The Textbook Case for Industrial Policy: Theory Meets Data

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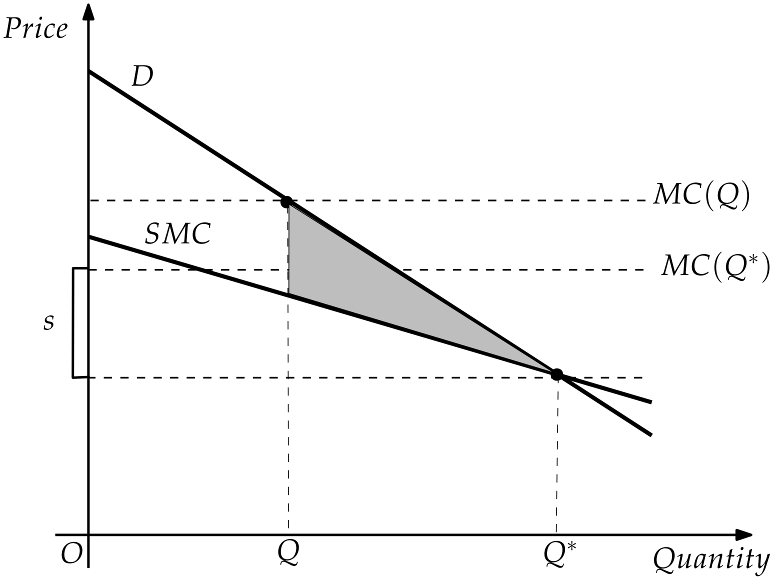
May 2020

“The State Strikes Back”

- Renewed interest in industrial policy
- Many forms, new and old
- We revisit the “textbook case,” with data

The Textbook Case for Industrial Policy



Industrial Policy in an Open Economy

- Ricardian trade + EES:
  - Multiple equilibria
  - Bad equilibrium: specialization against CA
  - Industrial policy to choose best equilibrium
  - Difficult to test or estimate/quantify

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- See paper for general international demand systems

Ricardian Trade with Gravity

- Many countries (i, j) and sectors (k)
- One factor: labor
- CES import demand:

$$x_{ij,k} \equiv \frac{X_{ij,k}}{\sum_l X_{lj,k}} = c_{ij,k}^{-\theta_k} P_{j,k}^{\theta_k}$$

with

$$c_{ij,k} = \frac{\tau_{ij,k} w_i}{A_{i,k}}$$

and

$$P_{j,k} = \left(\sum_i c_{ij,k}^{-\theta_k} \right)^{-1/\theta_k}$$

Ricardian Trade with Gravity with EES

- Instead of

$$c_{ij,k} = \frac{\tau_{ij,k} w_i}{A_{i,k}}$$

we have

$$c_{ij,k} = \frac{\tau_{ij,k} w_i}{A_{i,k} L_{i,k}^{\gamma_k}}$$

- Firms and consumers take $L_{i,k}$ as given
- For equilibrium to be unique, need $\gamma_k \leq 1/\theta_k \forall k$

Optimal Policy

- Government of country i:
  - Objective = Maximize welfare of representative agent
  - Tools = trade taxes/subsidies, production taxes/subsidies
- Optimal Industrial Policy:
  - Pigouvian motive
  - Production subsidies $s_{i,k} = \gamma_k$
- Optimal Trade Policy:
  - TOT manipulation
  - Export taxes $t^x_{ij,k} = \frac{1}{1+\theta_k}$ [if country i is "small" and cannot affect relative prices in ROW]

Estimation and Quantification

1. Estimate demand, $\{\theta_k\}$
2. Invert demand to infer prices given trade flows
3. Regress prices on industry size to estimate EES, $\{\gamma_k\}$
4. Use estimated model to quantify gains from optimal policy

Step 1: Estimate Demand

- From

$$x_{ij,k} = c_{ij,k}^{-\theta_k} P_{j,k}^{\theta_k} \quad \text{with} \quad c_{ij,k} = \frac{\tau_{ij,k} w_i}{A_{i,k} L_{i,k}^{\gamma_k}}$$

we get

$$\ln x_{ij,k} = \ln \left(\frac{w_i}{A_{i,k} L_{i,k}^{\gamma_k}} \right)^{-\theta_k} + \ln P_{j,k}^{\theta_k} - \theta_k \ln \tau_{ij,k}$$

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- Assume that $\tau_{ij,k} = \tilde{\tau}_{ij,k} \exp \varepsilon_{ij,k}$ and write

$$\ln x_{ij,k} = \delta_{i,k}^{o} + \delta_{j,k}^{d} - \theta_k \ln \tilde{\tau}_{ij,k} + \varepsilon_{ij,k}$$

- Bring results from the literature (median of estimates)

Step 2: Invert Demand to Reveal Prices

- From

$$x_{ij,k} = c_{ij,k}^{-\theta_k} P_{j,k}^{\theta_k}$$

  we get

$$c_{ij,k} = x_{ij,k}^{-1/\theta_k} P_{j,k}$$

- We see that

$$x_{ij,k}^{-1/\theta_k}$$

  is a "trade-revealed" (inverse) measure of productivity (modulo $P_{j,k}$)

Step 3: Estimate EES (1)

- We have

$$x_{ij,k}^{-1/\theta_k} P_{j,k} = \frac{\tau_{ij,k} w_i}{A_{i,k} L_{i,k}^{\gamma_k}}$$

Step 3: Estimate EES (1)

- We have

$$x_{ij,k}^{-1/\theta_k} P_{j,k} = \frac{\tau_{ij,k} w_i}{A_{i,k} L_{i,k}^{\gamma_k}}$$

- Rearrange and take logs to get

$$\frac{1}{\theta_k} \ln x_{ij,k} = \ln P_{j,k} - \ln w_i + \gamma_k \ln L_{i,k} + \ln(A_{i,k} \tau_{ij,k}^{-1})$$

or

$$\frac{1}{\theta_k} \ln x_{ij,k} = \delta_{j,k}^d + v_{ij} + \gamma_k \ln L_{i,k} + \eta_{ij,k}$$

Step 3: Estimate EES (2)

$$\frac{1}{\theta_k} \ln x_{ij,k} = \delta^d_{j,k} + v_{ij} + \gamma_k \ln L_{i,k} + \eta_{ij,k}$$

- Construct demand-side IV $Z_{i,k}$ for RHS
  - Use domestic demand shocks
  - Similar to looking for home market effects
  - If Cobb-Douglas, then use $Z_{i,k} = e_{j,k} \cdot \bar{L}_j$
  - Generalize to CES: estimate $\rho = 1.47$, use residuals for IV
  - Identification: dom. demand shocks uncorrelated with $A_{i,k}$
- Estimate SEs (γ_k) using $\{\ln Z_{i,k}\}$ as IV for $\{\ln L_{i,k}\}$

Data

- OECD Inter-Country Input-Output tables
  - 61 countries
  - 34 sectors (15 manufacturing)
  - Focus on manufacturing
  - Years 1995, 2000, 2005, 2010
- Population from PWT v9.0

Sector-Level SEs (γ_k), Part I

Sector	OLS (1)	IV (2)	Reduced-form (3)	First-stage F-stat (4)	SW F-stat (5)
Food, Beverages and Tobacco	0.19	0.16	0.10	87.20	394.3
	(0.01)	(0.02)	(0.02)		
Textiles	0.14	0.12	0.06	56.70	349.9
	(0.01)	(0.01)	(0.02)		
Wood Products	0.13	0.11	0.05	15.50	210.7
	(0.01)	(0.02)	(0.01)		
Paper Products	0.14	0.11	0.05	55.60	661.9
	(0.01)	(0.02)	(0.01)		
Coke/Petroleum Products	0.09	0.07	0.03	14.20	299.1
	(0.01)	(0.01)	(0.01)		
Chemicals	0.23	0.20	0.17	31.10	335.8
	(0.01)	(0.02)	(0.02)		
Rubber and Plastics	0.29	0.25	0.22	39.13	436.0
	(0.02)	(0.03)	(0.03)		

Sector-Level SEs (γ_k), Part II

Sector	OLS	IV	Reduced-form	First-stage F-stat	SW F-stat
Mineral Products	0.16	0.13	0.08	40.50	405.0
	(0.01)	(0.02)	(0.01)		
Basic Metals	0.13	0.11	0.07	14.40	254.0
	(0.01)	(0.01)	(0.01)		
Fabricated Metals	0.16	0.13	0.07	57.10	421.1
	(0.01)	(0.02)	(0.01)		
Machinery and Equipment	0.15	0.13	0.07	66.40	401.6
	(0.01)	(0.01)	(0.01)		
Computers and Electronics	0.10	0.09	0.04	18.60	290.5
	(0.01)	(0.01)	(0.01)		
Electrical Machinery, NEC	0.11	0.09	0.03	45.90	419.5
	(0.01)	(0.01)	(0.01)		
Motor Vehicles	0.17	0.15	0.15	39.80	390.2
	(0.01)	(0.01)	(0.02)		
Other Transport Equipment	0.17	0.16	0.11	24.00	381.6
	(0.01)	(0.02)	(0.02)		

Step 4: Quantify Gains from Industrial Policy

- Assume small open economy under laissez-faire
- Assume EoS bw services and manufacturing also $\rho = 1.47$
- Assume no SEs in non-manufacturing
- Gains from IP = trade policy to optimal policy

Estimates of Welfare Gains

Table 3: Gains from Optimal Policies, Selected Countries

Country	Optimal Policy (1)	Ind. Policy Only (2)	Trade Policy Only (3)	Gains from Trade Policy (4)	Gains from Ind. Policy (5)
United States	0.65%	0.29%	0.28%	0.36%	0.37%
China	0.74%	0.42%	0.26%	0.32%	0.48%
Germany	1.11%	0.13%	0.49%	0.98%	0.62%
Ireland	2.32 %	-0.41%	1.23%	2.73%	1.10%
Vietnam	1.74%	0.67%	1.07%	1.07%	0.67%
Avg., Unweighted	**1.42%**	**0.41%**	**0.82%**	**1.01%**	**0.60%**
Avg., GDP-weighted	**0.87%**	**0.30%**	**0.42%**	**0.58%**	**0.46%**

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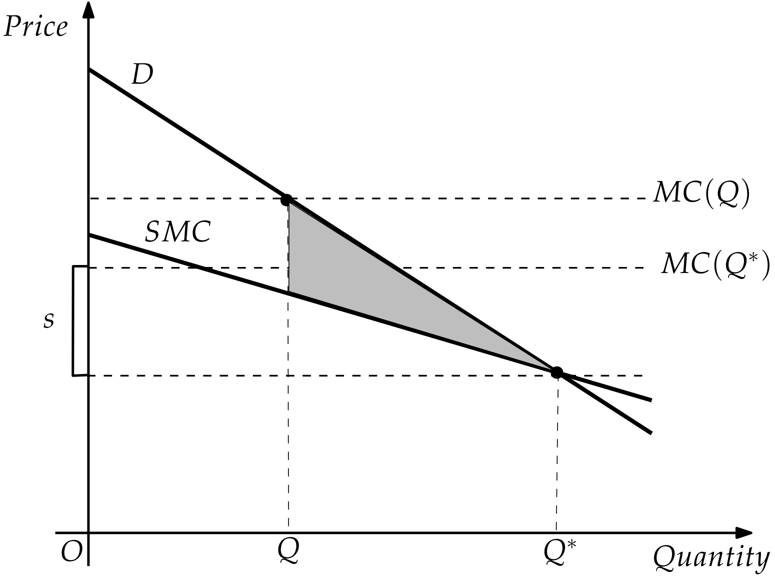


Explaining the Size of Gains

- Closed economy with outside good ⇒ gains approximately

$$\frac{\Delta W}{Y} = \frac{1}{2} \sum_{k \in K} \left(\frac{L_k}{L} \right) \frac{\gamma_k^2}{1/\rho - \gamma_k}$$

- Gains reflect size of subsidies (γ_k), and quantity response to subsidies ($\frac{L_k}{L} \cdot \frac{\gamma_k}{1/\rho - \gamma_k}$)
- Using averages to approximate magnitude of gains,

$$\frac{\Delta W}{Y} = \frac{1}{2} \times (0.28) \times \frac{(0.13)^2}{(1/1.47) - 0.13} \simeq 0.42\%$$

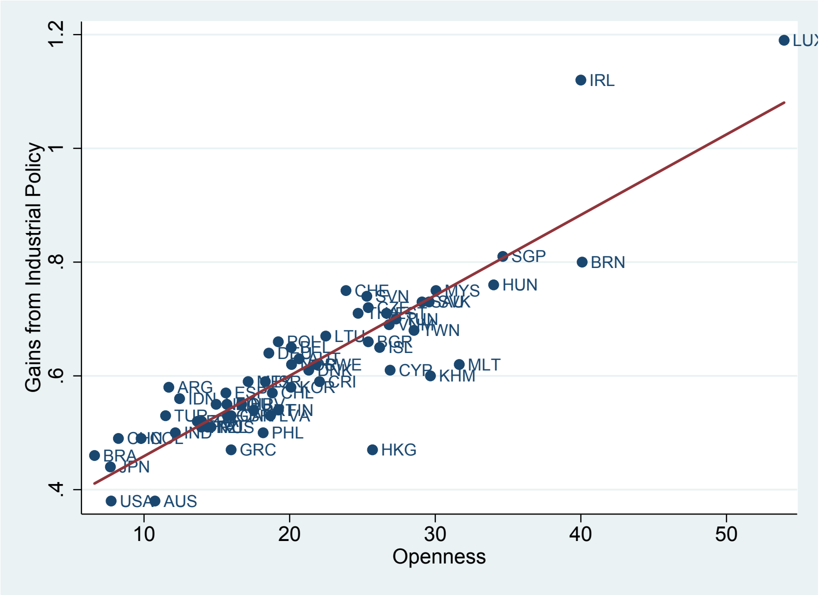
Explaining the Pattern of Gains

- Closed economy with outside good ⇒ gains approximately

$$\frac{\Delta W}{Y} = \frac{1}{2} \sum_{k \in K} \left(\frac{L_k}{L} \right) \frac{\gamma_k^2}{1/\rho - \gamma_k}$$

- Given γ_k, in autarky gains limited by domestic demand
- Open economy faces more elastic international demand
  - Gains tend to be higher for more open countries
  - Openness in high-γ_k AND low-γ_k important
  - World economy is closed, so global gains constrained by $1/\rho$

Gains from Industrial Policy Increase with Openness



Additional Policy Experiments

- *Constrained industrial policy*: gains from second-best production subsidies when no export taxes are available
- *Globally efficient industrial policy*: gains from all countries simultaneously implementing optimal production taxes

Estimates of Welfare Gains

Table 4: Gains from Constrained and Globally Efficient Industrial Policies, Selected Countries

Country	Baseline Industrial Policy (1)	Constrained Industrial Policy (2)	Globally Efficient Industrial Policy (3)
United States	0.37%	0.35%	0.42%
China	0.48%	0.45%	0.21%
Germany	0.62%	0.48%	-0.35%
Ireland	1.10%	1.55%	-1.78%
Vietnam	0.67%	0.99%	1.36%
Avg., Unweighted	**0.60%**	**0.79%**	**0.29%**
Avg., GDP-Weighted	**0.46%**	**0.48%**	**0.22%**

Robustness

- Higher SE in non-manufacturing $\rightarrow$ lower gains
- Higher elasticity of domestic demand $\rightarrow$ slightly higher gains
- Lower TEs $\rightarrow$ higher gains
- Intermediates: gains amplified 2x-4x depending on model

Conclusion

- Skepticism about textbook IP: "we don't know the SEs!"
- This paper shows how to estimate SEs using commonly available trade and production data and then how to compute gains from IP
  - Evidence of SEs, with large variability across sectors
  - Even an enlightened social planner achieves gains on the order of 1-4%
  - Lack of openness/inelastic demand constrain potential gains