Profit-shifting Frictions and the Geography of Multinational Activity

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Motivation

- The international corporate tax system is outdated.
  - Inherits the broad principles set out in the 1920s at the League of Nations.
  - Allows multinationals to exploit complexity, loopholes, and mismatches in international tax rules.

  $\Longrightarrow$ $\approx$ 5-10% of world corporate tax revenue losses due to profit shifting.

- Current system has eroded countries' tax sovereignty (Janet Yellen, June 2021).
  - Tax competition vs. fiscal dumping.
  - October 2021: Reform agreement
  - Main goal: plugging the "tax leaks," i.e., curb profit-shifting to low-tax jurisdictions.

This Paper

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   - → Flexible: various taxation regimes and policy options (Destination versus minimum taxation).
   - → Firms *respond* to tax reforms by reallocating activities and their tax planning strategy.

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2. Introduce two key elements to understand the international reallocation effects at stake in international reforms:
   - → Tax-elasticity of real activities vs. ”paper profits”.
   - → Non-tax determinants: bilateral profit shifting frictions.

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   - → Non-tax determinants: bilateral profit shifting frictions.

3. Assess the impact on corporate tax revenues, profit shifting, and welfare.
   - → New methodology to estimate bilateral profit shifting to calibrate the model.
   - → Estimate bilateral (source-haven) profit shifting frictions and residence-country
   - → Real-effects from tax reform of comparable magnitude to mechanical ones.
   - → Extensions: countries' best response, alternative designs (DBCFT).

Literature

Corporate income taxes and firms' location

- Hines & Rice (1994), Devereux & Griffith (1998), Barrios et al. (2012), Becker et al. (2012), Egger & Wamser (2015), Clausing (2016), Dowd et al. (2017).

Profit shifting, tax avoidance, and tax havens

- *Channels*: Dharmapala & Riedel (2013), Egger et al. (2014), Heckemeyer & Overesch (2017), Alstadsaeter et al. (2018), Davies et al. (2018), Bilicka (2019), Beer et al. (2020), Laffitte & Toubal (2022).
- *Macro estimates*: UNCTAD (2015), Crivelli et al. (2016), Clausing (2016), Alvarez-Martinez et al. (2018), Cobham & Jansky (2018), Jansky & Palansky (2019), Tørsløv et al. (2022), Dyreng et al. (2022)

Tax reforms

- Auerbach et al., 2017, Avi-Yonah et al. (2011), Azemar et al. (2019), Devereux et al. (2019), Fuest et al. (2019), Guo et al. (2019).

(New quantitative multinational production models)

- Arkolakis et al. (2018), Fajgelbaum et al. (2019), Head & Mayer (2019), Wang (2020).

Model

Model Outline

- Literature on MNEs: **interdependence** between the location of headquarters (HQ), production, and sales.
- Headquarters i, Production l, Sales n,

Context

International corporate taxation's principle: firms' profits should be taxed where economic activities take place and value is created.

- Allowing for tax avoidance $\rightarrow$ addition of a 4^{th} jurisdiction, a tax haven h.
- Jurisdictions indexed by i, l, n and h:
  - Headquarters i,
  - Production l,
  - Sales n,
  - Profits and taxes h.

Model Outline

Firm in residence country i

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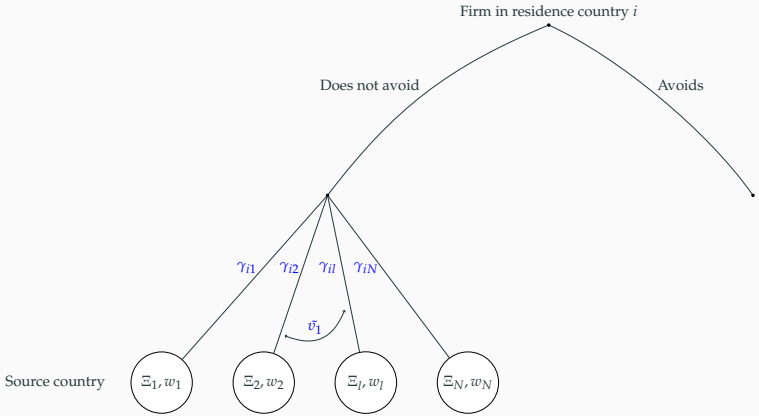

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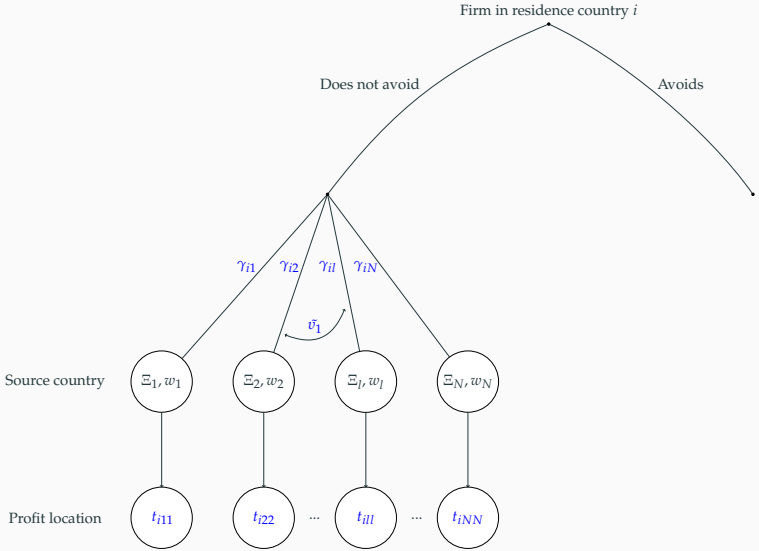

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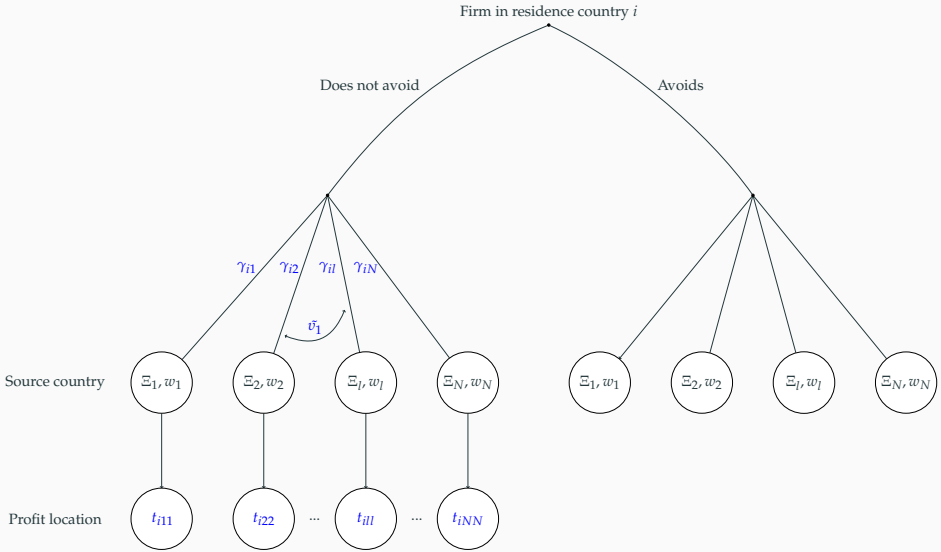

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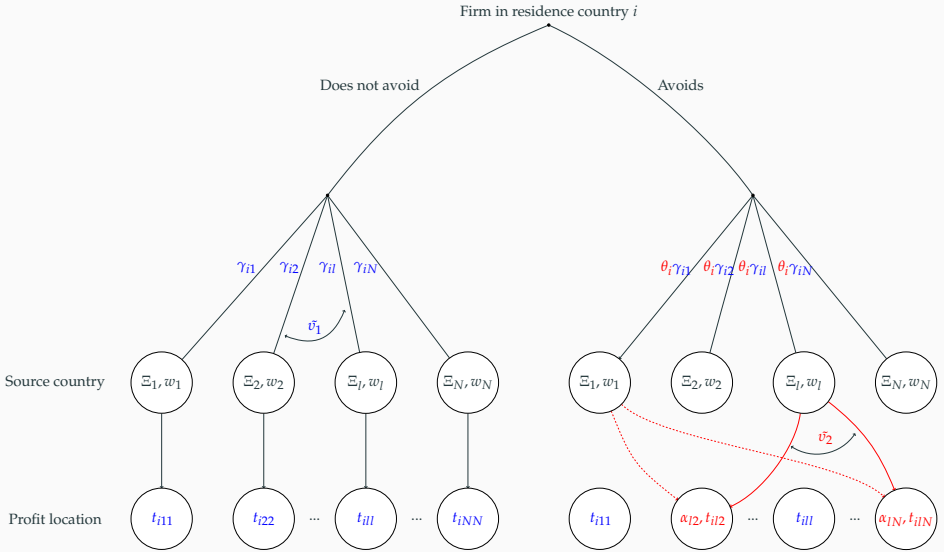

Firm profits, firm location and tax avoidance

- Firms in i decide to **enter**.
- Firms differ in φ_{lh}, i.e., their **productivity** and **tax-avoidance ability** in each pair lh.

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- Decide on the **production site** and **tax location**:

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- $\varphi_{lh} \sim \mathcal{F}(\boldsymbol{A}, \upsilon_1, \upsilon_2)$: multivariate Frechet distribution of productivities with scale parameters A_{lh} and a homogenous correlation function $G(.)$ akin to a nested logit.

Aggregation

Proposition (Gravity Structure of Multinational Production and Profit Shifting)

The fraction of profits that remain taxable in each source country l is

$$\frac{X_{ill}}{X_i} = \frac{\tilde{A}_{ill}(1-t_{ill})^{\frac{v_1}{\sigma-1}-1}\iota_l^{-1}}{\sum_{jk}\tilde{A}_{ijk}(1-t_{ijk})^{\frac{v_1}{\sigma-1}-1}\iota_j^{-1}G_{i,jk}(\tilde{\mathbf{A}}_i,\mathbf{t})}.$$

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The fraction of shifted income generated by firms from i that is produced in l and reported in tax haven h

$$\frac{X_{ilh}}{\sum_{jk,j\neq k}X_{ijk}} = \frac{\tilde{A}_{ilh}^{\frac{v_2}{v_1}}(1-t_{ilh})^{\frac{v_2}{\sigma-1}-1}\iota_l^{-1}}{\sum_{jk,j\neq k}\tilde{A}_{ijk}^{\frac{v_2}{v_1}}(1-t_{ijk})^{\frac{v_2}{\sigma-1}-1}\iota_j^{-1}}.$$

Hence, the partial elasticity of the tax base in l to $1-t_{ill}$ is $\tilde{v}_1 := \frac{v_1}{\sigma-1}-1$ and the partial elasticity of profits shifted from l to h w.r.t. $1-t_{ilh}$ is equal to $\tilde{v}_2 := \frac{v_2}{\sigma-1}-1$.

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- Key trade-off of curbing PS:

  $\uparrow$ **public goods + better spatial allocation vs** $\downarrow \mathcal{N}$

Model to Data

Calibration

- **Sample**:
  - 40 countries $\rightarrow$ 84% of world GDP.
  - Including 7 tax havens: Hong Kong, Ireland, Luxembourg, Netherlands, Singapore, Switzerland + "Offshore Financial Centers" (aggregate of 29 tax havens).

- **To be calibrated/estimated**:
  - Elasticity parameters (e.g., v_1,v_2).

- **Inputs**:
  - $\mathbb{P}_{ilh}$: the probability for firms HQ in i to produce in l and shift in h. .
  - Trade shares from source l to market n.
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Identification

- The model structure gives two important results

Proposition (Decomposition of $\mathbb{P}_{ilh}$)

The probability that a tax-avoiding firm from i produces in l and shifts to h is

$$\mathbb{P}_{ilh} = \mathcal{P}_i \times \zeta_{il} \times \chi_{lh} \text{ , for } h \neq l,$$

where $\mathcal{P}_i = \frac{PS_i}{\Pi_i}$ is the probability that firms headquartered in i shift profits, ζ_{il} is the probability that a tax-avoiding firm headquartered in i locates production in l and χ_{lh} is the probability that a tax-avoiding firm producing in l books its profits in h.

$\Rightarrow$ **We can get $\mathbb{P}_{ilh}$ as a composition of unilateral and bilateral probabilities.**

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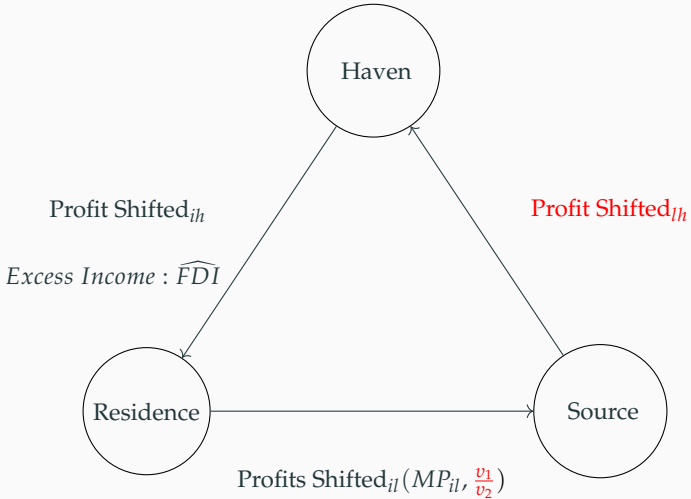
Proposition (Triangle of Profit Shifting)

The following holds

$$\frac{PS_{ih}}{PS_i} = \sum_{l \neq h} \zeta_{il} \times \chi_{lh}.$$

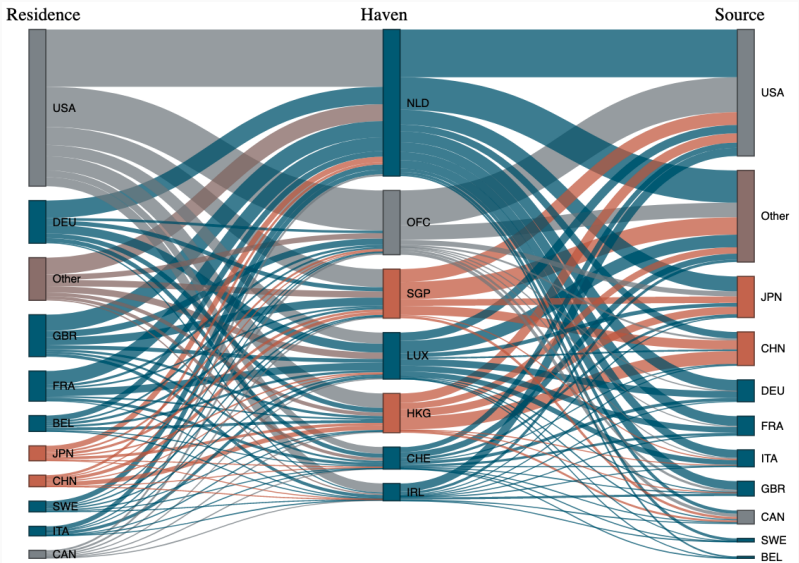
$\Rightarrow$ **PS flows from l to h are implied by a system of equation taking as inputs MP from i to l and shifted incomes from i to h.**

Identification



▸ Details ▸ Excess Income Estimation

Profit shifting from i to l and l to h.



PS Flows Comparisons

Source	Correlation	Obs.
TWZ (bilateral)	0.62	111
Excess services (bilateral)	0.64	182
TWZ (unilateral)	0.91	33
TJN	0.92	33
CORTAX	0.94	21

▸ Details Excess Services

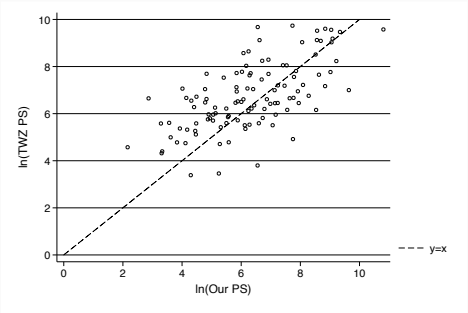


Figure 1: Comparison with TWZ (2022).

Estimating Elasticities

- The model gives us gravity equations for real activity and shifted incomes

$$\frac{X_{ill}}{X_i} = \frac{\tilde{A}_{ill}(1-t_{ill})^{\frac{v_1}{\sigma-1}-1}\iota_l^{-1}}{\sum_{jk}\tilde{A}_{ijk}(1-t_{ijk})^{\frac{v_1}{\sigma-1}-1}\iota_j^{-1}G_{i,jk}(\tilde{\mathbf{A}}_i,\mathbf{t})} \qquad \text{(Real Activity)}$$

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(PS)

- Backing out σ from firm-level markups, we obtain v_1 and v_2

Estimating Elasticities

	Estimation $\tilde{v}_1$		Estimation $\tilde{v}_2$	
Dep. Var.	$ln\left(\frac{X_{ill}}{\sum_i X_{ill}}\right)$	$\frac{X_{ill}}{\sum_i X_{ill}}$	$ln\left(\frac{X_{ilh}}{\sum_i X_{ilh}}\right)$	$\frac{X_{ilh}}{\sum_i X_{ilh}}$
$ln(\tilde{t}_{ll})$	2.639***	3.047*		
	(0.688)	(1.674)		
$ln(\tilde{t}_{lh})$ (Med.)			7.869***	8.625***
			(0.191)	(1.295)
Observations	1,256	1,600	6,561	7,091
Estimator	OLS	PPML	OLS	PPML
Gravity controls	Yes	Yes	Yes	Yes
i country FE	Yes	Yes	No	No
i-l pair FE	–	–	Yes	Yes
Technology controls	Yes	Yes	–	–

Profit Shifting Frictions

Proposition (Profit-Shifting Frictions)

At the calibrated equilibrium the following holds

$$\frac{\mathbb{P}_{ilh}}{\mathbb{P}_{ill}} = \bar{\theta}\tilde{\theta}_i\alpha_{lh} \times f(\mathcal{O}),$$

where $f(\cdot)$ is a known function of observables and $\bar{\theta}$ is a normalizing constant such that $\theta_i = \bar{\theta}\tilde{\theta}_i$.

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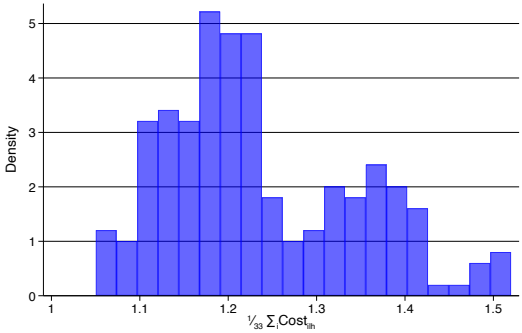

Figure 2: Profit shifting friction α_{lh}

Profit Shifting Frictions

	$ln(Cost_{ilh})$				
$ln(distance_{lh})$	0.0118***	0.00901***	0.0114***	0.00957***	0.0129***
	(0.000420)	(0.000361)	(0.000348)	(0.000350)	(0.000402)
$ln(t_l - t_{lh})$	-0.00149***	-0.0104***	-0.0124***	-0.00553***	-0.0209***
	(0.000214)	(0.000883)	(0.000984)	(0.000450)	(0.00189)
Corporate tax haven index$_h$			-0.000979***		
			(2.60e-05)		
Loopholes and gaps$_h$				-0.000311***	
				(1.33e-05)	
Transparency$_h$ (inverse)					-0.000796***
					(2.32e-05)
Observations	6,996	6,996	6,996	6,996	6,996
Gravity Controls	Yes	Yes	Yes	Yes	Yes
Residence Fixed Effects	Yes	Yes	Yes	Yes	Yes
Source Fixed Effects	Yes	Yes	Yes	Yes	Yes
Haven Fixed Effects	Yes	No	No	No	No
Haven-level controls	No	Yes	Yes	Yes	Yes

▸ Gravity Structure of PS Frictions

Policy Analysis

Policy Counterfactuals

- Today: 2 policy alternatives
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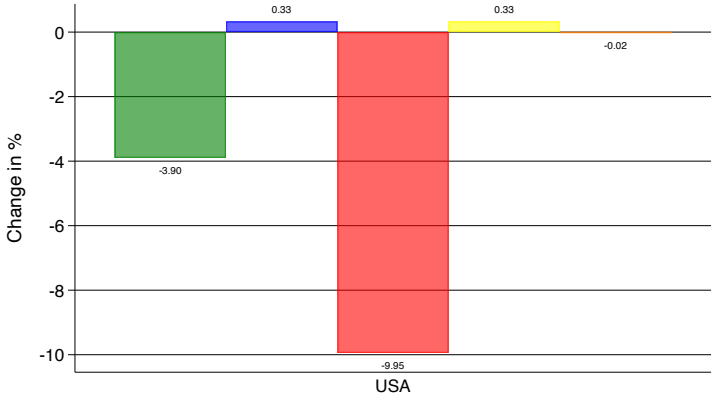
- Outcomes
  - tax revenues,
  - profit shifting,
  - production,
  - real income,
  - welfare.

US decreases its tax rate by 5% (40% to 38%)

Effect on the U.S.



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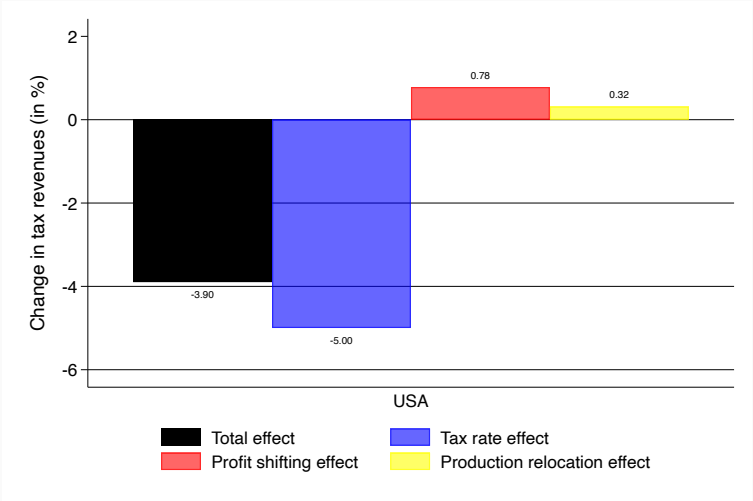
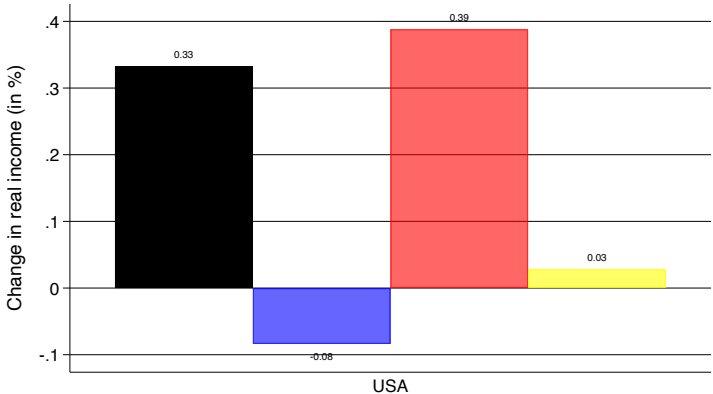
Effect on tax revenues in the U.S.



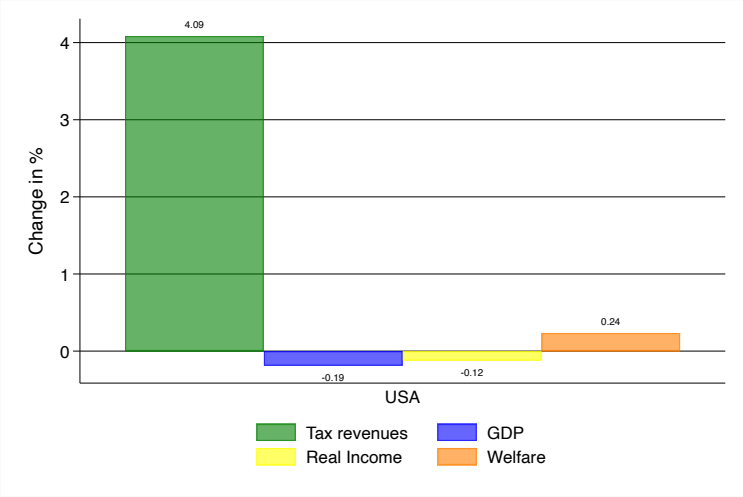
US decreases its tax rate by 5% (40% to 38%)

Effect on real income in the U.S.



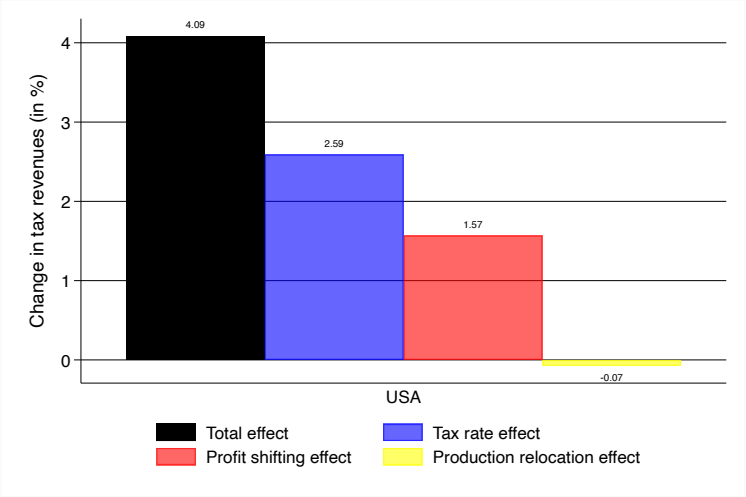
Multilateral Residence Minimum taxation 15%

Effect on the U.S.



Multilateral Residence Minimum taxation 15%

Effect on tax revenues in the U.S.

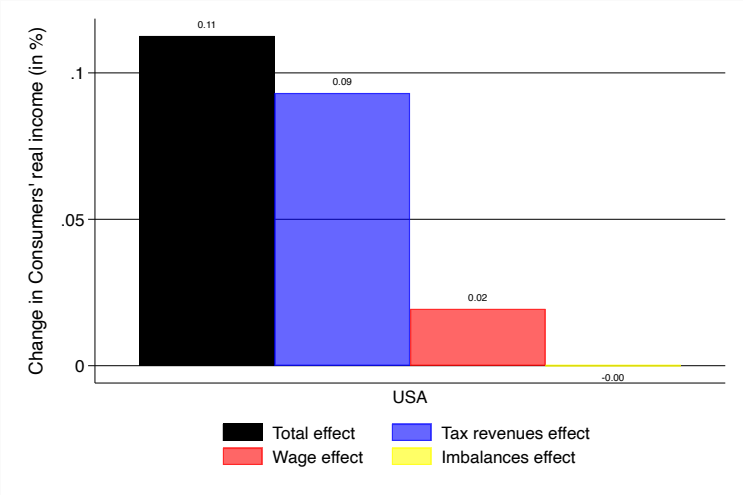


Multilateral Residence Minimum taxation 15%

Effect on real income in the U.S. without entry

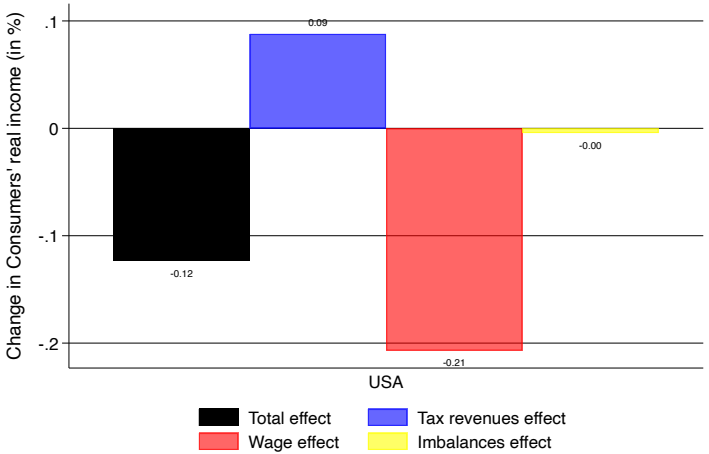
Multilateral Residence Minimum taxation 15%

Effect on real income in the U.S. without entry

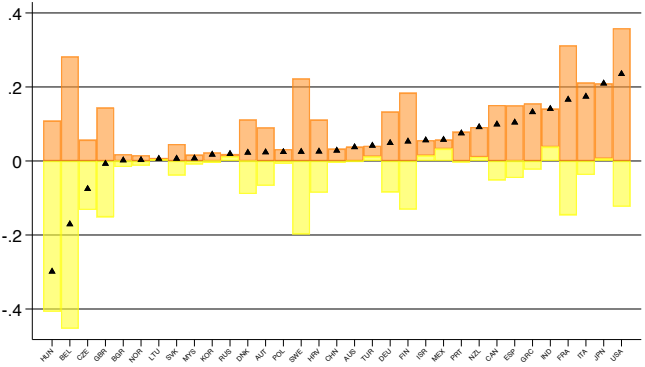


Multilateral Residence Minimum taxation 15%

Effect on real income in the U.S. with endogenous entry



Multilateral Residence Minimum taxation 15% (US).



Note: Welfare of country n is defined as $\tilde{U}_n = (B_n/P_n)^{\beta_n} Y_n/P_n$. Bars are stacked.

More results

- Counterfactual scenarios:
  - End of profit shifting.
  - Unilateral vs multilateral. ▸ Table
- Partial equilibrium *vs.* general equilibrium:
  - Tax revenues. ▸ Table
  - Real Income. ▸ Table
- Countries best response.

Conclusion

- Develop a quantitative model of MNCs with corporate taxation and profit shifting.
- Provide a new, model-consistent methodology to calibrate bilateral profit-shifting and profit-shifting frictions.
  - Profit-shifting frictions shape the geography of multinational production.
- Structurally estimate the corporate tax elasticity of real activity and profit shifting.
  - Ongoing estimations using micro-level data.
- Simulate various tax reforms $\longrightarrow$ impact of the international relocation of firms across countries is of comparable magnitude as the gains in tax revenues.
  - Ongoing: alternative design.

Appendix

Excess FDI income

	Dependent variable: FDI income				
$EATR_k - EATR_{k'}$	0.056***	0.036*	0.091***	0.091***	0.033*
	(0.019)	(0.019)	(0.017)	(0.016)	(0.017)
$Haven_{k'}$	1.565***	2.336***	2.767***	2.104***	2.682***
	(0.227)	(0.238)	(0.337)	(0.747)	(0.326)
$ln(GDP_{k'})$	0.497***	0.574***	-4.472***	-4.392***	-3.395***
	(0.058)	(0.080)	(0.737)	(0.722)	(0.607)
$ln(GDP_{k'})^2$			0.095***	0.093***	0.069***
			(0.014)	(0.014)	(0.012)
$ln(GDPpc_{k'})$	0.355*	0.372**	0.337***	0.304***	0.537***
	(0.191)	(0.157)	(0.111)	(0.109)	(0.100)
$ln(Dist_{kk'})$	-0.645***	-0.501***	2.592***	2.163*	2.617***
	(0.089)	(0.073)	(0.923)	(1.167)	(0.985)
$ln(Dist_{kk'})^2$			-0.198***	-0.173**	-0.188***
			(0.057)	(0.073)	(0.060)
Contig.	-0.632**	-0.358*	0.115	0.279	-0.046
	(0.246)	(0.204)	(0.198)	(0.212)	(0.182)
Com. Lang. index	1.309***	1.809***	1.340***	1.067***	1.039**
	(0.412)	(0.520)	(0.514)	(0.398)	(0.499)
Colony	0.436	0.272	0.088	-0.227	-0.263
	(0.294)	(0.302)	(0.248)	(0.224)	(0.245)
Common Colonizer	0.648**	0.822*	0.423	0.090	0.247
	(0.322)	(0.476)	(0.594)	(0.475)	(0.478)
Com. Legal origin	0.507	0.099	0.409	1.045***	0.578
	(0.365)	(0.458)	(0.424)	(0.381)	(0.413)
ln(# employees)					0.393***
					(0.080)
Observations	1,444	1,444	1,444	1,444	1,216

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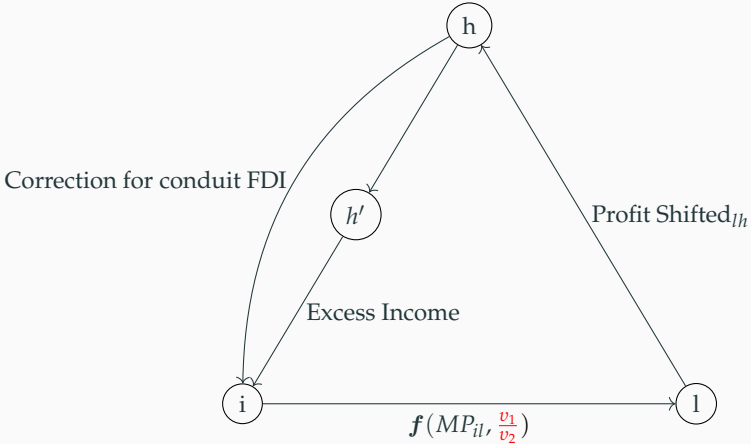
Controlling for conduit FDI between tax havens



i: headquarter l: production h: haven h': conduit haven

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Calibrating $\mathbb{P}_{ilh}$: summary

1. Estimate χ_{ih}, share of profits by firms from i shifted to country h

$$\frac{PS_{ih}}{PS_i} = \sum_l \zeta_{il}\chi_{lh}$$

2. Determine the conditional probability ζ_{il}: depends on multinational production located in country l:

$$\zeta_{il} = \frac{\Gamma_{il}\zeta_{i_0 l}}{\sum_l \Gamma_{il}\zeta_{i_0 l}}$$

with

$$\Gamma_{il} = \left(\frac{\gamma_{il}/\gamma_{il_0}}{\gamma_{i_0 l}/\gamma_{i_0 l_0}}\right)^{\frac{\upsilon_2}{\upsilon_1}}$$

captures the attractiveness of country l for profits of firms headquartered in i relative to a reference country $_0$.

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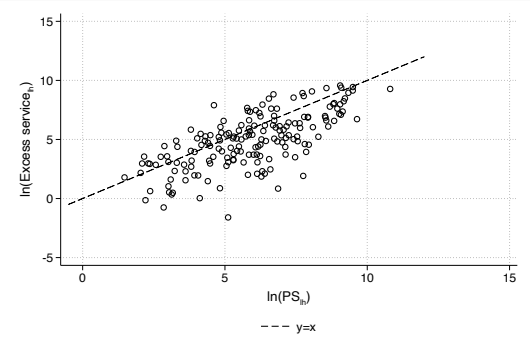
Our methodology

- Inspired by TWZ, we can directly approximate PS_{lh}
  - PS_{lh} is estimated as excessive high-risk services in a gravity equation.
  - $Service_{ijst} = \beta_1 High\text{-}Risk_s \times Haven_j + \mu_{ist} + \mu_{jt} + \mu_{ij} + \epsilon_{ijst}$



Controlling for conduit FDI between tax havens

- International investment data biased by **conduit** countries (Damgaard & Elkjaer, 2017; Casella, 2019, Damgaard et al., 2019).

$\rightarrow$ Double-counting and overestimation for conduit countries.

- Example: $FRA \rightarrow NLD \rightarrow IRL$. We want: $FRA \rightarrow IRL$.

- We use data from Damgaard et al. (2019): FDI stocks **ultimate control** instead of direct control ($Corrected_{ij}$).
- Denote conduit investment $Conduit_{ij} = FDI_{ij} - Corrected_{ij}$ and its share $Allocation\ Conduit_{ij} = \frac{Conduit_{ij}}{\sum_i Conduit_{ij}}$.
- Aggregate that needs to be reallocated: $Share\ Conduit_{ij} = \frac{\sum_i Conduit_{ij}}{\sum_i FDI_{ij}}$.
- We obtain an **allocation key** to go from $Excess_{ih'}$ to $Excess_{ih}$.

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Global profit shifting estimates in the literature

Author, fiscal estimate approach (date)	Scope	Range (US$ billions)	Year (level)
UNCTAD, offshore investment matrix (2015)	Global	200*	2012
OECD, aggregate tax rate differential (2015)	Global	100–240	2014
Crivelli et al., tax haven spillover (2016)	Global	123	2013 short-term
Crivelli et al., tax haven spillover (2016)	Global	647	2013 long-term
Clausing, excess income in low-tax countries (2016)	Global	280	2012
Cobham and Janský, tax haven spillover (2018)	Global	500	2013 long-term
Janský and Palanský, offshore investment matrix (2018)	Global	80+*	2015
Tørsløv, Wier, and Zucman, high profits-to-wage ratios of foreign-owned firms (2018)**	Global	230	2015

Source: Bradbury et al. (2018)

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Elasticity v_1 and v_2

	Dependent variable: $ln\left(\frac{X_{ijl}}{\sum_i X_{ijl}}\right)$	
	Statutory Tax Rate	Effective Average Tax Rate
$ln(\tilde{t}_l)$	2.639***	2.267***
	(0.688)	(0.708)
Headquarter country FE	Yes	Yes
Technology controls	Yes	Yes
Gravity controls	Yes	Yes
Observations	1,256	1,256
R-squared	0.667	0.666
Implied v_1 (σ = 4)	10.90	9.800
Implied v_1 (σ = 6.88)	21.40	19.20

Notes: Corporate tax base "*semi-elasticity*'" as found in the literature ($\sim$ -3.6 compared to [-5, -3] found in Head & Mayer, '04) ▸ Back

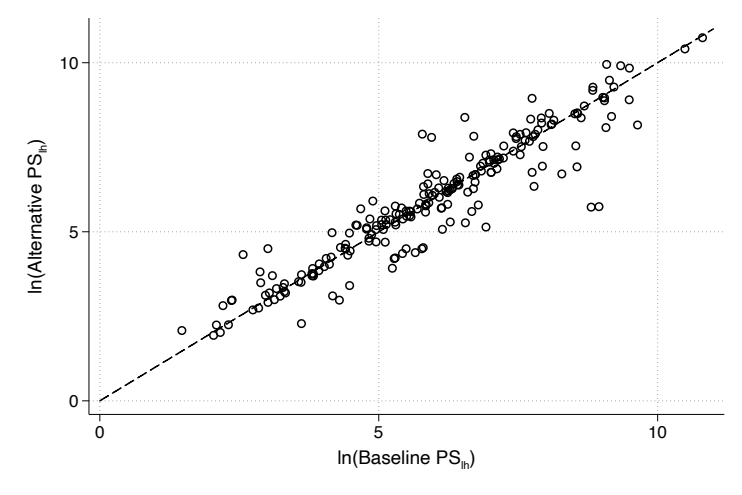
Elasticity v_1 and v_2

	Dependent Variable: $ln\left(\frac{X_{ilh}}{\sum_{l,h,l\neq h} X_{ilh}}\right)$
	Median Effective Tax Rate (t_{lh})
$ln(\tilde{t}_h)$ (Av.)	7.869***
	(0.191)
FE_{il}	Yes
Gravity controls	Yes
Observations	6,561
R-squared	0.994
Implied v_2 (σ = 4)	26.60
Implied v_2 (σ = 6.88)	52.10

Back

Our methodology

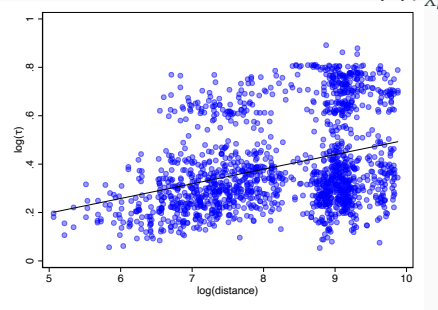
- Instead of calibrating s_l, use Torslov et al. (2022) data. Back



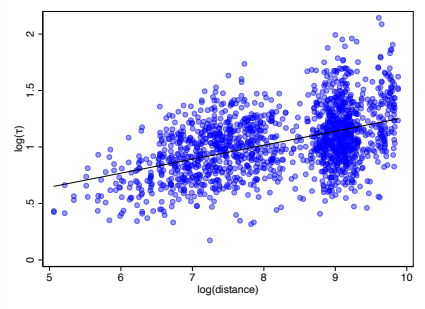
Bilateral frictions τ_{ln} and γ_{il}

γ_{il} and τ_{ln} can be expressed as **ratios of shares**:

$$\gamma_{il} = \left(\frac{\frac{X_{lll}}{\sum_k X_{ikk}}}{\frac{X_{lll}}{\sum_k X_{lkk}}} \right)^{-\frac{1}{v_1}} \qquad \tau_{ln} = \left(\frac{\frac{X_{ln}}{X_l}}{\frac{X_{nn}}{X_n}} \right)^{\frac{1}{1-\sigma}}$$



(a) MP costs γ



(b) Trade costs τ

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Profit shifting frictions α_{lh}

- α_{lh} correlated w/ gravity vars and the tax haven index of the Tax Justice Network.

	$ln(\alpha_{lh})$				
$ln(distance_{lh})$	0.0117***	0.00962***	0.0114***	0.00957***	0.0129***
	(0.00250)	(0.00213)	(0.00206)	(0.00207)	(0.00238)
Ever colony $_{lh}$	-0.00989*	-0.0157***	-0.0173**	-0.0163**	-0.0176***
	(0.00513)	(0.00553)	(0.00654)	(0.00681)	(0.00569)
Common colonizer $_{lh}$	-0.00951**	-0.0178***	-0.0122**	-0.0151***	-0.0116**
	(0.00452)	(0.00440)	(0.00448)	(0.00460)	(0.00452)
Common legal origin $_{lh}$	-0.00343	-0.000954	-0.00559	-0.00671	-0.00154
	(0.00499)	(0.00554)	(0.00537)	(0.00563)	(0.00522)
Contiguity $_{lh}$	-0.00222	-0.00371	0.00133	-0.00239	0.00360
	(0.00702)	(0.00957)	(0.00979)	(0.00970)	(0.00982)
$ln(GDP_h)$		-0.00697***	-0.00423**	-0.00792***	-0.00221
		(0.00110)	(0.00179)	(0.00147)	(0.00241)
$ln(GDPpc_h)$		-0.00191	-0.0108***	-0.00749**	-0.00442
		(0.00212)	(0.00310)	(0.00312)	(0.00335)
$ln(t_l - t_{lh})$			-0.0124**	-0.00553**	-0.0209*
			(0.00584)	(0.00267)	(0.0112)
Corporate tax haven index $_h$			-0.000979***		
			(0.000154)		
Loopholes and exemptions $_h$				-0.000311***	
				(7.87e-05)	
Transparency $_h$					-0.000796***
					(0.000138)
Observations	212	212	212	212	212
R-squared	0.983	0.963	0.966	0.966	0.967
Source Fixed Effects	Yes	Yes	Yes	Yes	Yes
Haven Fixed Effects	Yes	No	No	No	No

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Multilateral Source Minimum taxation 15% (US).

Minimum Taxation	Tax revenues	Profit Shifting	Real Production	Consumer Real Income	Welfare
			A. Short Run		
Unilateral					
– Residence	4.20	-28.38	0.06	0.08	0.45
– Source	4.40	-38.68	-0.06	-0.001	0.38
Multilateral					
– Residence	4.33	-29.37	0.11	0.11	0.49
– Source	3.99	-29.37	0.11	0.11	0.46
			B. Long Run		
Unilateral					
– Residence	4.00	-27.77	-0.04	-0.14	0.21
– Source	4.33	-38.58	-0.12	-0.09	0.29
Multilateral					
– Residence	4.09	-28.94	-0.06	-0.12	0.24
– Source	3.79	-28.95	-0.06	-0.13	0.20
– Tax havens' adjustment	2.33	-28.95	-0.06	-0.16	0.05

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Effects on tax revenues in the U.S.: Partial *vs.* General equilibrium

Counterfactual	Change in real tax revenues (in %)		Contribution (in %)	
	Tax Rate Effect (no reallocation) (1)	GE effect (reallocation) (2)	PS effect (change in PS) (3)	Real effect (reallocation) (4)
15% min. tax				
Unil. Residence	2.59	4.00	1.49	-0.08
Unil. Source	2.12	4.33	2.32	-0.1
Multi. Residence	2.59	4.09	1.57	-0.07
Multi. Source	2.12	3.79	1.70	-0.03
TH adjustment	0	2.33	2.40	-0.07

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Effects on welfare in the U.S.: Partial *vs.* General equilibrium

Counterfactual	Change in real tax revenues (in %)		Contribution (in %)	
	Tax Rate Effect (no reallocation) (5)	GE effect (reallocation) (6)	Tax Rate Effect (no reallocation) (7)	GE effect (reallocation) (8)
15% min. tax				
Unil. Residence	0.06	-0.14	0	-0.25
Unil. Source	0.05	-0.09	0	-0.20
Multi. Residence	0.06	-0.12	0	-0.23
Multi. Source	0.05	-0.13	0	-0.23
TH adjustment	0	-0.16	0	-0.23

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