

14.582: International Trade II

— Lecture 23: Trade and Growth (Empirics I)

Plan for Today's Lecture

- We will study two common motives for industrial policy:
 - 1 Within-sector external economies of scale: Bartleme, Costinot, Donaldson and Rodriguez-Clare (2017)
 - 2 Cross-sector spillovers: Faber and Gaubert (2018, AER)

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External Economies of Scale

1. **Long-standing concern (e.g. in fields like Trade):** Mill (1848), Graham (1923), Chipman (1970), Ethier (1982)
2. **Cornerstone of new trade theory and economic geography:** Krugman (1980), Krugman (1991), Fujita, Krugman and Venables (1999)
3. **Pivotal consideration for trade and industrial policy:** Krugman (1987), Harrison and Rodriguez-Clare (2010)
4. **Important missing elasticity in quantitative trade models:** Costinot and Rodriguez-Clare (2014), Kucheryavyy, Lyn and Rodriguez-Clare (2017)

External Economies of Scale

- But how large are those external economies of scale? And how successful could the resulting optimal industrial policy be?
- Bartelme, Costinot, Donaldson and Rodriguez-Clare (2018):
 - 1 Exploit trade data to
 - Infer country-sector productivity
 - Construct IV for scale from country-sector demand shocks
 - 2 Estimate EES (γ_s) via IV regression of productivity on size
 - Pooled estimate: $\hat{\gamma} = 0.13$
 - Heterogenous estimates: $\hat{\gamma}_s \in [0.02, 0.20]$

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 - Pooled estimate: $\hat{\gamma} = 0.13$
 - Heterogenous estimates: $\hat{\gamma}_s \in [0.02, 0.20]$
 - 3 Compute gains from optimal policy in small economy
 - Gains from optimal industrial policy $\approx 0.2\%$ of GDP
 - Gains from optimal trade policy $\approx 0.8\%$ of GDP

Basic Environment

- Countries indexed by $i, j = 1, \dots, I$
- Sectors indexed by $s = 1, \dots, S$
- Technology:

$$Q_{i,s} = A_{i,s} L_{i,s}$$

with

$$A_{i,s} = \alpha_{i,s} A_s(L_{i,s})$$

- Preferences within industry:

$$C_{j,s} = U_{j,s}(B_{1,s} Q_{1j,s}, \dots, B_{I,s} Q_{Ij,s})$$

with

$$B_{i,s} = \beta_{i,s} B_s(L_{i,s})$$

- Trade frictions $\tau_{ij,s} \geq 1$
- Country-industry equilibrium:

$$Q_{i,s} = \sum_j \tau_{ij,s} Q_{ij,s}$$

- Trade shares satisfy

$$x_{ij,s} = \chi_{ij,s} (c_{1j,s}, \dots, c_{lj,s})$$

with

$$c_{ij,s} \equiv \eta_{ij,s} w_i / E_s(L_{i,s})$$

$$\eta_{ij,s} \equiv \tau_{ij,s} / (\alpha_{i,s} \beta_{i,s})$$

$$E_s(L_{i,s}) \equiv A_s(L_{i,s}) B_s(L_{i,s})$$

- Adao, Costinot and Donaldson (2017): if $U_{j,s}$ satisfies the *connected substitutes property* then $\chi_{ij,s}$ is invertible and non-parametrically identified
- Given χ function, get $c_{ij,s}$ from $x_{ij,s}$ data using
$$c_{ij,s} = \chi_{ij,s}^{-1}(x_{1j,s}, \dots, x_{lj,s})$$
- $\hat{c}_{ij,s}$ is “trade-revealed” (inverse) measure of sector-level productivity
- Use $\hat{c}_{ij,s} = \eta_{ij,s} w_i / E_s(L_{i,s})$ to estimate $E_s(\cdot)$, the EES function.

Non-parametric identification

- Double difference $\hat{c}_{ij,s} = \eta_{ij,s} w_i / E_s(L_{i,s})$ across i and s ,

$$\begin{aligned} \ln \frac{\hat{c}_{i_1j,s_1}}{\hat{c}_{i_2j,s_1}} - \ln \frac{\hat{c}_{i_1j,s_2}}{\hat{c}_{i_2j,s_2}} \\ = \ln \frac{E_{s_1}(L_{i_2,s_1})}{E_{s_1}(L_{i_1,s_1})} - \ln \frac{E_{s_2}(L_{i_2,s_2})}{E_{s_2}(L_{i_1,s_2})} + \ln \frac{\eta_{i_1j,s_1}}{\eta_{i_2j,s_1}} - \ln \frac{\eta_{i_1j,s_2}}{\eta_{i_2j,s_2}} \end{aligned}$$

- Regression in the form

$$y = h(l) + \epsilon$$

- Endogeneity is unavoidable here, so nonparametric identification (NPI) requires an IV
- Once $h(\cdot)$ is identified, then $E_{s_1}(\cdot)$ and $E_{s_2}(\cdot)$ are NPI

Comparison to “micro” approach

- If had firm-level data on physical output, inputs, and prices
 - Estimate production function, then see how residual varies with $L_{i,s}$ to estimate $A_s(\cdot)$
 - Estimate demand function, then see how residual varies with $L_{i,s}$ to estimate $B_s(\cdot)$
- Compared to this, BCDR approach
 - Folds estimation of firm level production and demand functions into demand for inputs
 - Inversion to recover quality adjusted input prices
 - Estimate how these prices change with industry size

Comparison to “micro” approach

- Only need sector-level trade flows, sector sizes (with an IV), and wider scope (many countries and industries)
- Cannot estimate $A_s(\cdot)$ and $B_s(\cdot)$ separately, but only $E_s(\cdot)$ matters for policy
- Links directly to quantitative model for welfare analysis

BCDR's Approach vs. Alternatives

- BCDR approach does not rely on such price indices.
- Instead, leverage trade data and cost shifters to (1) identify demand, (2) infer quality-adjusted input prices (productivity), (3) construct instrument, (4) identify $E_s(\cdot)$
- Benefits
 - Strictly weaker assumptions (don't need to specify within-sector production functions or demand systems)
 - Wider scope (many countries and industries)
 - Fewer data requirements
 - Tightly linked to quantitative trade models being used for counterfactuals (e.g. computing gains from industrial policy)
- Costs:
 - Silent on micro mechanisms.
 - Can't study micro aspects of counterfactuals.

- BCDR's data has 4 time periods and 61 countries, so estimation needs to proceed parametrically
- Functional form assumptions:

$$\chi_{ij,s}(c_{1j,s}, \dots, c_{lj,s}) = \frac{(c_{ij,s})^{-\theta_s}}{\sum_{i'} (c_{i'j,s})^{-\theta_s}}$$

$$E_s(L_{i,s}) = (L_{i,s})^{\gamma_s}$$

- The previous functional form assumptions imply that

$$\frac{1}{\theta_s} \left[\ln \left(\frac{x_{i1j,s_2}}{x_{i2j,s_2}} \right) - \ln \left(\frac{x_{i1j,s_1}}{x_{i2j,s_1}} \right) \right] = \\ \gamma_{s_1} \ln \left(\frac{L_{i2,s_1}}{L_{i1,s_1}} \right) - \gamma_{s_2} \ln \left(\frac{L_{i2,s_2}}{L_{i1,s_2}} \right) + \ln \left(\frac{\eta_{i1j,s_1}}{\eta_{i2j,s_1}} \right) - \ln \left(\frac{\eta_{i1j,s_2}}{\eta_{i2j,s_2}} \right)$$

- Using fixed effects, this is equivalent to

$$\frac{1}{\theta_s} \ln x_{ij,s}^t = \delta_{ij}^t + \delta_{j,s}^t + \delta_i^t + \gamma_s \ln L_{i,s}^t + \ln \mu_{ij,s}^t$$

- Set $\theta_s = 5$ for all s (Head and Mayer'14) — otherwise, estimate $\theta_s \gamma_s$

Instrumental Variables

- Need a demand shifter uncorrelated with unobserved comparative advantage
- Combine two sources of variation:
 - Distance, d_{ij}
 - Population of destination, \bar{L}_j^t
- Two building blocks to construct IV....
- **IV Step 1:**
 - Per-capita income of j can be predicted by $\sum_l \bar{L}_l^t d_{jl}^{-1}$
 - Non-homotheticity (if function $g_s(\cdot)$ varies by sector s):

$$\ln \left(X_{j,s}^t / \bar{L}_j^t \right) = g_s \left(\sum_l \bar{L}_l^t d_{jl}^{-1} \right) + \xi_{j,s}^t$$

• IV Step 2:

- Letting $\beta_{j,s} \equiv X_{j,s} / \sum_{s'} X_{j,s'}$, use $\hat{g}_s(\cdot)$ to get

$$\hat{\beta}_{j,s}^t \equiv \frac{\exp \hat{g}_s(\sum_l (\bar{L}_l^t / d_{jl}))}{\sum_{s'} \exp \hat{g}_{s'}(\sum_l (\bar{L}_l^t / d_{jl}))}$$

- Gravity equation \rightarrow demand for (i, s) related to $\sum_j X_{j,s}^t d_{ij}^{-1}$
- Construct IV as follows:

$$Z_{i,s}^t \equiv \ln \left(\sum_j \hat{\beta}_{j,s}^t \bar{L}_j^t d_{ij}^{-1} \right)$$

- 2SLS system with S endogenous variables and S instruments:

$$\frac{1}{\theta} \ln x_{ij,s}^t = \delta_{ij}^t + \delta_{j,s}^t + \delta_i^t + \gamma_s \ln(L_{i,s}^t) + \ln \mu_{ij,s}^t$$

$$Z_{i,s}^t \equiv \ln \left(\sum_j \hat{\beta}_{j,s}^t \bar{L}_j^t d_{ij}^{-1} \right)$$

$$\hat{\beta}_{j,s}^t \equiv \frac{\exp \hat{g}_s(\sum_l (\bar{L}_l^t / d_{jl}))}{\sum_{s'} \exp \hat{g}_{s'}(\sum_l (\bar{L}_l^t / d_{jl}))}$$

$$\ln \left(X_{j,s}^t / \bar{L}_j^t \right) = g_s \left(\sum_l \bar{L}_l^t d_{jl}^{-1} \right) + \xi_{j,s}^t$$

- Primitive assumptions:

$$E[\mu_{ij,s}^t | \bar{L}_j^t] = 0, \quad E[\mu_{ij,s}^t | d_{ij}] = 0$$

- One concern is misspecification of cost function
- Add controls for the interaction between per-capita GDP and a full set of sector dummies
- (Feasible also to explicitly model IO linkages.)

- OECD Inter-Country Input-Output tables
 - 61 countries
 - 34 sectors (27 traded, 15 manufacturing)
 - Focus on manufacturing
 - Years 1995, 2000, 2005, 2010
- Population and per-capita GDP from PWT v8.1
- Bilateral distance from CEPII Gravity Database
 - Set $d_{ii} = d$ slightly below $\min_{i,j} d_{ij}$

Results: Pooled Across Sectors

Table 2: Pooled (All Sectors) Estimates of External Economies of Scale

	log (employment)	log (bilateral sales)	
	OLS (1)	OLS (2)	IV (3)
log (predicted demand)	1.48 (0.35)		
log (employment)		0.18 (0.01)	0.13 (0.05)
Within R^2	0.0191	0.209	0.196
Observations	207,557	207,557	207,557
First-stage F-statistic			18.07

Notes: Column (2) reports the OLS estimate, and column (3) the IV estimate, of equation (5) subject to the constraint that all sectors have the same economies of scale elasticity (i.e. $\gamma_s = \gamma$, for all sectors s). Column (1) reports the corresponding pooled first-stage specification. The instrument ("log predicted demand") is $Z_{i,s}^t$ defined in equation (7). All regressions control for exporter-year, exporter-importer-year and importer-sector-year fixed-effects, as well as interactions between exporter-year per-capita GDP and a set of sector indicators. Standard errors in parentheses are clustered at the exporter-sector level.

Results: Separate γ_s for Each Sector

Table 3: Sector-specific Estimates of External Economies of Scale (Part I)

Sector	γ_s (OLS)	γ_s (2SLS)	First-stage SW F-statistic
	(1)	(2)	(3)
Food, Beverages and Tobacco	0.17 (0.01)	0.02 (0.08)	13
Textiles	0.18 (0.01)	0.16 (0.06)	15
Wood Products	0.17 (0.02)	0.13 (0.08)	12
Paper Products	0.20 (0.01)	0.17 (0.07)	15
Coke/Petroleum Products	0.16 (0.01)	0.13 (0.06)	13
Chemicals	0.17 (0.01)	0.14 (0.05)	19
Rubber and Plastics	0.19 (0.01)	0.20 (0.06)	20

Continued on next slide...

Results: Separate γ_s for Each Sector

Table 3: Sector-specific Estimates of External Economies of Scale (Part II)

Sector	γ_s (OLS)	γ_s (2SLS)	First-stage SW F-statistic
	(1)	(2)	(3)
<i>Continued from previous slide...</i>			
Mineral Products	0.20 (0.01)	0.20 (0.07)	20
Basic Metals	0.18 (0.01)	0.10 (0.06)	12
Fabricated Metals	0.19 (0.01)	0.18 (0.06)	18
Machinery and Equipment	0.18 (0.01)	0.15 (0.05)	27
Computers and Electronics	0.18 (0.01)	0.13 (0.04)	12
Electrical Machinery, NEC	0.19 (0.01)	0.16 (0.05)	15
Motor Vehicles	0.20 (0.01)	0.18 (0.05)	15
Other Transport Equipment	0.20 (0.01)	0.18 (0.05)	15
Observations	207,557	207,557	
Within R^2	0.22	0.16	

- Requires closing the rest of the model:
 - Labor market clearing: $\sum_s L_{i,s} = L_i$
 - Upper-tier preferences: $U_i(C_{i,1}, \dots, C_{i,S})$
- Planner's Problem
 - *Optimal Industrial Policy* to internalize externalities
 - *Optimal Trade Policy* to improve ToT
- Simplify: optimal policy in a Small Economy:
 - Take limit $L_i \rightarrow 0$ so that i is a “small economy”
 - Home bias: not small in own market
 - Planner's solution can be decentralized with production subsidies $= \gamma_s$ and export taxes $= 1/\theta_s$

Gains from Optimal Policy

- To compute gains from OP for i , assume that
 - Preferences in i are Cobb-Douglas
 - γ in non-manufacturing = $\bar{\gamma}_M$
 - $\theta_s = 5$ for all s
 - Data from equilibrium with no subsidies or taxes in i
 - Compute welfare effect of OP using Dekle, Eaton and Kortum (2008) approach

Gains from Optimal Policy

Table 4: Gains from Optimal Policies, Selected Countries

Country	Gains from Optimal Industrial Policy (1)	Gains from Optimal Trade Policy (2)	Gains from Optimal Combination of Trade and Industrial Policy (3)
United States	0.1%	0.1%	0.5%
China	0.1%	0.3%	0.5%
Ireland	0.4%	1.6%	2.1%
Brazil	0.2%	0.3%	0.4%
Vietnam	0.3%	0.06%	1.0%
World Average	0.2%	0.8%	1.1%

Notes: Column (1) reports the gains, expressed as a share of initial real national income, that could be achieved by each selected country were it to pursue its optimal industrial policy (under a small open economy assumption), as given by equation (25). Columns (2) and (3) contain the results of the analogous calculation for optimal trade policy, and for an optimal combination of industrial and policy, respectively. Reported world averages are computed as the unweighted average across all 61 countries in our sample.

Why Are the Gains from Industrial Policy Small?

- ① Gains come from *heterogeneity* in γ_s
 - Baseline assumes $\gamma_s = \bar{\gamma}_M$ for non-manufacturing
 - But even if assume $\gamma_s = 0$ in non-manufacturing \rightarrow mean gains $\approx 0.3\%$
- ② Deeper answer: too little trade in non-manufacturing
 - In autarky, gains constrained by domestic demand
 - Domestic demand still binds when low- γ sectors non-traded
 - \Rightarrow Larger gains in more open economies
 - \Rightarrow Global gains are small (since world economy is closed)

Plan for Today's Lecture

- We will study two common motives for industrial policy:
 - ① Within-sector external economies of scale: Bartleme, Costinot, Donaldson and Rodriguez-Clare (2017)
 - ② **Cross-sector spillovers: Faber and Gaubert (2018, AER)**

- Study impact of rise in inbound tourism (an exportable service) on local economic growth/development in Mexico
- We would expect this to be good for output in this sector. But what about output in other tradable sectors such as manufacturing?

Some Background on Tourism in Mexico

- Tourism activity accounts for roughly 10 percent of Mexican GDP.
- The bulk of domestic and international tourism in Mexico is driven by beach tourism.
 - Coastal municipalities account for two thirds of total tourism.
- Beach tourism in Mexico started emerging in the 1950s and 1960s.
 - Annual number of foreign visitors has grown from close to zero in 1950s to 29 million in 2014.

- Using two most recent cross-sections of Mexican municipalities (2000 and 2010):

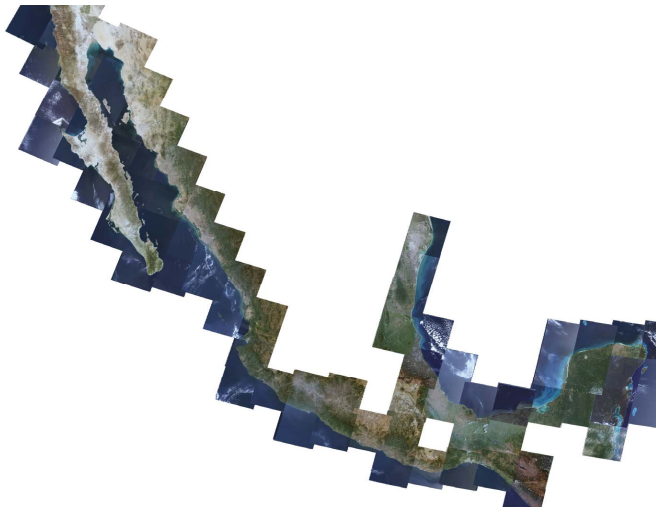
$$\ln(y_{mct}) = \alpha_{ct} + \beta \ln(\text{HotelSales}_{mct}) + \alpha' X_{mct} + \epsilon_{mct}$$

- Identification of β :
 - Main concern is that variation in local tourism activity is driven by unobserved factors that also affect local economic outcomes.

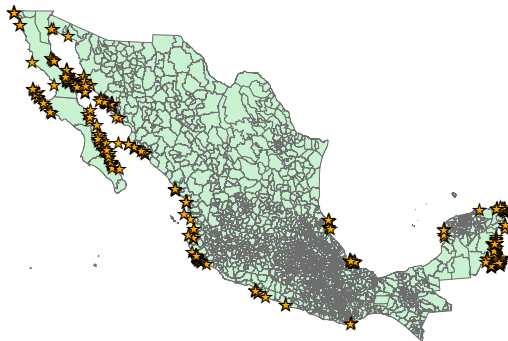
Instrumental Variables

- Idea from literature on tourism management:
 - Tourism activity to large extent determined by very specific natural amenities.
 - “*Beach Rating: A Methodological Approach*” (Leatherman, 1997, aka “Dr Beach”).
- FG identify two criteria that they can measure well using satellite data:
 - Presence of offshore island close to coastline (5 or 10 km).
 - Fraction of picturesque white-sand beaches within 100 or 200 m of shoreline.
- Method:
 - Take best existing Mexican beach rating.
 - Measure wavelength ranges of top-ranked beaches.
 - Use satellite data to classify pixels along the coastline.
- Results in 6 IVs for tourism attractiveness:
 - 1 Island IV, and 5 different IVs for onshore beach quality.

Satellite Data



Island Instrument



Identification

- Identifying assumption:
 - These features of beach quality affect local economic outcomes only through their effect on local tourism activity.
- Two potential remaining concerns:
 - ① IVs are correlated with omitted factors that affect local production.
 - ② IVs have direct effect on immigration through local amenities.
- FG further assess the identifying assumption in several ways:
 - How do OLS and IV estimates change after inclusion of pre-determined controls?
 - Exclude origin municipality of top-ranked beaches.
 - Test whether 6 IVs lead to similar point estimates.
 - Placebo falsification: Test effects before beach tourism became discernible force.
 - Test for correlation of current-day model-based estimates of amenities with IVs.
 - Test whether effect comes from economically active population.

Tourism's Effect on Municipality Employment and Population

Dependent variables:	Log Municipality Employment 2000, 2010								Log Municipality Population 2000, 2010	
	(1) OLS	(2) OLS	(3) Island IV	(4) Island IV	(5) Beach IV	(6) Beach IV	(7) Both IVs	(8) Both IVs	(9) Both IVs	(10) Both IVs
Log Hotel Sales	0.236*** (0.00605)	0.218*** (0.00568)	0.295*** (0.0890)	0.323*** (0.122)	0.228** (0.0917)	0.243*** (0.0888)	0.263*** (0.0573)	0.275*** (0.0643)	0.212*** (0.0613)	0.221*** (0.0686)
Log Distance to US Border	0.0790** (0.0386)	-0.0290 (0.0416)	0.105** (0.0513)	0.0206 (0.0676)	0.0754 (0.0568)	-0.0171 (0.0588)	0.0910** (0.0436)	-0.00217 (0.0486)	0.138*** (0.0465)	0.0444 (0.0514)
Log Distance to Mexico City	-0.587*** (0.0258)	-0.578*** (0.0284)	-0.508*** (0.122)	-0.463*** (0.137)	-0.598*** (0.125)	-0.550*** (0.101)	-0.551*** (0.0810)	-0.516*** (0.0761)	-0.595*** (0.0862)	-0.568*** (0.0809)
Log Municipality Area	0.340*** (0.0172)	0.351*** (0.0169)	0.263** (0.118)	0.223 (0.150)	0.350*** (0.121)	0.320*** (0.110)	0.305*** (0.0774)	0.282*** (0.0810)	0.364*** (0.0826)	0.343*** (0.0863)
State Capital Dummy		0.796*** (0.191)		0.378 (0.506)		0.696* (0.398)		0.570* (0.304)		0.540* (0.328)
Old City Dummy		1.028*** (0.229)		0.624 (0.513)		0.931** (0.404)		0.809** (0.323)		0.836** (0.349)
Colonial Port Dummy		0.699*** (0.141)		0.300 (0.509)		0.603* (0.364)		0.483* (0.291)		0.589* (0.308)
Log Average Precipitation		0.263*** (0.0402)		0.244*** (0.0483)		0.258*** (0.0431)		0.253*** (0.0425)		0.241*** (0.0428)
Log Average Temperature		0.233** (0.106)		0.194 (0.123)		0.224** (0.111)		0.212* (0.111)		0.273** (0.108)
Year-By-Coast FX	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	4,889	4,889	4,889	4,889	4,889	4,889	4,889	4,889	4,889	4,889
R-squared	0.659	0.682	0.642	0.635	0.658	0.679	0.655	0.668	0.642	0.660
Number of Municipalities	2455	2455	2455	2455	2455	2455	2455	2455	2455	2455
First Stage F-Stat			9.549	5.748	11.71	11.81	14.36	11.59	14.36	11.59
Over-ID Test P-Value							0.625	0.617	0.538	0.533

Summary of Reduced-Form Effects

Dependent variables:	(1) Log Employment Both IVs	(2) Log Population Both IVs	(3) Log Wages Both IVs	(4) Log GDP Both IVs	(5) Log Manu+ Mining GDP Both IVs	(6) Log Manu GDP Both IVs
Log Hotel Sales	0.275*** (0.0643)	0.221*** (0.0686)	0.0333*** (0.0108)	0.425*** (0.0932)	0.273* (0.147)	0.317** (0.124)
Log Distance to US Border	-0.00217 (0.0486)	0.0444 (0.0514)	-0.0872*** (0.00893)	-0.317*** (0.0814)	-0.405*** (0.132)	-0.282** (0.127)
Log Distance to Mexico City	-0.516*** (0.0761)	-0.568*** (0.0809)	0.0251* (0.0130)	-0.747*** (0.112)	-1.137*** (0.176)	-1.123*** (0.152)
Log Municipality Area	0.282*** (0.0810)	0.343*** (0.0863)	-0.0159 (0.0137)	0.264** (0.118)	0.478*** (0.186)	0.373** (0.157)
State Capital Dummy	0.570* (0.304)	0.540* (0.328)	-0.0312 (0.0534)	1.317*** (0.431)	1.659** (0.711)	1.589** (0.641)
Old City Dummy	0.809** (0.323)	0.836** (0.349)	-0.0367 (0.0562)	1.454*** (0.447)	2.179*** (0.751)	2.064*** (0.690)
Colonial Port Dummy	0.483* (0.291)	0.589* (0.308)	-0.177** (0.0707)	0.693 (0.512)	1.326 (0.832)	1.275 (0.817)
Log Average Percipitation	0.253*** (0.0425)	0.241*** (0.0428)	-0.0677*** (0.0105)	-0.571*** (0.0787)	-0.917*** (0.118)	-0.900*** (0.114)
Log Average Temperature	0.212* (0.111)	0.273** (0.108)	0.00815 (0.0282)	1.083*** (0.187)	1.486*** (0.291)	1.518*** (0.291)
Year-By-Coast FX	✓	✓	✓	✓	✓	✓
Observations	4,889	4,889	4,889	4,889	4,889	4,889
Number of Municipalities	2455	2455	2455	2455	2455	2455
First Stage F-Stat	11.59	11.59	11.59	11.59	11.59	11.59
Over-ID Test P-Value	0.617	0.533	0.305	0.107	0.137	0.308

Summary of Robustness Checks (See paper)

- Point estimates pretty insensitive to:
 - Six different instruments.
 - Excluding origin municipality of top beaches.
 - Controlling for coastal elevation or fishery potential.
- IVs have no positive effect on population before beach tourism arrived.
- IVs are uncorrelated to model-based measures of local amenities.
- Results driven by economically active population (zero effect for pensioners).
- Point estimates look similar if use pre-Hispanic ruins as alternative IV strategy.
- Causal interpretation of IVs corroborated using shorter-term panel variation.

Interpretation of Multiplier Effects

- Two important questions remaining about positive effects on traded sector production:
 - ① To what extent driven by infrastructure investments?
(airports, ports, roads, railways)
 - ② To what extent driven by local inputs into tourism?
- These are plausible hypotheses but paper documents that (surprisingly) they don't explain what is going on.

Welfare Implications of Tourism

- Takeaway from reduced-form analysis:
 - Strong positive long-term effects of tourism on local economic outcomes.
 - Multiplier effect on traded sector production.
- But no direct route from reduced form estimates to welfare effects:
 - Estimates based on relative regional outcomes, not aggregate.
 - Population mobile in the long run to arbitrage away real wage differences.
 - Not clear to what extent multipliers imply spillovers in GE.
(Need to account for direct demand effect and input-output linkages.)
- Strategy to quantify aggregate welfare implications of tourism:
 - 1 Write down a spatial equilibrium model.
 - 2 Use reduced-form moments to discipline the calibration.
 - 3 Explore counterfactuals without tourism to quantify the gains from tourism.

Model Summary

- Builds on Allen & Arkolakis (2014), Ahlfeldt et al (2015), Redding (2015).
 - Economic geography (labor mobility) with Eaton-Kortum (2002) trade structure.
- Introduce into this framework:
 - Trade in tourism-related services in addition to goods.
 - Within and cross-sector spillovers (agglomeration economies).
 - Input-output linkages.
- Tourism affects regional economies and aggregate welfare through two channels.
 - Classical gains from market integration (lowering travel costs between regions and countries).
 - Spillover effects on traded goods production (local and aggregate implications).

Model: Preferences and Local Amenities

- N regions within Mexico, plus Rest of the World.
 - Workers choose where to live within Mexico.

- Utility of worker ω living in region n is:

$$U_n(\omega) = \left(\left[\beta_M C_{M,n}^{\frac{\rho-1}{\rho}} + \beta_T C_{T,n}^{\frac{\rho-1}{\rho}} \right]^{\frac{\rho}{\rho-1}} \right)^{1-\alpha} (C_{S,n})^\alpha B_n L_n^\epsilon \chi_n(\omega).$$

- Cobb-Douglas aggregate of traded and non traded goods.
 - $C_{M,n}$ CES consumption basket for manufactured goods.
 - $C_{T,n}$ CES consumption basket for tourism services.
 - $C_{S,n}$ Consumption of local non-traded services (e.g. housing).
 - $B_n L_n^\epsilon$ local amenities for residents.
 - Endogenous agglomeration/congestion in amenities ($\epsilon > 0$ or $\epsilon < 0$).
 - $\chi_n(\omega)$ idiosyncratic preferences for region n , distributed Frechet (shape κ).

Manufacturing Production

- Traded goods: EK structure, with input-output linkages.
 - Local productivity M_n .
 - Stochastic draws of productivity for each good in each region n (Frechet).
 - Goods traded subject to iceberg trade costs τ_{in} .
- Production uses labor and intermediate manufacturing input
 - Input cost in region n : $c_{M,n} = w_n^{\nu^M} P_{M,n}^{1-\nu^M}$
- Bilateral traded goods expenditure shares:
 - $\pi_{ni} = \frac{(\tau_{ni} c_{M,i})^{-\theta} M_i^\theta}{\sum_{k=1}^N (\tau_{nk} c_{M,k})^{-\theta} M_k^\theta}$, where
- Allow for local production externalities: $M_n = M_n^o L_{M,n}^{\gamma_M} L_{ST,n}^{\gamma_S}$
 - Exogenous local component (M_n^o)
 - Own-sector spillover (γ_M)—like in BCDR
 - Cross-sector spillover (γ_S)—beyond what we saw in BCDR

- Tourism services: Armington.

- Demand:
$$C_{T,n} = \left[\sum_{i \neq n} A_i^{\frac{1}{\sigma_T}} c_{T,i}^{\frac{\sigma_T-1}{\sigma_T}} \right]^{\frac{\sigma_T}{\sigma_T-1}}$$

- Attractiveness of destination i for tourism: A_i .
- Tourism consumed outside of region of residence.
- CES with elasticity of substitution σ_T .

- Production:

- Uses labor and intermediate manufacturing input.
- Input cost: $c_{T,n} = w_n^{\nu^T} P_{M,n}^{1-\nu^T}$
- Perfect competition.
- Tourism between region n and i is subject to travel costs t_{ni} .

- Bilateral tourism expenditure shares:

- $$\lambda_{ni} = \frac{A_i (t_{ni} c_{T,i})^{1-\sigma_T}}{\sum_{k=1}^N A_k (t_{nk} c_{T,k})^{1-\sigma_T}}$$

- Produced using local labor, perfect competition.
 - Isomorphic to having a local housing market.
 - B_n captures both local amenities and productivity of local services.

Workers' Location Choice and Welfare

- Workers choose where to live within Mexico.
 - Free mobility implies: $E[U_n(\omega)] = U_{\mathcal{M}}$ across all regions.
- Share of workers residing in region n :
 - $$\frac{L_n}{L_{\mathcal{M}}} = \frac{\left(B_n \left(\frac{w_n}{P_{MT,n}}\right)^{1-\alpha}\right)^{\tilde{\kappa}}}{\sum_{k \in \mathcal{M}} \left(B_k \left(\frac{w_k}{P_{MT,k}}\right)^{1-\alpha}\right)^{\tilde{\kappa}}}.$$
 - where $P_{MT,n}$ is the CES price index for manufacturing goods and tourism services.
- Observed spatial labor supply elasticity becomes $\tilde{\kappa} = \frac{\kappa}{1-\kappa\epsilon}$.
- To compute the welfare gains from tourism:
 - Solve for counterfactual equilibrium with prohibitive tourism frictions.
 - Welfare change is then:

$$\widehat{U_{\mathcal{M}}} = \left(\widehat{\frac{w_n}{P_{MT,n}}}\right)^{1-\alpha} \widehat{L_n}^{-\frac{1}{\tilde{\kappa}}} \quad \forall n \in \mathcal{M}.$$

Bringing the Model to the Data

- Data on w_n , $L_{M,n}$, $L_{T,n}$ and $L_{S,n}$.
- Estimates of τ_{ij} and t_{ij} (parameterized based on distances).
- Estimates of the elasticities ν_M , ν_T , α_{MT} , σ_T , θ , ρ , $\tilde{\kappa}$, γ_M and γ_S .

Estimation & Calibration: Steps and Key Parameters

- **Step 1:** Calibrate model to current-day equilib (requires ν_M , ν_T , α_{MT} , θ , σ_T , ρ).
 - Solve for (possibly endogenous) M_n and A_n that rationalize today's observed municipality cross-section.
- **Step 2:** Estimate spatial labor supply elasticity ($\frac{\kappa}{1-\kappa\epsilon}$).
 - Step 1 allows FG to compute local real wages in absence of rich enough local price data.
 - Use IV strategy to estimate $\frac{\kappa}{1-\kappa\epsilon}$.
- **Step 3:** Use reduced-form moments to identify cross and within-sector spillovers.
 - Approach based on indirect inference.
 - Simulate regional effects when shutting down tourism across grid of parameter combinations for γ_S and γ_M .
 - Choose parameters such that model fits cross-section today, but zero correlations between IVs and outcomes in absence of tourism.

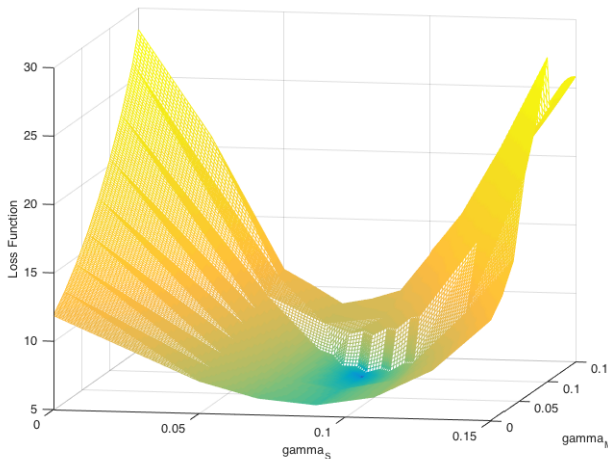
Step 3: Identify Spillovers Using Indirect Inference

- Traded sector productivity: $M_n = M_n^o L_{M,n}^{\gamma_M} L_{ST,n}^{\gamma_S}$.
- For each value for (γ_S, γ_M) :
 - Solve for counterfactual equilibrium with prohibitive frictions to tourism.
 - Find counterfactual populations $L_n^c = L_n^c(\gamma_M, \gamma_S)$ and manuf productivities $M_n^o = M_n^o(\gamma_M, \gamma_S)$.
 - Regress L_n^c and M_n^o on IVs, in the model:

$$\log L_n^c(\gamma_M, \gamma_S) = \alpha_{coast} + \beta_a^c IV_{na} + \alpha X_n + \epsilon_{na}^c \text{ for } a = 1..5.$$

- Find (γ_M, γ_S) that minimize the distance between β_a^c and 0.
 - Loss function approach, weighting each IV by inverse of std error for β_a^c .

Step 3: Identify Spillovers Using Indirect Inference



Best fitting counterfactuals: $\widehat{\gamma}_S = .088$ and $\widehat{\gamma}_M = .084$

Quantification of the Gains from Tourism

- Welfare gains from tourism:
 - Compute counterfactual equilibrium w/o tourism, compare welfare:

	Estimated	No Spillovers
Parameters	$\gamma_S = 0.088$ $\gamma_M = 0.084$	$\gamma_S = 0$ $\gamma_M = 0$
Gains from All Tourism	4.42% (1.09, 8.12) [2.52, 7.56]	4.16% (2.57, 7.82) [2.68, 6.57]
Gains from International Tourism	1.60% (-0.69, 3.09) [0.50, 2.86]	2.43% (2.02, 3.09) [2.05, 2.86]

- Spillovers have strong local effects but limited aggregate impact.
 - Spillovers induce strong co-agglomeration between tourism and manufacturing along the coast
 - But negative impact on manufacturing TFP in less touristic regions.
 - Reminiscent of Kline and Moretti (2014), but not driven by log-linear functional form.

Local and Aggregate Implications of Alternative Spillover Values

Dependent variable:	Counterfactual Change in Log Total GDP			
	(1)	(2)	(3)	(4)
Parameters	$\gamma_S = 0$ $\gamma_M = 0$	$\gamma_S = 0$ $\gamma_M = 0.15$	$\gamma_S = 0.15$ $\gamma_M = 0$	$\gamma_S = 0.088$ $\gamma_M = 0.084$
Log Tourism GDP	0.236*** (0.0575)	0.0501*** (0.0148)	0.637*** (0.144)	0.409*** (0.0928)
Coast FX	✓	✓	✓	✓
Full Set of Controls	✓	✓	✓	✓
Observations	300	300	300	300
Gains from Tourism	0.0416	0.0111	0.0673	0.0442
Number of Clusters	32	32	32	32