Factor-Biased Multinational Production and the Labor Share

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Introduction

- Prominence of multinational production (MP)
  - Multinationals worldwide produce 25% of world GDP (Antràs and Yeaple, 2014)

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  - Multinationals worldwide produce 25% of world GDP (Antràs and Yeaple, 2014)
  - Average MP share increased by 9.6 p.p over the last decade
- Standard quantitative models of MP (e.g., Ramondo and Rodriguez-Clare, 2013)
  - Transfer of more advanced technologies
  - Technologies differ only in Hicks-neutral productivities

This paper: Factor-Biased MP

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- Build a quantitative framework for modelling factor-biased multinational production (MP) and match both facts
- New channel: MP reallocates factors across firms and changes the demand for K relative to L
- Quantification
  - Declining MP costs explain up to 60% of the average decline in labor shares in the past decade
  - Relatively more important in capital-scarce countries

Related Literature

- Technology diffusion through MP, e.g., Ramondo and Rodriguez-Clare (13), Bilir and Morales (16), Arkolakis et al. (17), Tintlenot (17)
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- Decline in labor shares: Karabarbounis and Neiman (14), Oberfield and Raval (14), Elsby et al. (13), Koh et al. (16), Barkai (17), Autor et al. (17)
  This paper: the role of technology transfer within MNEs

Outline

Firm level data

- Orbis Database in 2012
  - Firm-level balanced sheet data to construct K/L

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  - Ownership information
    - Orbis identifies the "Global Ultimate Owner" (GUO)
    - Define the country of ultimate owner as the home country
- 2.6 million firms from 21 host and 22 home countries ▶ coverage
  - most are local independent firms
  - 60,000 are multinational affiliates

Empirical Fact 1: Size Effect

- Larger firms use more capital-intensive technologies
- Consistent with Oi and Idson (1999), Bernard et al. (2007)

	Dependent Var: log(deflated total assets/wage bill)			
	All (1)	MNE (2)	All (3)	MNE (4)
log(Revenue)	0.081**	0.055***	0.043*	0.043***
	(0.026)	(0.010)	(0.021)	(0.011)
debt-to-equity ratio			0.004**	0.004***
			(0.001)	(0.001)
R-squared	0.36	0.45	0.40	0.47
N	2,621,000	54,000	2,009,000	44,000
Country-industry FE	✓	✓	✓	✓

Standard errors are clustered at host country * industry and home country levels. + 0.10 * 0.05 ** 0.01 *** 0.001.

▸ Robustness

Empirical Fact 2: Technology Origin Effect

- Firms from capital-abundant countries use more capital-intensive technologies

	Dependent Var: log(deflated total assets/wage bill)					
	All (1)	MNE (2)	All (3)	MNE (4)	All (5)	MNE (6)
Home log(cap stock/emp)	0.256***	0.292*	0.172*	0.277*	0.158*	0.291*
	(0.063)	(0.124)	(0.082)	(0.137)	(0.068)	(0.141)
log(Revenue)			0.080**	0.054***	0.043*	0.042***
			(0.026)	(0.010)	(0.021)	(0.010)
debt-to-equity ratio					0.004**	0.004***
					(0.001)	(0.001)
# of home countries	22	22	22	22	22	22
R-squared	0.31	0.40	0.32	0.40	0.34	0.43
N	2,767,000	57,000	2,621,000	54,000	2,009,000	44,000
Country-industry FE	✓	✓	✓	✓	✓	✓

Standard errors are clustered at both home country and host country * industry levels. + 0.10 * 0.05 ** 0.01 *** 0.001.

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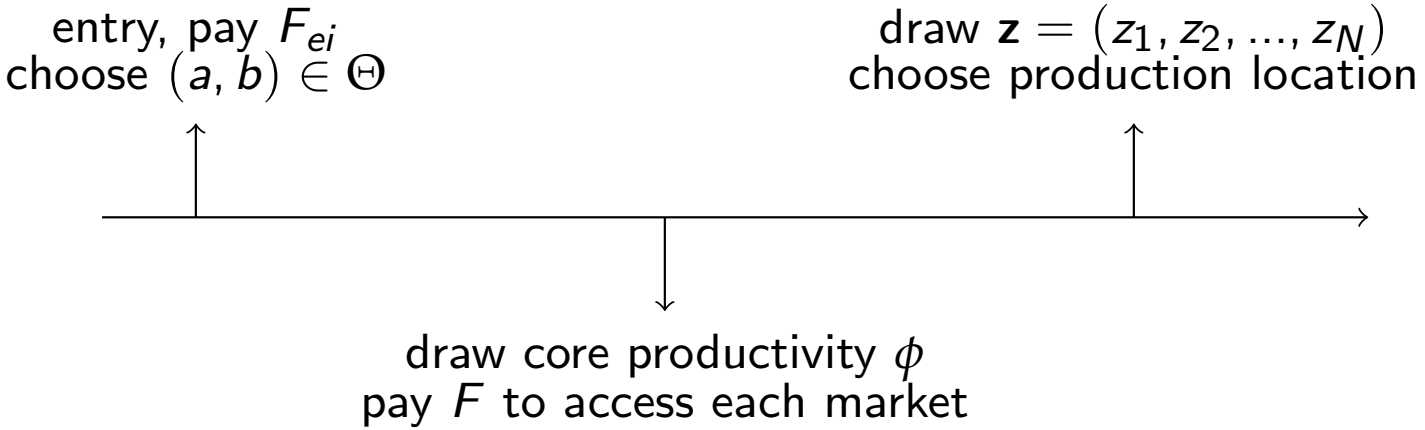
  - **Tech-capital complementarity** and **endogenous tech choice** affect K/L via factor-augmenting productivities
  - Affiliates inherit technology from the parent firm
- MP and trade structure follows Arkolakis et al. (2017)
  - A firm can headquarter in home country i, produce in host country l and sell to destination n
  - Trade is subject to iceberg trade costs τ_{ln} and fixed marketing costs
  - MP is subject to iceberg MP costs γ_{il}

Timing of Firm's Activities



Stage 1 Pay entry costs F_{ei} to headquarter in home country i. Choose technology (a, b) from tech menu Θ

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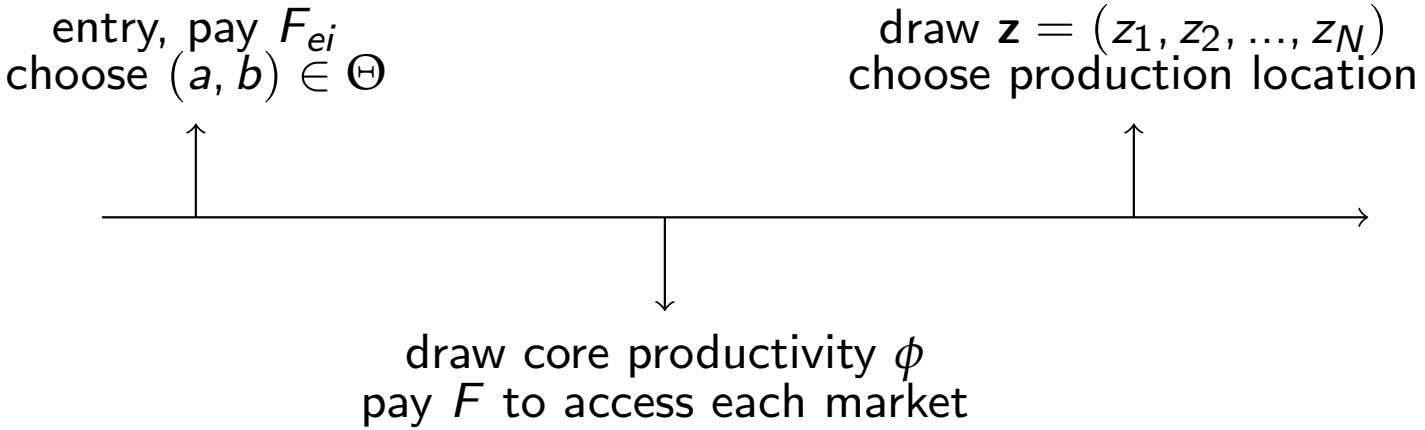

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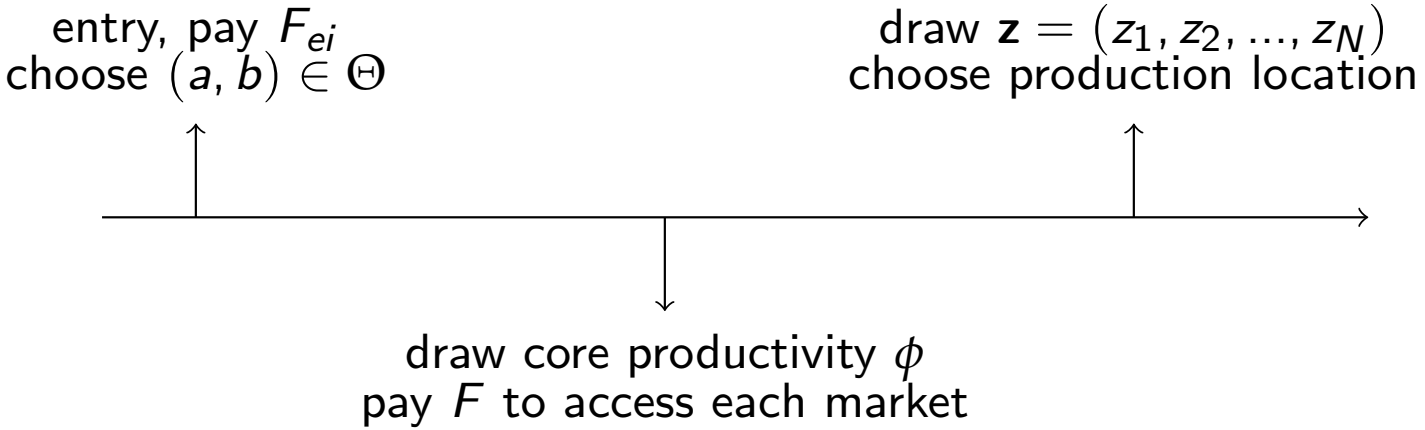

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Stage 3 Draw location-specific productivity $\mathbf{z} = (z_1, \ldots, z_N)$ from Fréchet $z_l \sim e^{-z^{-\theta}}$. Firm then chooses where to produce.

Firm's Production Function

- The production function is CES in capital and labor

$$q = \left(\lambda^{1/\varepsilon}\left(\phi^{1-\xi/2}aK\right)^{\frac{\varepsilon-1}{\varepsilon}} + (1-\lambda)^{1/\varepsilon}\left(\phi^{1+\xi/2}bL\right)^{\frac{\varepsilon-1}{\varepsilon}}\right)^{\frac{\varepsilon}{\varepsilon-1}}$$

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and capital-labor ratio

$$\frac{K}{L} = \frac{\lambda}{1-\lambda}\phi^{\xi(1-\varepsilon)}\left(\frac{a}{b}\right)^{\varepsilon-1}\left(\frac{r}{w}\right)^{-\varepsilon}$$

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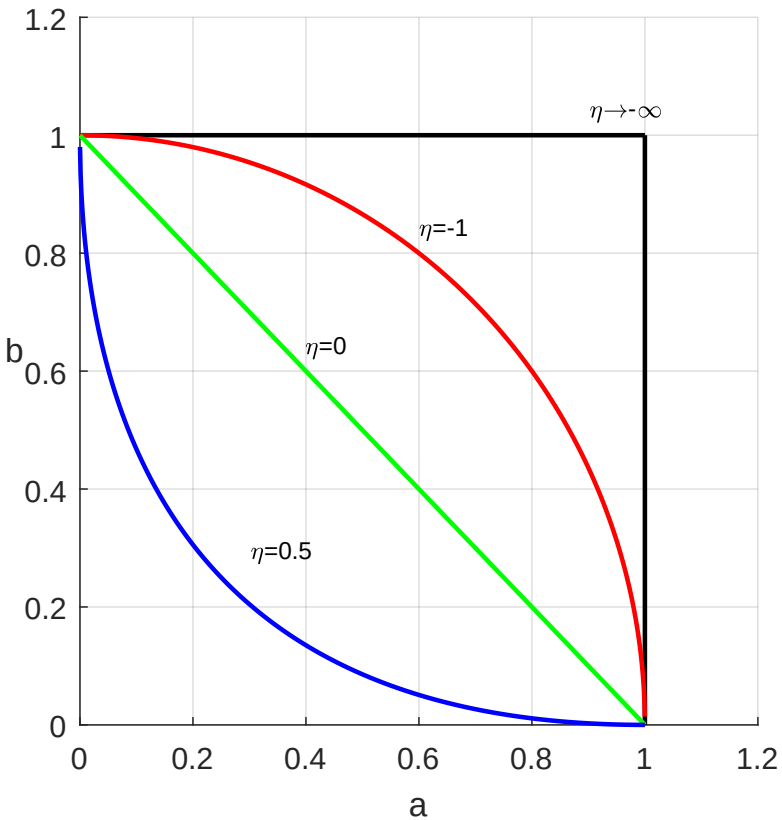
  - Technology-capital complementarity: $\xi(1-\varepsilon) > 0$, $|\xi| < 2$ (Burstein and Vogel, 17)
  - Endogenous technology choice: choose $(a, b) \in \Theta$

Technology Menu



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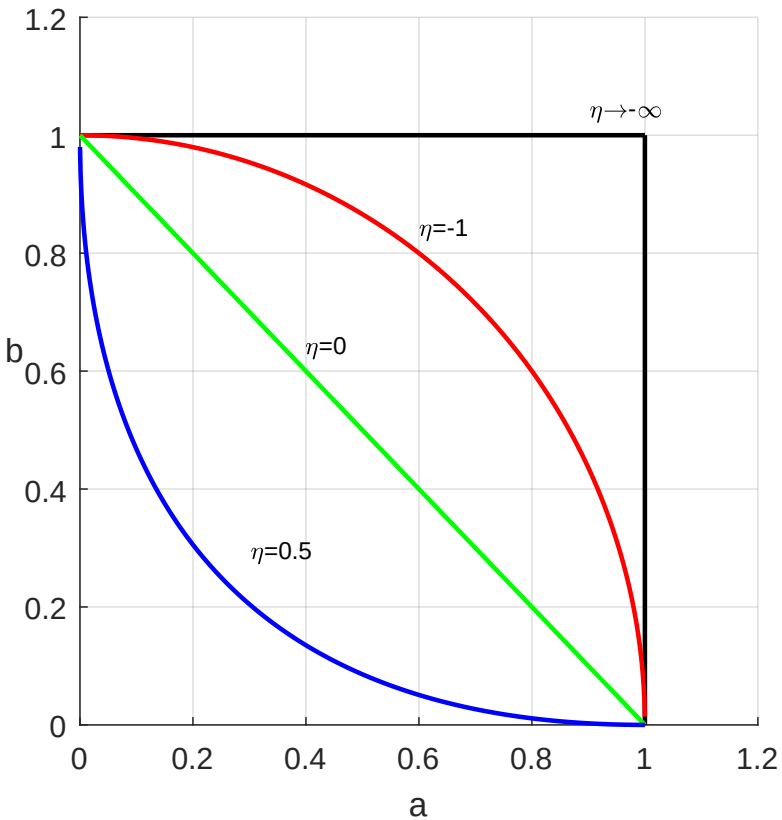

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- Face the constraint of the tech menu (Caselli and Coleman, 2006; Oberfield and Raval, 2014)

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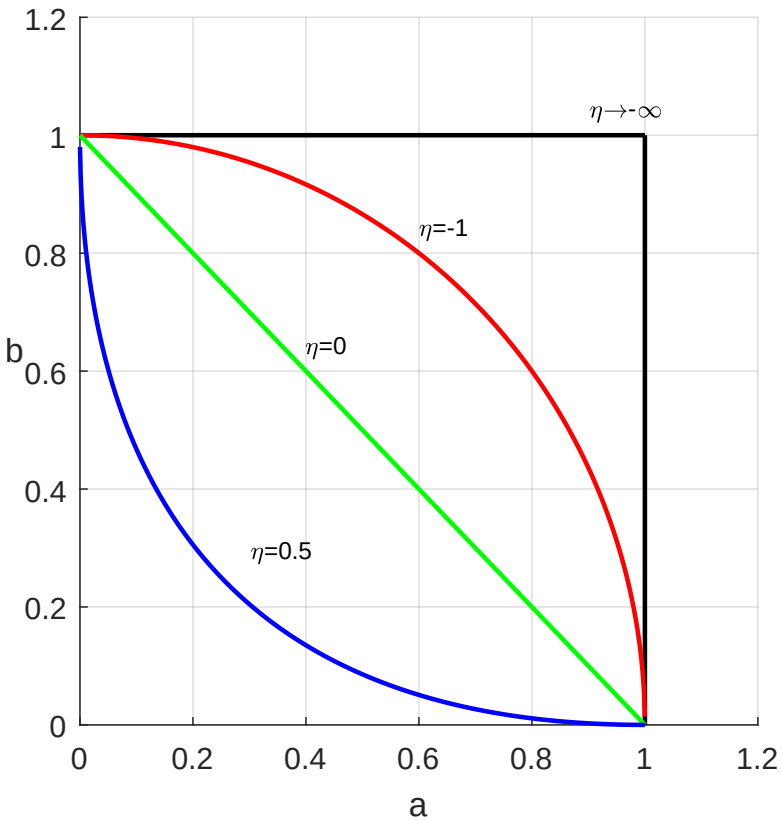

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- η controls for the flexibility of ex-ante technology choice

More on Technology Menu

- Firm's K/L responds to r/w at two margins

$$\frac{K}{L} = \frac{\lambda}{1-\lambda}\phi^{\xi(1-\varepsilon)} \underbrace{\left(\frac{a}{b}\right)^{\varepsilon-1}}_{\textit{extensive}} \underbrace{\left(\frac{r}{w}\right)^{-\varepsilon}}_{\textit{intensive}}$$

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- Oberfield and Raval (14) show the total response (total elasticity) satisfies

$$\frac{1}{\varepsilon^{tot}-1} = \frac{1}{\eta-1} + \frac{1}{\varepsilon-1}$$

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- Using multinational firm data, I can distinguish between the two
  - variation within multinational firm across host countries $\rightarrow$ intensive elasticity ε
  - compare firms in the same host country but from different home countries $\rightarrow$ extensive elasticity η

Definition of General Equilibrium

Vectors of variables $\{a_i, b_i, r_i, w_i, P_i, X_i, M_i\}_{i=1}^{N}$ such that

- Technology choice is optimal

$$(a_i, b_i) \equiv \arg \max_{(a,b)\in\Theta} \pi_i (a, b)$$

- Zero expected profit due to free entry
- Capital, labor and the final good markets clear in all countries
- Price index is consistent with consumer optimization

Theory: Technology Origin Effect

Assumption 1

No technology-capital complementarity $\xi = 0$

Assumption 2

North and South. Countries within each region are symmetric in endowment and entry costs. $K_N/L_N > K_S/L_S$. *MP and trade costs are the same for all country pairs* ($\gamma_{il} = \gamma$, $\tau_{il} = \tau$, $\forall i \neq l$)

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Proposition 1

If $\gamma \geq \tau > 1$ *or* $\tau = \infty$, $\gamma > 1$, *and* $\phi_{\min}$ *is small enough so entrants with* $\phi = \phi_{\min}$ *do not sell in every market. Then in a symmetric equilibrium*

1. *North has relatively cheaper capital*
2. *Northern firms use more capital-intensive technology*
3. *Firms enjoy a within-region cost advantage*

Outline

Data used in Calibration

- Firm-level data: Orbis

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- Aggregate data, 1996-2001 average
  - 37 countries, 91% of world GDP, 99% of outward MP sales
  - Bilateral trade shares $\lambda^T_{\cdot ln}$, bilateral MP shares $\lambda^M_{il\cdot}$
  - Endowment K_i and L_i from Penn World Table
  - Back out (r_i, w_i) from labor shares (Karabarbounis and Neiman, 14)

Model Parameters

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  - Intensive elasticity ε: direct estimation using variation within multinational firm
  - Demand elasticity $\sigma = 4$ (Arkolakis et al., 17; Bernard et al., 03)
- Others calibrated by matching endogenous outcomes of the model

Parameters	Targets
37×36 trade costs τ_{il}	bilateral trade shares
37×36 MP costs γ_{il}	bilateral MP shares
N Entry costs F_{ei}	prob serving home market 0.7
Extensive elasticity η	technology origin effect 0.28
Tech-capital complementarity ξ	size effect 0.05
Pareto k	unrestricted trade elasticity 4.3
Frechet θ	restricted trade elasticity 10.9
Capital share shifter λ	average labor share 0.52

Calibration - intensive elasticity ε

- Relative demand of affiliate f owned by parent p

$$\frac{r_l K_f}{w_l L_f} = \frac{\lambda}{1-\lambda} \underbrace{\phi_p^{\xi(1-\varepsilon)} \left(\frac{a_i}{b_i}\right)^{\varepsilon-1}}_{\text{parent fixed effect } \delta_p} \left(\frac{r_l}{w_l}\right)^{1-\varepsilon}$$

Identification: variation within multinational firms

Calibration - intensive elasticity ε

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Identification: variation within multinational firms

- Estimation equation

$$\log\left(\frac{r_l K_f}{w_f L_f}\right) = \delta_{p\times s} + (1-\varepsilon)\log\left(\frac{r_l}{w_l}\right) + u_f$$

  - control for industry differences using fixed effects
  - use firm-level wage bill to account for skill differences across firms
  - instrument $\log(r_l/w_l)$ with $\log(K_l/L_l)$ for measurement errors

Calibration - intensive elasticity ε

	Dependent Var: affiliates' $log(rK/wL)$			
Assumed Firm Age	10	5	20	40
$log(r_l/w_l)$	0.49	0.46	0.52	0.55
	(0.11)	(0.11)	(0.12)	(0.12)
Implied ε	0.51	0.54	0.48	0.45
N	23,000	23,000	23,000	23,000
First-stage F	145.47	145.47	145.47	145.47
Parent-industry FE	✓	✓	✓	✓

Standard errors are clustered at host and home country level.
I instrument $log(r_l/w_l)$ with $log(K_l/L_l)$ in all regressions.

- Similar estimates in Oberfield and Raval (14), Doraszelski and Jaumandreu (15)

▸ Robustness

Calibration results

Parameters	Values	Targets
ε	0.55	direct estimation
τ_{il}		bilateral trade shares
γ_{il}		bilateral MP shares
F_{ei}		prob serving home market 0.7
η	0.58	technology origin effect 0.28
ξ	0.55	size effect 0.05
k	4.21	unrestricted trade elasticity 4.3
θ	10.93	restricted trade elasticity 10.9
λ_k	0.29	average labor share 0.52
σ	4	Arkolakis et al. (14)

Untargeted moments:

- Cross-country variation in factor prices ▸ Details
- Gravity in τ_{il} and γ_{il} ▸ Details

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Overview of Counterfactual

- Question: how do changes in MP costs γ_{il} affect labor shares and real factor prices?

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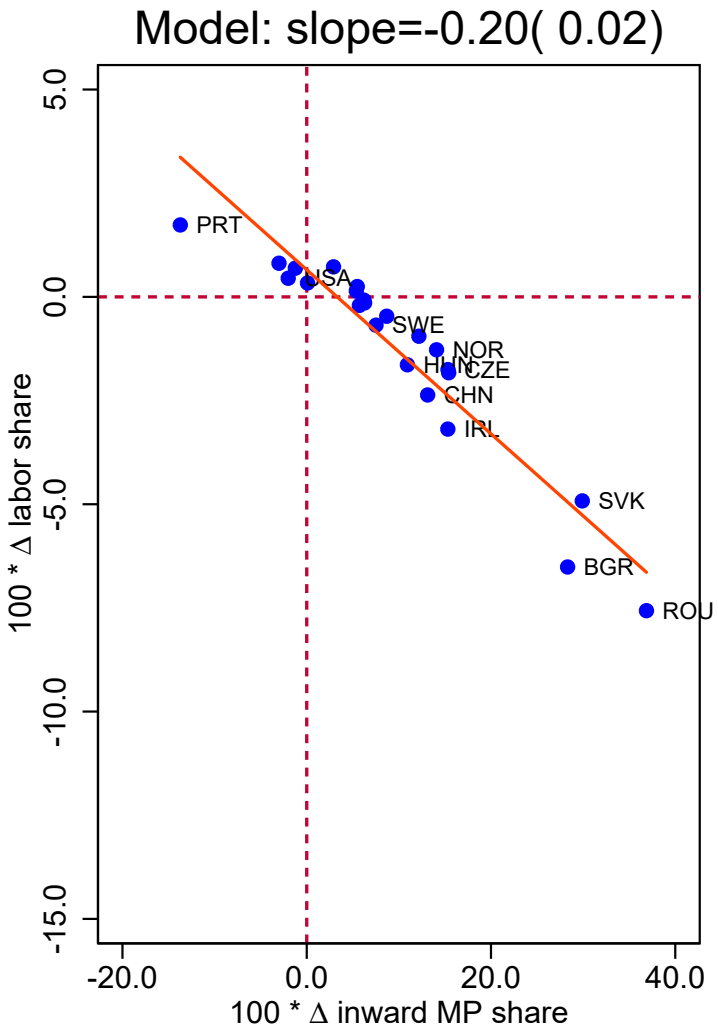
- Implementation
  - Calculate "total inward MP shares" in 1996-2001 and 2006-2011

$$\text{total inward MP shares} = \sum_{l \neq i} \lambda_{il}^{M}$$

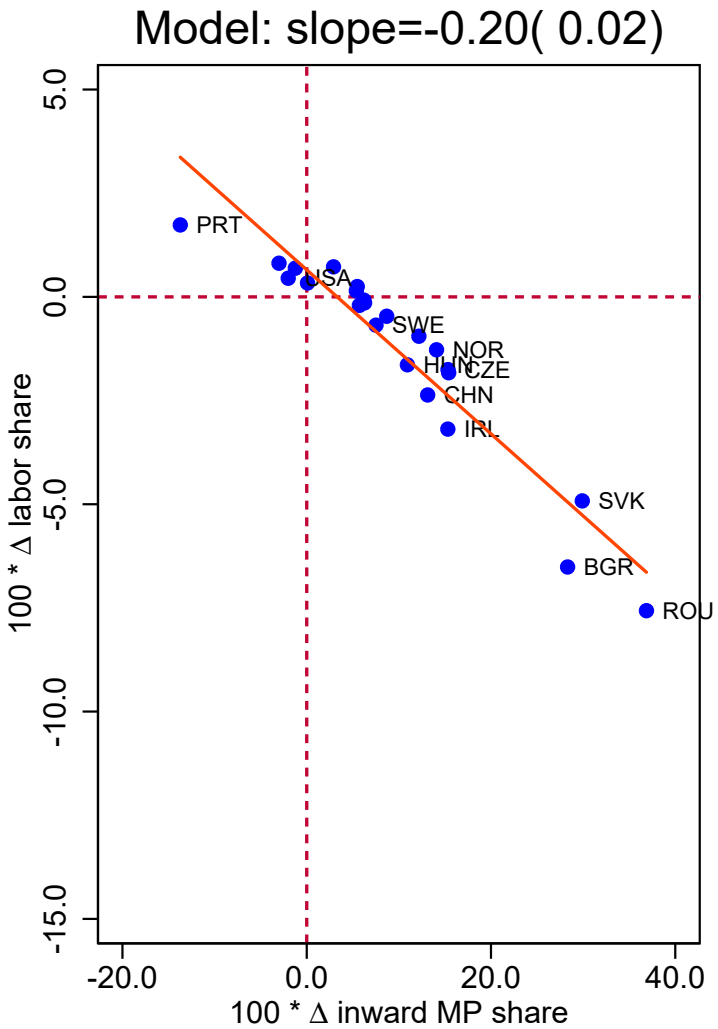
  - Calibrate new MP costs γ'_{il} by matching the changes in total inward MP shares Details
  - Solve the new equilibrium with γ'_{il} and compare to the old one

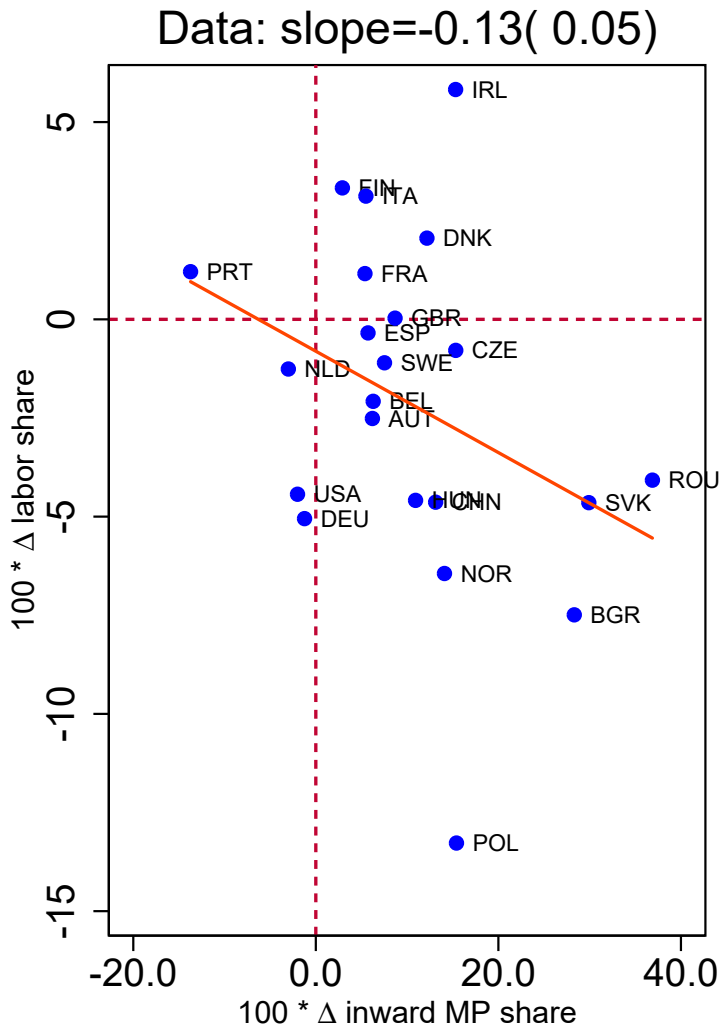
Predicted decline in labor shares



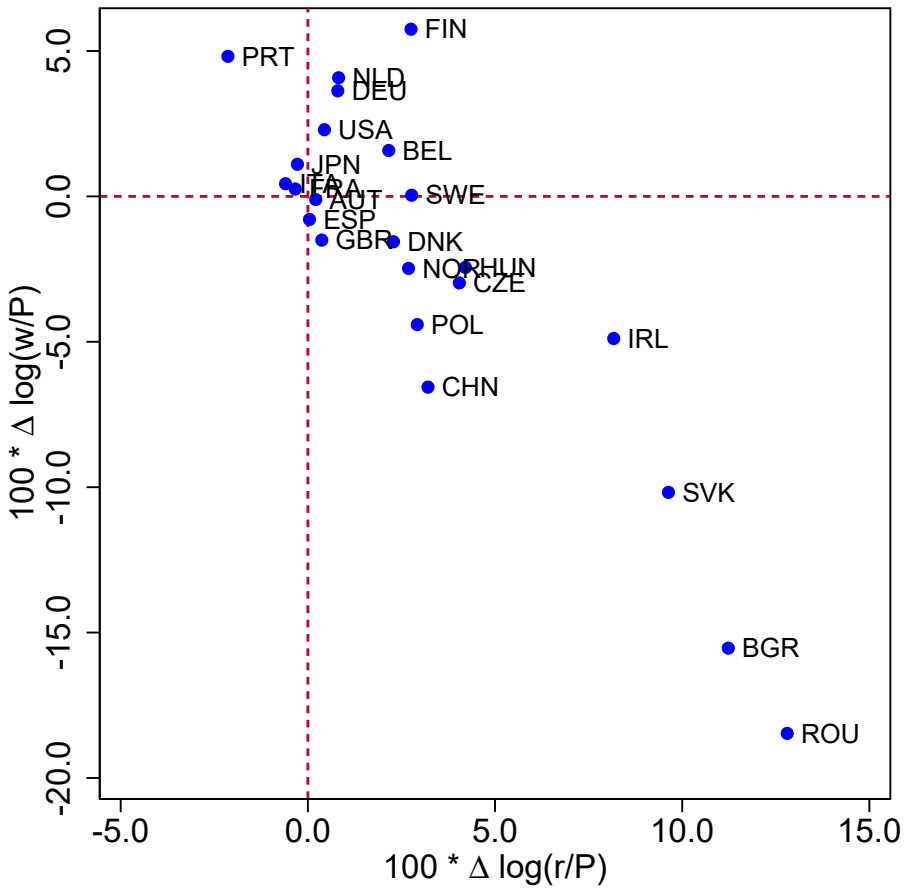
- Decline in labor shares in 15 out of 23 countries
- Average decline 1.2 p.p (data: 2.1 p.p) ▸ Compare ▸ Sensitivity
- Larger increase in MP $\rightarrow$ larger decline in labor shares

Increase in MP shares and decline in labor shares



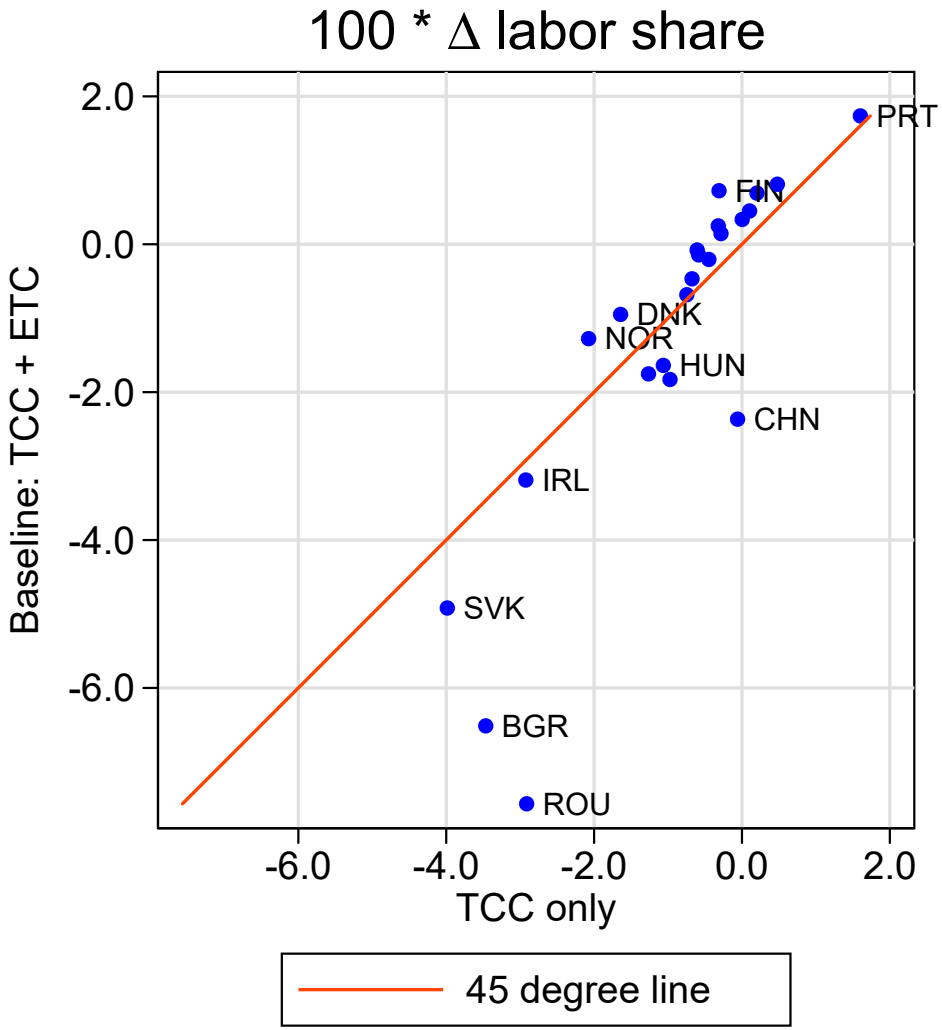


Real wage and real return to capital



- In 13 countries, capital gains and labor loses
- Changes in P cannot fully compensate workers
- At least one factor gains

Decompose the Two Mechanisms



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  - tech-capital complementarity (TCC)
  - endogenous technology choice (ETC)

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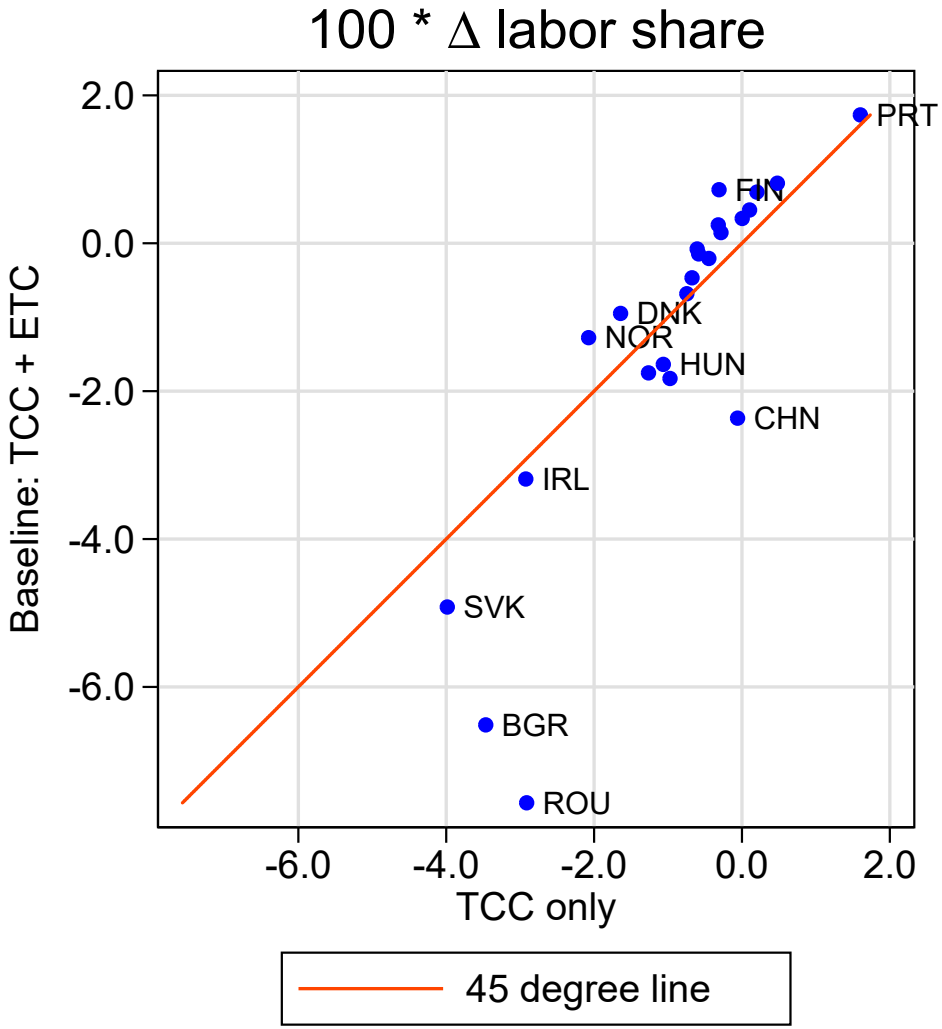

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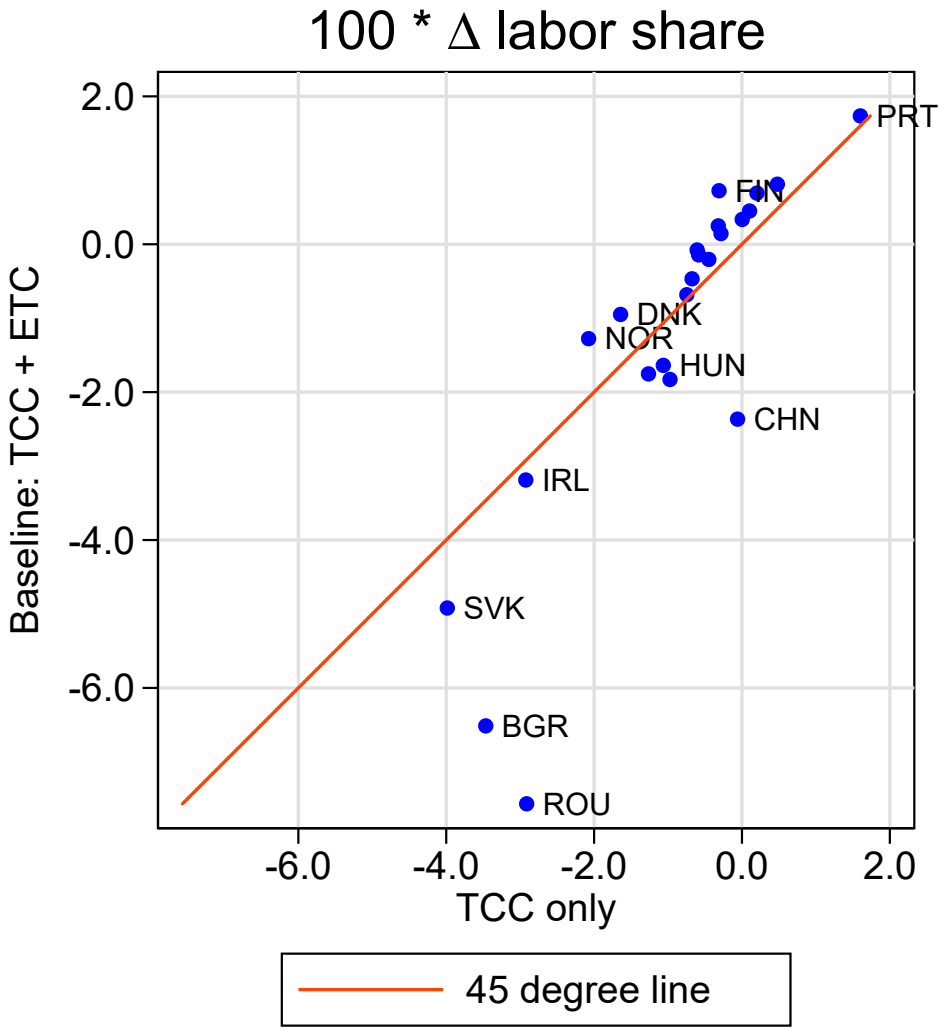

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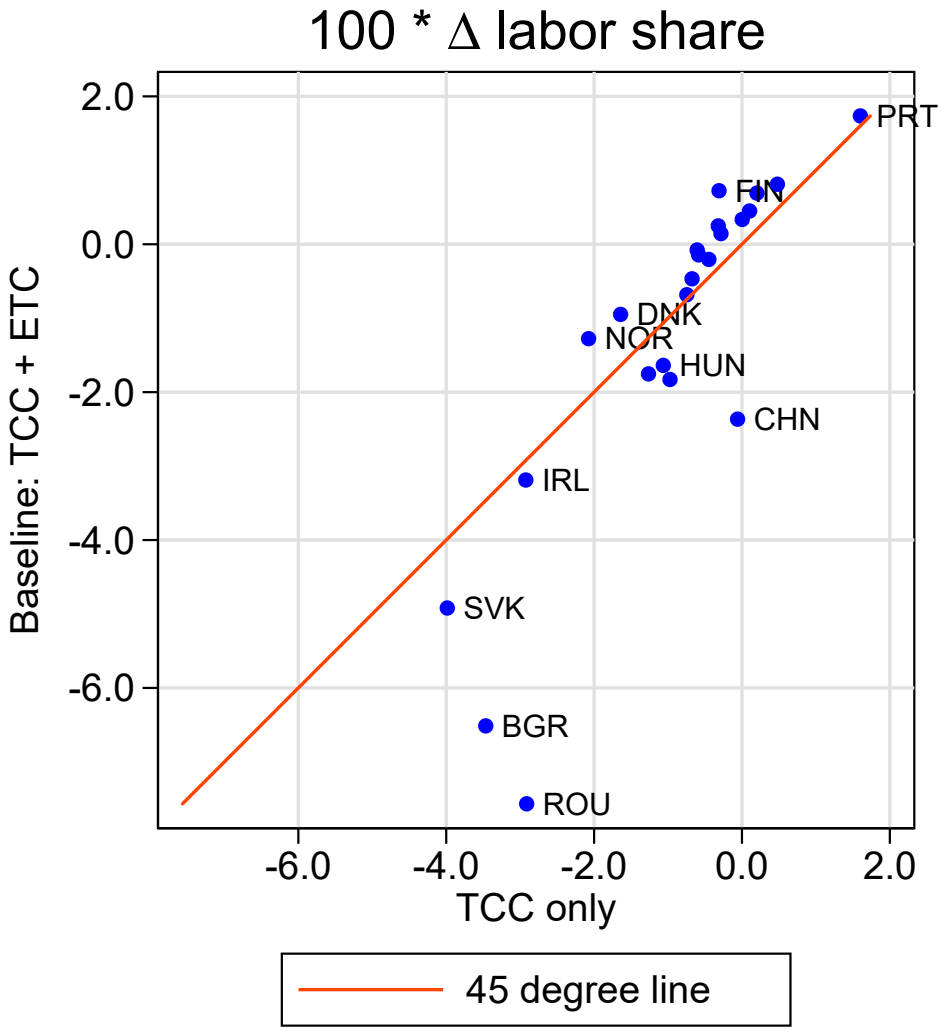

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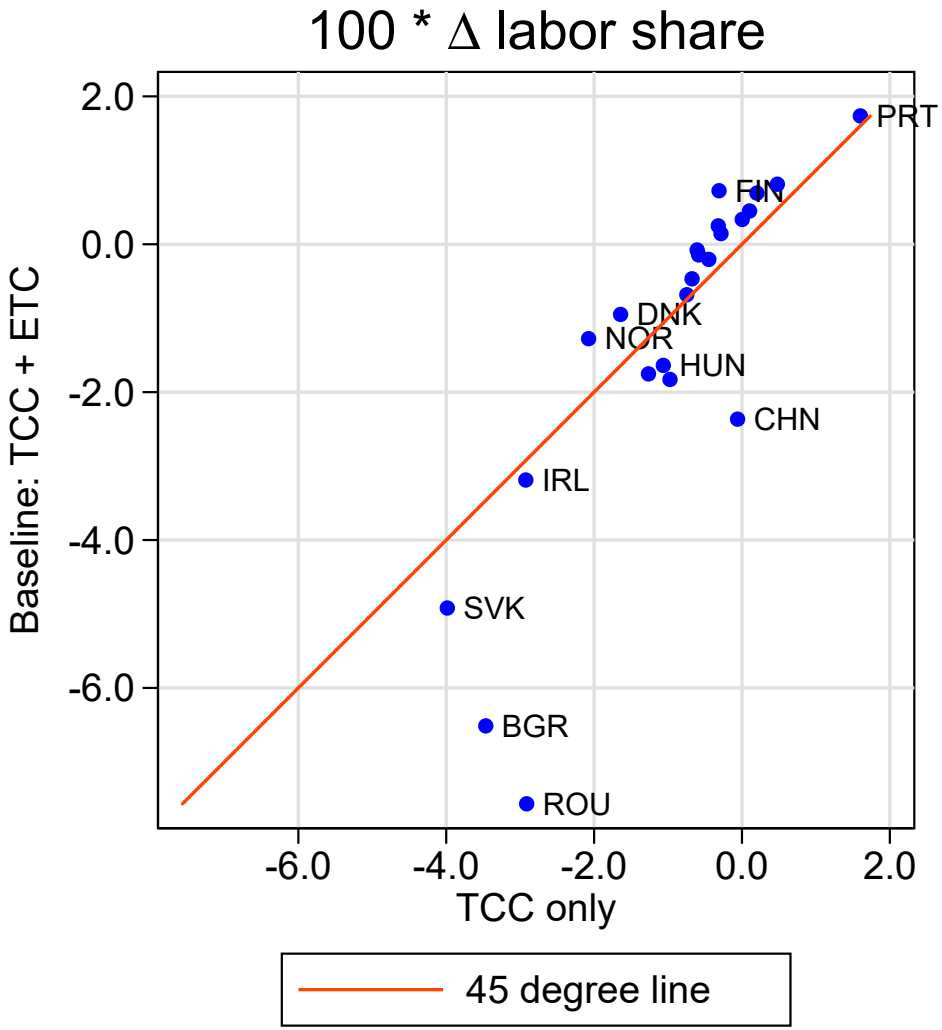
- ETC is more important for capital-scarce countries

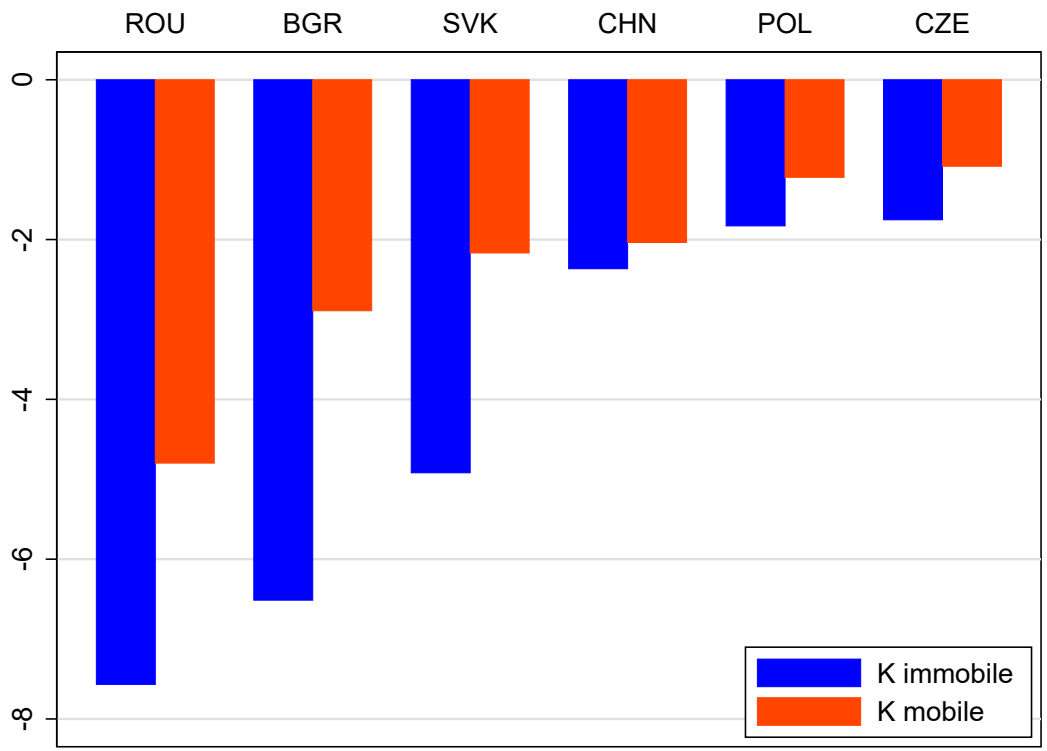
Decompose the Two Mechanisms



- Two mechanisms
  - tech-capital complementarity (TCC)
  - endogenous technology choice (ETC)
- Decomposition
  - shut down ETC by setting $\eta = -\infty$
  - deviation from the 45° line is the additional effect of ETC
- ETC is more important for capital-scarce countries

Capital Mobility

- Allow capital to move across borders
  - r are equalized across countries, w are different (increasing return to scale)
  - recalibrate the model and conduct same counterfactual exercise
  - movements of capital dampen the impact of MP on labor shares



Conclusion

- Firm heterogeneity in factor bias $\rightarrow$ large impact of MP on income distribution, particularly in capital-scarce countries
- Quantitative framework can be used to study intensities of other inputs: skilled workers, intermediate inputs, etc
- Future research
  - Are "entry activities" more capital intensive than production activities? - may explain decline in labor shares in the US and Germany
  - Other vehicles of technology transfer: offshoring and spillover

Robustness

- Coverage of the Orbis database Results
- Alternative definitions of home country Results
- Fixed assets as a measure of K Results
- Home country K/L v.s. weighted average of host country K/L Results
- Directly control for firm's relative factor prices Results 1 Results 2

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Coverage and distribution across countries

Country	(1) # of firms	(2) employment share	(3) # of inward affiliates	(4) employment share	(5) # outward affiliates
Belgium	116000	0.51	1734		1198
Bulgaria	143000	0.91	547	0.15	292
Czech	55000	0.45	2275	0.35	143
Germany	44000	0.18	2516	0.17	7343
Denmark	9000	0.14	525	0.17	738
Spain	426000	0.41	3802	0.28	1716
Estonia	32000	0.51	497	0.23	25
Finland	44000	0.34	315	0.12	682
France	207000	0.19	3044	0.20	3754
UK	42000	0.33	4976	0.36	3042
Croatia	55000	0.59	528	0.25	343
Hungary	203000	0.63	350	0.16	822
Italy	418000	0.37	3682	0.23	4168
Japan	208000	0.19	69	0.04	1744
Korea	66000		401		170
Norway	86000	0.70	822	0.24	514
Poland	11000	0.07	695	0.06	318
Portugal	212000	0.57	1534	0.35	415
Romania	305000	0.73	5728	0.27	206
Serbia	35000		1114		82
Slovenia	40000	0.53	416	0.25	503
US	7000		0		7352
Average	126000	0.44	1617	0.21	1617

Total number of firms in column (1) is rounded to 1000.

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Control for the coverage of multinational affiliates from *i*

	Dependent Var: log(total assets/wage bill)			
	All (1)	All (2)	Foreign Aff (3)	Foreign Aff (4)
$\log(K_i/L_i)$	0.257^{*}	0.167^{+}	0.238	0.182
	(0.101)	(0.087)	(0.164)	(0.166)
log(Revenue)	0.100^{***}	0.058^{**}	0.067^{***}	0.057^{***}
	(0.026)	(0.022)	(0.007)	(0.010)
debt-to-equity ratio		0.005^{***}		0.005^{***}
		(0.001)		(0.001)
Emp share (firms)	✓	✓		
Emp share (affiliates)			✓	✓
# of home countries	15	15	16	16
R-squared	0.35	0.41	0.45	0.48
N	1,912,000	1,407,000	27,000	21,000
Country-industry FE	✓	✓	✓	✓

Standard errors are clustered at both home country and host country * industry levels. + 0.10 * 0.05 ** 0.01 *** 0.001. Number of observations is rounded to thousands of firms.

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Alternative definitions of home country

	Dependent Var: log(deflated total assets/wage bill)					
	Alter Def 1		Alter Def 2		Alter Def 3	
	(1)	(2)	(3)	(4)	(5)	(6)
$log(K_i/L_i)$	0.140^{+}	0.175^{*}	0.233^{+}	0.239	0.263^{*}	0.272^{+}
	(0.078)	(0.089)	(0.139)	(0.149)	(0.134)	(0.143)
log(Revenue)	0.080^{***}	0.070^{***}	0.070^{***}	0.062^{***}	0.069^{***}	0.062^{***}
	(0.013)	(0.013)	(0.009)	(0.011)	(0.009)	(0.011)
debt-to-equity ratio		0.003^{**}		0.003^{***}		0.003^{***}
		(0.001)		(0.001)		(0.001)
R-square	0.46	0.49	0.44	0.46	0.44	0.46
N	26,000	21,000	43,000	35,000	43,000	35,000

Def 1: closest same-industry foreign owner.
Def 2: closest industrial foreign owner within 3 layers of control.
Def 3: closest industrial foreign owner.

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Using fixed assets to measure K

	Dependent Var: log(fixed assets/wage bill)					
	All	MNE	All	MNE	All	MNE
	(1)	(2)	(3)	(4)	(5)	(6)
Home country log(K/L)	0.234***	0.445**	0.176*	0.427**	0.193*	0.424*
	(0.069)	(0.142)	(0.083)	(0.162)	(0.088)	(0.183)
log(Revenue)			0.046	0.101***	0.045+	0.112***
			(0.029)	(0.016)	(0.026)	(0.020)
debt-to-equity ratio					-0.000	-0.003+
					(0.002)	(0.002)
# of home countries	22	22	22	22	22	22
R-squared	0.232	0.370	0.236	0.378	0.255	0.397
N	2,536,000	54,000	2,400,000	51,000	1,879,000	42,000
Country-industry FE	✓	✓	✓	✓		

Standard errors are clustered at both home country and host country * industry levels. + 0.10 * 0.05 ** 0.01 *** 0.001.

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Home country or production center?

	Dependent Var: log(total assets/wage bill)			
	(1)	(2)	(3)	(4)
Home country log(K/L)	0.284^{+}	0.306*	0.274^{+}	0.285^{+}
	(0.146)	(0.151)	(0.141)	(0.146)
Largest host country log(K/L)	-0.021	-0.038		
	(0.047)	(0.050)		
Average log(K/L) of host countries			0.018	0.027
			(0.046)	(0.048)
log(Revenue)	0.054***	0.042***	0.054***	0.042***
	(0.010)	(0.010)	(0.010)	(0.010)
debt-to-equity ratio		0.004***		0.004***
		(0.001)		(0.001)
# of home countries	22	22	22	22
R-squared	0.45	0.47	0.45	0.47
N	54,000	44,000	54,000	44,000
Country-industry FE	✓	✓	✓	✓

Standard errors are clustered at both home country and host country * industry levels.
$+$ 0.10 * 0.05 ** 0.01 *** 0.001.

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Directly controlling for r/w

	Dependent Var: log(total assets/employment)			
	All (1)	All (2)	MNE (3)	MNE (4)
Home country log(K/L)	0.304***	0.307***	0.394***	0.372***
	(0.045)	(0.037)	(0.092)	(0.092)
log(Revenue)	0.169***	0.144***	0.115***	0.104***
	(0.020)	(0.018)	(0.010)	(0.011)
Firm's log(r/w)	-0.142***	-0.147***	-0.126***	-0.136***
	(0.029)	(0.026)	(0.023)	(0.024)
debt-to-equity ratio		0.002***		0.002**
		(0.000)		(0.001)
# of home countries	22	22	22	22
R-squared	0.46	0.46	0.49	0.51
N	1,554,000	1,304,000	39,000	33,000
Country-industry FE	✓	✓	✓	✓

Standard errors are clustered at both home country and host country * industry levels. + 0.10 * 0.05 ** 0.01 *** 0.001.

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Back out capital bias using K/L and r/w

	Dependent Var: $log(K/L) + \varepsilon log(r/w)$			
	All (1)	All (2)	MNE (3)	MNE (4)
Home country log(K/L)	0.326***	0.351***	0.374***	0.366***
	(0.041)	(0.037)	(0.106)	(0.105)
log(Revenue)	0.100***	0.073***	0.087***	0.075***
	(0.020)	(0.016)	(0.010)	(0.012)
debt-to-equity ratio		0.002***		0.002**
		(0.001)		(0.001)
# of home countries	22	22	22	22
R-squared	0.40	0.41	0.44	0.47
N	1,554,000	1,304,000	39,000	33,000
Country-industry FE	✓	✓	✓	✓

Standard errors are clustered at both home country and host country * industry levels. + 0.10 * 0.05 ** 0.01 *** 0.001.

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Robustness of the estimated intensive elasticity ϵ

- Use K_f / L_f instead of $r_l K_f / w_f L_f$ ▸ Results
- OLS instead of IV regressions ▸ Results
- Estimates by industry ▸ Results
- Assume r is the same within a multinational firm ▸ Results

OLS instead of IV regressions

	Dependent Var: affiliates' $log(rK/wL)$			
Assumed Firm Age	10	5	20	40
$log(r_l/w_l)$	0.64 (0.07)	0.61 (0.07)	0.67 (0.07)	0.70 (0.08)
Implied ε	0.36	0.39	0.33	0.30
N	23,000	23,000	23,000	23,000
Parent-industry FE	✓	✓	✓	✓

Standard errors are clustered at host and home country level.

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Use K/L instead of rK/wL

	Dependent Var: affiliates' $log(K/L)$			
Assumed Firm Age	10	5	20	40
$log(r_l/w_l)$	-0.63 (0.13)	-0.66 (0.13)	-0.60 (0.14)	-0.58 (0.14)
Implied ε	0.63	0.66	0.60	0.58
N	23,000	23,000	23,000	23,000
First-stage F	145.47	145.47	145.47	145.47
Parent-industry FE	✓	✓	✓	✓

Standard errors are clustered at host and home country level.
I instrument $log(r_l/w_l)$ with $log(K_l/L_l)$ in all regressions.

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Estimate by sector

	Dependent Var: affiliates' $log(rK/wL)$				
	Mining and Construction	Manufacturing	Wholesale, retail and repair	Transportation and storage	Other services
$log(r_l/w_l)$	0.66 (0.09)	0.48 (0.10)	0.52 (0.12)	0.64 (0.12)	0.33 (0.18)
Implied ε	0.34	0.52	0.48	0.36	0.67
N	1,000	4,000	6,000	1,000	7,000
First-stage F	80.85	174.97	147.24	128.34	124.10
Parent-industry FE	✓	✓	✓	✓	✓

Standard errors are clustered at host and home country level. I instrument $log(r_l/w_l)$ with $log(K_l/L_l)$ in all regressions.

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Assume same r within a multinational firm

	Dependent Var: affiliates' $log(rK/wL)$			
Assumed Firm Age	10		20	
$log(w_l)$	-0.54	-0.59	-0.58	-0.64
	(0.10)	(0.15)	(0.10)	(0.16)
Implied ε	0.46	0.41	0.42	0.36
N	23,000	23,000	23,000	23,000
First-stage F		57.5		57.5
Parent-industry FE	✓	✓	✓	✓

Standard errors are clustered at host and home country level. Instrument is $log(K_l/L_l)$ in IV regressions.

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Non-targeted Moments: "Gravity" in τ and γ

	trade cost		MP cost	
	$log(\tau_{il})$	$log(\tau_{il})$	$log(\gamma_{il})$	$log(\gamma_{il})$
log(distance)	0.28***	0.25***	0.27***	0.24***
	(0.02)	(0.02)	(0.02)	(0.01)
contiguity		-0.08**		-0.07*
		(0.03)		(0.03)
common language		-0.07		-0.09*
		(0.04)		(0.04)
colony		-0.08**		-0.14***
		(0.03)		(0.04)
N	1332	1332	1052	1052
R^2	0.99	0.99	0.94	0.94
Home FE	✓	✓	✓	✓
Host FE	✓	✓	✓	✓

MP and trade costs are lower if two countries (1) are close in distance (2) share border (3) share common language (4) have colonial relations

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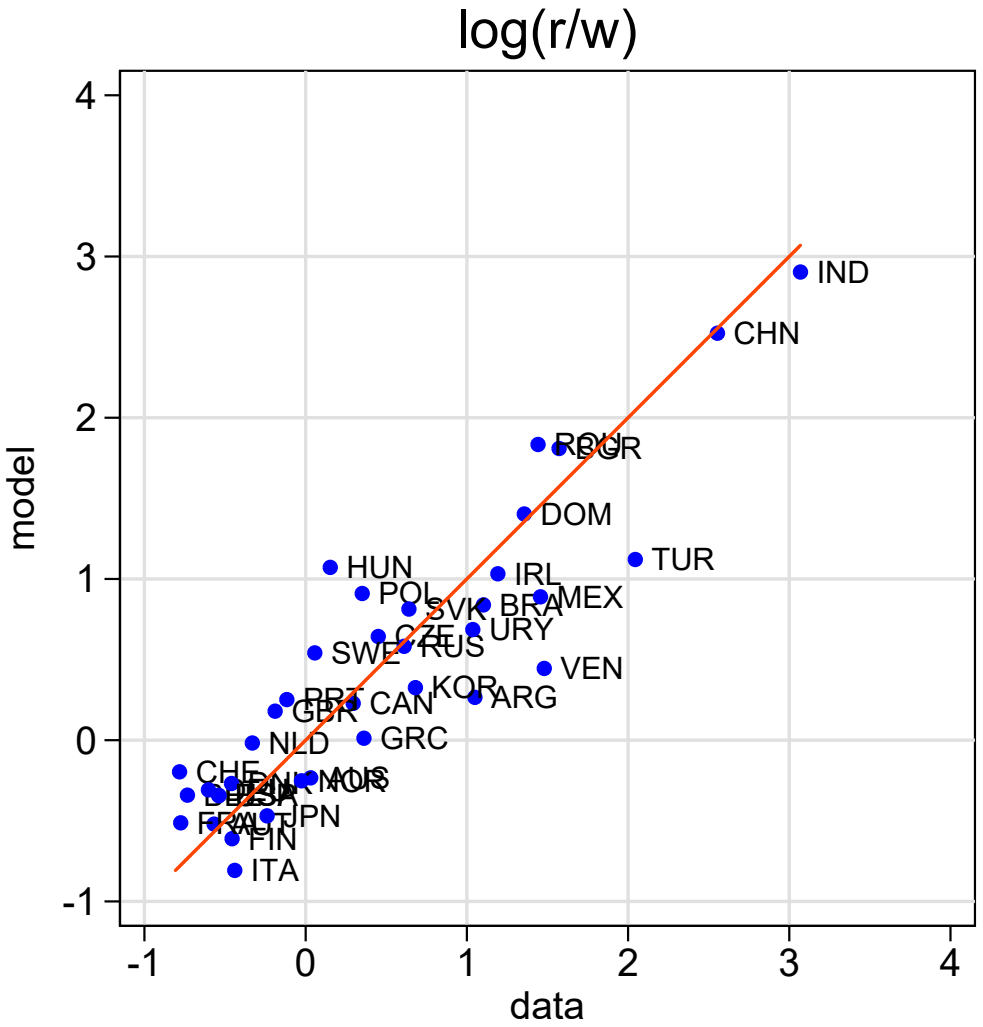
Non-targeted Moments: Factor Prices



- Calibration targets average labor shares
- Model captures cross-country variation ($corr = 0.9$)
- Endogenous technology choice improves the match Details

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Non-targeted Moments: the relationship between aggregate factor prices and endowments

	Dependent var: $log(r/w)$		
	Data	Model	
		$\eta = 0.58$	$\eta \to -\infty$
$\log(K/L)$	-1.33	-1.30	-1.81
	(0.07)	(0.02)	(0.01)
N	37	37	37

- In the calibration, $\eta = 0.60 \Rightarrow$ extensive substitution is at work
- Setting $\eta \to -\infty$ and recalibrating the model $\Rightarrow$ shuts down endogenous technology choice
- The model without endogenous technology choice cannot match the relationship between factor prices and endowments!

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Calibrated change in MP costs γ_{il}

- Calibrate $\hat{\gamma}_{il}$ to match change in total inward MP shares (under-identified)
  - for a particular host country l, $\hat{\gamma}_{il} = \hat{\gamma}_l$ for all $i \neq l$
  - for 14 countries without data, assume $\log(\hat{\gamma}_l)$ is global average

Calibrated change in MP costs γ_{il}

- Calibrate $\hat{\gamma}_{il}$ to match change in total inward MP shares (under-identified)
  - for a particular host country l, $\hat{\gamma}_{il} = \hat{\gamma}_l$ for all $i \neq l$
  - for 14 countries without data, assume $\log(\hat{\gamma}_l)$ is global average

Country	$log(\hat{\gamma})$	Δ inward MP share	inward MP share 96-01	inward MP share 06-11
Largest Declines				
Romania	-33.9	36.9	5.6	42.4
Bulgaria	-33.9	28.3	3.5	31.8
China	-27.3	13.1	2.4	15.6
Slovakia	-15.9	29.9	20.0	49.9
Norway	-14.1	14.1	11.0	25.1
Smallest Declines				
Germany	-0.2	-1.2	23.7	22.4
Japan	0.8	0.1	3.9	4.0
US	1.5	-2.0	12.6	10.6
Netherland	1.5	-3.0	34.6	31.6
Portugal	8.8	-13.7	33.9	20.1
Average	-8.0	9.6	20.3	29.8

All numbers are in percentage points or 100$\times$ change in log points

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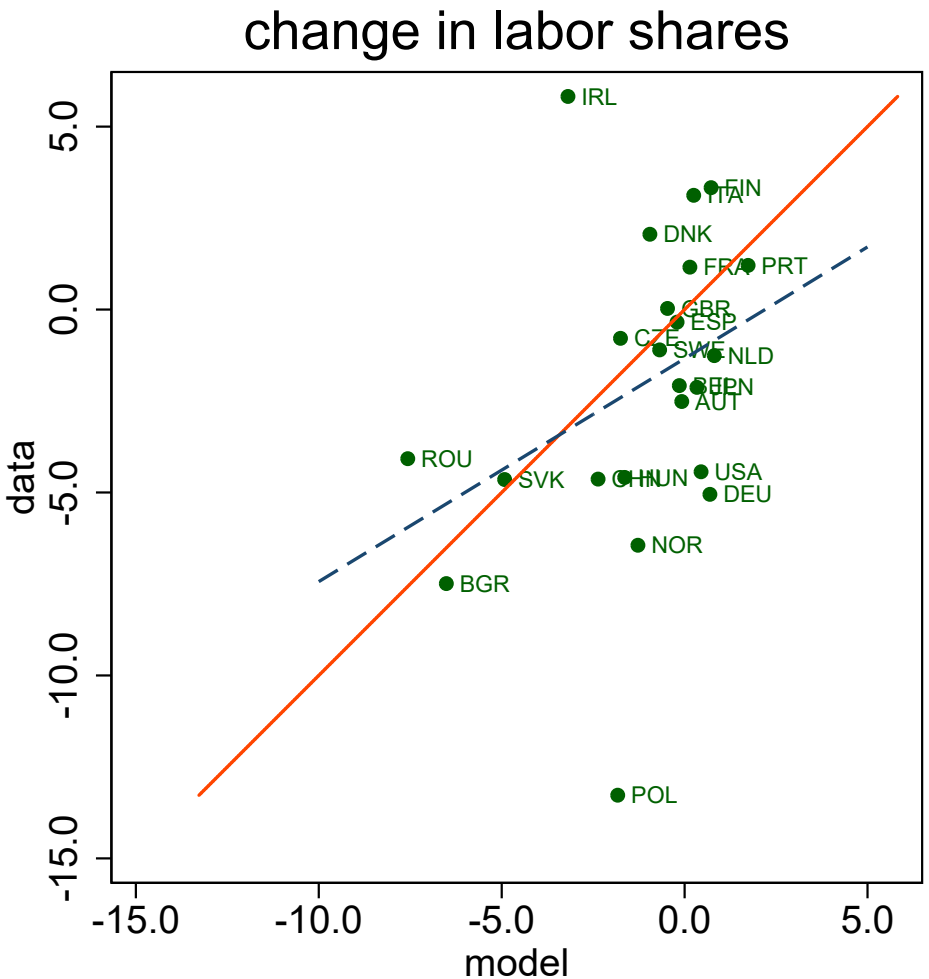
Change in labor shares : model vs data



Coef = 0.61 (s.e. = 0.26, r-squared = 0.12)

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Sensitivity

1. Different values of ε Results

2. Change the strength of technology-capital complementarity and endogenous technology choice (ξ, η) Results

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Sensitivity to ϵ

ϵ	0.4	0.51 (baseline)	0.6
Δ labor share	-1.52	-1.24	-1.17

Each column corresponds to calibration with the intensive elasticity ϵ set to 0.4, 0.51 (baseline) and 0.6.

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Sensitivity to targeted regression coefficients

ξ	low	medium	high
η			
low	-0.73	-1.06	-1.25
medium	-0.92	-1.20	-1.37
high	-1.04	-1.26	-1.42

Low, medium and high η correspond to calibrations in which the technology origin effect is targeted at 0.1, 0.2 and 0.3, respectively. Low, medium and high ξ correspond to calibrations in which the size effect is targeted at 0.025, 0.05 and 0.075, respectively.

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