# GLOBALIZATION AND THE LADDER OF DEVELOPMENT

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# THE LADDER OF DEVELOPMENT

- **Popular 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:**
  - Use ladder metaphor as a starting point 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 if ***(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**
  - Robust to alternative measures of complexity and capability

# RELATED LITERATURE

- **Theory**
  - **Comparative advantage:** Krugman (1979), Krugman (1986), Matsuyama (2005), Costinot (2009), Cunat Melitz (2012), Sutton Trefler (2016), Schetter (2020)
  - **Learning-by-Doing:** Krugman (1987), Boldrin Scheinkman (1988), Grossman Helpman (1990), Young (1991), Stokey (1991)
  - **Knowledge diffusion:** Perla, Tonetti and Waugh (2015), Sampson (2016), Buera Oberfield (2017)
- **Empirics**
  - **Complexity and capability:** Hausman Hidalgo (2009), Costinot, Donaldson, and Komunjer (2012), Hausman Hidalgo Bustos Coscia Chung Jimenez Simoes Yildirim (2013), Levchenko and Zhang (2016), Hanson Lind Muendler (2016)
  - **Trade patterns and growth:** Hausman Hwang Rodrik (2007), Lederman Mahoney (2012), Bartelme Lan Levchenko (2021)

# ROADMAP

- Theory
- Measurement
- Estimation
- Counterfactuals
- Robustness

# THEORY

# ENVIRONMENT

- Many countries indexed by $i$
- Continuum of goods indexed by $k$
  - Total measure of goods normalized to one
- 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:**

$$U_i = \int_0^\infty e^{-\rho_i t} u_i(C_{i,t}) dt$$

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

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

- 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 $N_{i,t}$:
  - $F_t$= cdf of complexity across goods
  - $N_t = \{N_{i,t}\}$= state of world technology
- **Linear technology:**

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

$$\text{Prob}(A_{i,t}^k \leq a) = G_{i,t}(a \mid n_t^k = n, N_{i,t})$$

FROM DEVELOPMENT TO TRADE

# TECHNOLOGY

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

FROM TRADE TO DEVELOPMENT

$$\dot{N}_{i,t} = H_{i,t}(N_{i,t}, F^{\ell}_{i,t})$$

$$F^{\ell}_{i,t}(n) = \frac{\int_{0 \leq n^k \leq n} \sum_j \ell^k_{ij,t} dk}{\int \sum_j \ell^k_{ij,t} dk}$$

- **Dynamic spillovers:**
  - $H_{i,t}$ is increasing in $F^{\ell}_{i,t}$ (in M.L.R.P sense)
  - 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

$$\Rightarrow \quad \{w_{i,t}\}, \{p^k_{ij,t}, P^k_{j,t}, P_{j,t}\}, \{c^k_{ij,t}, C^k_{j,t}, C_{j,t}\}, \{\ell^k_{ij,t}\}$$

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

# PUSHED TO THE TOP OR HELD AT THE BOTTOM? A BENCHMARK

- **Pure ladder economy** (Generalization of Krugman 1979)**:**

$$A^k_{ij,t} = \begin{cases} A_{ij,t} & \text{if } n^t_k \leq N^t_i, \\ 0 & \text{otherwise.} \end{cases}$$

- **Key features:**
  - More capable countries ➡ more likely to export
  - More complex goods ➡ less likely to be exported
  - More capable countries ➡ CA in more complex goods
- **Question:** *What is the difference between time paths of capability* $N_{i,t}$ *and consumption* $C_{i,t}$ *with & without trade?*

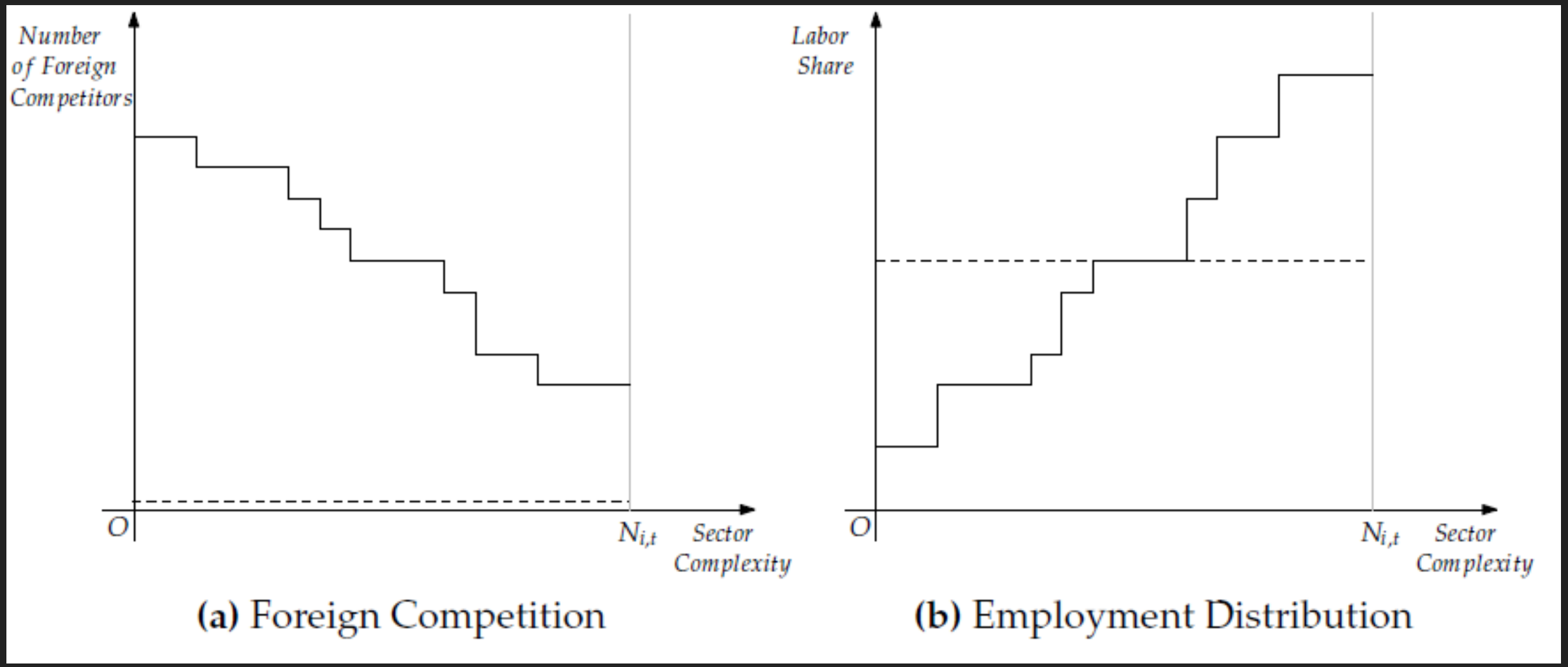
# THE CASE FOR DYNAMIC GAINS FROM TRADE IN ALL COUNTRIES

PROPOSITION 1.

IN A PURE LADDER ECONOMY, OPENING UP TO TRADE RAISES TECHNOLOGICAL CAPABILITY $\{N_{i,t}\}$ AND AGGREGATE CONSUMPTION $\{C_{i,t}\}$ 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

# MORE COMPLEX, LESS FOREIGN COMPETITION!




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

# THE CASE FOR DYNAMIC GAINS FROM TRADE IN ALL COUNTRIES

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- **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 $t$, $(N_{i,t})_{trade} = (N_{i,t})_{autarky}$ → $(\dot{N}_{i,t})_{trade} > (\dot{N}_{i,t})_{autarky}$
  - $(N_{i,t})_{trade} > (N_{i,t})_{autarky}$ → $(C_{i,t})_{trade} > (C_{i,t})_{autarky}$

# HOW LARGE ARE THE STATIC AND DYNAMIC GAINS FROM TRADE?

**PROPOSITION 2.**

IN A PURE LADDER ECONOMY, GAINS FROM TRADE ARE BOUNDED FROM BELOW AND ABOVE BY

$$\underline{GT}_i = 1 - \underbrace{\left[\int e_i(n)(\lambda_{ii}(n))^{\frac{\epsilon-1}{\sigma-1}} dF(n)\right]^{\frac{1}{\epsilon-1}}}_{\text{Static Gains}}$$

$$\bar{GT}_i = 1 - \underbrace{\left[\int e_i(n)(\lambda_{ii}(n))^{\frac{\epsilon-1}{\sigma-1}} dF(n)\right]^{\frac{1}{\epsilon-1}}}_{\text{Static Gains}} \cdot \underbrace{\left[H_i^{-1}(0,F_i^{\ell})/H_i^{-1}(0,F)\right]^{\frac{1}{(1-\epsilon)}}}_{\text{Dynamic Gains}}$$

# 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

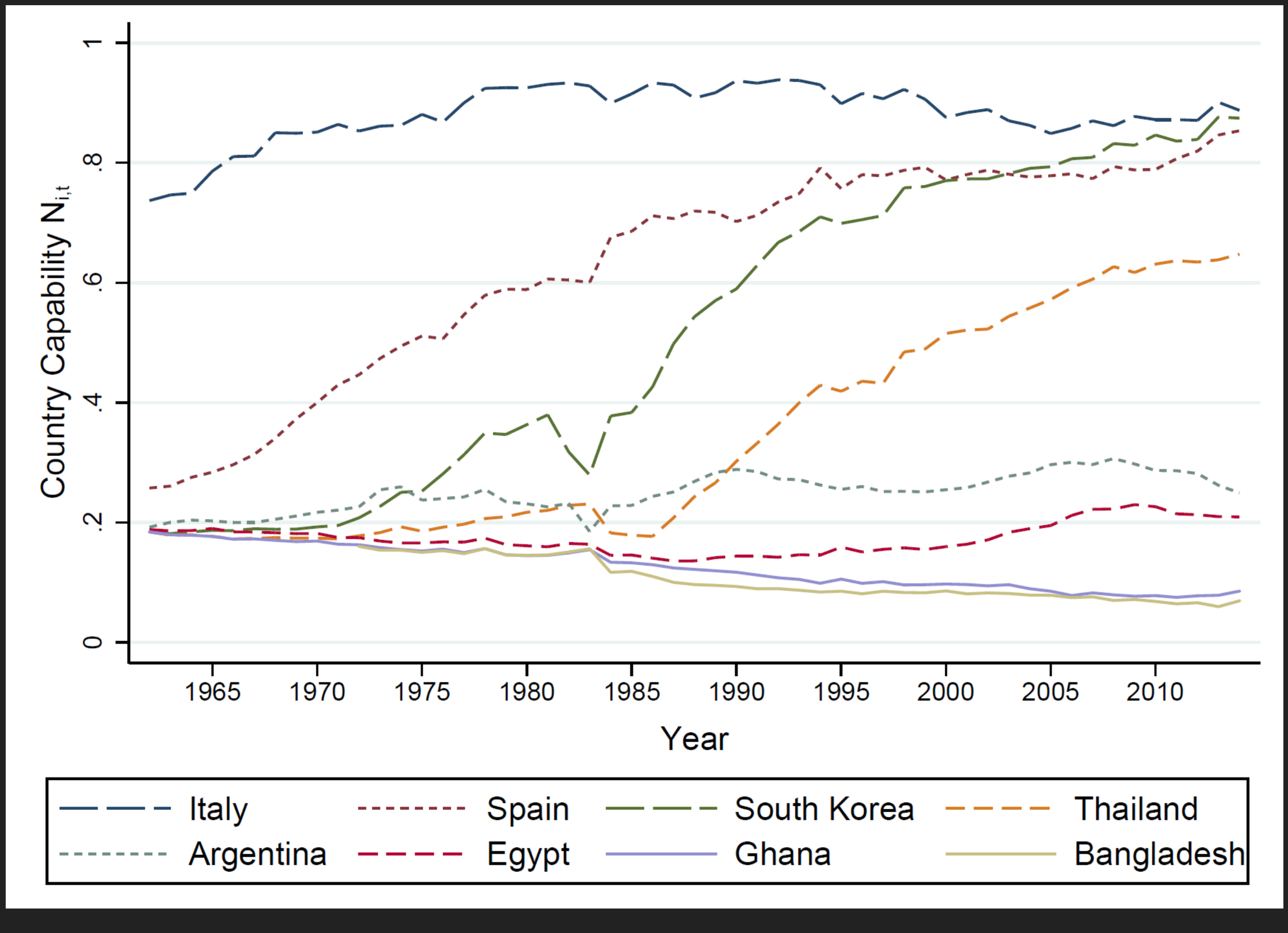
$$N_{i,t} - N_{i_0,t} = [(\pi_{ij,t}^{ME} - \pi_{ij,t}^{TS}) - (\pi_{i_0j,t}^{ME} - \pi_{i_0j,t}^{TS})]/(n_t^{ME} - n_t^{TS})$$

- Given $u_{ij,t}^k$, assert that G10 members are capable and iterate...

# DATA

- Use COMTRADE SITC (Rev2) 4-digit bilateral trade data for 146 countries 1962-2014
  - 715 manufacturing sectors
- Replicate Feenstra et al. (2005) to clean data
  - But use all flows, bottom coding trade flows ≤ $100,000
  - Remove countries <40 years data, never export >$100m

# BASELINE CAPABILITY (1962–2014)

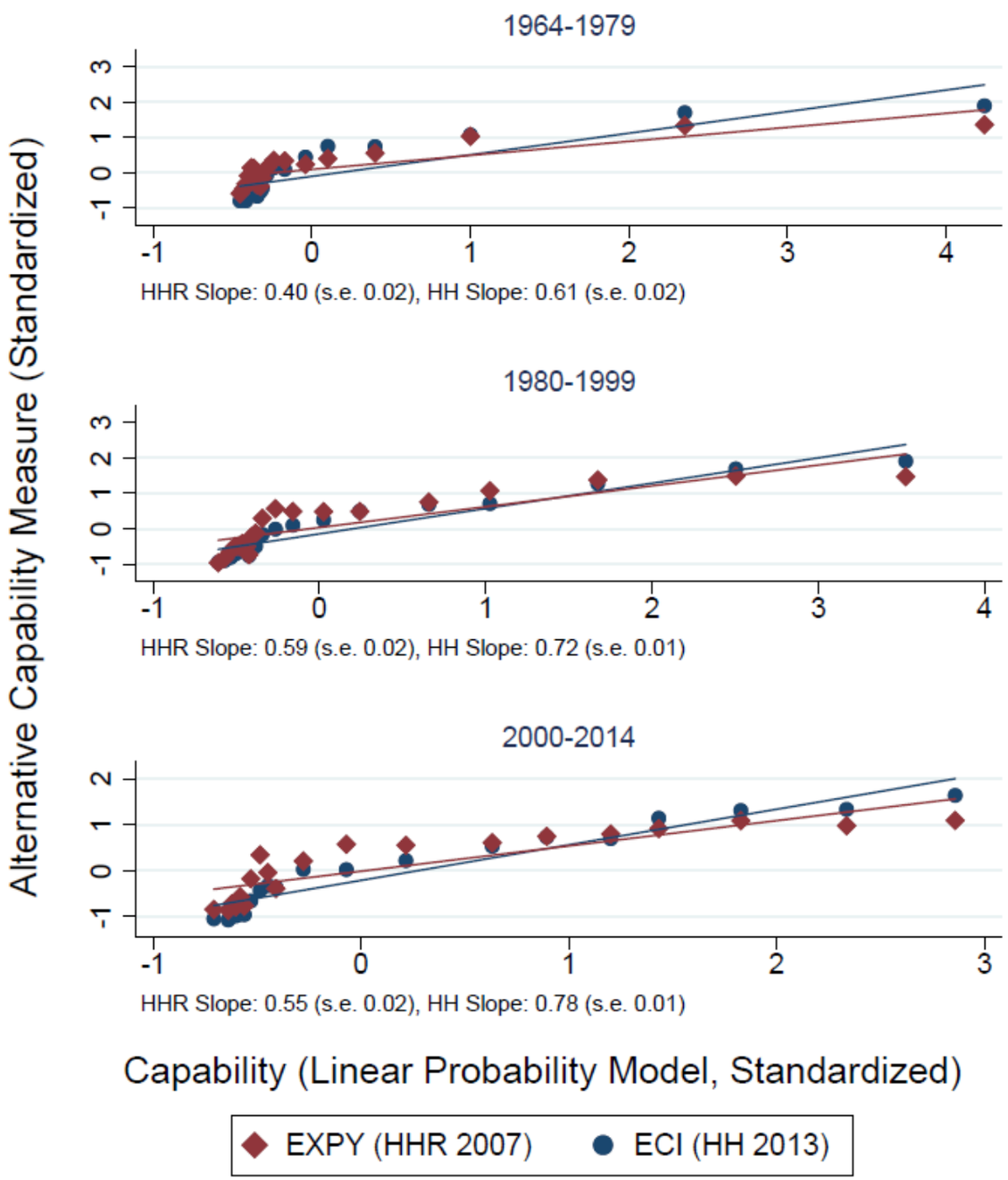


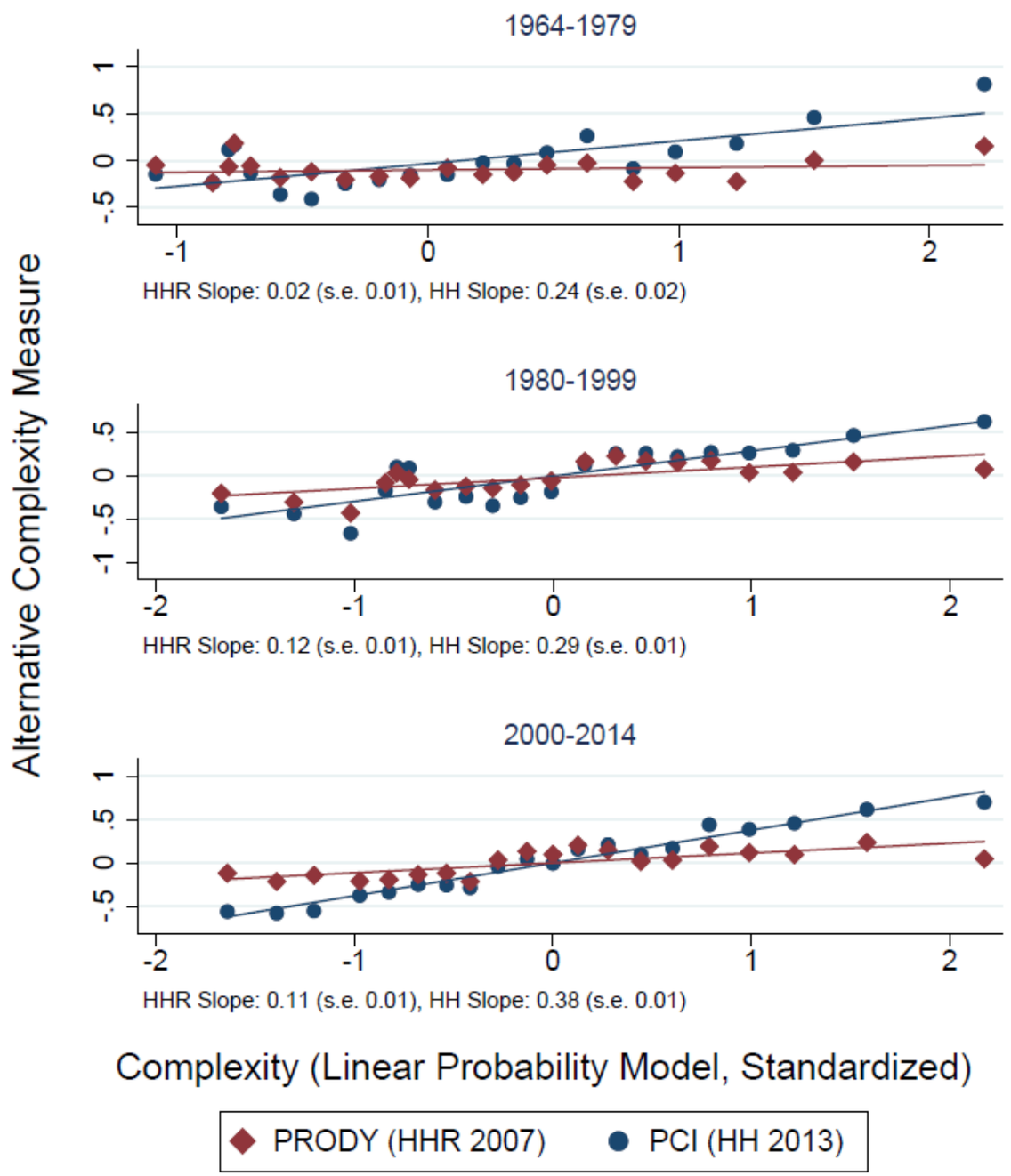
# BASELINE COMPLEXITY (1962–2014)

| | 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:**

$$N_{i,t+1} = \beta \int n dF^{\ell}_{i,t}(n) + \phi N_{i,t} + \gamma_i + \delta_t + \varepsilon_{i,t+1}$$

- **Key endogeneity issue:**

$$S_{i,t} \equiv \int n dF^{\ell}_{i,t}(n) \not\perp \varepsilon_{i,t+1}$$

# 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

⇒

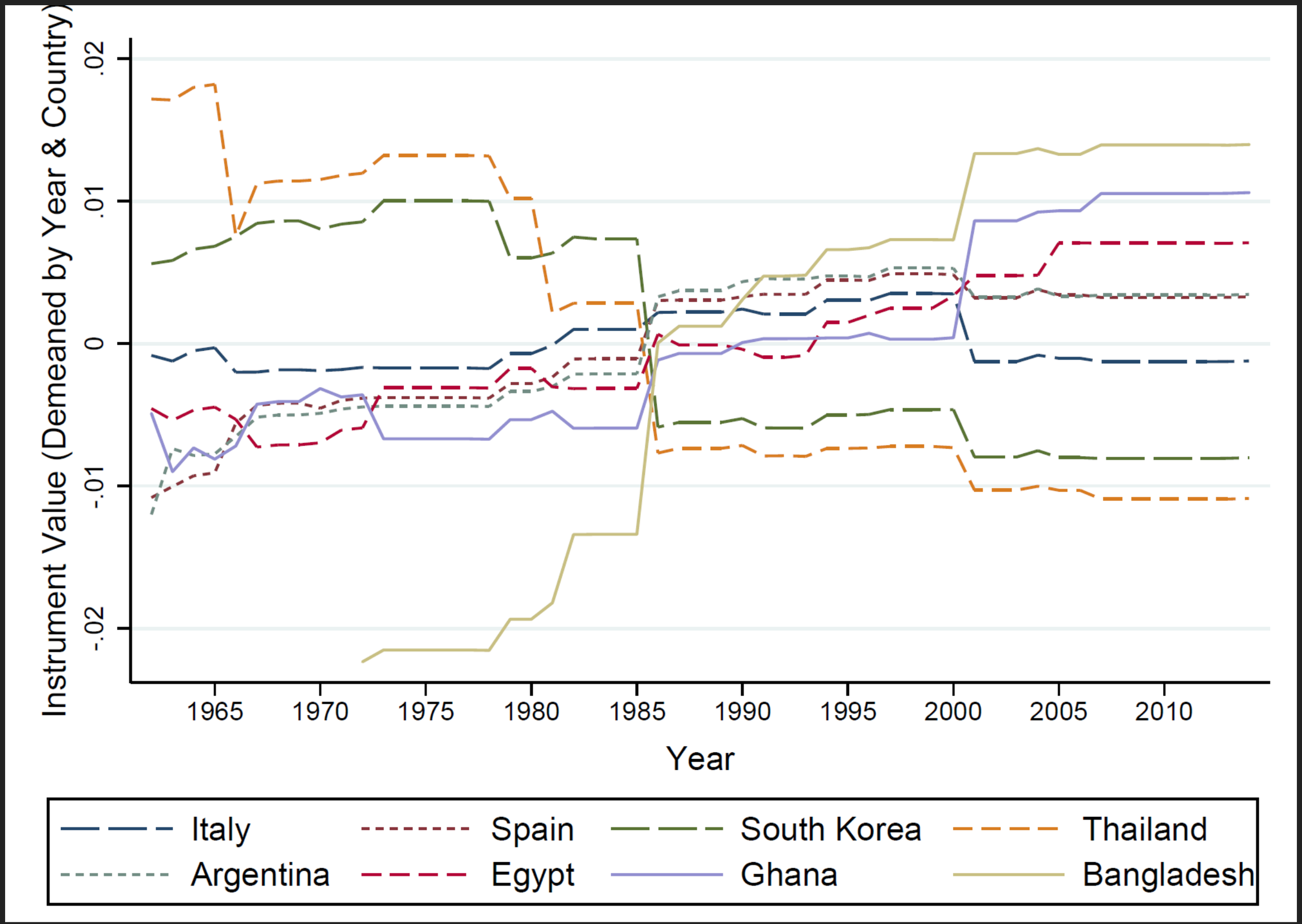
- **IV (I):** *Product-destination-level labor demand shifter*

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

- **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

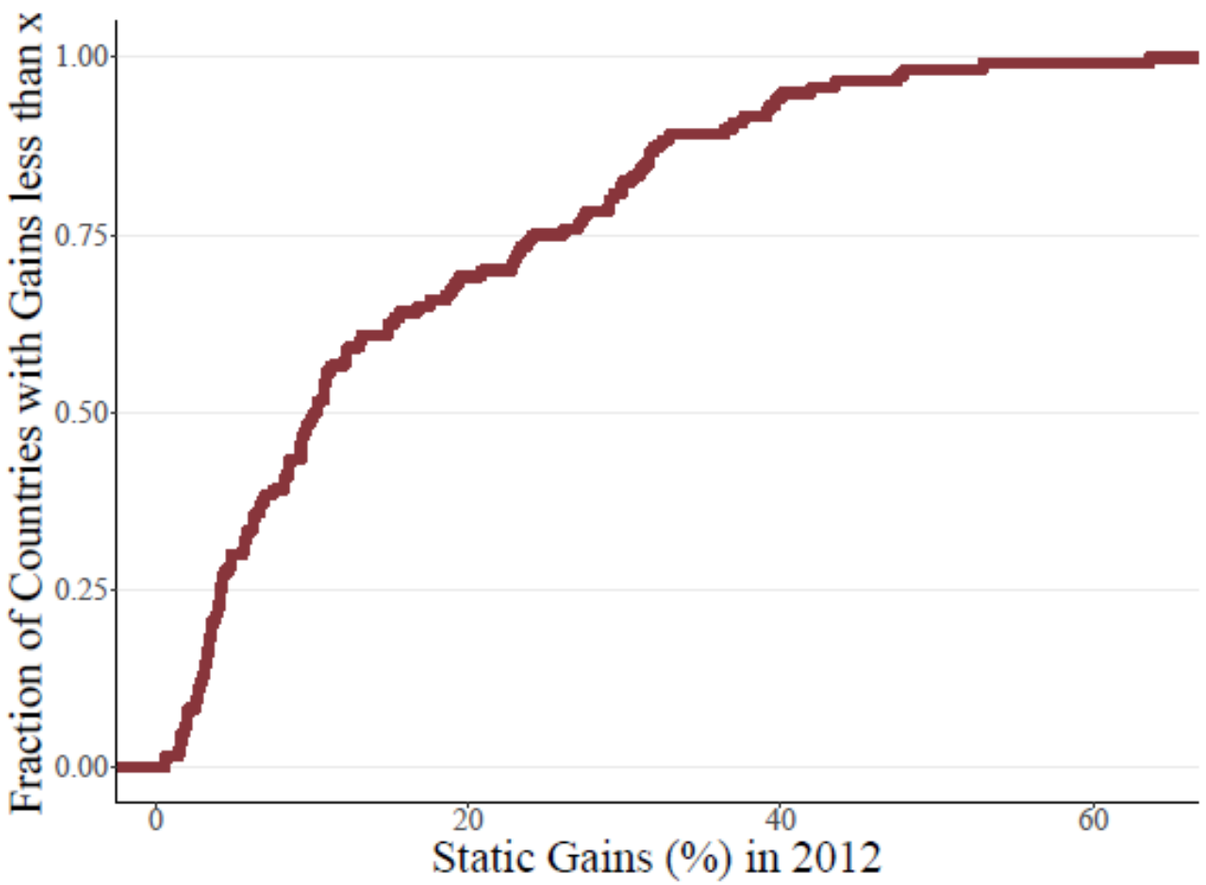
| Parameter | Value | Choice Calibration |
|---|---|---|
| **Panel A: Nested CES Preferences** | | |
| $\sigma$ | 2.7 | Broda and Weinstein (2006) |
| $\epsilon$ | 1.36 | Redding and Weinstein (2018) |
| **Panel B: Dynamic Spillovers** | | |
| $\beta$ | 0.288 | Baseline estimate |
| $\phi$ | 0.855 | 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

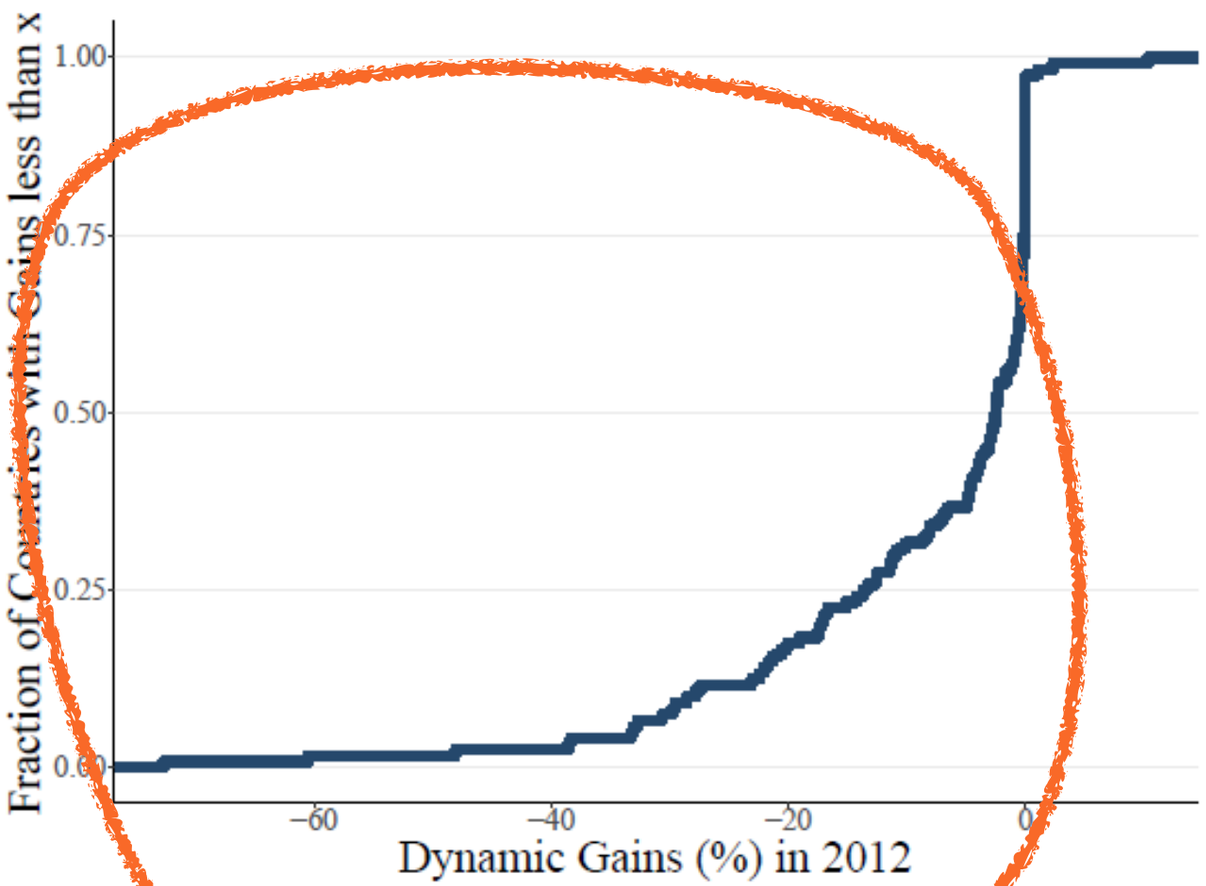
# STATIC AND DYNAMIC GAINS FROM TRADE

STATIC GAINS

DYNAMIC LOSSES

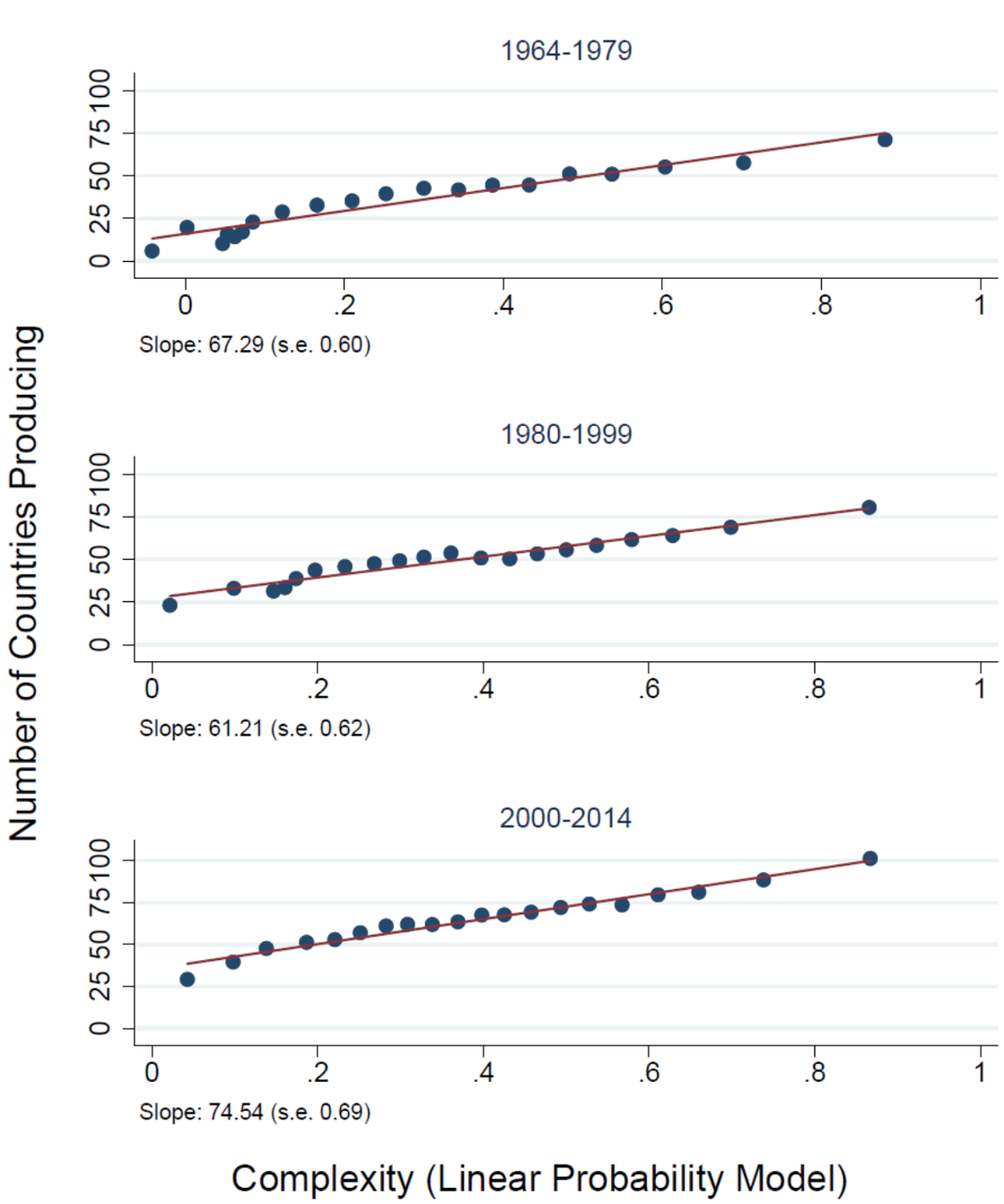



**(a)** Distribution of the Static Gains from Trade

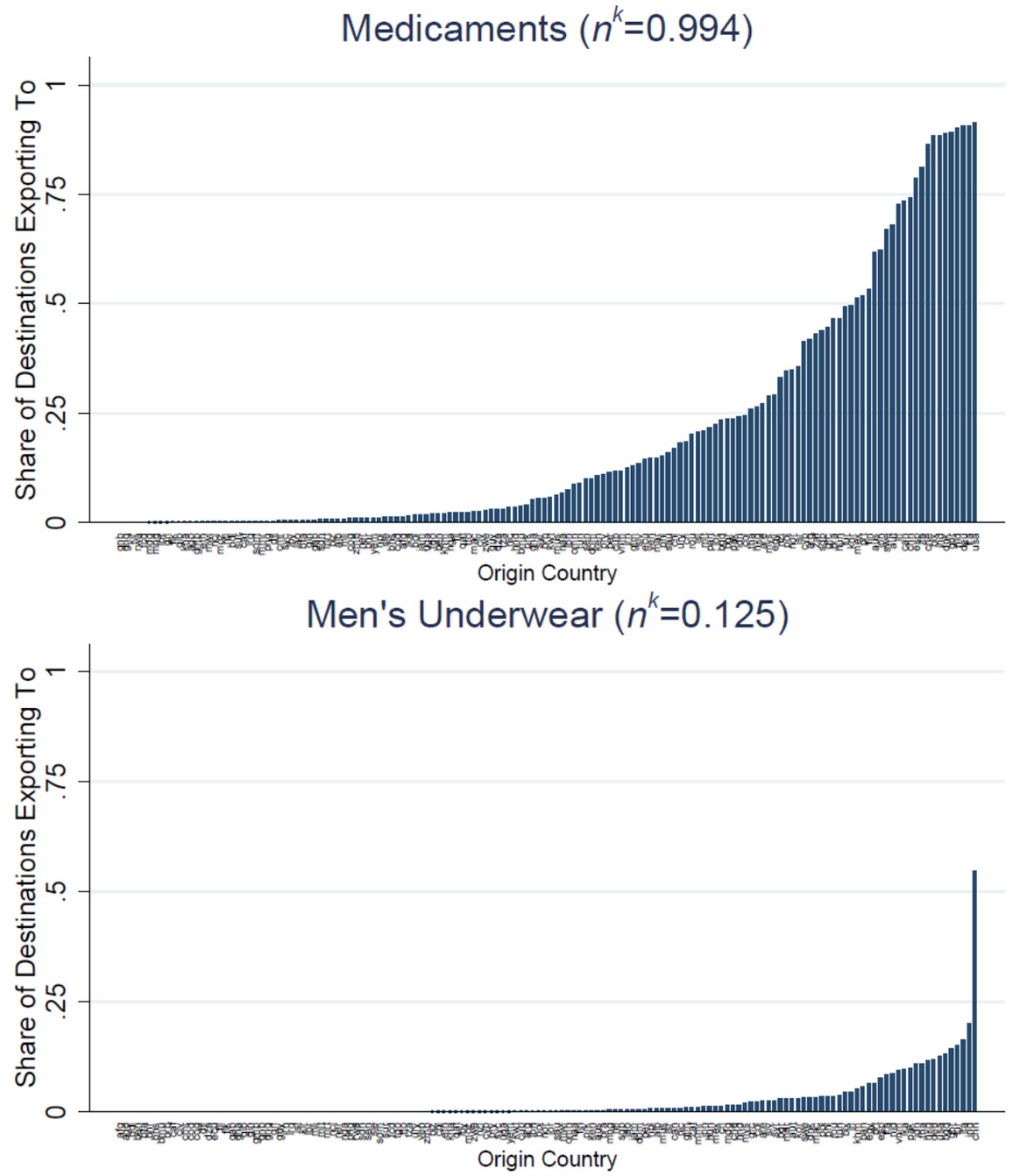



**(b)** Distribution of the Dynamic Gains from Trade

# MORE COMPLEX, MORE FOREIGN COMPETITION!




**(a)** Complexity and Number of Exporters

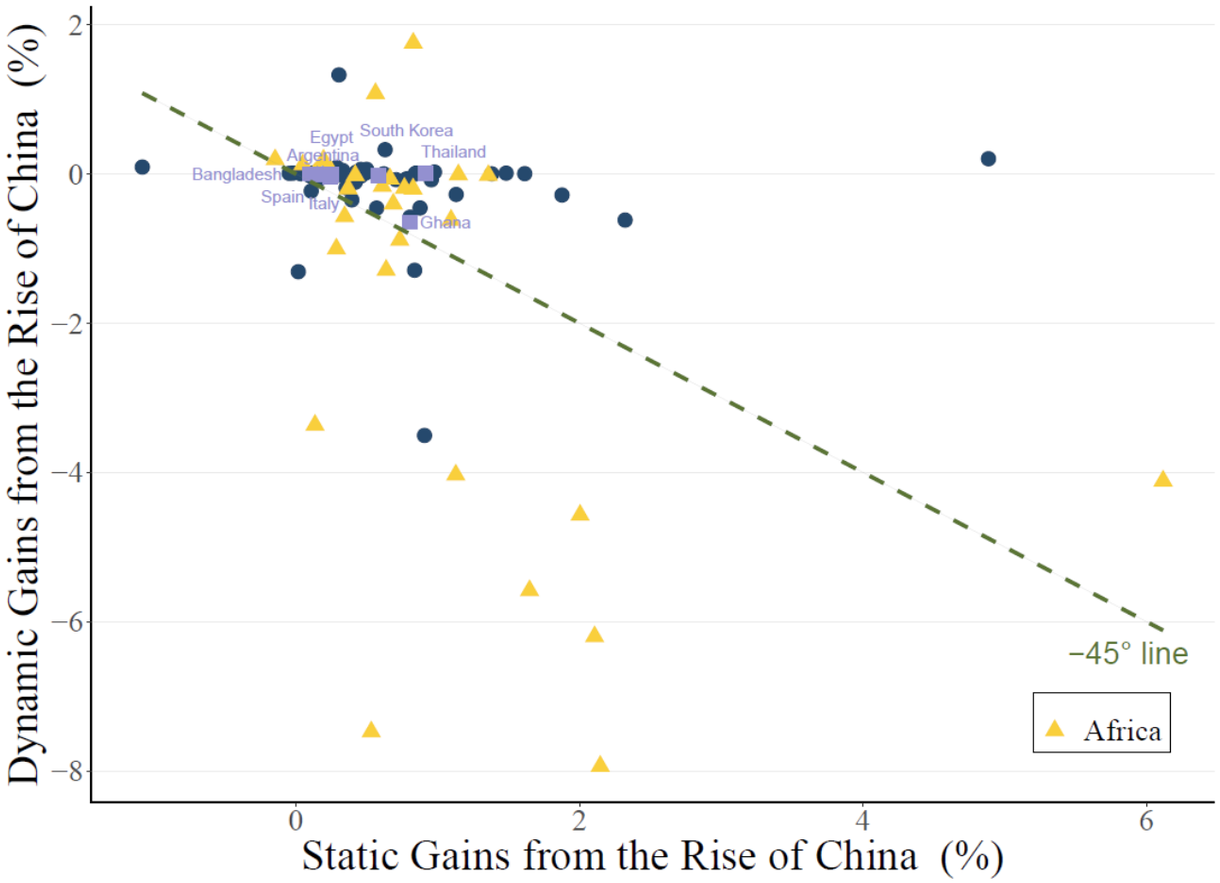



**(b)** Complexity and Share of Destinations Exported To

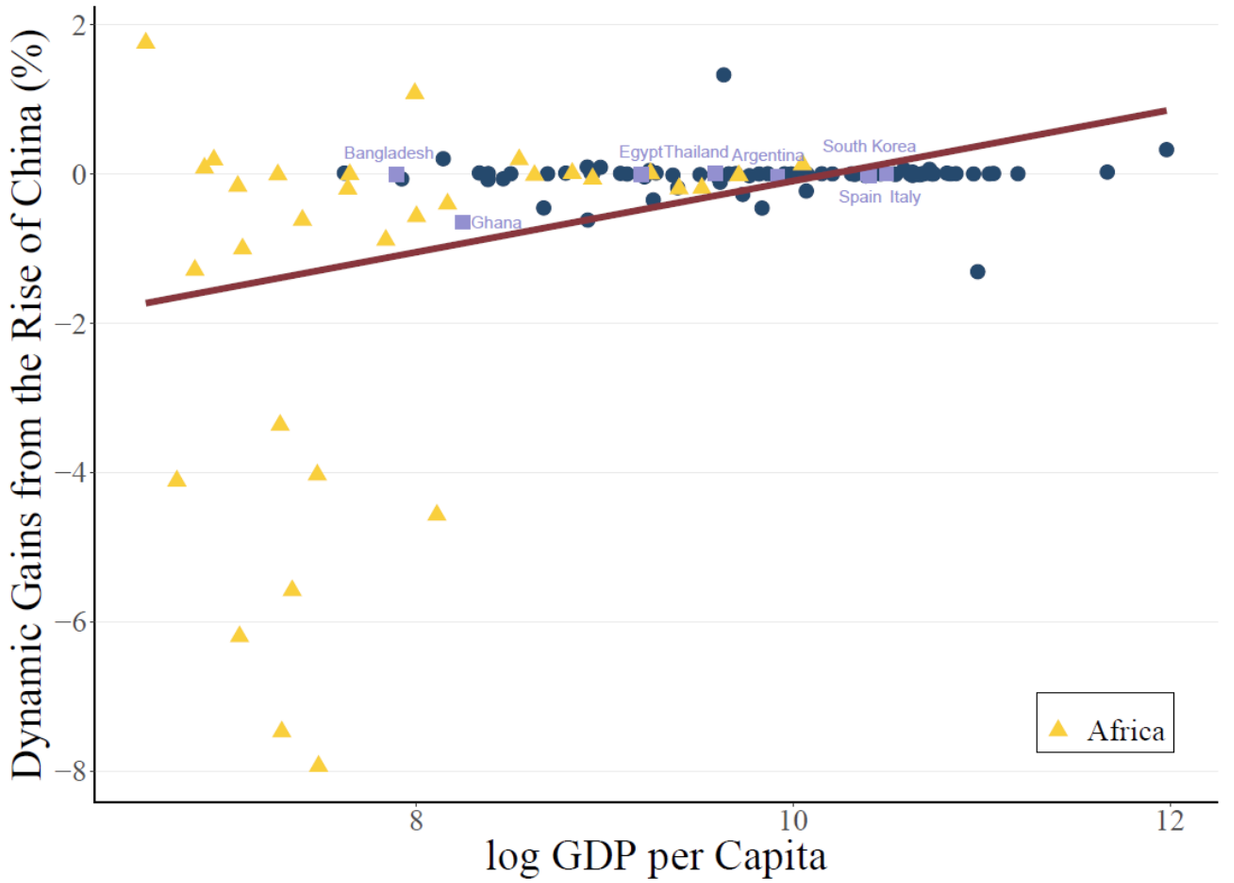
# DYNAMIC CONSEQUENCES OF THE RISE OF CHINA: PUSH OR PULL?

- 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 |

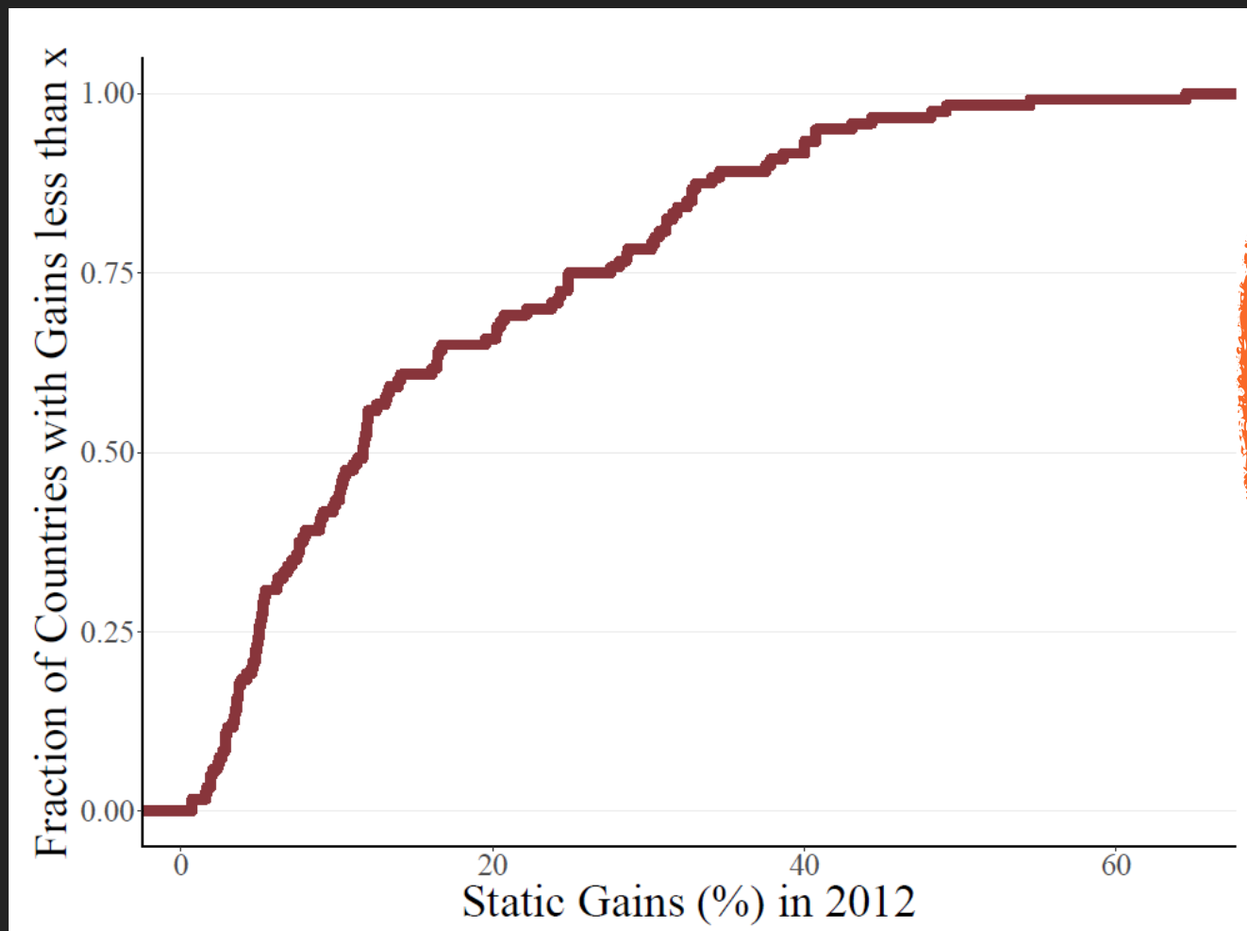
# BUT DYNAMIC SPILLOVERS ARE NOW NEGATIVE...

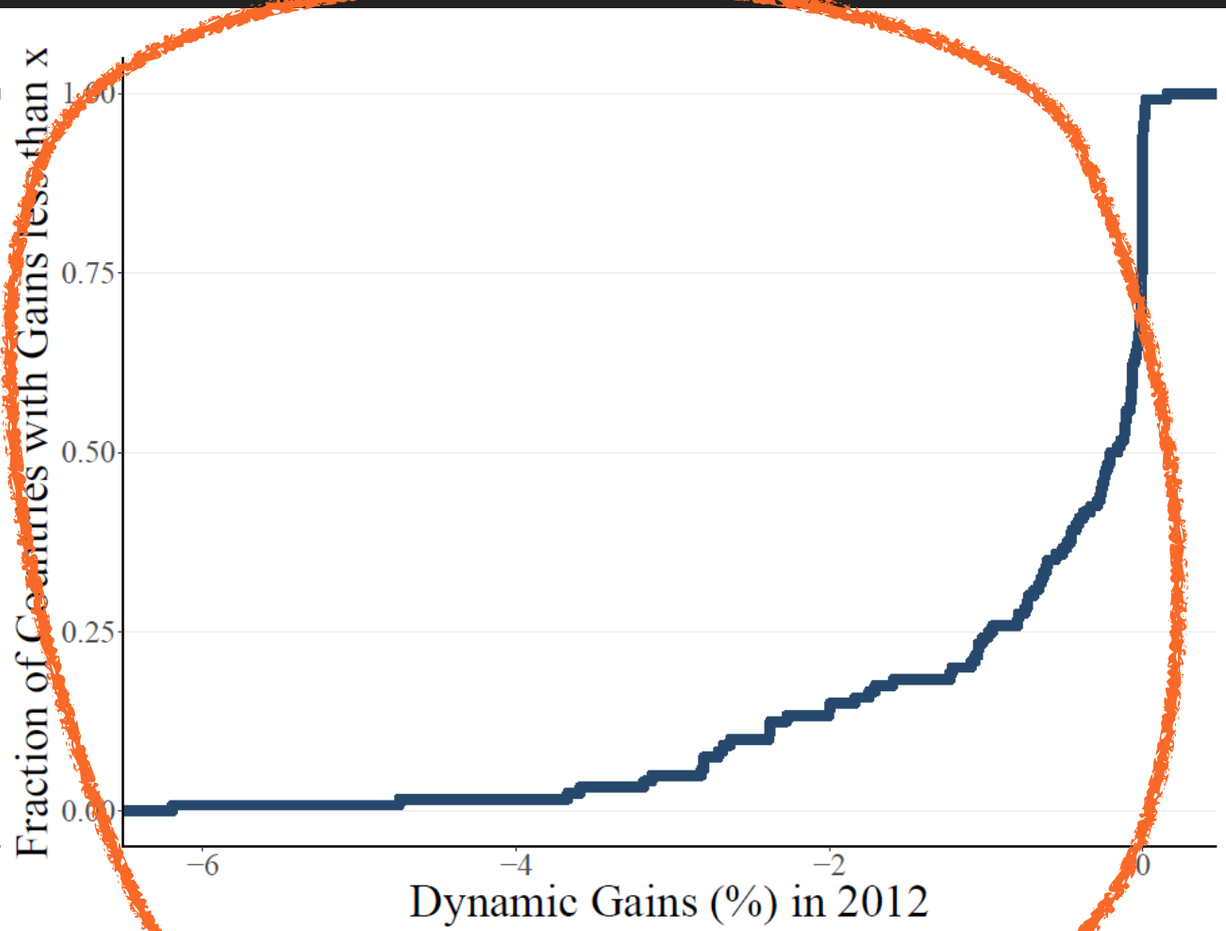
| | Country Capability $N_{i,t+1}$ | | |
|---|---|---|---|
| | (1) OLS | (2) IV ($Z^I_{i,t}$) | (3) IV ($Z^I_{i,t}$ and $Z^{II}_{i,t}$) |
| Average Complexity $S_{i,t}$ | 0.0412 | -0.0474 | -0.390** |
| | (0.0302) | (0.249) | (0.196) |
| Initial Capability $N_{i,t}$ | 0.595*** | 0.586*** | 0.549*** |
| | (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

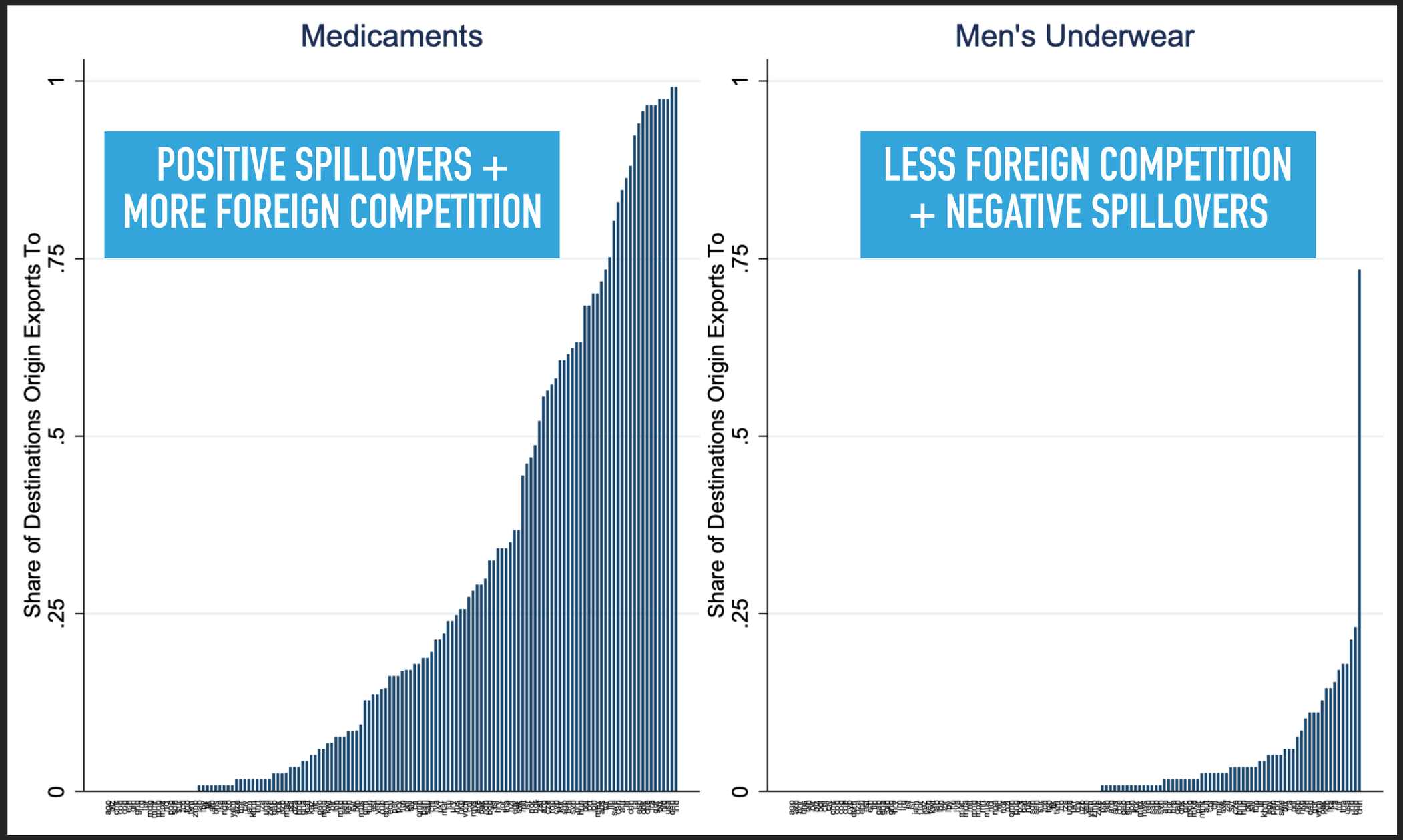
STATIC GAINS

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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