TRADE AND DEVELOPMENT

DAVID ATKIN (MIT)

HOW DOES TRADE AFFECT THE PROCESS OF DEVELOPMENT?

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- **Hard to think of more important question in trade:**
  - Without such dynamic gains, the gains from trade are non-trivial but far from transformative
    - E.g. estimates of static GFT for China range from 4% to 78% (Costinot Rodriguez-Clare 2014)
  - China grew 83% in the 6 years after WTO accession
  - And smaller than RF estimates (e.g. Feyrer 2019, 2021)

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      - China grew 83% in the 6 years after WTO accession
      - And smaller than RF estimates (e.g. Feyrer 2019, 2021)
- Recent explosion of work on intersection of trade and development (Atkin Khandelwal 2020, Atkin Donaldson 2022), but surprisingly little on this question

TRADE AND GROWTH REDUX

- Large lit. in 80s/90s brought learning-by-doing into two-country trade models
  Krugman (1987), Boldrin Scheinkman (1988), Grossman Helpman (1990), Young (1991), Stokey (1991)
  - Common theme: good sectors/bad sectors, with trade bringing dynamic gains/losses to country with CA in good/bad sector
  - But two-county models fell out of fashion, hard to link to data, hard to identify good/bad sectors

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- Recently, scholars such as Chang, Hausman, Lin and Rodrik have dominated the policy debate, resurrecting talk of good and bad sectors
  - What you export matters: buttressed by much-cited measures of country capabilities, product complexity Hausman Hwang Rodrik (2007), Hausman Hidalgo (2009)

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- Today: will try to bring both lits. closer to each other, and to modern trade

GLOBALIZATION AND THE LADDER OF DEVELOPMENT

WITH ARNAUD COSTINOT AND MASAO FUKUI

- **Popular and influential metaphor about development:**
  - Countries sit at different rungs of a ladder
  - Each rung associated with a set of economic activities
  - As countries develop, they become more capable, move up the ladder, produce and export more complex goods
- **This paper:**
  - Formalize ladder metaphor to explore relationship between globalization and development

TRADE ⟷ DEVELOPMENT

- **Development → Trade:**
  - Countries with growing capability (because of domestic shocks) may acquire CA in more complex goods
- **Trade → Development:**
  - Countries specializing in more complex goods (because of foreign shocks) may have faster capability growth

THIS PAPER

- **Theory:** *Does trade push countries up the development ladder or hold them at the bottom?*
  - Trade can move ***all*** countries up the ladder
  - This happens because ***(i)*** complex goods raise capability and ***(ii)*** fewer countries export complex goods

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- **Empirics:** *Does producing complex goods raise capability?*
  - Supporting evidence using entry of other countries in WTO as IV for sectoral distribution of employment

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- **Empirics:** *Does producing complex goods raise capability?*
  - Supporting evidence using entry of other countries in WTO as IV for sectoral distribution of employment
- **Putting it together:** *Are the conditions necessary for trade to push all countries up the ladder satisfied in the data?* **No**
  - Has China's emergence held back developing world? **Yes** & **No**

ROADMAP

- Theory
- Measurement
- Estimation
- Counterfactuals
- Robustness

THEORY

ENVIRONMENT

- Many countries indexed by i
- Continuum of goods indexed by k
- Time is continuous and indexed by t
- Labor is the only factor for production
  - $L_{i,t}$ = exogenous labor endowment in country i at date t

PREFERENCES

- **Nested CES utility:**

$$C_{i,t} = \left(\int (C_{i,t}^{k})^{(\epsilon-1)/\epsilon} dk \right)^{\epsilon/(\epsilon-1)}$$

$$C_{i,t}^{k} = \left(\sum_{j} (c_{ji,t}^{k})^{(\sigma-1)/\sigma} \right)^{\sigma/(\sigma-1)}$$

- Elasticities of substitution such that:
  - $\epsilon > 0, \sigma > 1, \sigma > \epsilon$
  - Foreign competition in a sector → less employment

TECHNOLOGY

- Goods differ in complexity n_t^k, countries differ in capability $N_{i,t}$:

- **Linear technology:**

FROM DEVELOPMENT TO TRADE

$$q_{ij,t}^k = A_{ij,t}^k \ell_{ij,t}^k$$

$$A_{ij,t}^k = \begin{cases} A_{ij,t} & \text{if } n_t^k \leq N_{i,t}, \\ 0 & \text{otherwise.} \end{cases}$$

- The most complex goods can only be produced by the most capable countries

TECHNOLOGY

- Future capabilities depend on present capabilities and their endogenous patterns of specialization

$$\dot{N}_{i,t} = H_{i,t}(N_{i,t}, S_{i,t})$$

$$S_{i,t} \equiv \int n dF^{\ell}_{i,t}(n)$$

FROM TRADE TO DEVELOPMENT

- **Dynamic spillovers:**
  - $H_{i,t}$ is increasing in average complexity $S_{i,t} \equiv \int n dF^{\ell}_{i,t}(n)$
    - Where $F^{\ell}_{i,t}$ is CDF of employment across sectors
  - More employment in complex sectors → more growth

COMPETITIVE EQUILIBRIUM

- Competitive equilibrium with free trade + financial autarky
- At each date t, conditional on state of world technology N_t:
  - Profit maximization, utility maximization, market clearing

$$\Rightarrow \quad \{w_{i,t}\}, \{p^k_{ij,t}\}, \{c^k_{ij,t}\}, \{\ell^k_{ij,t}\}$$

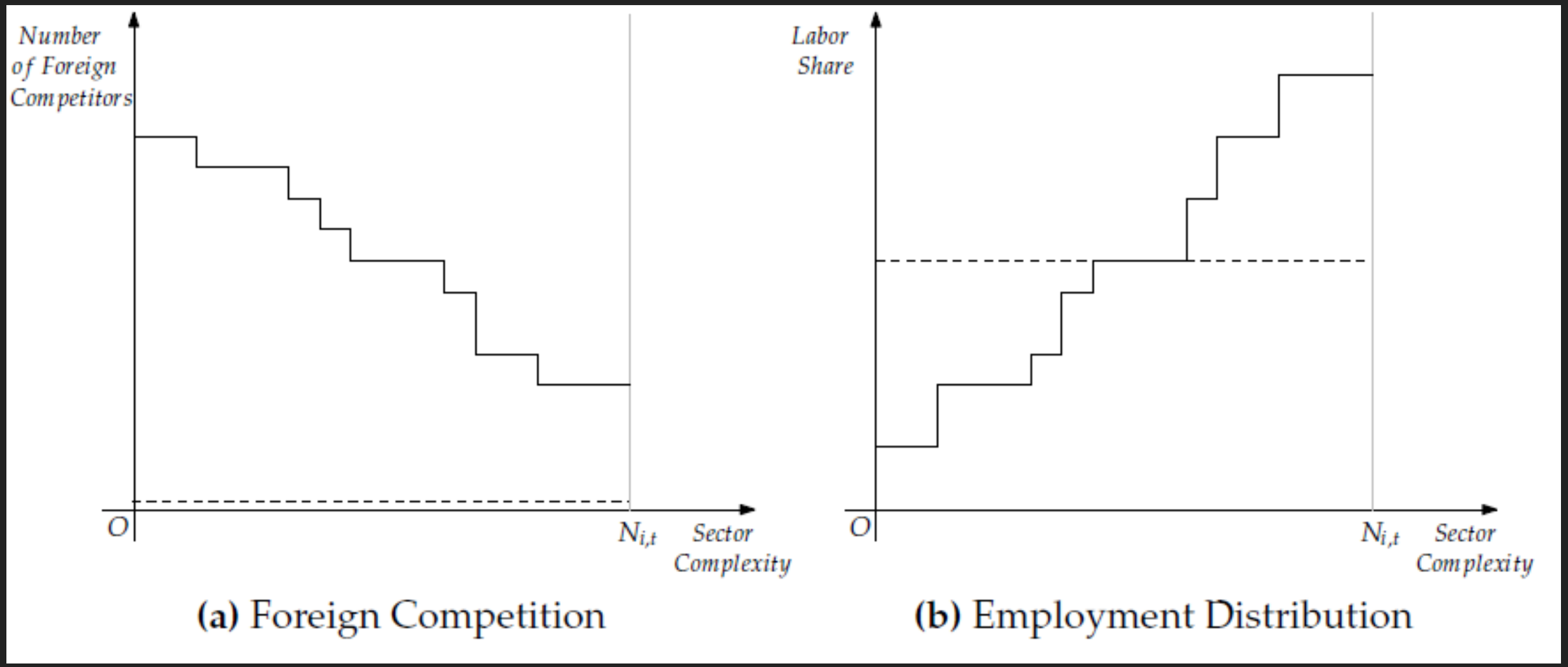
- From t to $t + dt$, employment distribution $F^{\ell}_{i,t}$ $\Rightarrow$ N_{t+dt}

PUSHED TO THE TOP OR HELD AT THE BOTTOM?

- **Question:** *What is the difference between time paths of capability $N_{i,t}$ and consumption $C_{i,t}$ with & without trade?*

PROPOSITION 1. IN A LADDER ECONOMY, OPENNESS TO TRADE RAISES CAPABILITY AND AGGREGATE CONSUMPTION AT ALL DATES IN ALL COUNTRIES.

MORE COMPLEX, LESS FOREIGN COMPETITION!



(a) Foreign Competition **(b)** Employment Distribution

PUSHED TO THE TOP OR HELD AT THE BOTTOM?

PROPOSITION 1. IN A LADDER ECONOMY, OPENNESS TO TRADE RAISES CAPABILITY AND AGGREGATE CONSUMPTION AT ALL DATES IN ALL COUNTRIES.

- **Sketch of Proof:**
  - More foreign competition in less complex sectors in ***all*** countries
    → more employment in more complex sectors in ***all*** countries
  - At any date t, $(N_{i,t})_{trade} = (N_{i,t})_{autarky}$ → $(\dot{N}_{i,t})_{trade} > (\dot{N}_{i,t})_{autarky}$
  - $(N_{i,t})_{trade} > (N_{i,t})_{autarky}$ → $(C_{i,t})_{trade} > (C_{i,t})_{autarky}$

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  - $(N_{i,t})_{trade} > (N_{i,t})_{autarky}$ → $(C_{i,t})_{trade} > (C_{i,t})_{autarky}$

- **When would trade lower capability at all dates in all countries?**
  If $H_{i,t}$ is decreasing in $S_{i,t'}$ or if $A^k_{ij,t} > 0$ when $g(n^t_k) \leq N^t_i$ with $g' < 0$

PUSHED TO THE TOP OR HELD AT THE BOTTOM?

PROPOSITION 1. IN A LADDER ECONOMY, OPENNESS TO TRADE RAISES CAPABILITY AND AGGREGATE CONSUMPTION AT ALL DATES IN ALL COUNTRIES.

- **What are policy implications of the ladder economy?**
  - Pigouvian arguments → employment subsidies increasing in n_t^k
  - In absence of optimal IP, opening to trade helps correct distortion (opposite if "inverted" ladder)
  - Optimal IP elsewhere reduces dynamic gains from trade by raising competition in good sectors

MEASURING CAPABILITY AND COMPLEXITY

TWO APPROACHES

- **General idea =** Use trade data to reveal productivity distribution and, in turn, capability and complexity
- **Approach 1 (next, closer to HHR and HH):**
  - Assumption: more capable countries more likely to export more complex goods + more complex goods more likely to be exported by more capable countries
- **Approach 2 (later, closer to pure ladder benchmark):**
  - Assumption: more capable countries more likely to export + more complex goods less likely to be exported

BASELINE MEASURES OF CAPABILITY AND COMPLEXITY

- Productivity distribution $G_{i,t}$ such that:

$$\text{Prob}(A^k_{ij,t} > 0) = \delta_{ij,t} + \gamma^k_{j,t} + N_{i,t} n^k_t$$

- **Linear probability model:**

$$\text{Dummy}\{x^k_{ij,t} > 0\} = \delta_{ij,t} + \gamma^k_{j,t} + N_{i,t} n^k_t + u^k_{ij,t}$$

- With u independent across i, k but not across j within (i,k)
- RCA (CDK, LZ, HLM), but at extensive margin (HHR, HH)

BASELINE MEASURES OF CAPABILITY AND COMPLEXITY

- E.g. if US more capable than BG, good k more complex than k_0 if US relatively more likely to export it than BG

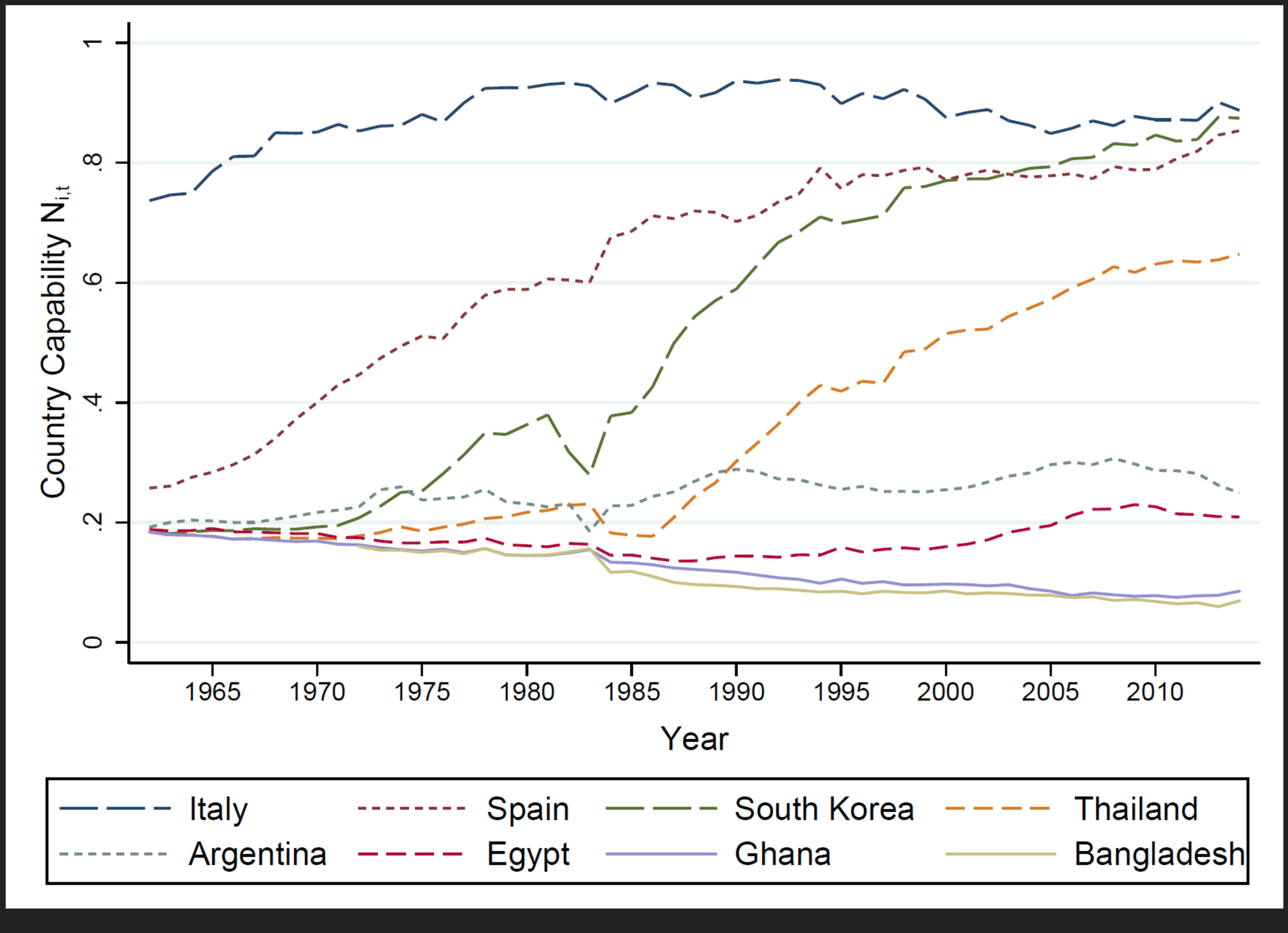
$$n_t^k - n_t^{k_0} = [(\pi_{USj,t}^k - \pi_{USj,t}^{k_0}) - (\pi_{BGj,t}^k - \pi_{BGj,t}^{k_0})]/(N_{US,t} - N_{BG,t})$$

- Conversely, if medicines more complex than t-shirts, country i more capable than i_0 if relatively more likely to export ME than TS

$$N_{i,t} - N_{i_0,t} = [(\pi_{ij,t}^{ME} - \pi_{ij,t}^{TS}) - (\pi_{i_0j,t}^{ME} - \pi_{i_0j,t}^{TS})]/(n_t^{ME} - n_t^{TS})$$

- Given $u_{ij,t}^k$, assert that G10 members are capable and iterate...
  - G10 irrelevant, converges to same values with G7, OECD etc.

BASELINE CAPABILITY (1962–2014)

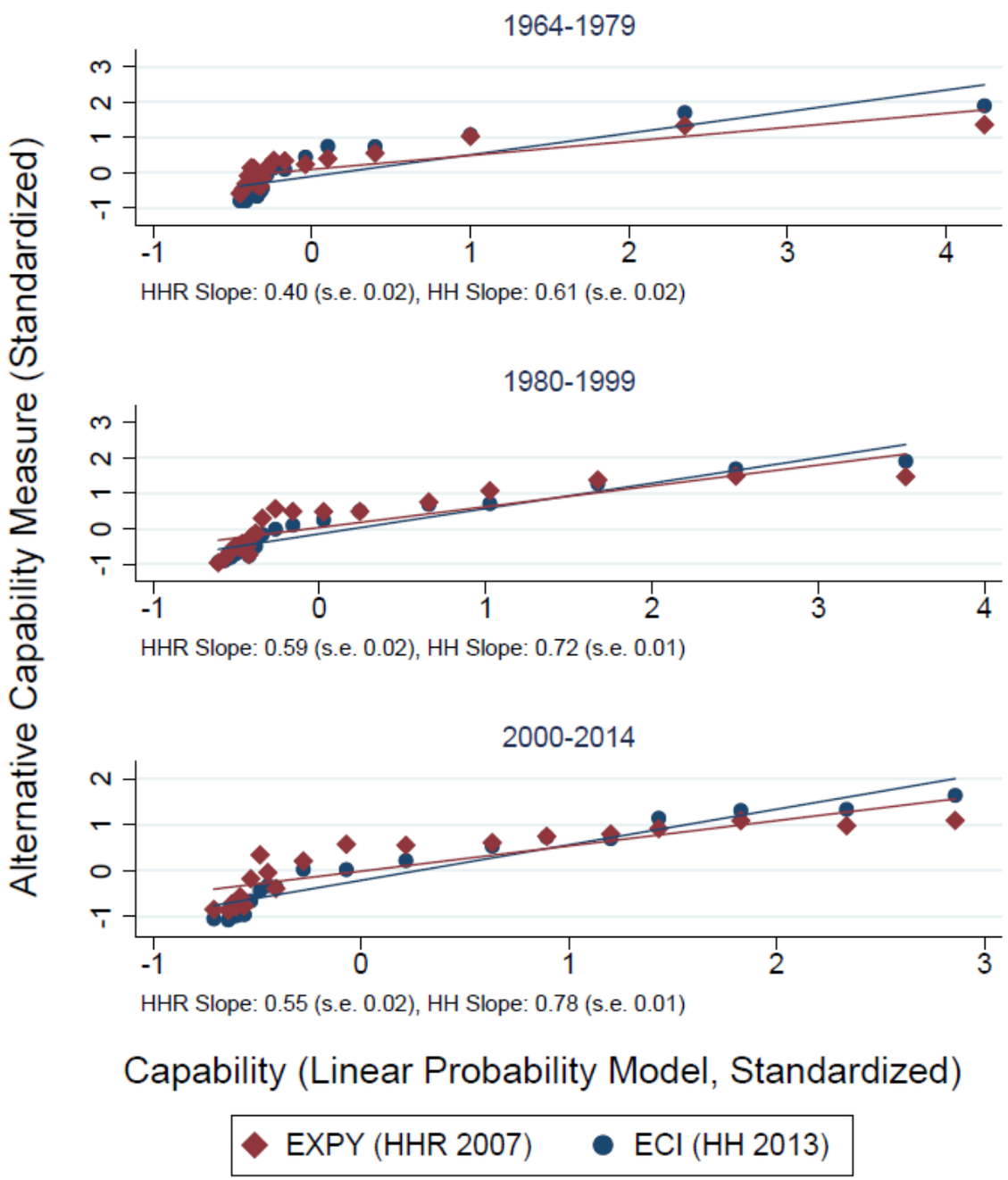


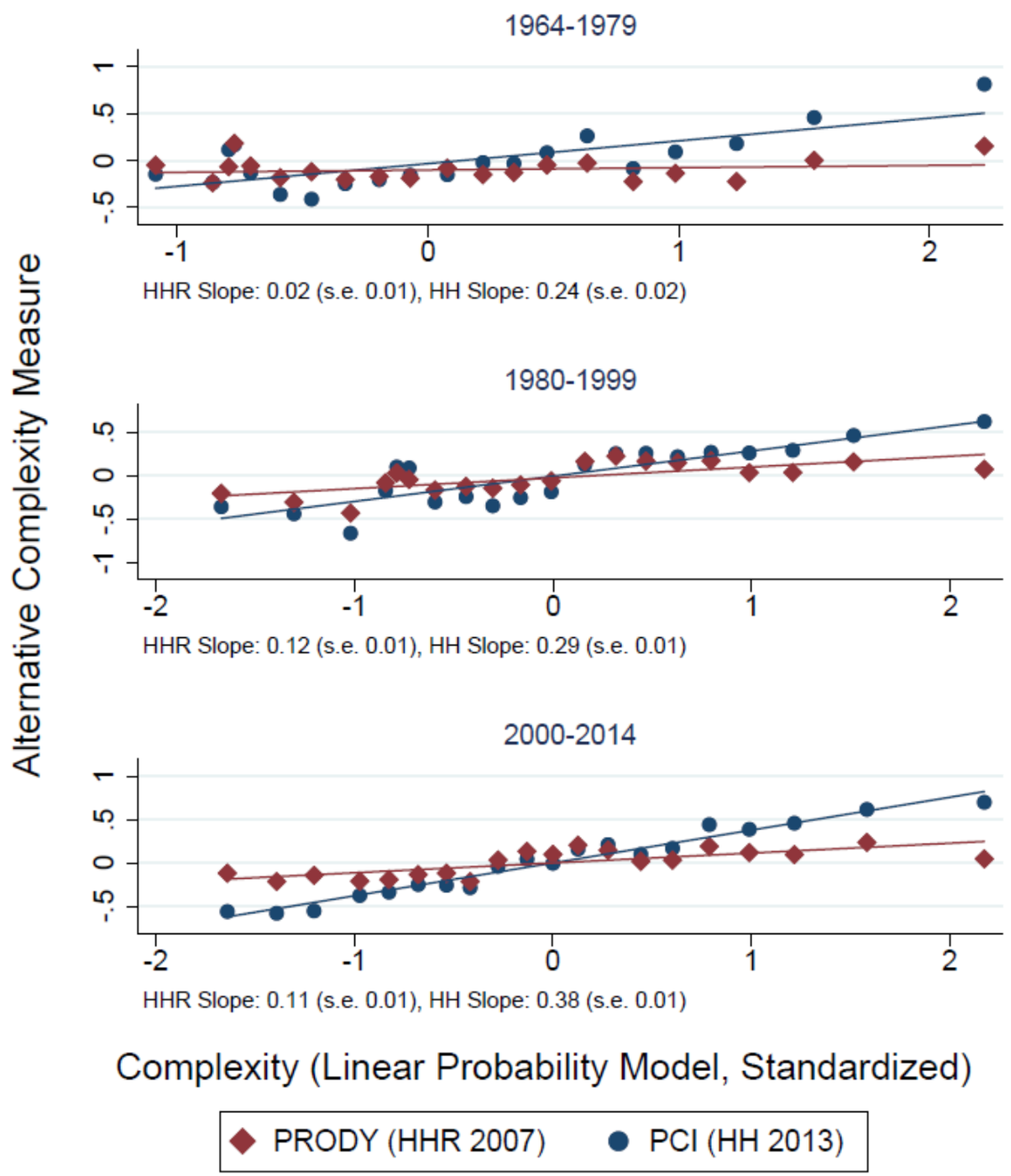
BASELINE COMPLEXITY (1962–2014)

	Sectors with highest n^k (Average Value, 1962-2014)	
1	Medicaments	0.964
2	Miscellaneous Non-Electrical Machinery Parts	0.878
3	Chemical Products	0.872
4	Cars	0.861
5	Miscellaneous Non-Electrical Machines	0.857
6	Miscellaneous Electrical Machinery	0.831
7	Miscellaneous Hand Tools	0.808
8	Medical Instruments	0.805
9	Electric Wire	0.768
10	Fasteners	0.759

	Sectors with lowest n^k (Average Value, 1962-2014)	
1	Wool Undergarments	0.067
2	Undergarments of Other Fibres	0.083
3	Men's Underwear	0.100
4	Wood Panels	0.096
5	Aircraft Tires	0.089
6	Rotary Converters	0.081
7	Sheep and Lamb Leather	0.110
8	Retail Yarn of More Than 85% Synthetic Fiber	0.091
9	Women's Underwear	0.115
10	Plastic Ornaments	0.137

COMPARISON TO EARLIER WORK (HHR 2007 + HH 2013)





ESTIMATING DYNAMIC SPILLOVERS

BASELINE SPECIFICATION

- **Dynamic spillovers:**

$$N_{i,t+1} = \beta S_{i,t} + \phi N_{i,t} + \gamma_i + \delta_t + \varepsilon_{i,t+1}$$

- **Key endogeneity issue:**

$$S_{i,t} \not\perp \varepsilon_{i,t+1}$$

IV STRATEGY

- **General idea:**
  - Reductions in other countries tariffs affect domestic production mix, exogenous to domestic policies
  - Construct IV from FO approx. of impact of others' WTO entry

⇒

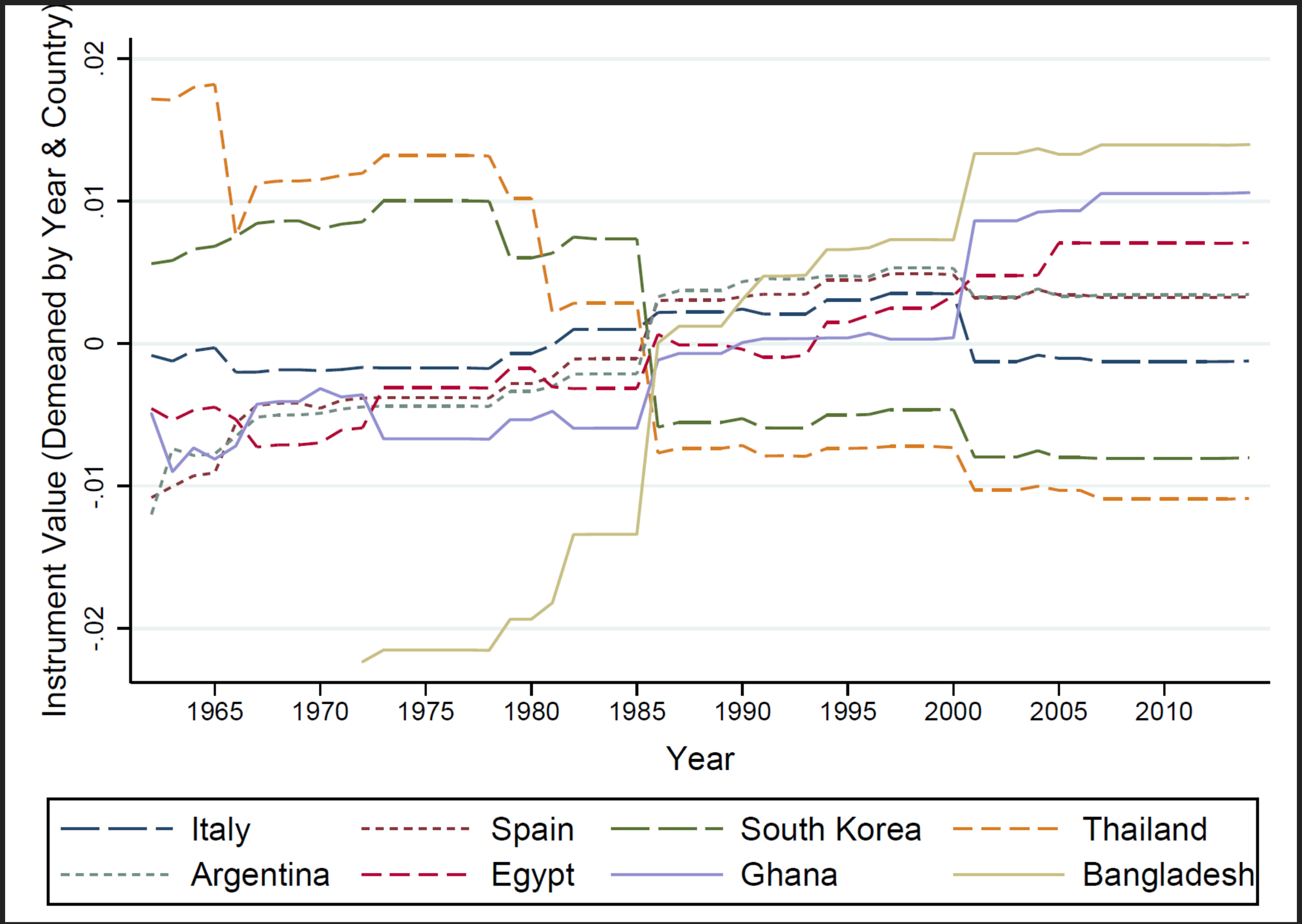
- **IV (I):** *Product-destination-level labor demand shifter*

$$Z^{I}_{i,t} = \sum_{t_c<t} \sum_{k} n^{k}_{t_c-1} \times \underbrace{\omega^{k}_{i,t_c-1} \left(\sum_{j \neq c} \rho^{k}_{ij,t_c-1} \lambda^{k}_{cj,t_c-1} - \sum_{k'} \omega^{k'}_{i,t} \sum_{j \neq c} \rho^{k'}_{ij,t_c-1} \lambda^{k'}_{cj,t_c-1} \right)}_{\text{reduction in } k\text{'s employment share predicted by sector-level price changes}}$$

- **IV (II):** *Destination-level labor demand shifter*

$$Z^{II}_{i,t} = \sum_{t_c<t} \sum_{k} n^{k}_{t_c-1} \times \underbrace{\omega^{k}_{i,t_c-1} \left(\sum_{j \neq c} \rho^{k}_{ij,t_c-1} \lambda_{cj,t_c-1} - \sum_{k'} \omega^{k'}_{i,t} \sum_{j \neq c} \rho^{k'}_{ij,t_c-1} \lambda_{cj,t_c-1} \right)}_{\text{reduction in } k\text{'s employment share predicted by aggregate-level price changes}}$$

TIMEPATH OF IV (I)



FIRST STAGE RESULTS

	Average Complexity $S_{i,t}$	
	(1)	(2)
WTO Entrant Shock $Z^{I}_{i,t}$	-0.674***	-0.186
(Product-Destination Level)	(0.212)	(0.223)
WTO Entrant Shock $Z^{II}_{i,t}$		-4.017***
(Destination Level)		(0.793)
Country and year FEs	Yes	Yes
Observations	7,617	7,617
R-squared	0.586	0.592
Clusters	1588	1588

IV RESULTS: POSITIVE DYNAMIC SPILLOVERS

	Country Capability $N_{i,t+\Delta}$			
	(3) OLS	(4) IV ($Z^I_{i,t}$)	(5) IV ($Z^I_{i,t}$, $Z^{II}_{i,t}$)	(6) RF ($Z^I_{i,t}$, $Z^{II}_{i,t}$)
Average Complexity $S_{i,t}$	0.00840**	0.368***	0.288***	
	(0.00390)	(0.141)	(0.0902)	
Initial Capability $N_{i,t}$	0.936***	0.831***	0.855***	0.934***
	(0.0211)	(0.0468)	(0.0364)	(0.0213)
WTO Entrant Shock $Z^I_{i,t}$ (Product-Destination Level)				-0.167***
				(0.0515)
WTO Entrant Shock $Z^{II}_{i,t}$ (Destination Level)				-0.599***
				(0.224)
Country and year FEs	Yes	Yes	Yes	Yes
Observations	6,872	6,872	6,872	6,872
R-squared	0.988	0.619	0.701	0.988
Clusters	1438	1438	1438	1438
CD F-Stat		32.66	36.03	
KP F-Stat		9.330	8.445	

Sensitivity

DOES TRADE PUSH ALL COUNTRIES TO THE TOP?

DYNAMIC CONSEQUENCES OF TRADE: PUSH OR PULL?

- **Counterfactual Question:**
  - *What would happen to path of capability and aggregate consumption from 1962 to 2014 if, from 1962 onwards, a country were to move to autarky?*

- **Decomposition of welfare changes into:**
  - **Static gains:**

$$GT_{i,t}^{static} = 1 - \frac{C_{i,t}^{autarky}}{C_{i,t}} \Big|_{N_{i,t}=N_{i,t}^{data}}$$

  - **Dynamic gains:**

$$GT_{i,t}^{dynamic} = GT_{i,t} - GT_{i,t}^{static}$$

BASELINE ECONOMY

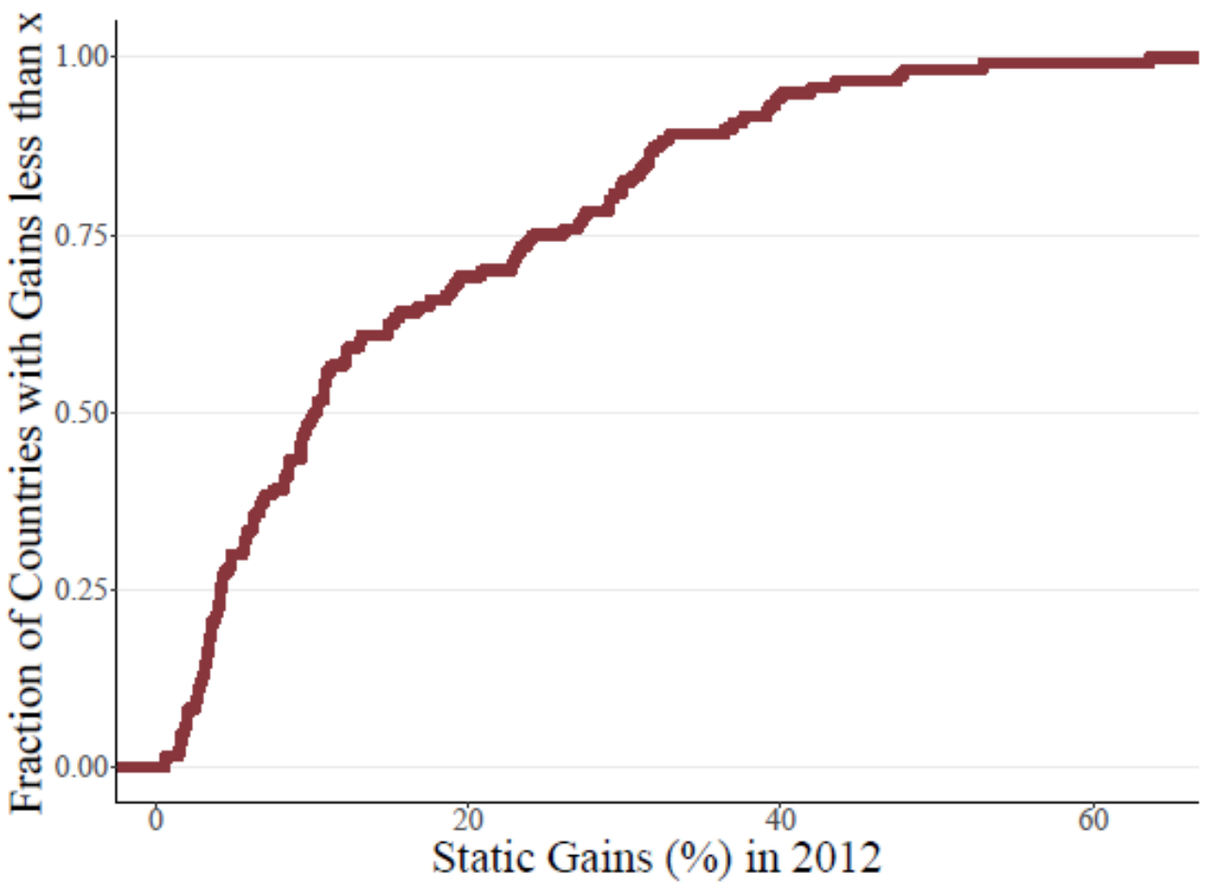
Parameter	Value	Choice Calibration
Panel A: Nested CES Preferences		
σ	2.7	Broda and Weinstein (2006)
ϵ	1.36	Redding and Weinstein (2018)
Panel B: Dynamic Spillovers		
β	0.288	Baseline estimate
ϕ	0.855	Baseline estimate

- Under trade equilibrium, $\{A_{ij,t}^k\}$ = match all trade flows
- Under autarky equilibrium, Prob$(A_{ij,t}^k > 0)$ = linear probability model

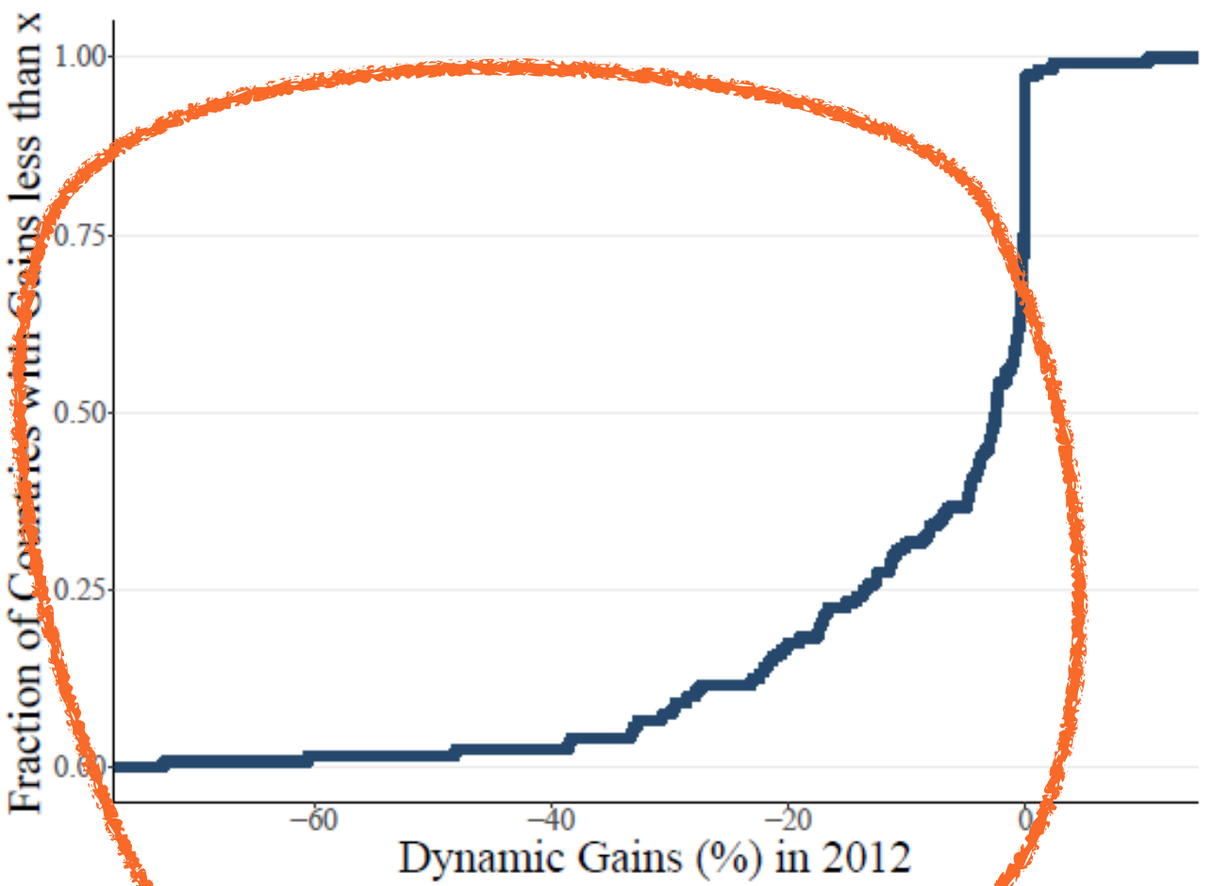
STATIC AND DYNAMIC GAINS FROM TRADE

STATIC GAINS

DYNAMIC LOSSES

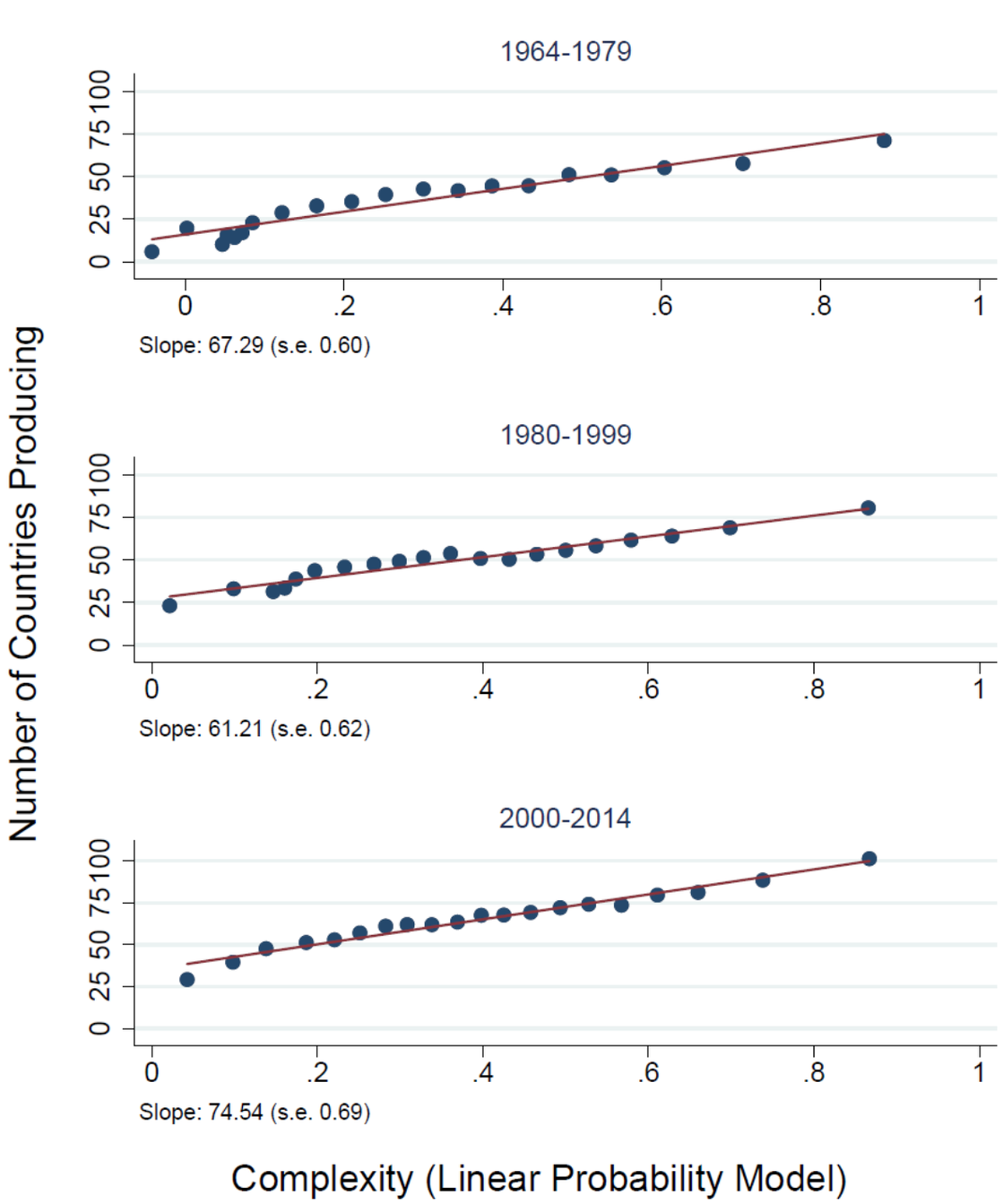


(a) Distribution of the Static Gains from Trade

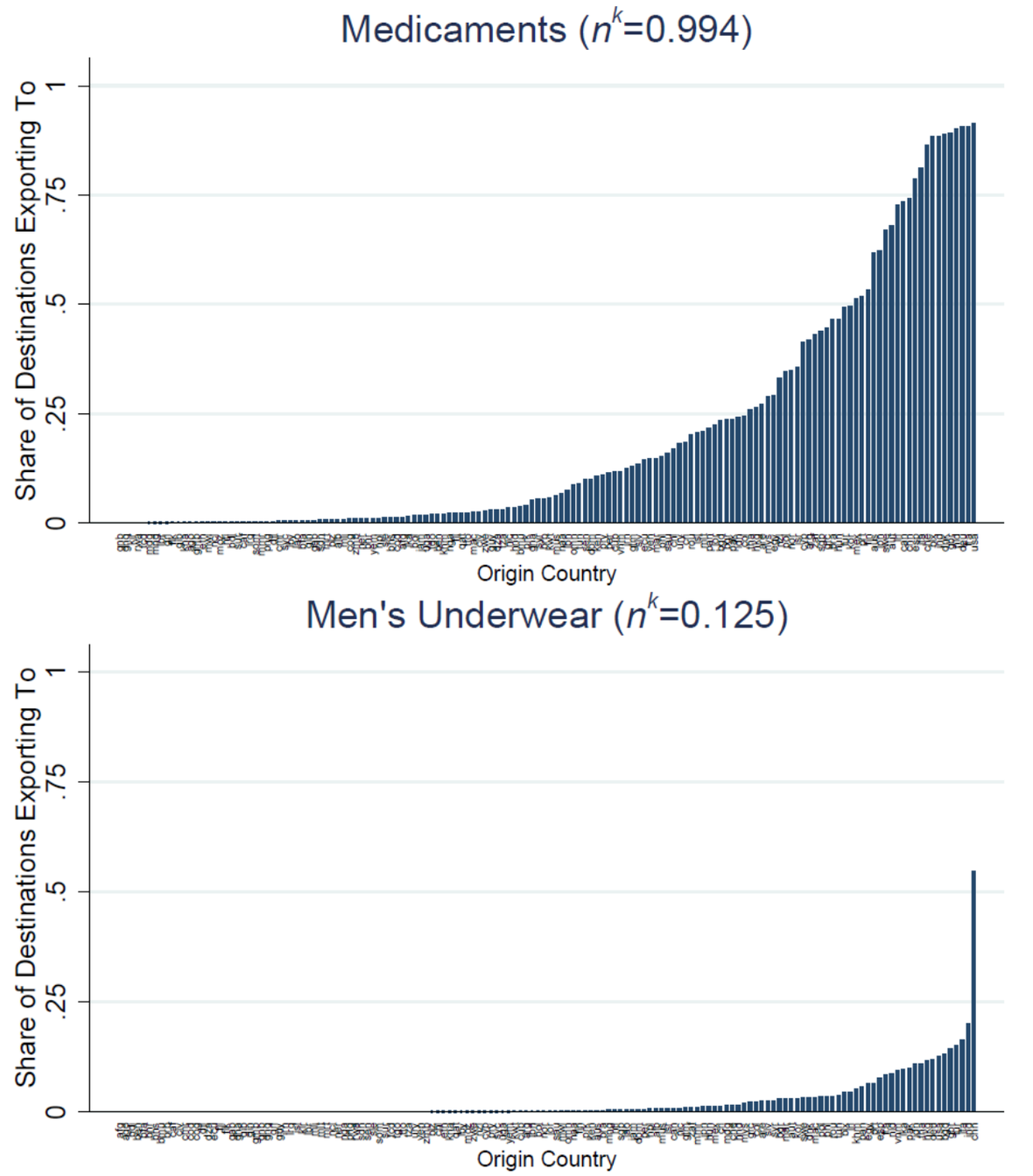


(b) Distribution of the Dynamic Gains from Trade

MORE COMPLEX, MORE FOREIGN COMPETITION!



(a) Complexity and Number of Exporters

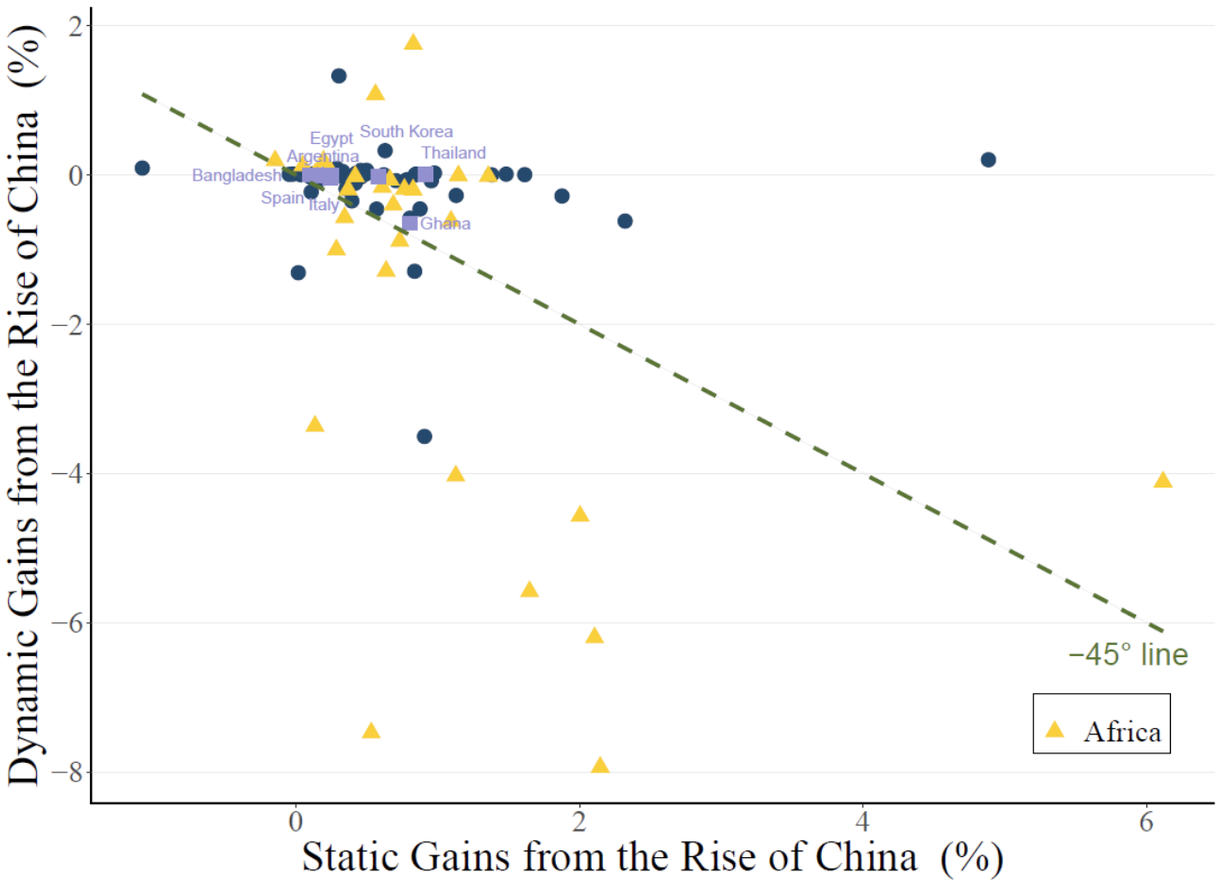


(b) Complexity and Share of Destinations Exported To

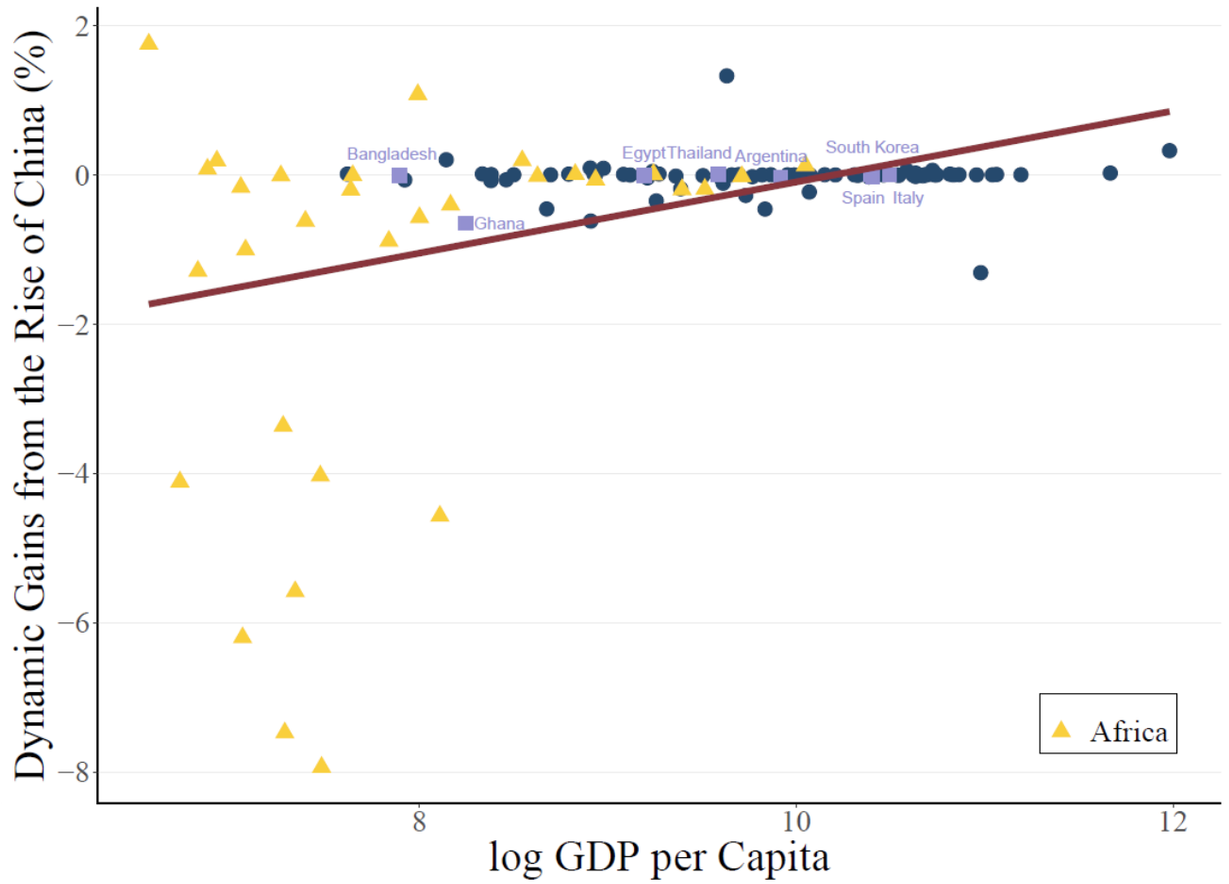
DYNAMIC CONSEQUENCES OF THE RISE OF CHINA: PUSH OR PULL?

- Model provides natural springboard to ask how a country's development path is affected by other countries' entry into world economy
- **Counterfactual Question:**
  - *If not for China's emergence in the 1990s, would Ghana or Bangladesh have developed like South Korea did in previous decades?*

CHINA'S RISE PULLS MORE COUNTRIES DOWN THAN IT PUSHES UP



(a) Dynamic Gains vs. Static Gains



(b) Dynamic Gains vs. GDP per Capita

- **Why are dynamic losses predominantly in Africa?**
  - China big seller of Africa's more complex sectors
  - China big buyer of Africa's least complex goods
  - African countries produce few goods, small capability changes have large W effects

HOW ROBUST ARE DYNAMIC LOSSES?

ALTERNATIVE MEASURES OF CAPABILITY AND COMPLEXITY

- Productivity distribution $G_{i,t}$ such that:
  - More capable countries export more goods
  - More complex goods exported by fewer countries

- **Logit model:**

$$\text{Prob}(A^k_{ij,t} > 0) = \frac{e^{(N_{i,t} - n^k_t)}}{1 + e^{(N_{i,t} - n^k_t)}}$$

ALTERNATIVE COMPLEXITY (1962–2014)

	Sectors with highest n^k (Average Value, 1962-2014)	
1	Railway Passenger Cars	3.233
2	Electric Trains	3.230
3	Warships	3.193
4	Mechanically Propelled Railway	2.894
5	High-pressure hydro-electric conduits of steel	2.690
6	Leather Articles Used in Machinery	2.665
7	Rotary Converters	2.557
8	Hats	2.533
9	Aircraft Tires	2.526
10	Nuclear Reactors	2.526
	Sectors with lowest n^k (Average Value, 1962-2014)	
1	Medicaments	-1.626
2	Chemical Products	-1.237
3	Miscellaneous Non-Electrical Machinery Parts	-1.157
4	Miscellaneous Electrical Machinery	-1.128
5	Miscellaneous Non-Electrical Machines	-1.067
6	Finished Cotton Fabrics	-1.007
7	Footwear	-1.001
8	Medical Instruments	-0.985
9	Electric Wire	-0.969
10	Miscellaneous Hand Tools	-0.969

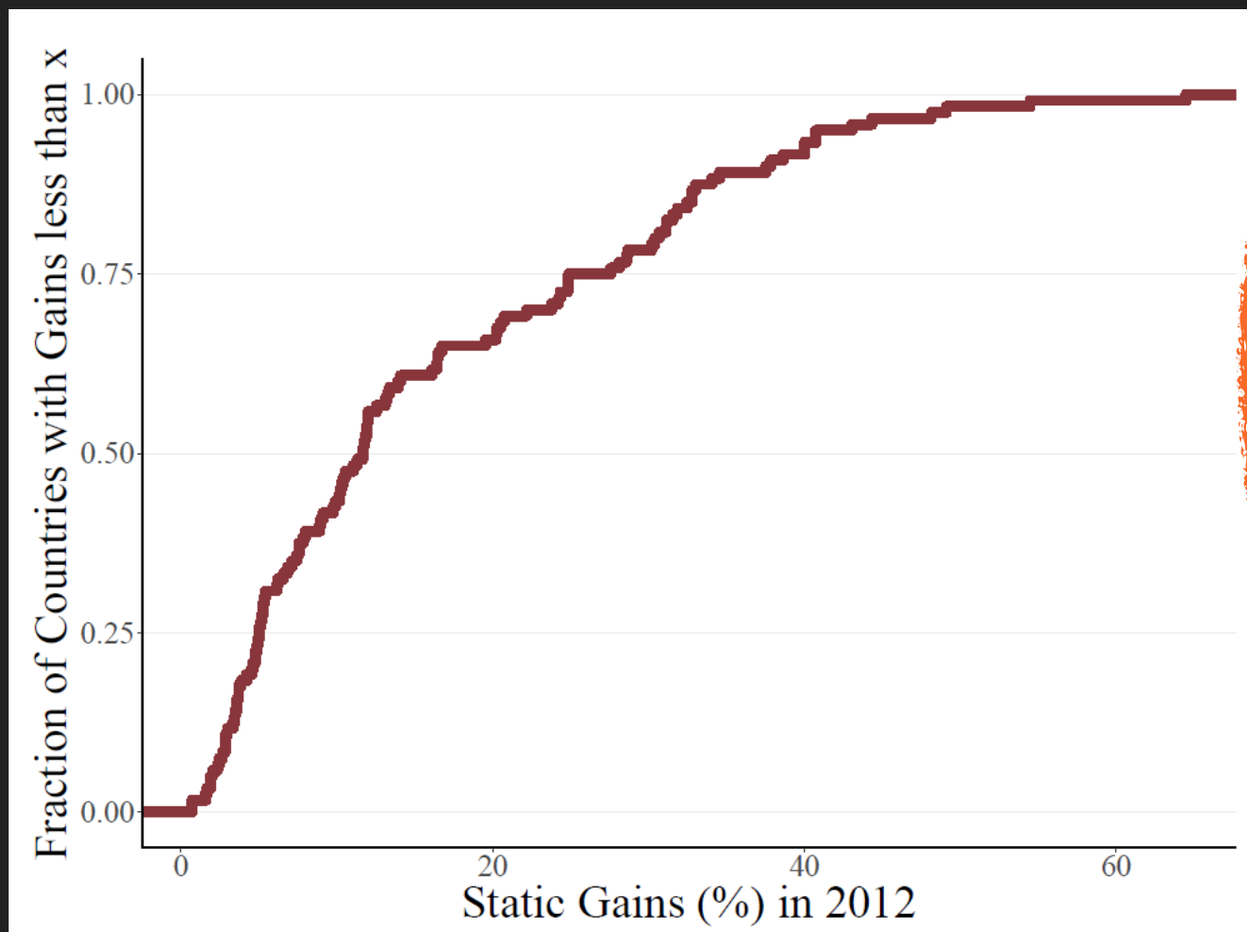
BUT DYNAMIC SPILLOVERS ARE NOW NEGATIVE...

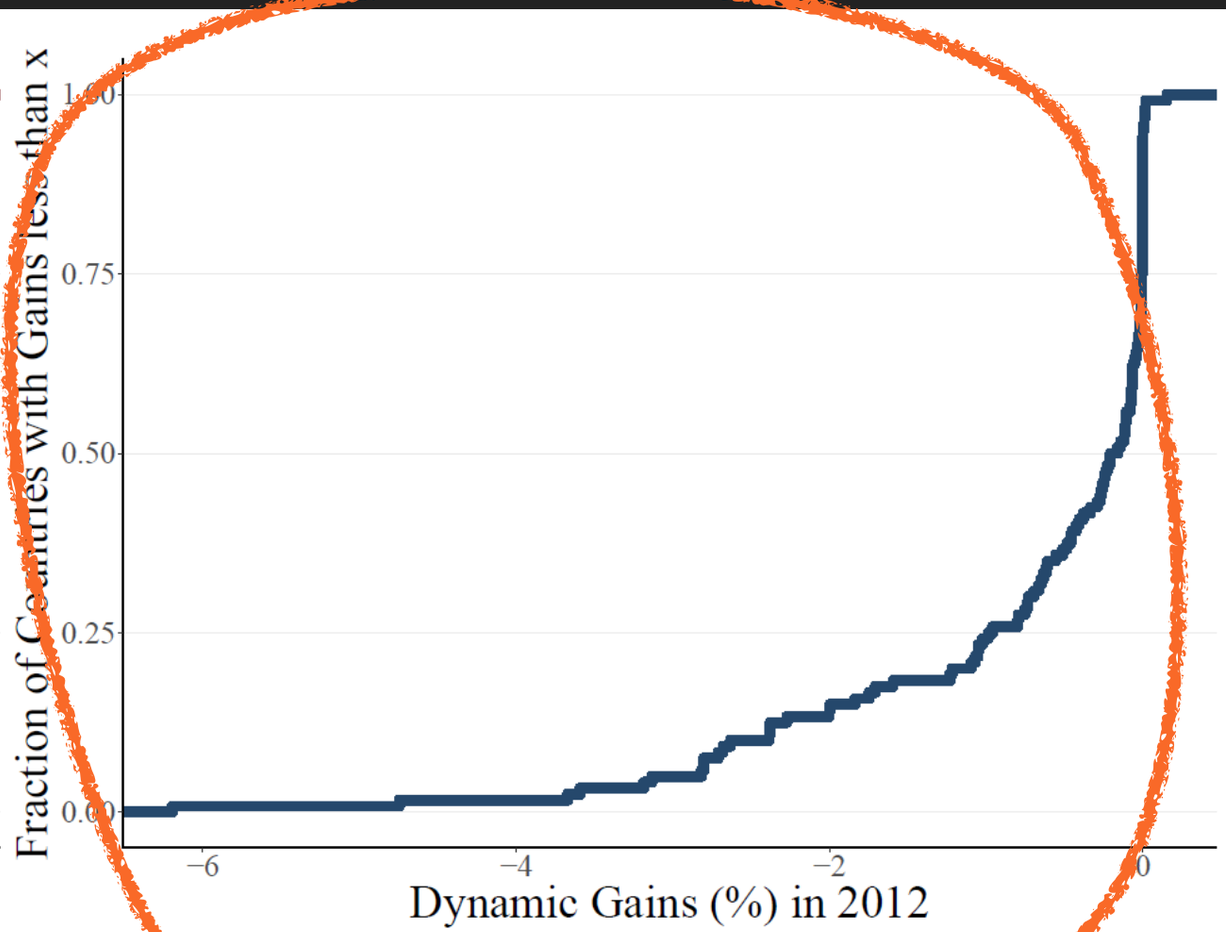
	Country Capability $N_{i,t+1}$		
	(1) OLS	(2) IV ($Z^I_{i,t}$)	(3) IV ($Z^I_{i,t}$ and $Z^{II}_{i,t}$)
Average Complexity $S_{i,t}$	0.0412	-0.0474	-0.390**
	(0.0302)	(0.249)	(0.196)
Initial Capability $N_{i,t}$	0.595***	0.586***	0.549***
	(0.0210)	(0.0320)	(0.0296)
Country and year FEs	Yes	Yes	Yes
Observations	6,872	6,872	6,872
R-squared	0.970	0.405	0.348
Clusters	1438	1438	1438
CD F-Stat		107.5	119.7
KP F-Stat		21.65	23.43

. . . AND SO DYNAMIC LOSSES REMAIN PERVASIVE

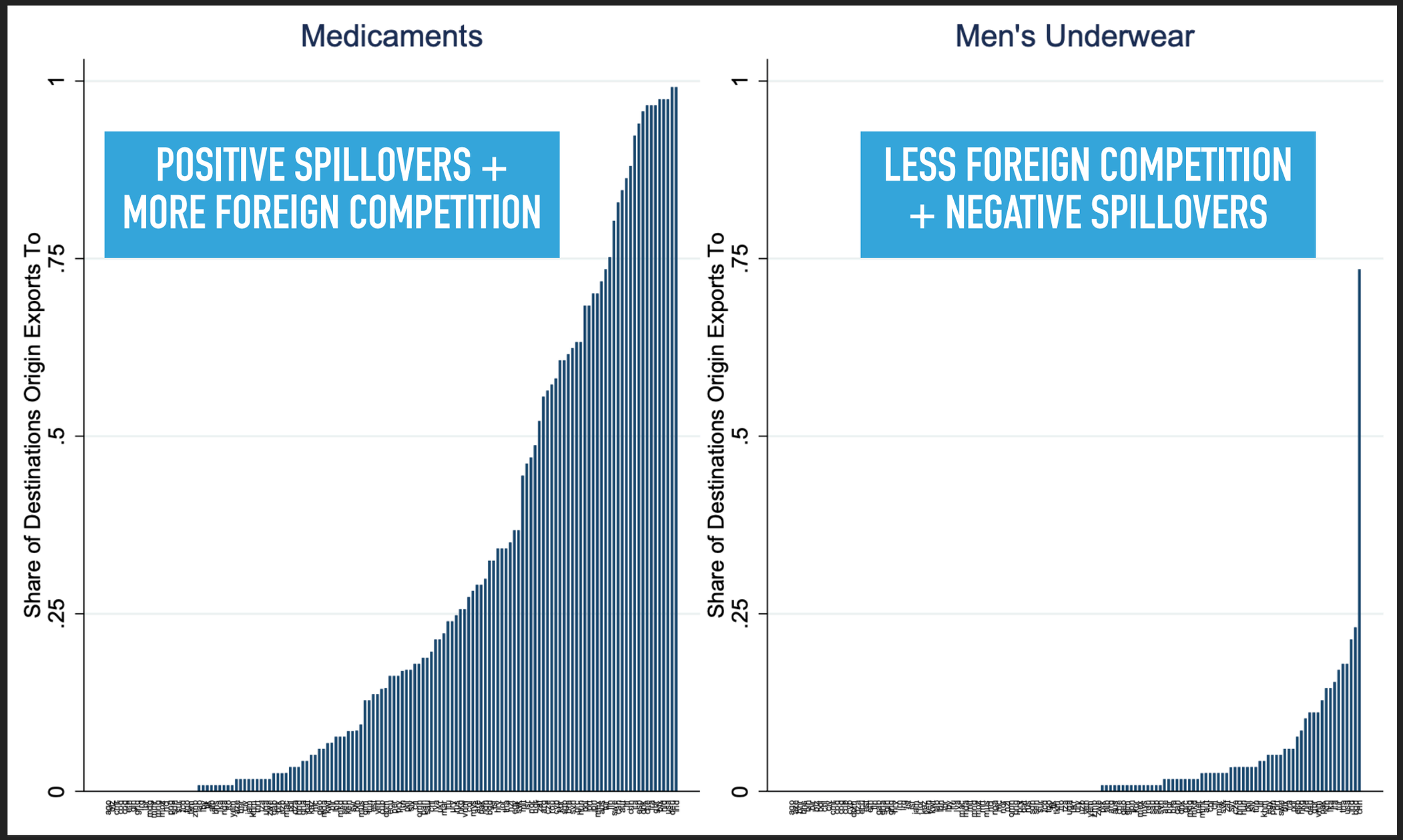
STATIC GAINS

DYNAMIC LOSSES





A TALE OF TWO SECTORS



- **Other explanations:**
  - Complex sectors have lower σ so trade doesn't shift labor out: No, σ and n correlate only weakly
  - More countries exporting intermediates may expand employment: No, IO links magnify losses

WHAT HAVE WE LEARNT?

MAIN TAKEAWAYS

1. ***Theory:***

   - Trade can move ***all*** countries up the ladder
   - This happens if (i) complex goods raise capability and (ii) fewer countries export complex goods

2. ***Empirics:***

   - Evidence of plausibly exogenous employment shifts towards some sectors raising technological capability
   - However, more countries export in those sectors (Why?)

1 + 2 → pervasive dynamic welfare losses from trade

IV RESULTS: SENSITIVITY (I)

	Country Capability $N_{i,t+1}$				
	(1)	(2)	(3)	(4)	(5)
	Baseline	Feenstra Dataset	All Length Panels	No Size Threshold	High Size Threshold
Average Complexity $S_{i,t}$	0.288***	0.298**	0.223***	0.291***	0.414***
	(0.0902)	(0.127)	(0.0732)	(0.0901)	(0.149)
Initial Capability $N_{i,t}$	0.855***	0.929***	0.868***	0.857***	0.805***
	(0.0364)	(0.0416)	(0.0359)	(0.0354)	(0.0532)
Country and year FEs	Yes	Yes	Yes	Yes	Yes
Observations	6,872	6,864	7,905	6,995	5,986
R-squared	0.701	0.721	0.711	0.689	0.648
Clusters	1438	1438	1673	1466	1249
CD F-Stat	36.03	17.52	37.97	34.09	27.05
KP F-Stat	8.445	4.145	9.282	8.475	5.551

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IV RESULTS: SENSITIVITY (II)

	Country Capability $N_{i,t+1}$				$GNI_{i,t+1}$
	(1)	(2)	(3)	(4)	(5)
	Baseline	10-year Lag	1 Obs. per 5-year Cluster	IV $N_{i,t}$	
Average Complexity $S_{i,t}$	0.288***	0.405***	0.205**	0.275***	0.906**
	(0.0902)	(0.144)	(0.0877)	(0.0955)	(0.417)
Initial Capability $N_{i,t}$	0.855***	0.690***	0.876***	0.721***	
	(0.0364)	(0.0651)	(0.0381)	(0.0981)	
GNI per capita $GNI_{i,t}$					0.758***
					(0.0330)
Country and Year FEs	Yes	Yes	Yes	Yes	Yes
Observations	6,872	6,151	1,295	6,195	6,107
R-squared	0.701	0.308	0.751	0.669	0.588
Clusters	1438	723	1295	1303	1269
CD F-Stat	36.03	35.85	7.177	12.98	63.55
KP F-Stat	8.445	8.733	5.094	3.674	16.70

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