14.581 International Trade
— Lecture 21: Economic Geography (II)—

Plan for Two Lectures

1. Stylized facts about agglomeration of economic activity
2. Testing sources of agglomeration:
    1. Direct estimation
    2. Estimation from spatial equilibrium
    3. Estimation via tests for multiple equilibria

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    3. **Estimation via tests for multiple equilibria**

Krugman (JPE, 1991): Basic Setup

- This is an extremely influential paper on a theory of economic geography (8,500 cites).
- It formalizes, in an extremely simple and clear manner, one particular form of agglomeration externality: that which arises with the combination of IRTS in production and trade costs.
- At a more prosaic level, this is just Krugman (1980) with the added assumption of free labor mobility.

Krugman (JPE, 1991): Aside on HME Empirics

- Core of Krugman (1980) and the reason for agglomeration in Krugman (1991) is the 'home market effect'.
- We should therefore ask what independent evidence there is for the HME (regardless of agglomeration externalities). This is also of interest in its own right as the HME has been highlighted as the one testable empirical prediction that differs strongly across neoclassical and IRTS-based models of trade.
- On this, see:
  - Davis and Weinstein (JIE, 2003)
  - Hanson and Xiang (AER, 2004)
  - Behrens et al (2009)
  - Head and Ries (2001)
  - Feenstra, Markusen and Rose (2004)
- But the punchline is that there is no one convincing test. The reason is that it is (of course) challenging to come up with a plausible source of exogenous demand shocks (which lie at the heart of the HME).

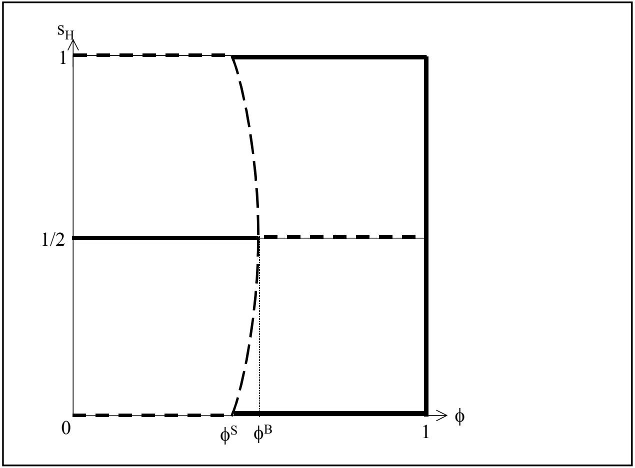
Krugman (JPE, 1991): Basic Setup

- 2 regions
- 2 sectors:
  - 'Agriculture': CRTS, freely traded, workers immobile geographically
  - 'Manufacturing': IRTS (Dixit-Stiglitz with CES preferences), iceberg trade costs τ, mobile workers
  - Cobb-Douglas preferences between A and M sectors
- Basic logic can have other interpretations:
  - Krugman and Venables (QJE, 1995): immobile factors but input-output linkages between two Dixit-Stiglitz sectors
  - Baldwin (1999): endogenous factor accumulation rather than factor mobility
  - And others; see Robert-Nicoud (2005) or a synthesis and simplification to the 'core' of these models.
- Hard to extend beyond 2 regions, but see:
  - Krugman and Venables (1995, wp) for a continuous space version (on a circle)
  - Fujita, Krugman and Venables (1999 book) for a wealthy discussion of extensions to the basic logic (and more)

Krugman (1991): Key Result

s_H is the share of mobile workers in one location (call it H) relative to the other location; $\phi \equiv \tau^{1-\sigma}$ is index of freeness of trade

Figure 1: The Tomahawk Diagram



Davis and Weinstein (AER, 2002)

- DW (2002) ask whether regions/cities' population levels respond to one-off shocks
- The application is to WWII bombing in Japan
- Their findings are surprising and have been replicated in many other settings:
  - Germany (WWII): Brakman, Garretsen and Schramm (2004)
  - Vietnam (Vietnam war): Miguel and Roland (2011)
  - ...
- Davis and Weinstein (J Reg. Sci., 2008) extend the analysis in DW (2002) to the case of the fate of industry-locations. This is doubly interesting as it is plausible that industrial activity is mobile across space in ways that people are not.

Davis and Weinstein (2002)

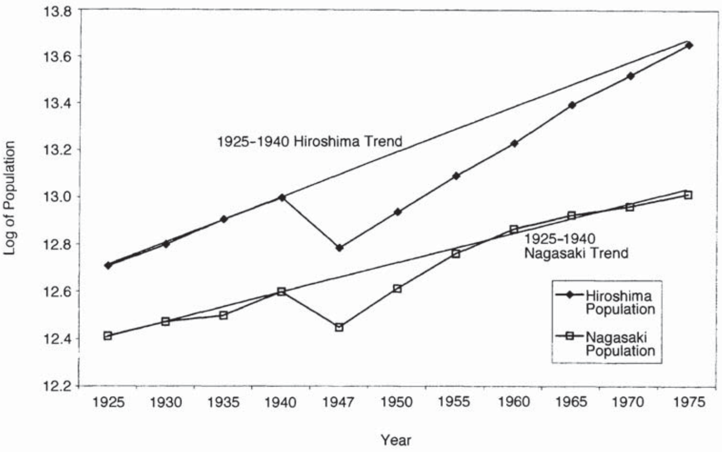


FIGURE 2. POPULATION GROWTH

Davis, Donald R., and David E. Weinstein. "Bones, Bombs, and Break Points: The Geography of Economic Activity." *American Economic Review* 92, no. 5 (2002): 1269–89.

Davis and Weinstein (2002)

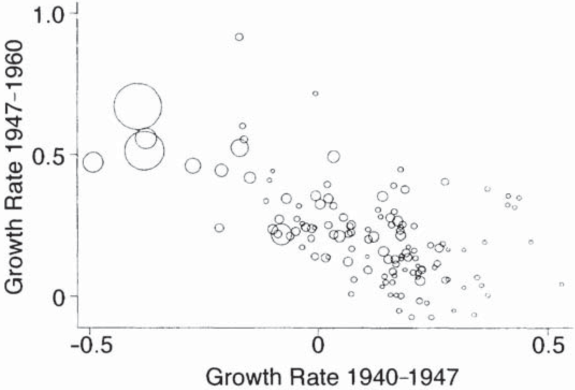


FIGURE 1. EFFECTS OF BOMBING ON CITIES WITH MORE THAN 30,000 INHABITANTS

Davis, Donald R., and David E. Weinstein. "Bones, Bombs, and Break Points: The Geography of Economic Activity." *American Economic Review* 92, no. 5 (2002): 1269–89.

Davis and Weinstein (2008)

Evolution of Japanese manufacturing during World War II
(**Quantum Indices from Japanese Economic Statistics**)

Industry	1941	1946	Change
Chemicals	252.9	36.9	-85%
Lumber and Wood	187.0	91.6	-51%
Machinery	639.2	38.0	-94%
Manufacturing	206.2	27.4	-87%
Metals	270.2	20.5	-92%
Printing and Publishing	133.5	32.7	-76%
Processed Food	89.9	54.2	-40%
Stone, Clay, Glass	124.6	29.4	-76%
Textiles and Apparel	79.4	13.5	-83%

Image by MIT OpenCourseWare.

Davis and Weinstein (2008)

Correlation of Growth Rates of Industries Within Cities 1938 to 1948

	Metals	Chemicals	Textiles	Food	Printing	Lumber	Ceramics
Machinery	0.60	0.30	0.12	0.32	0.11	0.23	0.13
Metals	-	0.36	0.35	0.65	0.30	0.35	0.53
Chemicals	-	-	0.25	0.31	0.04	0.21	0.36
Textiles	-	-	-	0.49	0.29	0.25	0.38
Food	-	-	-	-	0.35	0.25	0.50
Printing	-	-	-	-	-	0.41	0.41
Lumber	-	-	-	-	-	-	0.23

Image by MIT OpenCourseWare.

Davis and Weinstein (2008)

Inflation Adjusted Percent Decline in Assets Between 1935 and 1945

	Decline
Bridges	3.5
Railroads and tramways	7.0
Harbors and canals	7.5
Electric power generation facilities	10.8
Telecommunication facilities	14.8
Water and sewerage works	16.8
Cars	21.9
Buildings	24.6
Industrial machinery and equipment	34.3
Ships	80.6
Total	**25.4**

Image by MIT OpenCourseWare.

Davis and Weinstein (2008)

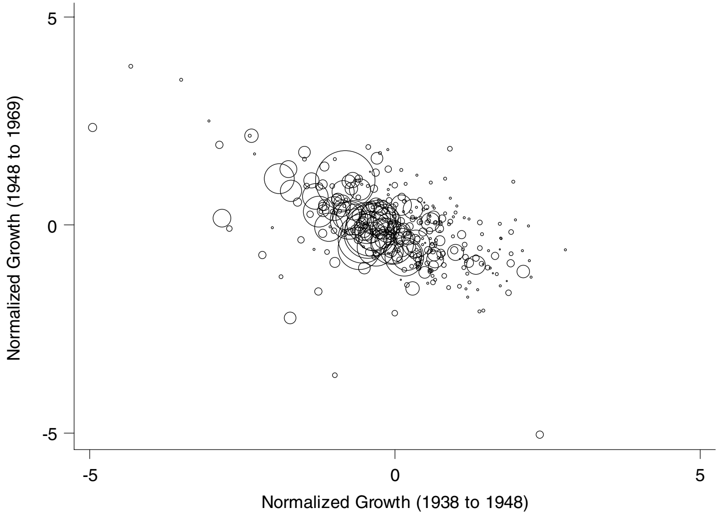


FIGURE 7: Mean-Differenced Industry Growth Rates.

Davis and Weinstein (2008)

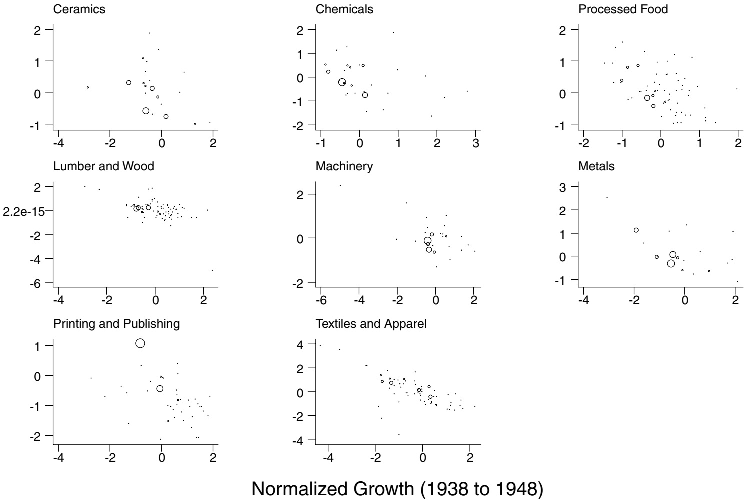


FIGURE 8: Prewar vs Postwar Growth Rate.

Davis, Donald R., and David E. Weinstein. "Bones, Bombs, and Break Points: The Geography of Economic Activity." American Economic Review 92, no. 5 (2002): 1269–1289. Courtesy of American Economic Association. Used with permission.

Bleakley and Lin (QJE, 2012)

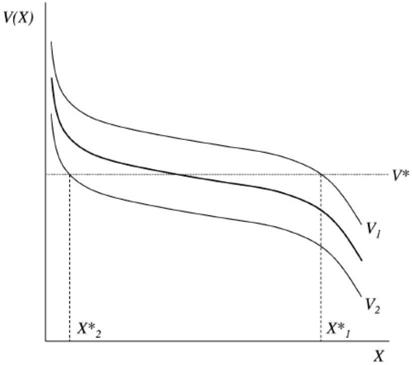
- BL (2012) look for an even that removed a location's natural (i.e. exogenous) productivity advantage/amenity.
- If there are no agglomeration externalities then this location will suffer from this removal.
- But if there are agglomeration externalities then this location might not suffer much at all. Its future success is assured through the logic of multiple equilibria. (This is typically referred to as 'path dependence'.)

Bleakley and Lin (QJE, 2012): Portage

- What is the natural advantage that got removed from some locations?
- BL (2012) look at 'portage sites': locations where portage (i.e. the trans-shipment of goods from one type of boat to another type of boat) took place before the construction of canals/railroads. Prior to canals/railroads portage was extremely labor-intensive so portage sites were a source of excess labor demand.
- What is an exogenous source for a portage site? BL (2012) use the 'fall line', a geological feature indicating the point at which (in the US) navigable rivers leaving the ocean would first become unnavigable

Bleakley and Lin (2012): Theory

Panel A: Differences in density with natural advantages and strong congestion costs



Courtesy of Hoyt Bleakley and Jeffrey Lin. Used with permission.

Bleakley and Lin (2012): Theory

Panel B: Differences in density with strong increasing returns

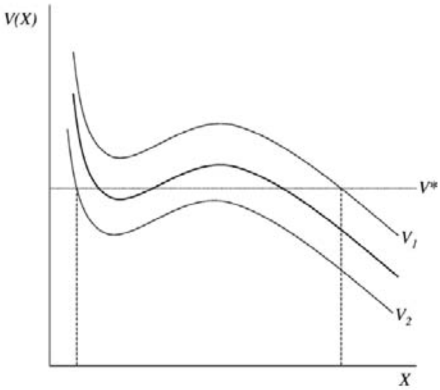


FIGURE VII
Equilibrium Density in a Model with Natural Advantages and Increasing Returns

Bleakley and Lin (2010): The Fall Line

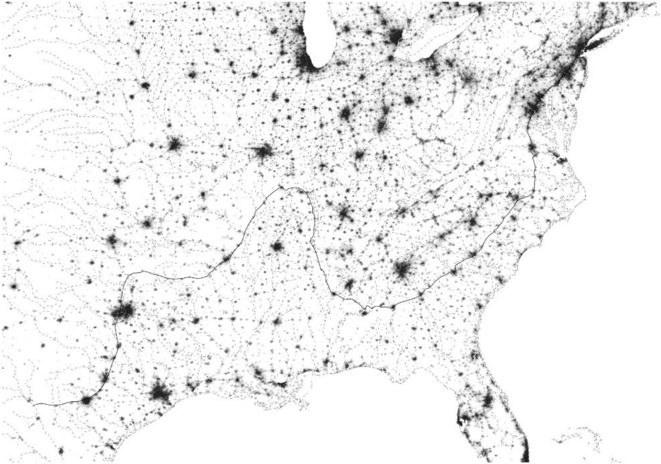


FIGURE A.1

The Density Near Fall-Line/River Intersections

This map shows the contemporary distribution of economic activity across the southeastern United States measured by the 2003 nighttime lights layer. For information on sources, see notes for Figures II and IV.

Bleakley and Lin (2012): The Fall Line

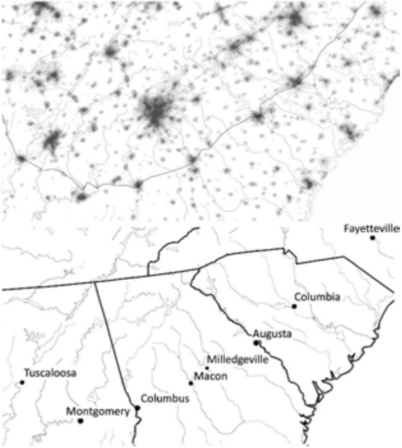


FIGURE II

Fall-Line Cities from Alabama to North Carolina

The map in the upper panel shows the contemporary distribution of economic activity across the southeastern United States, measured by the 2003 nighttime lights layer from NationalAtlas.gov. The nighttime lights are used to present a nearly continuous measure of present-day economic activity at a high spatial frequency. The fall line (solid) is digitized from *Physical Divisions of the United States*, produced by the U.S. Geological Survey. Major rivers (dashed gray) are from NationalAtlas.gov, based on data produced by the United States Geological Survey. Contemporary fall-line cities are labeled in the lower panel.

Bleakley and Lin (2012): The Fall Line

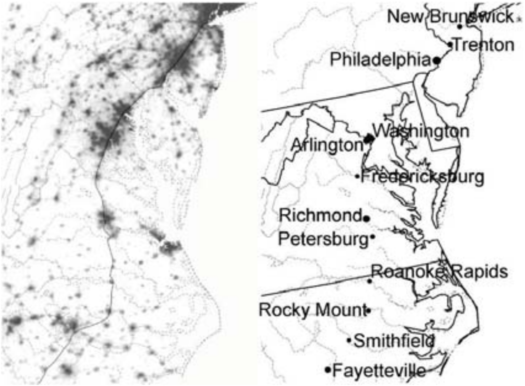
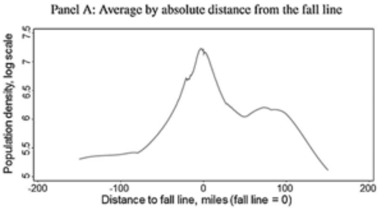


FIGURE IV

Fall-Line Cities from North Carolina to New Jersey

The map in the left panel shows the contemporary distribution of economic activity across the southeastern United States measured by the 2003 nighttime lights layer from NationalAtlas.gov. The nighttime lights are used to present a nearly continuous measure of present-day economic activity at a high spatial frequency. The fall line (solid) is digitized from *Physical Divisions of the United States*, produced by the U.S. Geological Survey. Major rivers (dashed gray) are from NationalAtlas.gov, based on data produced by the U.S. Geological Survey. Contemporary fall-line cities are labeled in the right panel.

Bleakley and Lin (2012): Results



Courtesy of Jeffrey Lin and Hoyt Bleakley. Used with permission.

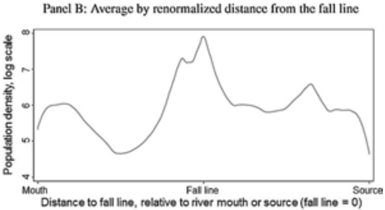


FIGURE III

Population Density in 2000 along Fall-Line Rivers

These graphs display contemporary population density along fall-line rivers. We select census 2000 tracts whose centroids lie within 50 miles along fall-line rivers; the horizontal axis measures distance to the fall line, where the fall line is normalized to zero, and the Atlantic Ocean lies to the left. In Panel A, these distances are calculated in miles. In Panel B, these distances are normalized for each river relative to the river mouth or the river source. The raw population data are then smoothed via Stata's lowess procedure, with bandwidths of 0.3 (Panel A) or 0.1 (Panel B).

Courtesy of Hoyt Bleakley and Jeffrey Lin. Used with permission.

Bleakley and Lin (2012): Results

TABLE II

UPSTREAM WATERSHED AND CONTEMPORARY POPULATION DENSITY

Specifications:	(1) Basic	(2) Other spatial controls: State fixed effects	(3) Other spatial controls: Distance from various features	(4) Water power	(5) Water power
Explanatory variables:					
Panel A: Census Tracts, 2000, $N = 21452$					
Portage site times upstream watershed	0.467 (0.175)**	0.467 (0.164)***	0.500 (0.114)***	0.496 (0.173)***	0.452 (0.177)**
Binary indicator for portage site	1.096 (0.348)***	1.000 (0.326)***	1.111 (0.219)***	1.099 (0.350)***	1.056 (0.364)***
Portage site times horsepower/100k				−1.812 (1.235)	
Portage site times I(horsepower > 2000)					0.110 (0.311)
Panel B: Nighttime Lights, 1996–97, $N = 65000$					
Portage site times upstream watershed	0.418 (0.115)***	0.352 (0.102)***	0.456 (0.113)***	0.415 (0.116)***	0.393 (0.111)***
Binary indicator for portage site	0.463 (0.116)***	0.424 (0.111)***	0.421 (0.121)***	0.462 (0.116)***	0.368 (0.132)***
Portage site times horsepower/100k				0.098 (0.433)	
Portage site times I(horsepower > 2000)					0.318 (0.232)
Panel C: Counties, 2000, $N = 3480$					
Portage site times upstream watershed	0.443 (0.209)**	0.372 (0.185)**	0.423 (0.207)**	0.462 (0.215)**	0.328 (0.154)**
Binary indicator for portage site	0.890 (0.211)***	0.834 (0.194)***	0.742 (0.232)***	0.889 (0.211)***	0.587 (0.210)***
Portage site times horsepower/100k				−0.460 (0.771)	
Portage site times I(horsepower > 2000)					0.991 (0.442)

Bleakley and Lin (2012): Results

TABLE III

PROXIMITY TO HISTORICAL PORTAGE SITE AND HISTORICAL FACTORS

	Baseline	(1) Railroad network length, 1850	(2) Distance to RR hub, 1850	(3) Literate white men, 1850	(4) Literacy rate white men, 1850	(5) College teachers per capita, 1850	(6) Manuf. / agric., 1880	(7) Non-agr. share, 1880	(8) Industrial diversity (1-digit), 1880	(9) Industrial diversity (3-digit), 1880	(10) Water power in use 1885, dummy
Explanatory variables:											
Panel A. Portage and historical factors											
Dummy for proximity		1.451	−0.656	0.557	0.013	0.240	0.065	0.073	0.143	0.927	0.164
to portage site		(0.304)***	(0.254)**	(0.222)**	(0.014)	(0.179)	(0.024)***	(0.025)***	(0.078)*	(0.339)***	(0.053)***
Panel B. Portage and historical factors, conditioned on historical density											
Dummy for proximity		1.023	−0.451	0.021	−0.003	0.213	0.022	0.019	0.033	−0.091	0.169
to portage site		(0.297)***	(0.270)	(0.035)	(0.014)	(0.162)	(0.019)	(0.019)	(0.074)	(0.262)	(0.054)***
Panel C. Portage and contemporary density, conditioned on historical factors											
Dummy for proximity	0.912	0.774	0.751	0.729	0.940	0.883	0.833	0.784	0.847	0.691	0.872
to portage site	(0.236)***	(0.236)***	(0.258)***	(0.187)***	(0.237)***	(0.229)***	(0.227)***	(0.222)***	(0.251)***	(0.221)***	(0.233)***
Historical factor		0.118	−0.098	0.439	0.666	1.349	1.989	2.390	0.838	0.310	0.331
		(0.024)***	(0.022)***	(0.069)***	(0.389)$*$	(0.164)***	(0.165)***	(0.315)***	(0.055)***	(0.015)***	(0.152)**

Notes. This table displays estimates of equation 1, with the below noted modifications. In Panels A and B, the outcome variables are historical factor densities, as noted in the column headings. The main explanatory variable is a dummy for proximity to a historical portage. Panel B also controls for historical population density. In Panel C, the outcome variable is 2000 population density, measured in natural logarithms, and the explanatory variables are portage proximity and the historical factor density noted in the column heading. Each panel/column presents estimates from a separate regression. The sample consists of all U.S. counties, in each historical year, that are within the watersheds of rivers that cross the fall line. The estimator used is OLS, with standard errors clustered on the 53 watersheds. The basic specification includes a polynomial in latitude and longitude, a set of fixed effects by the watershed of each river that crosses the fall line, and dummies for proximity to the fall line and to a river. Reporting of additional coefficients is suppressed. Data sources and additional variable and sample definitions are found in the text and appendixes.