The Regional Specialization Trade-off

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  1. How does regional specialization affect growth?
  2. What is the optimal regional specialization?

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- Efficient regional specialization in 1950 raises welfare by 1.2-2.2%

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   [Solow (1956), Baumol (1986), Barro and Sala-i-Martin (1991), Autor & Dorn (2013), Giannone (2022), Eckert & Peters (2023), Comin et al (2021), Gaubert et al (2020), Caselli et al (2016)]

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3. **Long-run implications of financial frictions:**

   [Kiyotaki & Moore (1997), Bernanke, Gertler & Gilchrist (1999), Mendoza (2010), Gertler & Karadi (2012), Bianchi (2011), Bianchi & Mendoza (2019), Bonciani et al (2023)]

   Contribution: Derive financial friction in multi-industry setting + long-run effects

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5. Conclusion

Empirical results

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  - Robustness: other measures (HHI, max share), other variables (employment, value added)

▸ Topcoding ▸ Further Details

Fact 1: The Specialization Trade-off

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- Define
  - r for commuting zone $r = \{1, ..., 722\}$
  - Y_r as dependent variable
  - $Gini_{r,1950}$ as 1950 Gini on income p.c. by 3-digit industry

$$Y_r = \alpha + \beta \cdot Gini_{r,1950} \qquad\qquad + \epsilon_r$$

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$$Y_r = \alpha + \beta \cdot Gini_{r,1950} + \gamma' \cdot Z_r \qquad + \epsilon_r$$

  - Z_r including a set of control variables:
    - 1950 log income p.c. [Barro & Sala-i-Martin (1992)]
    - 1950 population [Eckert, Ganapati & Walsh (2024)]
    - 1950 share of high-skilled workers [Autor & Dorn (2013)]
    - 1950 old-age dependency ratio [Autor, Dorn & Hanson (2019)]
    - 1950 share of female workers [Fosso, Bergholt, Furlanetto (2025)]

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$$Y_r = \alpha + \beta \cdot Gini_{r,1950} + \gamma' \cdot Z_r + \delta \cdot \hat{g}_r + \epsilon_r$$

  - Z_r including a set of control variables
  - $\hat{g}_r$ as shift-share predicted growth from structural change [Borusyak et al (2025)]

$$\hat{g}_r = \sum_{i=1}^{I} s_{i,r,1950} \cdot g_i^{US}$$

  with
    - $s_{i,r,1950}$ as 1950 income share in industry i
    - g_i^{US} as 1950-2020 US growth in industry i

Fact 1: The Specialization Trade-off after controls

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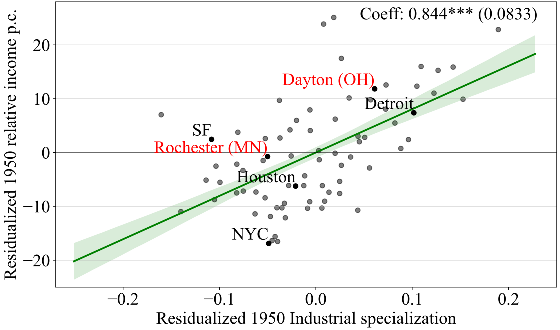

Figure 1: 1950 Income level

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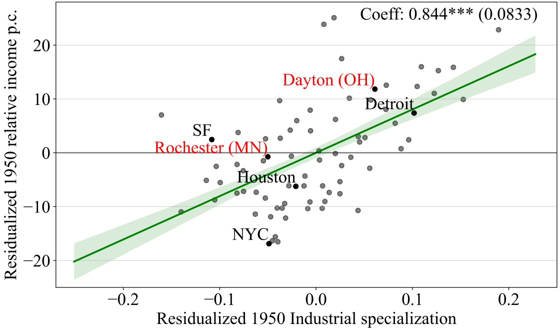

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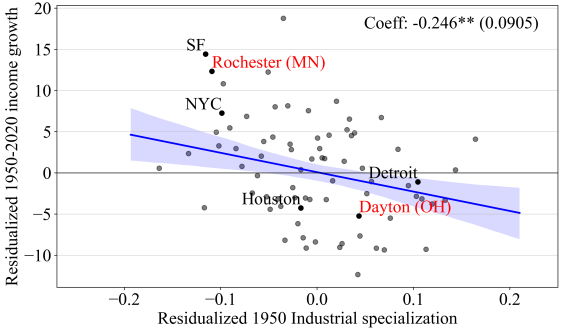

Figure 2: 1950-2020 Growth

▸ Regression table

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- Goals:
  1. Characterize dynamic relationship between specialization and income
  2. Observe how regions move in distribution

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- Key point: dynamics can be highly non-linear [Imbs & Wacziarg (2003)]

- Define non-parametric locally weighted regression:
  - i as single observation: Commuting Zone $\times$ Year
  - y_i as normalized specialization (Gini)
  - x_i as normalized per capita income

$$y_i = \alpha(x_i) + \beta(x_i)x_i + \epsilon_i$$

with

- $(\hat{\alpha}(x_i), \hat{\beta}(x_i)) = \arg\min_{\alpha,\beta} \sum_j w_j(x_i)(y_i - (\alpha + \beta x_j))^2$

Further details

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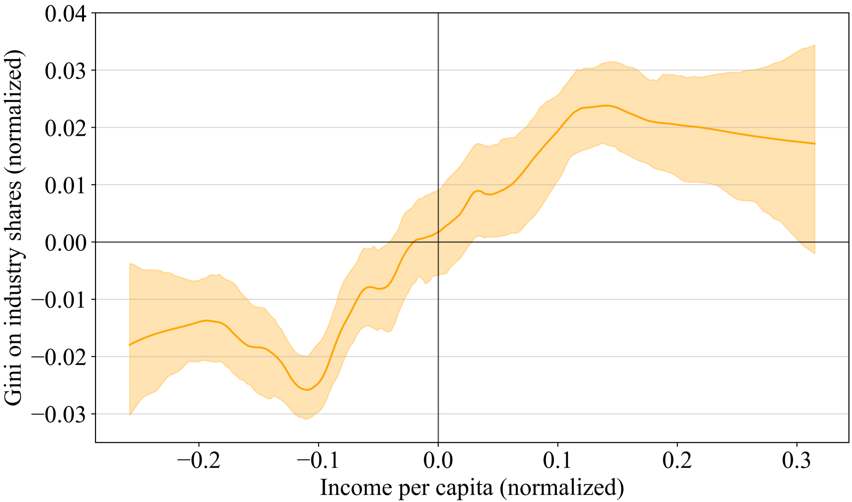

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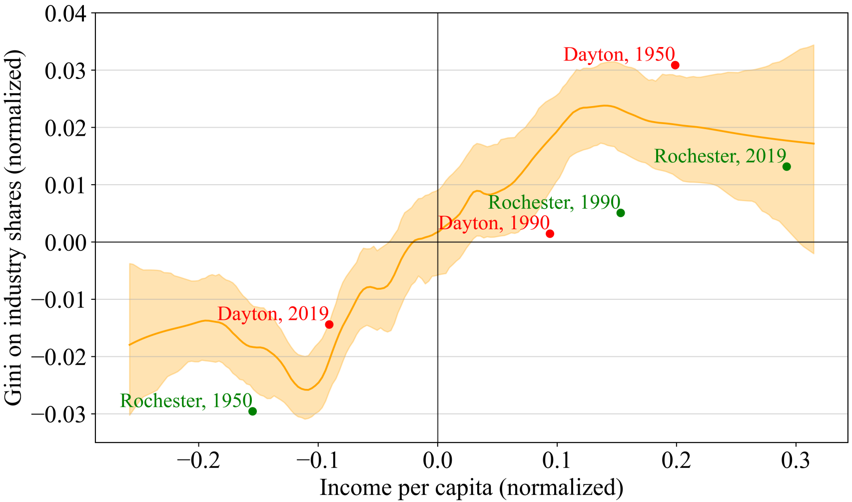

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  - $\delta_{r,t}$ as region-year FE
  - $\gamma_{i,t}$ as industry-year FE
  - h as horizon

$$\text{logRankRCA}_{i,r,t} = \alpha + \beta_h \cdot \text{logRankRCA}_{i,r,t-h} + \delta_{r,t} + \gamma_{i,t} + \epsilon_{i,r,t}$$

- Coefficent β_h: Rank-rank elasticity of RCA (persistence measure)

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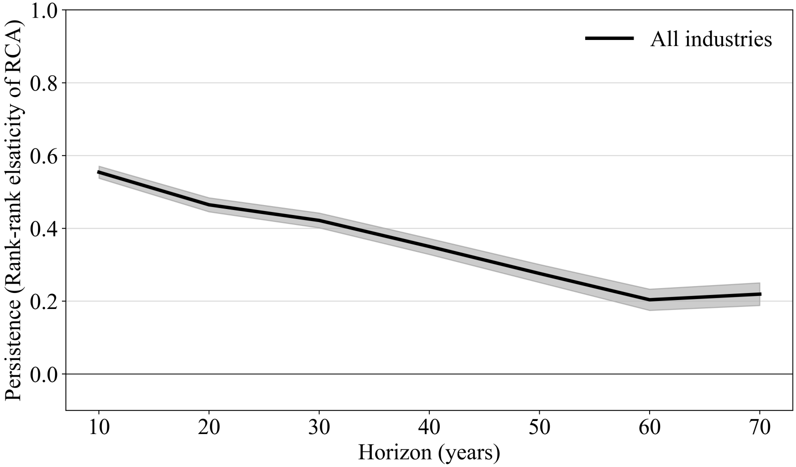

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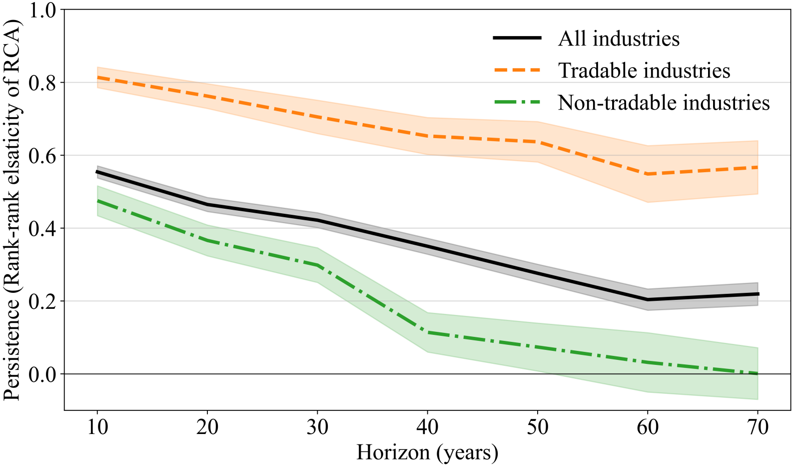

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- Extensions and Robustness: ▸ Role of tradability ▸ Horizons ▸ Industries ▸ Persistence ▸ Measures
- Next: Formalize specialization trade-off theoretically
  1. Rationalize U.S. regional growth since 1950
  2. Assess welfare under optimal specialization

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Consumption-savings: $u'(c_t) = \beta R_t \, \mathbb{E}_t \big[u'(c_{t+1}) \big] + \eta_t$

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3. **Consistency:**
   - Law of motion of aggregate bond holdings: $B' = \Gamma(B, \mathcal{K}, \mathcal{Z})$
   - Capital pricing function: $q(B, \mathcal{K}, \mathcal{Z}) = \hat{q}(B, \mathcal{K}, \mathcal{Z})$

Specialization and financial frictions: Intuition

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Shock to industry i → Decline in value of capital → Collateral constraint tightens → Investment declines

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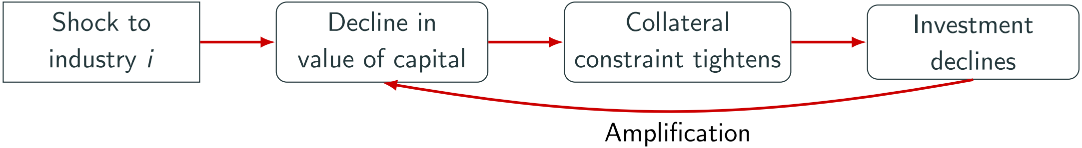

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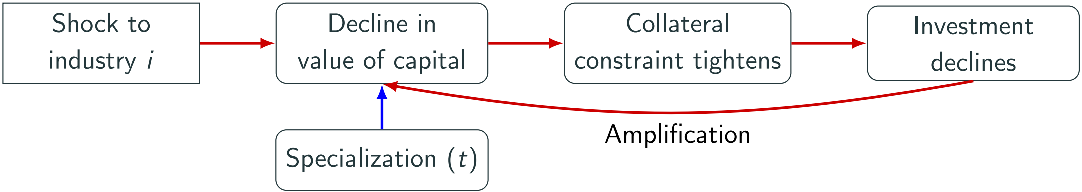

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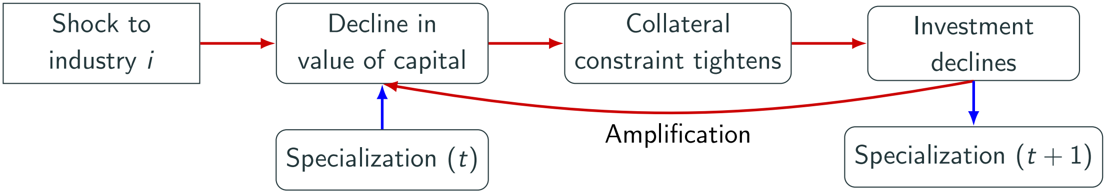

Specialization and the value of capital

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- Re-write pricing condition:

$$q_t = \mathbb{E}_t \sum_{j=0}^{\infty} \underbrace{\left[\prod_{l=0}^{j} \mathbb{E}_{t+j} (\bar{R}^q_{t+1+l})^{-1} \right]}_{\text{Weighted capital return}} \underbrace{\bar{d}_{t+j+1}}_{\substack{\text{Weighted} \\ \text{expected dividends}}} - \underbrace{\bar{\phi}^2_t}_{\substack{\text{Weighted} \\ \text{Adj. costs}}}$$

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  3. $[I > 1$ and $\Phi > 0]$: $Cov\,(q, z_i) = F(\sum_i s_i)$ $\rightarrow$ **Specialization matters for exposure**

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- Re-write bond Euler condition:

$$\beta R_t \mathbb{E}_t \left[\frac{u'(c_{t+1})}{u'(c_t)} \right] = (1 - \eta_t)$$

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- Collateral constraint **determines ability to invest**:

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Quantitative Analysis

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  1. 1950 fixed capital stock: Matching 1950 income shares
  2. Discount factor: Matching U.S. NFA position

Calibration

Parameter	Value	Source/ Target
Parameters set independently		
Risk Aversion	$\gamma = 5$	Average value in literature
Capital Share	$\alpha = 0.3$	Avg. US capital income share
Adjustment Costs	$\Phi_i \in [0, 3.26]$	Hall (2004); Groth & Khan (2010)
Agglomeration	$\xi_i \in [0.1, 0.29]$	Bartelme et al. (2024)
Collateral regime	$\theta = 0.35$	Historical LTV ratio (Graham et al, 2015)
Interest Rate	$\bar{R} = 1.3\%, \rho_R = 0.01$	U.S. 90-day T-Bills
	$\sigma_R = 0.0186$	
TFP Process	$\rho_i \in [0.71, 0.9]$	Std. and autoc. of U.S. industry TFP
	$\sigma_i \in [0.013, 0.027]$	
Parameters set internally		
1950 capital stock	$k_{i,1950} \in [0.1, 0.29]$	Matching income shares
Discount Factor	$\beta = 0.95$	Avg. NFA position

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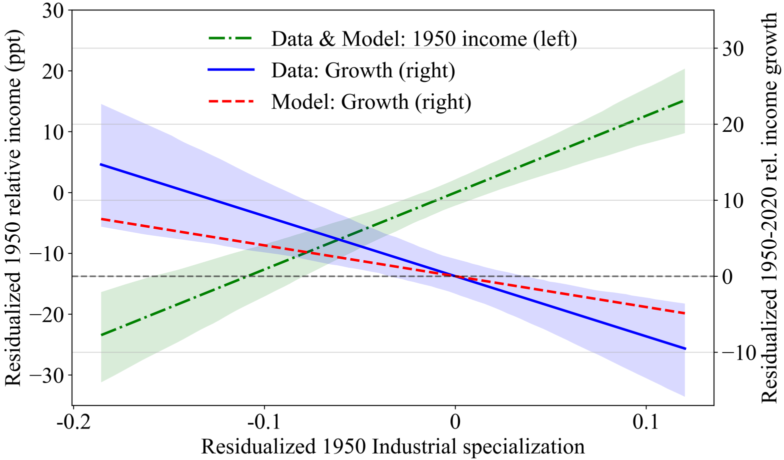

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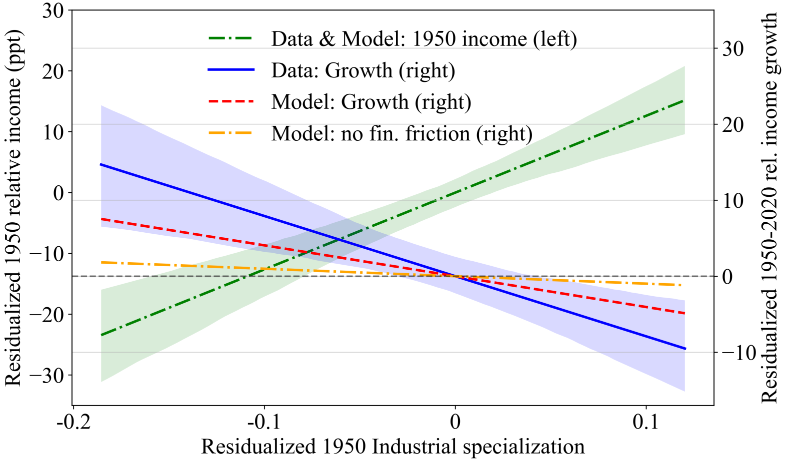

$\Rightarrow$ Financial friction captures 56% of adverse specialization effect on growth! ▸ IRF

Efficiency & Welfare

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  1. Agglomeration externality: Productivity = function of aggregate capital in industry i
     $\Rightarrow$ Increase specialization
  2. Pecuniary externality: Price of capital = function of capital portfolio + bond position
     $\Rightarrow$ Increase diversification

Constrained-efficient Planner

- Planner maximizes

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$$-\frac{b_{t+1}}{R_t} \leq \theta q_t$$

$$\sum\nolimits_i^I k_{i,t} = \bar{K} \quad \forall\, t$$

$$\boxed{z_{i,t} = \bar{z}_{i,t} \cdot k_{i,t}^{\xi_i} \quad \forall\, i}$$

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Cons.-savings: $$\lambda_t = \beta R_t\,\mathbb{E}_t\left[\lambda_{t+1} + \underbrace{\sum\nolimits_i^I \delta_{i,t}\Omega_{i,t+1}^B}_{\text{GE effect on price}}\right] + \eta_t^*$$

The Specialization Trade-off: Individual vs. Planner

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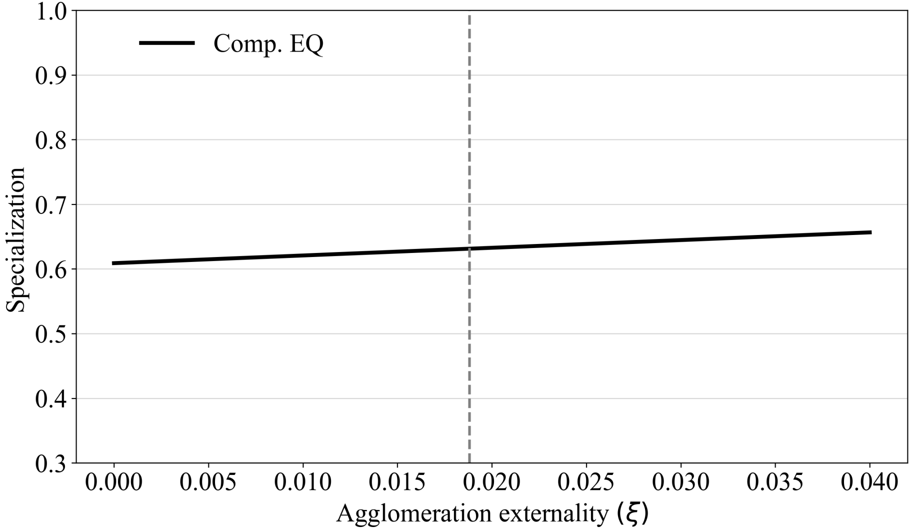

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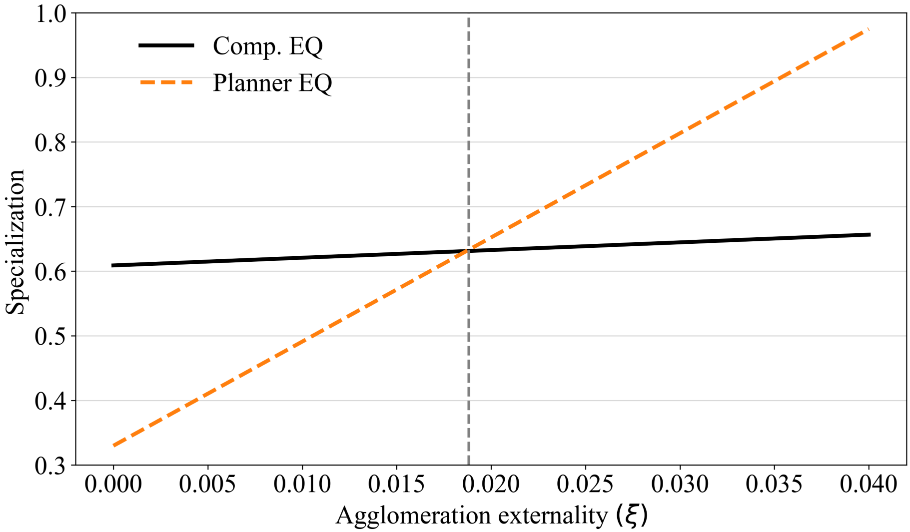

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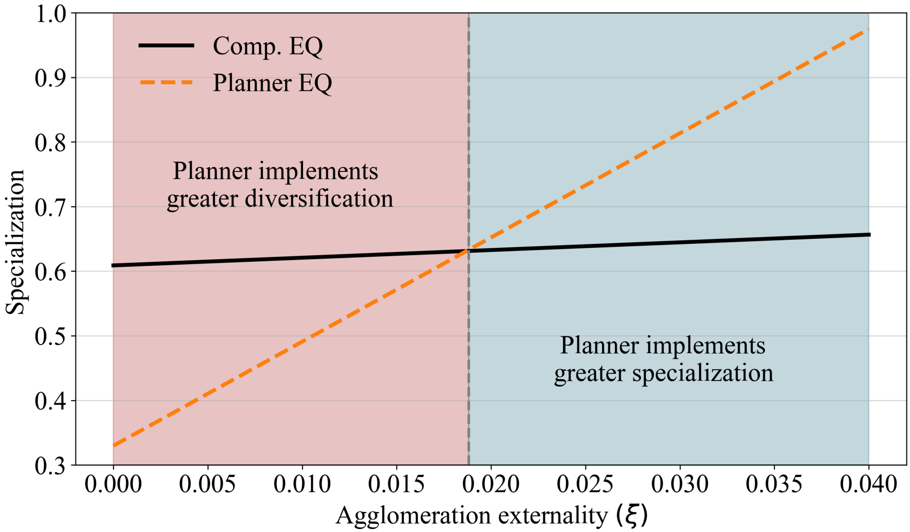

Constrained-efficient regional specialization in 1950

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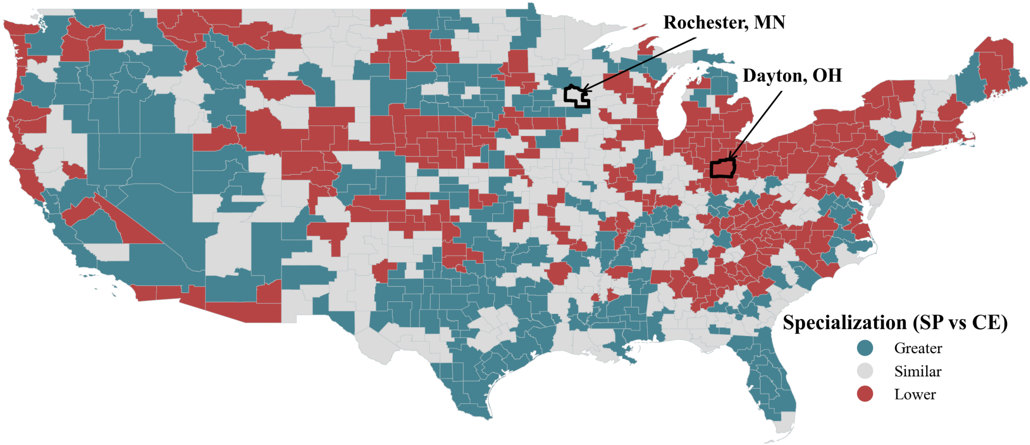

▸ Planner implementation

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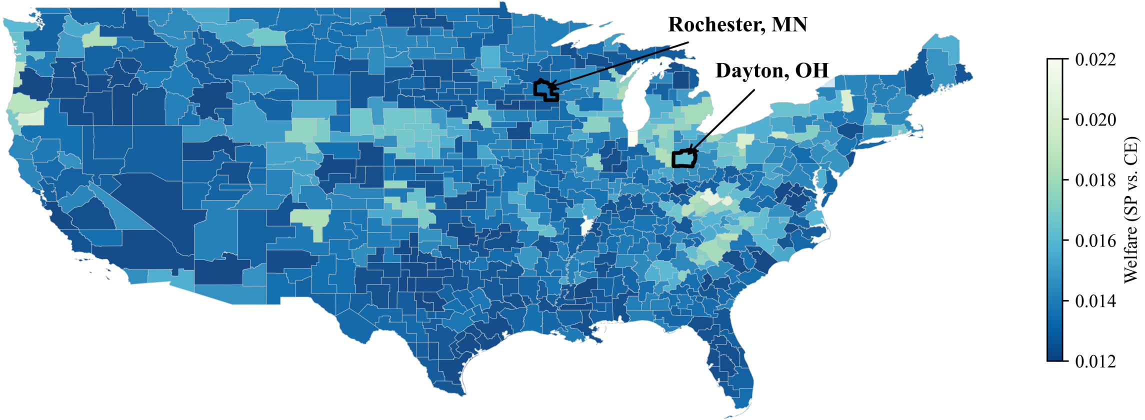

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- **Future Research**:
  - Regional vs. National Planner (introduce migration frictions + place-based insurance)
  - Heterogeneously specialized countries in a currency union [w. de Ferra, Mitman & Romei]

Thank you very much!

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Appendix

Topcoding income

- Topcoding: Recode/ cut income above certain threshold
  - In individual-level income survey
  - Prevent identification of individuals in sample

- Problem: manipulates income distribution for high earners

- Regression approach (following Heathcote et al, 2023):
  - Assume underlying distribution of income is Pareto
  - Forecast the mean top-coded income by extrapolating Pareto density fitted to upper end of non-top-coded income
  - Following algorithm by David Domeij

Return

Industry details

	Industry	1950	1990	2020	Tradable
1	Agriculture	20.71	3.61	3.46	Yes
2	Business Services	2.96	4.43	7.61	Yes
3	Communication	0.61	1.52	1.36	No
4	Construction	8.75	9.98	11.91	No
5	Durable	13.53	15.88	10.77	Yes
6	Entertainment	0.66	1.06	1.28	No
7	Finance	2.20	4.47	4.79	No
8	Mining	3.99	1.90	1.82	Yes
9	Nondurable	9.48	8.64	5.77	Yes
10	Personal Services	2.37	1.39	1.60	No
11	Routine Prof. Serv.	4.39	11.26	13.19	No
12	Non-routine Prof. Serv.	0.37	2.02	3.33	Yes
13	Public	4.67	7.96	6.98	No
14	Retail	11.84	11.15	13.26	No
15	Transportation	8.09	6.61	6.91	Yes
16	Utilities	1.80	2.53	2.34	No
17	Wholesale	3.59	5.60	3.63	Yes

Return

Fact 1: Controls

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	1950-2020 Growth		1950 Income p.c.	
	(1)	(2)	(3)	(4)
Specialization	-0.233*		0.844***	
	(0.0901)		(0.084)	
Tradable		-0.151***		0.110**
		(0.0388)		(0.0423)
Non-tradable		0.632		-0.43
		(0.294)		(0.456)
1950 measures:				
$\hat{g}$	-0.180***	-0.133*	-0.187**	-0.319***
	(0.0471)	(0.0521)	(0.058)	(0.0631)
log income p.c.	-0.868***	-0.885***		
	(0.0339)	(0.0323)		
High-skill labor share	1.435***	1.618***	6.042***	5.692***
	(0.41)	(0.418)	(0.402)	(0.431)
Old-age dependency ratio	0.0145**	0.0120*	-0.0187***	-0.0230***
	(0.00532)	(0.00553)	(0.00484)	(0.00526)
Female labor share	0.984***	0.965***	0.0754	0.283
	(0.167)	(0.184)	(0.164)	(0.187)
Population	170.6***	163.0***	136.8***	152.0***
	(35.55)	(33.46)	(25.75)	(31.66)
N	722	722	722	722
adj. R-sq	0.538	0.544	0.41	0.344

▸ Return ▸ Return

Regional specialization in the U.S.

Regional specialization in the U.S.

The US **labor markets become more specialized** over time.

Year	Gini on income shares			Gini on employment shares		
	Mean	CV	p90/p10	Mean	CV	p90/p10
1950	0.46	0.162	1.55	0.45	0.152	1.50
1970	0.48	0.123	1.35	0.47	0.116	1.35
1990	0.47	0.089	1.23	0.46	0.082	1.26
2010	0.53	0.089	1.29	0.50	0.073	1.20
2020	0.53	0.089	1.24	0.51	0.068	1.20

Table 1: U.S. Regional specialization over time

▸ Return

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- Define
  - Revealed Comparative Advantage (RCA): $RCA_{irt} = \frac{Y_{irt}}{Y_{rt}} / \frac{Y_{it}^{US}}{Y_{t}^{US}}$
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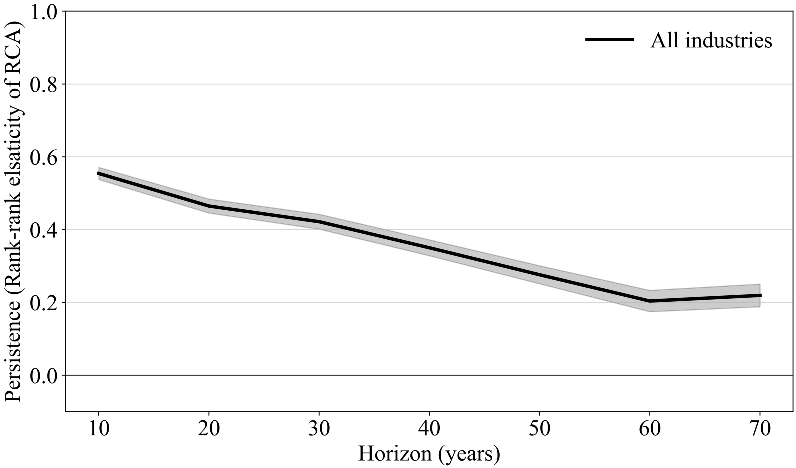
  - RankRCA_{irt}: Rank region-industries by RCA
  - $\delta_{r,t}$ as region-year FE
  - $\gamma_{i,t}$ as industry-year FE
  - h as horizon

$$\text{logRankRCA}_{i,r,t} = \alpha + \beta_h \cdot \text{logRankRCA}_{i,r,t-h} + \delta_{r,t} + \gamma_{i,t} + \epsilon_{i,r,t}$$

- Coefficent β_h: Rank-rank elasticity of RCA (persistence measure)

▸ Further details ▸ Return

Fact 3: Specialization at the region-industry level is highly persistent



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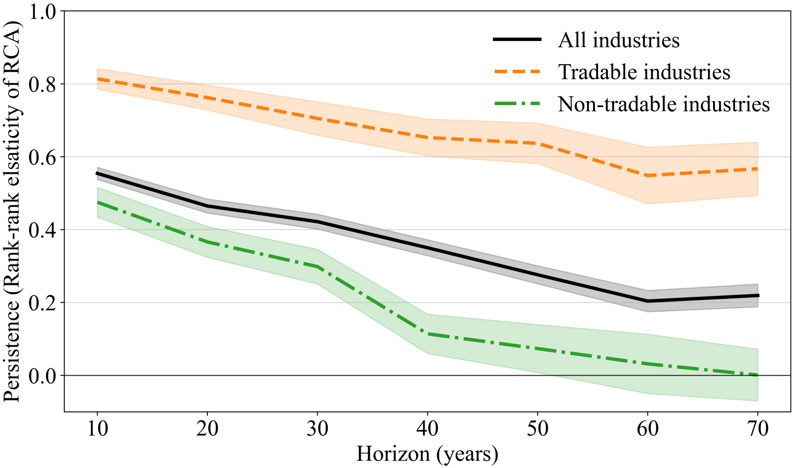


Further details Return

Specialization Trade-off at different horizons

	Income pc growth						
	10-year (1)	20-year (2)	30-year (3)	40-year (4)	50-year (5)	60-year (6)	70-year (7)
Trad. Specialization (t-10)	0.00152 (-0.025)						
Trad. Specialization (t-20)		-0.0747*** (-0.0209)					
Trad. Specialization (t-30)			-0.106*** (-0.0254)				
Trad. Specialization (t-40)				-0.162*** (-0.0293)			
Trad. Specialization (t-50)					-0.1420** (-0.0147)		
Trad. Specialization (t-60)						-0.152** (-0.0347)	
Trad. Specialization (t-70)							-0.154*** (-0.04)
N	3528	3563	2842	2123	1403	1007	700
adj. R-sq	0.101	0.113	0.152	0.219	0.308	0.403	0.549

▸ Return

Specialization Trade-off across different industries

	1950-2020 Growth	1950 Income level
	(1)	(2)
Specialization in		
Manufacturing	-1.086**	2.296***
	(0.373)	(0.488)
Services	1.441	-5.386**
	(1.201)	(1.776)
Agriculture	-0.0653	0.35
	(0.191)	(0.241)
Transportation	0.397	2.071*
	(0.912)	(0.894)
Wholesale	-2.356***	2.992**
	(0.698)	(0.994)
Retail	-0.747	3.404***
	(0.764)	(0.64)
N	722	722
adj. R-sq	0.54	0.399

Return

Specialization Trade-off with Herfindahl Index

	1950-2020 Growth	1950 Income level
	(1)	(2)
Specialization (HHI)	-0.212*	0.933***
	(0.122)	(0.134)
$\hat{g}$	-0.169***	-0.233**
	(0.0470)	(0.064)
log income	-0.886***	
	(0.0328)	
High-skill share	1.482***	6.351***
	(0.424)	(0.436)
Old-age dependency	0.0149**	-0.0213***
	(0.00532)	(0.00512)
Female share	1.04***	-0.172
	(0.167)	(0.179)
Population	172.7***	136.7***
	(35.77)	(25.67)
N	722	722
adj. R-sq	0.535	0.375

Return

Production and agglomeration

Production and agglomeration

- Multiple industries $i \in \{i, \ldots, I\}$ produce single tradable good c
- Productivity processes (AR1):

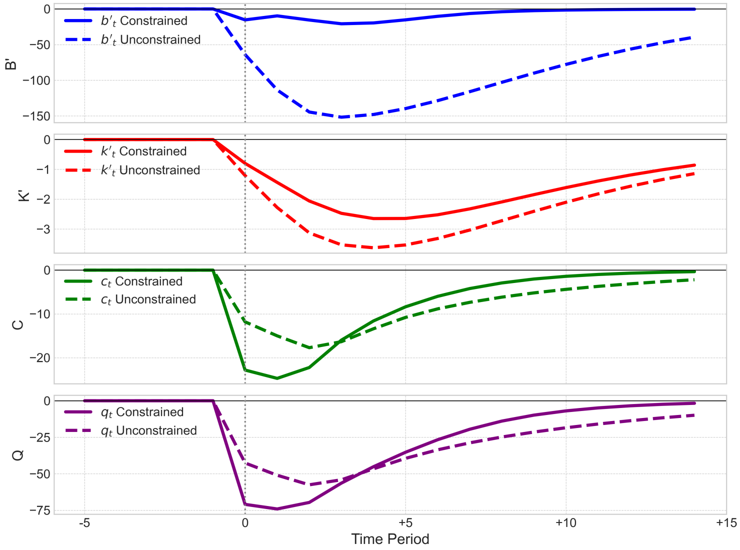
$$\bar{z}_{i,t} = \tilde{z}_i + g_{i,t}t + \rho u_{i,t-1} + \epsilon_{i,t} \quad \text{with } \epsilon_{i,t} \sim \mathcal{N}(0, \sigma_i^2)$$

- Agglomeration:

$$z_{i,t} = \bar{z}_{i,t} \cdot k_{i,t}^{\xi_i}$$

with intra-industry agglomeration $\xi_i \geq 0$ [Bartelme et al (2024)]

IRF to a 2SD adverse productivity shock to one industry



▸ Return

Planner FOCs: Cross-derivatives

$$\Omega_i^B = \frac{1}{R}\Big[\frac{\partial u'(\mathcal{C}(b',\mathcal{K}',\mathcal{Z}'))}{\partial b'}(\mathcal{Q}(b',\mathcal{K}',\mathcal{Z}') + \alpha z_i' k_i'^{\xi_i+\alpha-1} - \phi_{1i})$$
$$+ u'(\mathcal{C}(b',\mathcal{K}',\mathcal{Z}'))\Big(\frac{\partial \mathcal{Q}(b',\mathcal{K}',\mathcal{Z}')}{\partial b'} - \frac{\partial \phi_{1i}}{\partial b'}\Big) + \theta\Big(\frac{\partial q'}{\partial b'}\eta' - \frac{\partial \eta'}{\partial b'}\mathcal{Q}(b',\mathcal{K}',\mathcal{Z}')\Big)\Big] \tag{1}$$

$$\Omega_i^K = -u'(c)\phi_{22,i} + \frac{1}{R}\Big[\frac{\partial u'(\mathcal{C}(b',\mathcal{K}',\mathcal{Z}'))}{\partial k_i'}(\mathcal{Q}(b',\mathcal{K}',\mathcal{Z}') + \alpha z_i' k_i'^{\xi_i+\alpha-1} - \phi_{1i})$$
$$+ u'(\mathcal{C}(b',\mathcal{K}',\mathcal{Z}'))\Big(\frac{\partial \mathcal{Q}(b',\mathcal{K}',\mathcal{Z}')}{\partial k_i'} + (\xi_i + \alpha - 1)\alpha z_i' k_i'^{\xi_i+\alpha-2} - \phi_{11,i} - \phi_{12,i}\frac{\partial k_i''}{\partial k_i'}\Big)$$
$$+ \theta\Big(\frac{\partial q'}{\partial k_i'}\eta' - \frac{\partial \eta'}{\partial k_i'}\mathcal{Q}(b',\mathcal{K}',\mathcal{Z}')\Big)\Big] \tag{2}$$

Return

Recursive Constrained-Efficient Equilibrium

A **Recursive Constrained-Efficient Equilibrium** is a set $\{V, c, b', k_i', q\}$ such that:

1. **Planner optimization:** Given $(b, \mathcal{K}, \mathcal{Z})$, agents solve

$$V(b, \mathcal{K}, \mathcal{Z}) = \max_{c, b', k_i'} u(c) + \beta \mathbb{E} V(b', \mathcal{K}', \mathcal{Z}')$$

subject to budget, collateral constraint, market clearing and implementability constraints.

▸ Return

Planner Implementation: Constrained-efficient Decentralization

- Define:
  - τ_t^K state-contingent industry-specific tax or subsidy
  - τ_t^B state-contingent tax on debt

$\forall i$

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Portfolio all.: $\tilde{q}_t u'(c_t) = \beta \mathbb{E}_t \left[u'(c_{t+1}) \big(\tilde{q}_{t+1} + (1 + \tau_{i,t+1}^K) z_{i,t+1} f'(k_{i,t+1}) \big) + \theta_{t+1} q_{t+1} \eta_{t+1} \right] \forall i$

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Cons.-sav.: $u'(c_t) = \beta R_t (1 + \tau_t^B) \mathbb{E}_t \left[u'(c_{t+1}) \right] + \eta_t$

Return