Global Intangible capital and inequality: A two country heterogeneous agents framework

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What we do in this paper

- We observe a trend in the data:
  - Rise in intangible investment/capital.
- We introduce into a standard GE model two elements:
  - Intangible capital
  - Heterogeneous households
- Study the effect of intangible capital on inequality.

Motivation

This paper is motivated by:

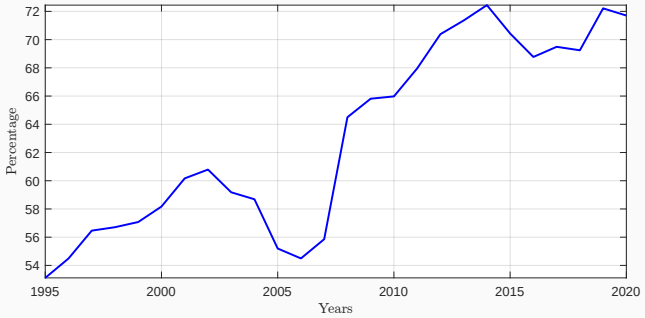
- The rising importance of intangible capital and investment in the production of modern economies, see e.g. McGrattan and Prescott (2014) and Corrado et al. (2022).

- The effects of this shift in production on inequality across and within countries.

- The need for economic policy to understand how this shift shapes aggregate and distributional outcomes globally (e.g., corporate tax).

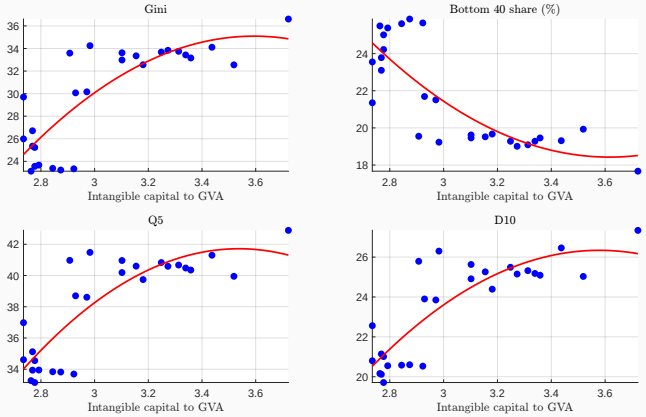
Rising importance of intangible capital in Europe

Intangible to tangible investment in Europe



Source: EUKLEMS-INTANProd database. GVA- weighted average of 12 countries. Intangible capital covers components such as industrial design, organisational capital, brand, and training.

Inequality and intangible capital: Germany



Sources: WIID and EUKLEMS-INTANProd databases.

Within-Country Correlation: Intangible Intensity and Inequality

$$\text{Gini}_{it} = \beta_1 \, \text{ShareIntangi}_{it} + \beta_2 \, \text{ShareTangi}_{it} + \beta_3 \, \text{ForeignIntangi}_{it} + \alpha_i + \lambda_t + \varepsilon_{it}$$

Share intangible	45.442***
	(5.218)
Share tangible	1.186***
	(0.399)
Weighted foreign intangible	0.946
	(8.380)
Country fixed effects	Yes
Year fixed effects	Yes
Observations	282
Countries	13

Robustness: ▸ Persistence ▸ 3-year lag

Research Aim

- The effect of intangible capital (a shift in production):
  - across countries (e.g., interrelated European economies)
  - within countries
- Develop a model and use it as a vehicle to study debated macroeconomic policy issues, particularly global corporate tax reforms.

Related Literature

- **Real Business Cycles**: McGrattan and Prescott (2010b), McGrattan and Prescott (2014), Prescott (2016), McGrattan (2020), McGrattan (2023),Dimakopoulou et al. (2025).

- **Fiscal policy**: Conesa and Dominguez (2013), Conesa and Dominguez (2020), Quadrini and Ríos-Rull (2024).

- **Intangible capital and inequality**: Guvenen et al. (2022), Dyrda et al. (2024), Bhandari et al. (2024).

Model

Model description

- Countries are denoted by $i \in \{1, 2\}$. Final good production Mutual fund Aggregate savings
- Multinationals are denoted by $j \in \{a, d\}$ (in the spirit of McGrattan and Prescott (2010a)).
  - Multinational a (d) is headquartered in country 1 (2) but operates in both countries.
  - Each multinational produces an intermediate good using the following productive inputs:
    - Physical capital, which is rival and country-specific,
    - Hours worked, which are rival and country-specific,
    - Intangible capital, which is non-rival.

Technology Profits Profit shifting

Description of the Model (cont'd)

- Within each country:
  - There are heterogeneous agents and incomplete markets, as in Bewley–Huggett–Aiyagari models.

    Households | Income process | Household problem
  - There is a government.
    - National governments issue public debt and impose distortionary taxes to finance government expenditures.
    - Distortionary taxes include taxes on assets, profits, and income.
    - Government spending is wasteful.
- The Rest of the World lends (or borrows) international assets to (from) the two countries (see e.g., Chen et al. (2025)).

  Rest of the World

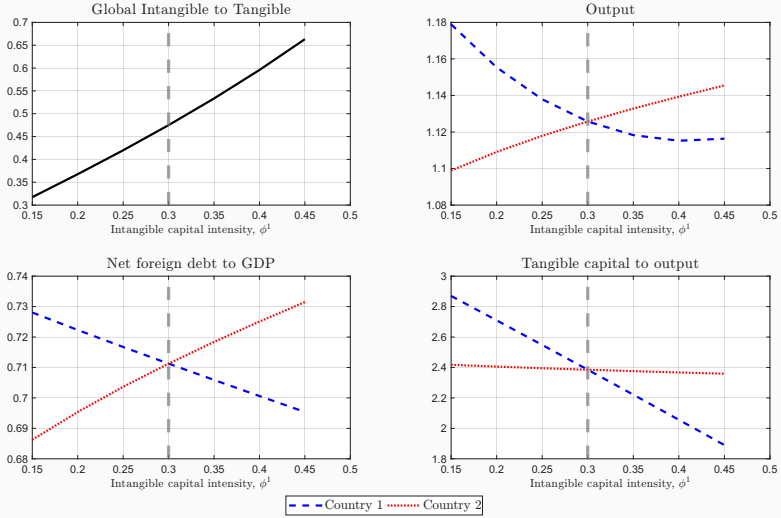
Results

Road map of results

- **Point of departure:** Symmetry
- **Structural asymmetry:** intangible intensity, ϕ_1.
- **Fiscal policy asymmetry:** Corporation tax, τ_1^p.

Structural asymmetry: Different stationary equilibria

Macro aggregates

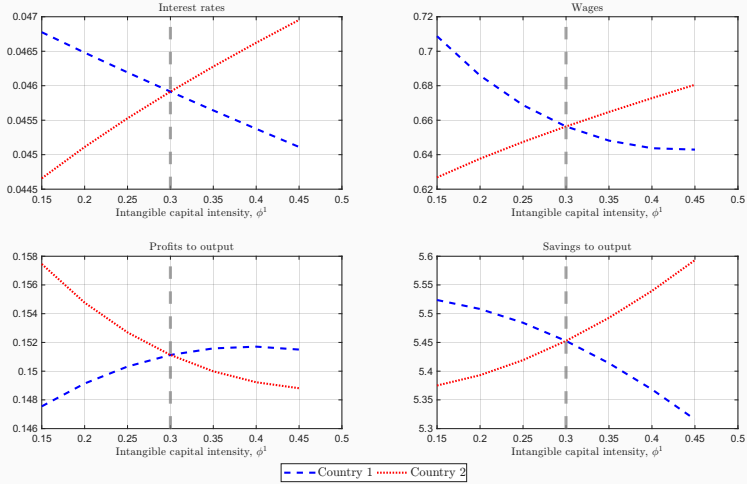


$\rightarrow$ Structural change in country 1 has significant cross-country effects.

$\rightarrow$ Rise in global intangible capital.

$\rightarrow$ Country 1 saves less, with intangible capital substituting for tangible capital, while the opposite happens in country 2.

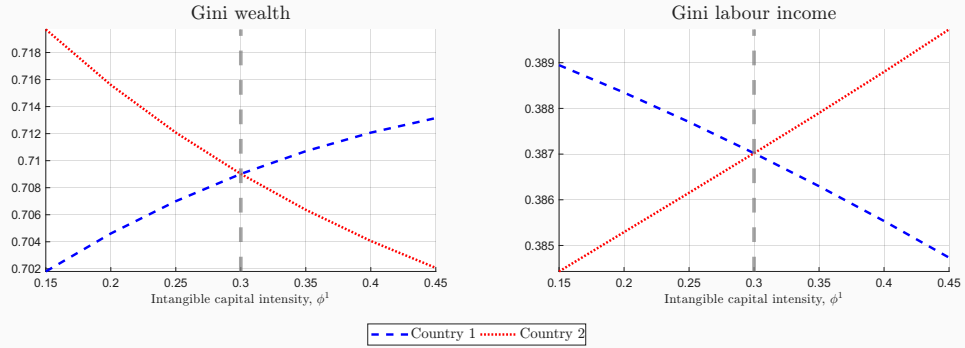
Resources


Interest rates
0.047
0.0465
0.046
0.0455
0.045
0.0445
0.15 0.2 0.25 0.3 0.35 0.4 0.45 0.5
Intangible capital intensity, ϕ^1
Wages
0.72
0.7
0.68
0.66
0.64
0.62
0.15 0.2 0.25 0.3 0.35 0.4 0.45 0.5
Intangible capital intensity, ϕ^1
Profits to output
0.158
0.156
0.154
0.152
0.15
0.148
0.146
0.15 0.2 0.25 0.3 0.35 0.4 0.45 0.5
Intangible capital intensity, ϕ^1
Savings to output
5.6
5.55
5.5
5.45
5.4
5.35
5.3
0.15 0.2 0.25 0.3 0.35 0.4 0.45 0.5
Intangible capital intensity, ϕ^1
Country 1
Country 2

$\rightarrow$ Profits increase in country 1 due to the shift toward intangible investment, which can be expensed for accounting purposes elsewhere.

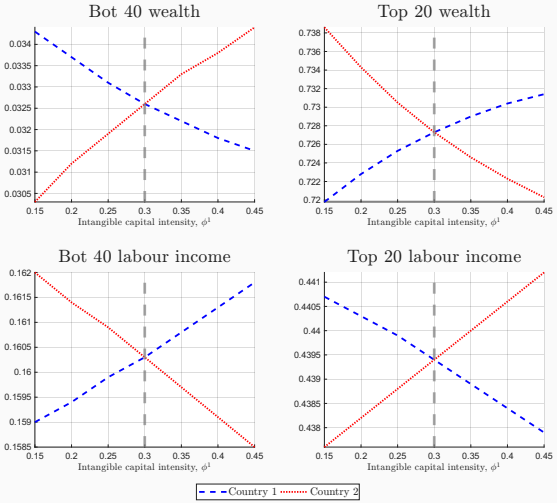
$\rightarrow$ Interest rates fall in country 1 due to lower savings.

Gini coefficients

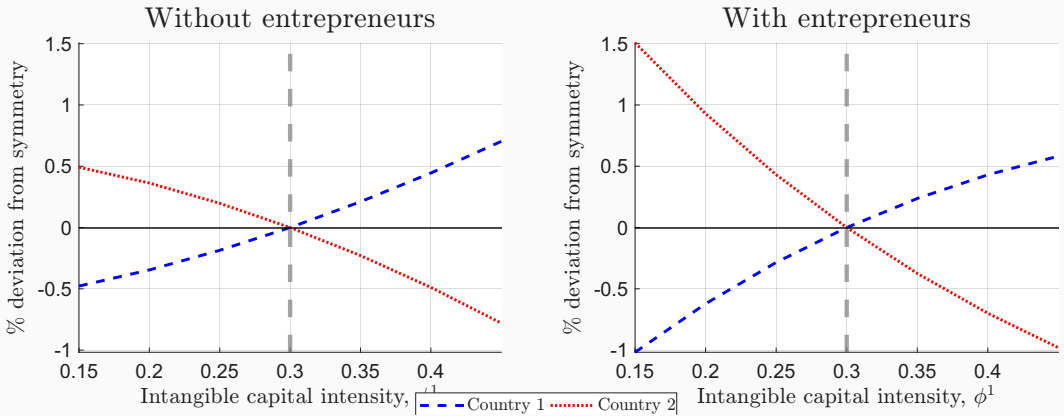


$\rightarrow$ In stationary economies with higher intangible intensity wealth inequality would be higher, while labor income inequality smaller.

Inequality indicators



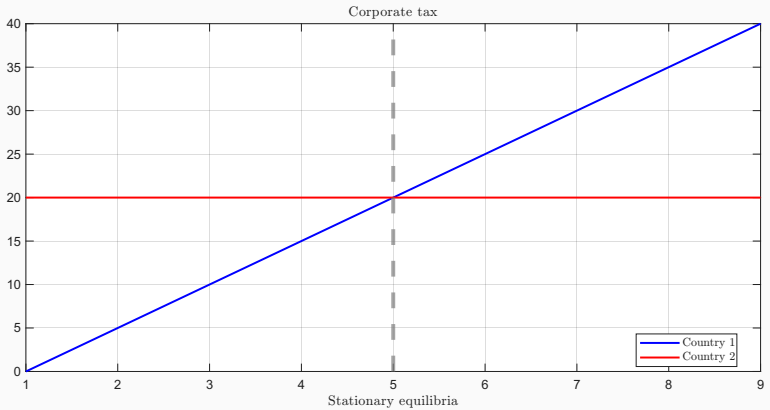
Gini Wealth: Entrepreneurs vs. No Entrepreneurs



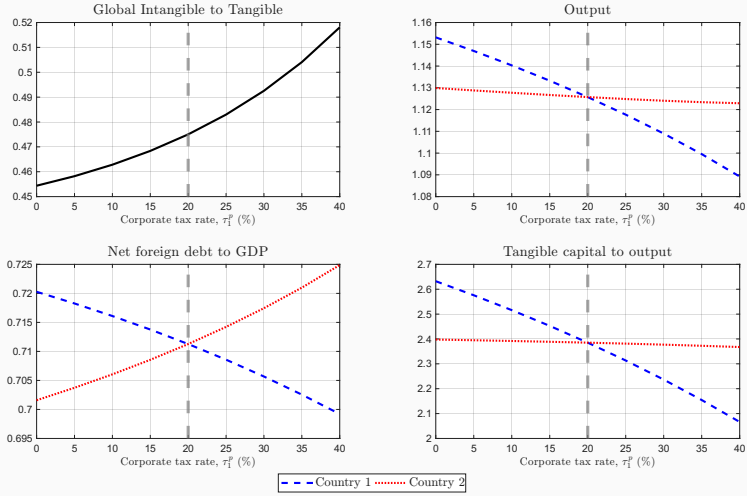
$\rightarrow$ The entrepreneurial states amplifies within-country inequality effects.

Fiscal policy asymmetry

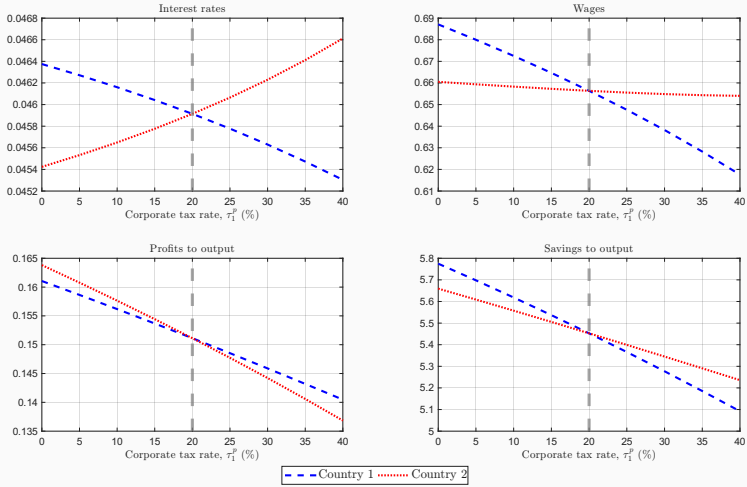
Corporate tax across stationary equilibria



Macro aggregates



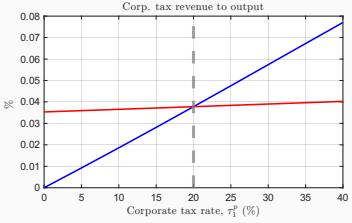
Resources

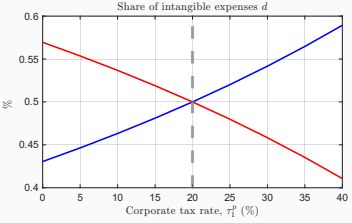

Interest rates
Wages
Profits to output
Savings to output
Corporate tax rate, τ_1^p (%)
Country 1
Country 2

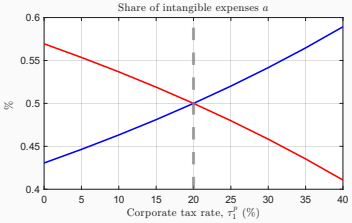
Corporate Tax: Macro Aggregates

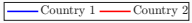
- **Substitute** tangible $\rightarrow$ intangible capital in country 1 for *both* multinationals
- **Motive:** intangible investment reduces reported profits in country 1
- **Result:** lower corporate tax payments in country 1

Corporate tax revenue and intangible expense shares







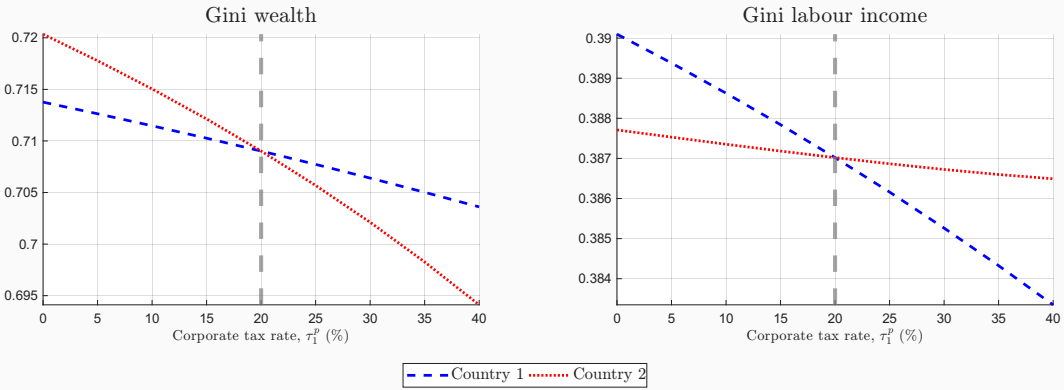


Optimal expense share

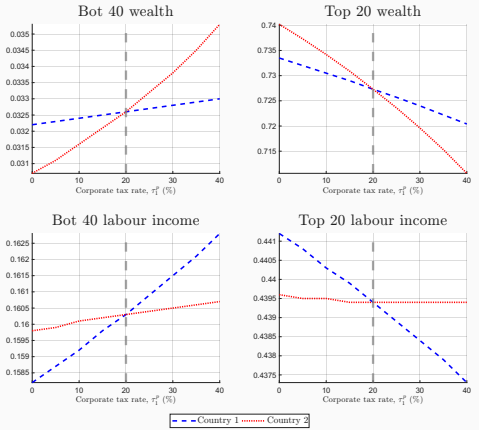
Corporate Tax: Profits Fall in Both Countries

- **Same direction**, different mechanisms across countries
- **Country 1:** higher $\tau^{p,1}$ directly erodes after-tax profits
- **Country 2:** intangible expenses (built up in country 1) are subtracted from country 2's profit base
- **Contrast** with the intangible-intensity case — here both drops are driven by the fiscal instrument

Gini coefficients



Inequality indicators



Corporate Tax: Inequality Compresses in both Countries

- **Wealth inequality** falls in both countries, driven mainly by the reduction in profits
- **Labor income inequality:** also declines $\rightarrow$

$\rightarrow$ **Labor supply reallocates:** productive households work less; less productive households work more

Appendices

Persistence and Intangible Intensity in Inequality

$$\text{Gini}_{it} = \rho\,\text{Gini}_{i,t-1} + \beta_1\,\text{ShareIntangi}_{it} + \beta_2\,\text{ShareTangi}_{it} + \beta_3\,\text{ForeignIntangi}_{it} + \alpha_i + \lambda_t + \varepsilon_{it}$$

Lagged Gini	0.634***
	(0.043)
Share intangible	16.373***
	(4.038)
Share tangible	0.576**
	(0.276)
Weighted foreign intangible	14.065**
	(6.351)
Country fixed effects	Yes
Year fixed effects	Yes
Observations	260
Countries	13
Within R^2	0.921

Back

Three-Year Lag: Intangible Intensity and Inequality

$$\text{Gini}_{it} = \beta_1 \, \text{ShareIntangible}_{i,t-3} + \beta_2 \, \text{Share}_{i,t-3} + \beta_3 \, \text{ForeignIntangible}_{i,t-3} + \alpha_i + \lambda_t + \varepsilon_{it}$$

Share intangible $(t-3)$	43.417***
	(5.485)
Share tangible $(t-3)$	0.591
	(0.447)
Weighted foreign intangible $(t-3)$	28.815***
	(7.759)
Country fixed effects	Yes
Year fixed effects	Yes
Observations	222
Countries	13

Back

Multinationals

Multinational d headquarted in country 1

- Multinational firm d headquartered in Core (country 1) operates a subsidiary in Periphery (country 2).
- It produces, $y_{1,t}^d$ and $y_{2,t}^d$, respectively, employing the following productive inputs:
  - Country-specific tangible capital: $K_{T,i,t}^d$
  - Country-specific hours worked: $L_{i,t}^d$
  - Non-rival intangible capital: M_t^d
  - Country-specific productivity: $z_{i,t}^d$
- Shares/parameters: labor share in the Cobb–Douglas composite $a^T \in (0,1)$; intangible intensity $\phi_i^d \in (0,1)$.

◂ Back

Technology of multinational d

A multinational headquartered in country 1 produces intermediate goods with the following production functions:

- Production in country 1

$$y_{1,t}^{d} = z_{1,t}^{d} \left(\left(M_{t-1}^{d} \right)^{\phi_1^d} \left(K_{1,t-1}^{d} \right)^{1-\phi_1^d} \right)^{a^T} \left(L_{1,t}^{d} \right)^{1-a^T}$$

- Production in country 2

$$y_{2,t}^{d} = z_{2,t}^{d} \left(\left(M_{t-1}^{d} \right)^{\phi_2^d} \left(K_{2,t-1}^{d} \right)^{1-\phi_2^d} \right)^{a^T} \left(L_{2,t}^{d} \right)^{1-a^T}$$

Back

Profits

Following McGrattan (2020) we assume that multinational d maximises the present value of dividends to its shareholders:

$$\max \sum_t \left(\frac{1}{R_t^d} \right)^t D_t^d,$$

where $D_t^d = D_{1,t}^d + D_{2,t}^d$ represents total dividends, i.e., the sum of after-tax profits from both countries.

Back

Profits (cont'ed)

After-corporate-tax profits in country 1 are:

$$D^d_{1,t} = \Big(q^d_{1,t} y^d_{1,t} - W_{1,t} L^d_{1,t} - K^d_{T,1,t} + (1-\delta_T) K^d_{T,1,t-1} - \left[\zeta^d_{1,t} + f(\zeta^d_{1,t})\right] \left(M^d_t - (1-\delta_M) M^d_{t-1}\right) \Big) - \tau^p_{1,t}\, \pi^d_{1,t}$$

where, $\pi^d_{1,t} = q^d_{1,t} y^d_{1,t} - W_{1,t} L^d_{1,t} - \delta_T K^d_{T,1,t-1} - \left[\zeta^d_{1,t} + f(\zeta^d_{1,t})\right] \left(M^d_t - (1-\delta_M) M^d_{t-1}\right)$
When computing taxable profits, corporations deduct the depreciation of tangible capital and fully expense the investment of intangible capital.

Back

Profits (cont'ed)

After-corporate-tax profits in country 2 are:

$$D^d_{2,t} = \Big(q^d_{2,t} y^d_{2,t} - W_{2,t} L^d_{2,t} - K^d_{T,2,t} + (1-\delta_T) K^d_{T,2,t-1} \\ - \left[\zeta^d_{2,t} + f(\zeta^d_{2,t}) \right] \left(M^d_t - (1-\delta_M) M^d_{t-1} \right) \Big) - \tau^p_{2,t}\, \pi^d_{2,t}$$

where, $\pi^d_{2,t} = q^d_{2,t} y^d_{2,t} - W_{2,t} L^d_{2,t} - \delta_T K^d_{T,2,t-1} - \left[\zeta^d_{2,t} + f(\zeta^d_{2,t}) \right] \left(M^d_t - (1-\delta_M) M^d_{t-1} \right)$

Back

Profit shifting

The multinational chooses how to split intangible assets between domestic and foreign operations via the shares $\zeta^d_{1,t}$ and $\zeta^d_{2,t}$, subject to

$$\zeta^d_{1,t} + \zeta^d_{2,t} = 1.$$

This discretion allows the firm *shift taxable profits* toward the country with the lower profit tax rate.

Back

Profit shifting

Deviating from the benchmark allocation is costly (audit risk, penalties):

$$f(\zeta_{1,t}^d) = \psi\big(\zeta_{1,t}^d - \lambda\big)^2, \qquad f(\zeta_{2,t}^d) = \psi\big(\zeta_{2,t}^d - (1-\lambda)\big)^2.$$

- λ: benchmark domestic share — costs are zero at $(\zeta_{1,t}^d, \zeta_{2,t}^d) = (\lambda, 1-\lambda)$, which is optimal only when both countries set equal profit tax rates.
- ψ: degree of flexibility in shifting (lower $\psi \Rightarrow$ cheaper to shift).

Back

Optimal profit-shifting shares

The first order conditions with respect to ζ's yield

$$\zeta_{1,t}^{d,*} = \frac{\tau_{1,t}^{p} - \tau_{2,t}^{p}}{2\psi\left(2 - \tau_{1,t}^{p} - \tau_{2,t}^{p}\right)} + \lambda,$$

and

$$\zeta_{2,t}^{d,*} = 1 - \zeta_{1,t}^{d,*},$$

Back

Multinational a

The problem of multinational a, headquartered in country 2, is symmetric to that of multinational d:

- **Produces** $y^a_{1,t}$ and $y^a_{2,t}$ in countries 1 and 2.
- **Maximizes** the present value of after-tax dividends, $D^a_{1,t}$ and $D^a_{2,t}$.
- **Shifts profits** by choosing how to split intangible assets, $\zeta^a_{1,t}$ and $\zeta^a_{2,t}$, with $\zeta^a_{1,t} + \zeta^a_{2,t} = 1$.

Back

Rest of the World and international interest rates

The Rest of the World (RoW) lends to (or borrows from) the mutual funds in the world financial markets. We assume that the international nominal interest rates faced by member countries are debt elastic in the spirit of Schmitt-Grohé and Uribe (2003) (see also Chen *et al.* 2025):

$$r^f_{1,t} = r^* + \varkappa \left[\exp\left(F_{1,t-1}\right) - 1\right]$$

$$r^f_{2,t} = r^* + \varkappa \left[\exp\left(F_{2,t-1}\right) - 1\right]$$

Back

Country

Final good production in each country

In each country $y^d_{i,t}$ and $y^a_{i,t}$ are used to produce a homogeneous and tradable final good with the production functions:

$$Y_{1,t} = \left(y^d_{1,t}\right)^{\lambda} \left(y^a_{1,t}\right)^{1-\lambda}$$

$$Y_{2,t} = \left(y^a_{2,t}\right)^{\lambda} \left(y^d_{2,t}\right)^{1-\lambda}$$

The production of final goods is done by competitive local firms and the prices of intermediate inputs are equal to their marginal products.

Back

Mutual fund in Country 1

Country 1's mutual fund can invest in:

- Foreign assets $F_{1,t}$ with return $r^f_{1,t}$
- Domestic bonds $B_{1,t}$ with return $r^b_{1,t}$
- Physical capital in multinationals d, a: $K^d_{1,T}$, $K^a_{1,T}$ with after-tax return $R^{K,d}_{t+1}$
- Intangible capital of d: M^d_t with after-tax return $R^{M,d}_{t+1}$
- Shares of d, a: $S^d_{1,t}$, $S^a_{1,t}$ with return $R^d_{V,t} = \frac{V^d_{t+1} + D^d_{t+1}}{V^d_t}$.

Simplification: $S^d_{1,t} = 1$, $S^a_{1,t} = 0$.

No aggregate uncertainty $\Rightarrow$ by no arbitrage, all assets earn equal nominal returns from t to $t+1$.

Back

Mutual fund (cont'ed)

Since there is no aggregate uncertainty, by no arbitrage, for any $t \geq 0$, all assets must have equal nominal returns from t to $t+1$:

$$1 + r_{1,t} = R_{t+1}^{K,d} = R_{t+1}^{M,d} = 1 + r_{1,t}^{b} = 1 + r_{1,t}^{f}$$

Back

Aggregate Savings in Country 1

Aggregate savings in country 1 are given by:

$$A_{1,t} = F_{2,t} + K^d_{1,T,t} + K^a_{1,T,t} + M^d_t + V^d_t$$

Back

Households

Households

In each country, there is a continuum of households, who are ex-ante homogeneous:

- Workers, 7 states.
- Entrepreneurs, 1 state.

Back

Households: Income process

$$\varepsilon_t = \begin{cases} \exp\left(\rho_\varepsilon \log \varepsilon_{t-1} + \epsilon_t\right), \text{ with probability } \left(1-\phi_d^1\right), \text{ if } \varepsilon_{t-1} > 0, \\ \overline{\varepsilon}, \qquad\qquad \text{with probability } \phi_w^1, \text{ if } \varepsilon_{t-1} = 0 \text{ and } e_{t-1}^1 > 0, \\ \overline{\varepsilon}, \quad 0, \qquad\qquad \text{with probability } \phi_d^1 \end{cases} \tag{1}$$

Back

Income Process: Worker–Entrepreneur Transitions

- **Stay** in the labor force with probability $1 - \phi_d^1$, with productivity following a log AR(1): $\varepsilon_t = \exp\left(\rho_\varepsilon \log \varepsilon_{t-1} + \epsilon_t\right)$, $\epsilon_t \sim N(0, \sigma_e^2)$.
- **Become** an entrepreneur with probability ϕ_d^1 (state e^1), earning $e^1 D_t^d$.
- **Return** to work from entrepreneurship with probability ϕ_w^1 (from e^1), re-entering at the median productivity $\overline{\varepsilon}$.
- **Remain** an entrepreneur otherwise, with probability $1 - \phi_w^1$.

Back

Heterogeneous Households: Recursive Problem

Each household in country j solves

$$v_{j,t}\big(a_{j,t-1}, s_{j,t}\big) = \max_{\substack{a_{j,t} \geq -\bar{a}_{j,t} \\ c_{j,t} \geq 0}} \left\{ \frac{c_{j,t}^{1-\sigma}}{1-\sigma} - \mathbb{I}_{s \leq m}\, \varphi \frac{l_{j,t}^{1+\eta}}{1+\eta} + \beta\, \mathbb{E}\big[v_{j,t+1}\big(a_{j,t}, s_{j,t+1}\big) \mid s_{j,t} \big] \right\}$$

subject to the real period budget constraint

$$c_{j,t} + a_{j,t} = \big(1 + (1-\tau_{j,t}^{s}) r_{j,t-1}\big) a_{j,t-1} + (1-\tau_{j,t}^{l}) \left(y(s_{j,t})\right)^{1-\tau_t^p}$$

where gross income combines labor and entrepreneurial earnings,

$$y(s_{j,t}) = w_{j,t}\, l_{j,t}\, \varepsilon(s_{j,t}) + e(s_{j,t}).$$

Back

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