
  - Parent division can sell fraction λ of intangible capital licensing rights to tax haven
  - Sale occurs at markdown $\varphi \leq 1$ below arm's-length price $\boldsymbol{q} = \sum_j q_j$
  - Incurs convex cost $\mathcal{C}(\lambda) = \lambda + (1-\lambda)\log(1-\lambda)$ per unit value of z
- Characterize solution to MNE's problem in two cases:
  - No profit shifting: $\lambda = 0$
  - With profit shifting: λ chosen optimally

Profit accounting

Theory of profit shifting

No profit shifting:

$$
\begin{aligned}
&\text{[Parent]} \quad \pi_i = p_i \left(A_i z^{\phi} l_i^{\gamma}\right) - w_i l_i - p_i z + \boldsymbol{q} z \\
&\text{[Affiliate]} \quad \pi_j = p_j \left(A_j z^{\phi} l_j^{\gamma}\right) - w_j l_j - q_j z, \quad \forall j \neq i
\end{aligned}
$$

With profit shifting:

$$
\text{[Parent]} \quad \pi_i = p_i \left(A_i z^{\phi} l_i^{\gamma}\right) - w_i l_i - p_i z + \left[\varphi \lambda \boldsymbol{q} - \lambda q_i + (1 - \lambda) \sum_{j \neq i} q_j - \mathcal{C}\left(\lambda\right) \boldsymbol{q} \right] z
$$

$$
\text{[Tax haven]} \quad \pi_{i^*} = p_{i^*} \left(A_{i^*} z^{\phi} l_{i^*}^{\gamma}\right) - w_{i^*} l_{i^*} + \left[\lambda \sum_{j \neq i^*} q_j - (1 - \lambda) q_{i^*} - \varphi \lambda \boldsymbol{q} \right] z
$$

$$
\text{[Affiliate]} \quad \pi_j = p_j \left(A_j z^{\phi} l_j^{\gamma}\right) - w_j l_j - q_j z, \quad \forall j \neq i, i^*
$$

Solution to MNE's problem

Theory of profit shifting

No profit shifting:

$$z = \left(\frac{\sum_{j=1}^{N} \phi \Lambda_j}{p_i} \right)^{\frac{1-\gamma}{1-\phi-\gamma}}$$

- Λ_j is a constant that depends on A_j, p_j, and w_j
- Unaffected by corporate taxes. Transfer pricing $\Rightarrow$ costs and benefits of z are taxed in i

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With profit shifting:

$$z^{PS} = \left(\frac{\sum_{j=1}^{N} \phi \Lambda_j}{p_i} \right)^{\frac{1-\gamma}{1-\phi-\gamma}} \underbrace{\left(1 - \mathcal{C}\left(\lambda\right) + \frac{\lambda(1-\varphi)(\tau_i - \tau_{i^*})}{(1-\tau_i)} \right)^{\frac{1-\gamma}{1-\phi-\gamma}}}_{\text{Per-unit net gain from profit shifting} > 1}$$

- Profit shifting increases $z \Rightarrow$ higher output in all production locations
- Effect increasing in τ_i, decreasing in φ and τ_{i^*}

Optimal profit shifting

Theory of profit shifting

The share of shifted intangible capital:

$$\lambda = 1 - \exp\left(-\frac{(1-\varphi)(\tau_i - \tau_{i^*})}{1-\tau_i}\right)$$

Lemma

The share of shifted intangible capital λ is:
1. Decreasing in φ.
2. Decreasing in τ_{i^*} with elasticity given by

$$\varepsilon^{\lambda}_{\tau_{i^*}} = -\frac{1-\lambda}{\lambda}\left(\frac{1-\varphi}{1-\tau_i}\right)\tau_{i^*}$$

Proposition

1. $z^{PS} > z \iff \varphi < 1$ and $z^{PS} = z \iff \varphi = 1$.
2. z^{PS} is decreasing in φ.
3. z^{PS} is decreasing in τ_{i^*}.

with the following elasticities:

$$\varepsilon^{z}_{\tau_{i^*}} = 0$$

and

$$\varepsilon^{z^{PS}}_{\tau_{i^*}} = \frac{1-\gamma}{1-\phi+\gamma}\left(\frac{-\tau_{i^*}}{\tau_i - \tau_{i^*}}\right)\frac{1}{\left[1+\frac{1-\mathcal{C}(\lambda)}{\mathcal{C}'(\lambda)}\right]} < 0$$

Effects of OECD/G20 pillar 1 (sales-based profit allocation)

Theory of profit shifting

The MNE's tax base in jurisdiction k as:

$$T_k = \underbrace{\pi_k^r}_{\text{Routine profit}} + (1-\boldsymbol{\theta}) \times \underbrace{\pi_k^R}_{\text{Residual profit}} + \boldsymbol{\theta} \times \underbrace{\frac{\boldsymbol{p_k y_k}}{\boldsymbol{\sum_k p_k y_k}}}_{\text{Sales share of } k} \times \underbrace{\Pi^R}_{\text{Global residual profit}}$$

where:

- $\pi_k^r = \boldsymbol{\mu} p_k y_k$
- $\pi_k^R = \pi_k^{PS} - \pi_k^r$
- $\Pi^R = \sum_k \pi_k^R$

with two policy parameters:

- $\boldsymbol{\mu}$ is the routine profit margin
- $\boldsymbol{\theta}$ is the fraction of global residual profits reallocated according to sales shares

Proposition

Let $\hat{\lambda}$ and $\hat{z}^{PS}$ be the allocations under Pillar 1. Then:

1. $\hat{\lambda} < \lambda$ *and* $\hat{z}^{PS} < z^{PS}$.
2. $\hat{\lambda}$ *and* $\hat{z}^{PS}$ *are decreasing in* θ.
3. *The economy is less responsive to changes in* τ_{i^*}*:*

$$\left|\varepsilon_{\tau_{i^*}}^{\hat{z}^{PS}}\right| < \left|\varepsilon_{\tau_{i^*}}^{z^{PS}}\right|$$

where

$$\lambda = 1 - \exp\left(-\frac{(1-\varphi)(\tau_i - \tau_{i^*})}{1-\tau_i}\right)$$

$$\hat{\lambda} = 1 - \exp\left(-\frac{(1-\varphi)\,(1-\boldsymbol{\theta})\,(\tau_i - \tau_{i^*})}{1 - ((1-\boldsymbol{\theta})\,\tau_i + \boldsymbol{\theta}\widehat{\boldsymbol{\tau}})}\right) \quad \text{with} \quad \widehat{\boldsymbol{\tau}} \equiv \sum_j \tau_j \cdot \frac{\boldsymbol{p_j y_j}}{\sum_{\boldsymbol{k}} \boldsymbol{p_k y_k}}$$

Quantitative model

Model environment

Quantitative model

- Quantitative version of model accounts for importance of firm heterogeneity in MNE activity, R&D, and profit shifting
  - Firms are heterogeneous in productivity
  - Exporting and establishing foreign affiliates require fixed costs. **Endogenous selection** to exports and FDI.
  - In terms of #: non-exporters $>$ exporters $>$ MNEs $>$ profit-shifting MNEs
  - In terms or size: non-exporters $<$ exporters $<$ MNEs $<$ profit-shifting MNEs
- N productive regions
  - A region: population, TFP, trade/FDI openness, corporate taxes
  - Representative consumer, gov't, and measure of firms
- 1 unproductive region ("tax haven")
  - Gov't earns revenue by taxing profits of foreign MNEs' affiliates

Households

- Preferences:

$$u\left(\frac{C_i}{N_i}, \frac{L_i}{N_i}\right) = \log\left(\frac{C_i}{N_i}\right) + \psi_i \log\left(1 - \frac{L_i}{N_i}\right).$$

- Budget constraint:

$$P_i C_i = W_i L_i + D_i + T_i,$$

  where W_i is the wage, D_i is the aggregate dividend payment from firms based in region i, and T_i is a transfer from the government.

- Consumption is a constant-elasticity-of-substitution aggregate of products from different source countries,

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

Intermediate Goods Producers: Technology

- Each productive region i has a unit measure Ω_i of firms that compete monopolistically (Chaney, 2008).

- A firm from region i produces in any productive region j according to:

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

- Two modifications relative to theory:
  - $\rightarrow$ FDI barriers, $\sigma_{ij} \in [0, 1]$, as in (Ellen R. McGrattan and Prescott, 2010)
  - $\rightarrow$ Idiosyncratic productivity: a

- Intangible capital:

$$z = A_i l_i^z$$

Trade and Foreign Direct Investment

- Let $J_X \subseteq I \setminus \{i\}$ denote the set of foreign regions to which a firm exports, and let $J_F \subseteq I \setminus \{i\}$ denote the set of regions in which it operates a foreign affiliate.

- The firm's resource constraints:

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

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

  where

  → ξ_{ij}: iceberg transportation cost for each unit of goods shipped abroad.
  → q_{ij}^X: exported goods
  → q_{ij}: goods that are produced and consumed in the same location

Stage 2: Operating profits

- The domestic parent corporation's profits are

$$\pi_i^D(a,z;J_X) = \max_{q_{ii},\{q_{ij}^X\}_{j\in J_X},\ell_i} \left\{ p_{ii}(q_{ii})q_{ii} + \sum_{j\in J_X} p_{ij}(q_{ij}^X)q_{ij}^X - W_i\ell_i \right\}$$

$$\text{s.t} \quad q_{ii} + \sum_{j\in J_X} \xi_{ij}q_{ij} = y_{ii}$$

- Foreign subsidiaries' profits are

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

Stage 1: Locations, intangible capital and profit shifting.

Firm maximizes dividends:

$$d_i(a) = \max_{\substack{z, J_X, J_F, \\ \boldsymbol{\lambda} \in \Gamma}} \Bigg\{ (1-\tau_i)\pi_{ii} + \sum_{j \in J_F \setminus \{LT\}} (1-\tau_j)\pi_{ij} \\ + (1-\tau_{LT})\pi_{i,LT} 1_{\{LT \in J_F\}} + (1-\tau_{TH})\pi_{i,TH} 1_{\{\lambda_{TH} > 0\}} \Bigg\}$$

subject to

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

where:

- $\boldsymbol{\lambda} = (\lambda_{LT}, \lambda_{TH})$
- π_{ii}: taxable profits of the parent division
- π_{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

Taxable profits: parent division

$$\pi_{ii} = \pi_i^D(a, z; J_X) - W_i \overbrace{\left(l_i^z + \sum_{j \in J_X} \kappa_{ij}^X + \sum_{j \in J_F} \kappa_{ij}^F + \kappa_{iTH} 1_{\{\lambda_{TH} > 0\}} \right)}^{\text{Costs of intangible capital production and fixed costs}}$$

$$+ \overbrace{(\varphi_{iLT}\lambda_{LT} + \varphi_{iTH}\lambda_{TH})\,\nu_i(z) z}^{\text{Proceeds from selling } z} + \overbrace{\sum_{j \in J_F} (1 - \lambda_{LT} - \lambda_{TH}) \vartheta_{ij}(z) z}^{\text{Licensing fee receipts}} - \overbrace{(\lambda_{LT} + \lambda_{TH}) \vartheta_{ii}(z) z}^{\text{Licensing fee payments}}$$

$$- \overbrace{W_i \mathcal{C}_i(\lambda_{LT}, \lambda_{TH}) \nu_i(z) z}^{\text{Cost of transferring } z}.$$

where:

- κ_i^X: a fixed cost to export domestically produced goods
- κ_i^F: a fixed cost to open a foreign affiliate and produce locally
- $\vartheta_{ij}(z) z \equiv \gamma p_{ij} y_{ij} / z$: licensing fee of a subsidiary in region j
- $\nu_i z \equiv \sum_{j \in J_F \cup \{i\}} \vartheta_{ij}(z) z$: total amount of licensing fees across the conglomerate

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) :

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

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:

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

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

Aggregation and accounting measures: Services trade

- High-tax regions' services:

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

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

- The low-tax region's services:

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

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

Market clearings

- Labor market:

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

- 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: North America (NA), 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.
  - NA, 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 (σ_a): GDP and firm size dist.
- Intangible share (ϕ): Foreign MNEs' intangible share
- Trade costs (κ^X, ξ): Num. exporters, trade flows
- FDI costs (κ^F, σ): Num. MNEs, foreign MNEs' VA shares
- Corporate tax rates (τ): taken from Tørsløv et al. (2022)
- Markdowns (φ_i): Lost profit estimates from Tørsløv et al. (2022)
  - Lost profits/GDP: 0.6% for NA, 1.4% for EU, 0.7% for RoW.

Calibration: Region-specific target moments

Taking the Model to the Data

Region	North America	Europe	Low-tax	RoW	Tax haven
Population (NA = 100)	100	92	11	1,323	–
Real GDP (NA = 100)	100	80.78	14.57	297.10	–
Corporate tax rate (%)	22.5	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	–	1.28	1.77	1.74	–
Europe	1.70	–	12.39	3.78	–
Low tax	0.35	2.98	–	0.59	–
Row	6.15	7.96	6.78	–	–

Measuring profit shifting in the model

Taking the Model to the Data

- The profits shifted out of region j by firm ω 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.
- β_τ: 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

Study	**Data source**	β_τ
Johansson et al., 2017	ORBIS, 2000-2010	1.11
Heckemeyer and Overesch, 2017	Meta: 27 studies, 203 estimates	0.79
Beer et al., 2020	Meta: 38 studies, 402 estimates	0.98
This paper	Simulated model data	0.87

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

Experiments & results

Inspecting the Mechanism: Macro Effects of Profit Shifting

Experiments & results

Region	Lost profits (% GDP)	Corp. tax rev. (% chg.)	Value added (% chg.)	Tech. capital (% chg.) Total	Tech. capital (% chg.) Non MNEs	Tech. capital (% chg.) Domestic MNEs
North America	0.68	-3.82	0.08	0.21	-0.11	0.45
Low tax	-4.37	23.52	-0.04	-0.55	-0.60	-0.49

Inspecting the Mechanism: Macro Effects of Profit Shifting

Experiments & results

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On impact Domestic MNEs in NA increase intangible investment as the return on them rises. All other firms are hit by increase in wages thus reduce investment.

Inspecting the Mechanism: Macro Effects of Profit Shifting

Experiments & results

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The net effect is positive in NA and negative in Low tax region.

Inspecting the Mechanism: Macro Effects of Profit Shifting

Experiments & results

Region	Lost profits (% GDP)	Corp. tax rev. (% chg.)	Value added (% chg.)	Tech. capital (% chg.) Total	Non MNEs	Domestic MNEs
North America	0.68	-3.82	0.08	0.21	-0.11	0.45
Low tax	-4.37	23.52	-0.04	-0.55	-0.60	-0.49

Profits flow out of NA and are largely booked in Tax Haven and Low tax region.

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Corporate tax base and hence tax revenues expand in Low tax region and they shrink in NA.

Inspecting the Mechanism: VA decomposition

Experiments & results

	Value added (% chg.)			
Region	Total	Non MNEs	Domestic MNEs	Foreign MNEs
North America	0.08	-0.03	0.15	0.15
Low tax	-0.04	-0.33	-0.29	0.64

Inspecting the Mechanism: VA decomposition

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Both Foreign and Domestic MNEs benefit from profit shifting in NA.

Inspecting the Mechanism: VA decomposition

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Foreign MNEs expand in the Low tax region.

Inspecting the Mechanism: VA decomposition

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At the expense of domestic MNEs and Non MNEs, which are priced out through the GE effect.
The net effect leaves VA almost unchanged.

OECD/G20 plan details

Experiments & results

Pillar 1: Sales-based profit allocation

- Allocate rights to tax 25% of an MNE's global residual profits based on countries' shares of its global sales
- Residual profits defined as reported profits above pre-determined share of revenues
- Independent of a physical presence; export destinations without foreign affiliates get a cut

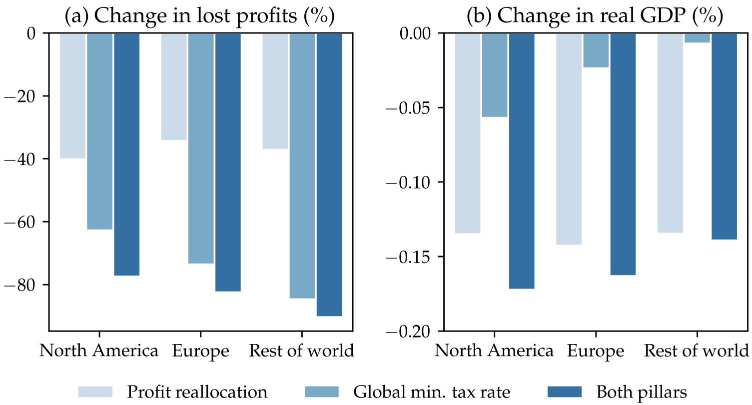
Pillar 2: Global minimum corporate income tax

- If firm from i reports profits in j with $\tau_j < \underline{\tau} = 15\%$, then i taxes these profits at rate $\underline{\tau} - \tau_j$
- 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.
- Additional revenue for i is

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

OECD/G20 plan: effects on profit shifting and output

Experiments & results



OECD/G20 plan: effects on profit shifting and output

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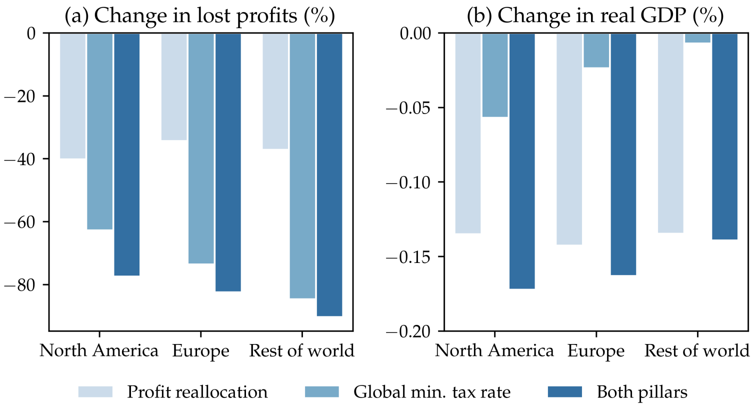
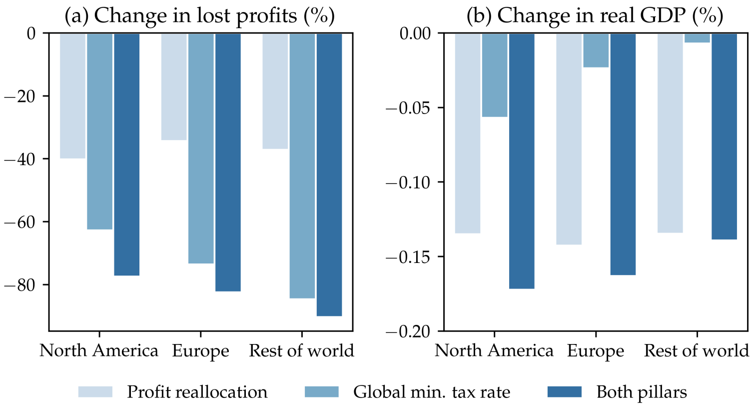


Both pillars reduce profit shifting, but also GDP

OECD/G20 plan: effects on profit shifting and output

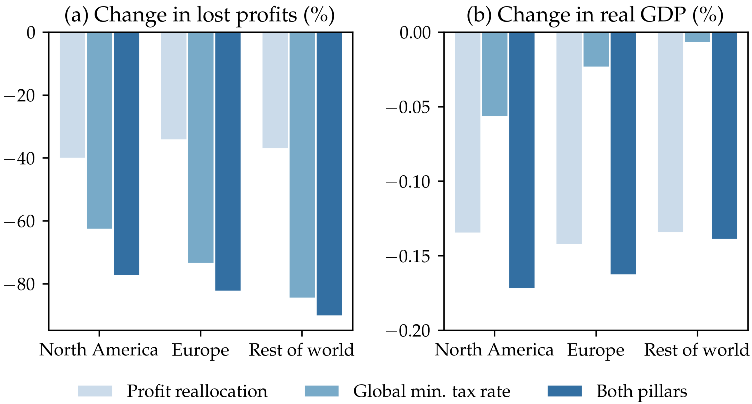
Experiments & results



Global min tax has larger effect on profit shifting, but smaller effect on output

OECD/G20 plan: effects on profit shifting and output

Experiments & results



Combined effect of both pillars on profit shifting similar to effect of global min tax. Combined effect on GDP similar to effect of profit reallocation.

OECD/G20 plan: decomposition of output effects (NA vs. LT)

Region	Value added (% chg.)				Intang. capital (% chg.)		
	Total	Non MNEs	Domestic MNEs	Foreign MNEs	Total	Non MNEs	Domestic MNEs
(a) Pillar 1: Profit reallocation							
North America	-0.13	-0.01	-0.30	-0.05	-0.40	0.15	-0.80
Low tax	-0.13	-0.10	0.36	-0.56	0.79	0.23	1.35
(b) Pillar 2: Global minimum tax rate							
North America	-0.06	0.01	-0.10	-0.13	-0.15	0.08	-0.31
Low tax	0.02	0.23	0.19	-0.46	0.32	0.36	0.28
(c) Pillars 1 & 2 together							
North America	-0.17	-0.02	-0.36	-0.11	-0.48	0.17	-0.94
Low tax	-0.13	0.07	0.50	-0.98	1.00	0.48	1.51

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Output falls in both high- and low tax regions, but for different reasons.

OECD/G20 plan: decomposition of output effects (NA vs. LT)

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In high-tax regions, losses come primarily from domestic MNEs' lower intangible investment. But foreign MNEs matter too.

OECD/G20 plan: decomposition of output effects (NA vs. LT)

Experiments & results

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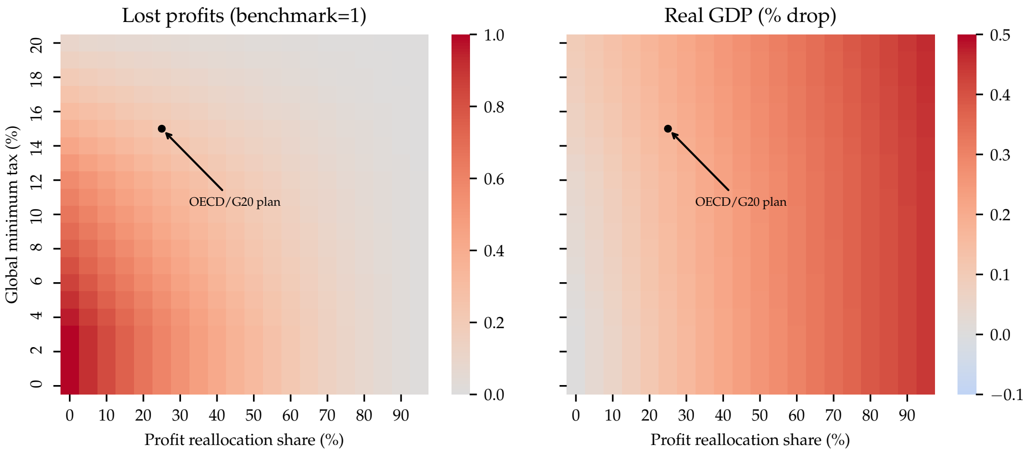
In low-tax region, losses come solely from foreign MNEs' lower intangible investment. Note domestic firms actually invest and produce more.

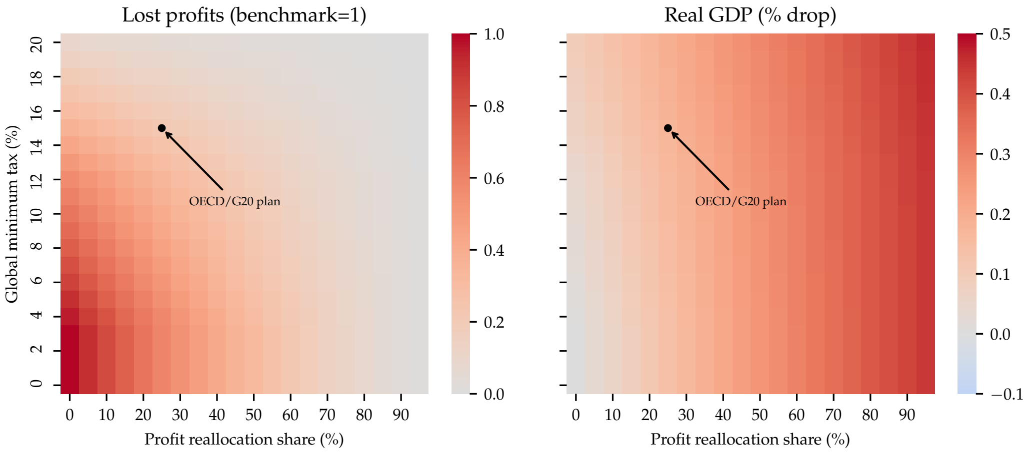
OECD/G20 plan: varying the pillar parameters (NA only)

Experiments & results



OECD/G20 plan: varying the pillar parameters (NA only)

Experiments & results



Effect of OECD/G20 plan plan on profit shifting can be achieved with smaller output loss by raising global min tax slightly and eliminting profit reallocation rule

Conclusion

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Methodology: Develop theory in which MNEs shift profits by transferring IP to tax havens. Integrate into quantitative GE model.

Theoretical insight: Profit shifting increases' MNEs' incentives to invest in intangible investment. Boosts output both at home and abroad.

Quantification: OECD/G20 reform will materially reduce global GDP. Despite small number of firms targeted, similar magnitude to welfare effects of major trade liberalizations.

- U.S. gained 0.06% from NAFTA (Caliendo and Parro, 2014)
- OECD gained 0.15% from China trade (Giovanni et al., 2014)

Broader agenda:

- "Optimal Taxation of Multinational Enterprises: A Ramsey Approach" (JME 2024)
- "The Ripple Effects of Global Tax Reform on the U.S.Economy"