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

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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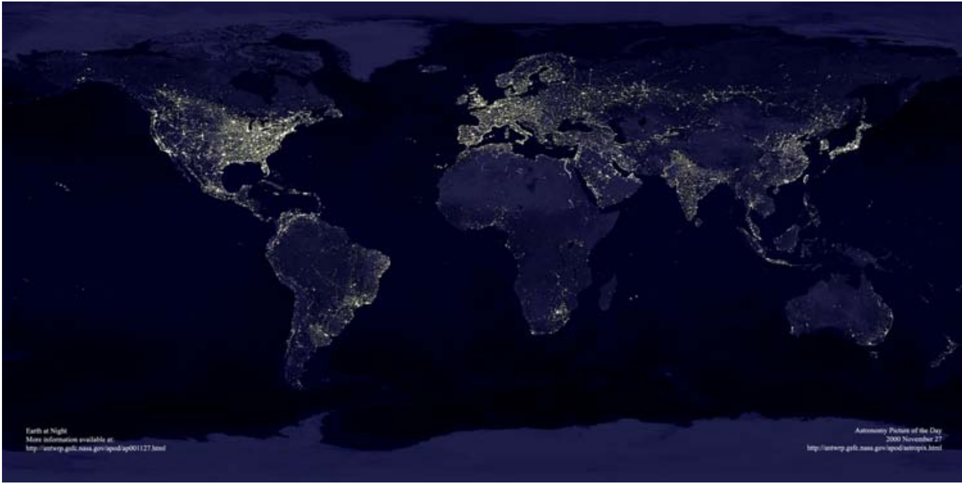
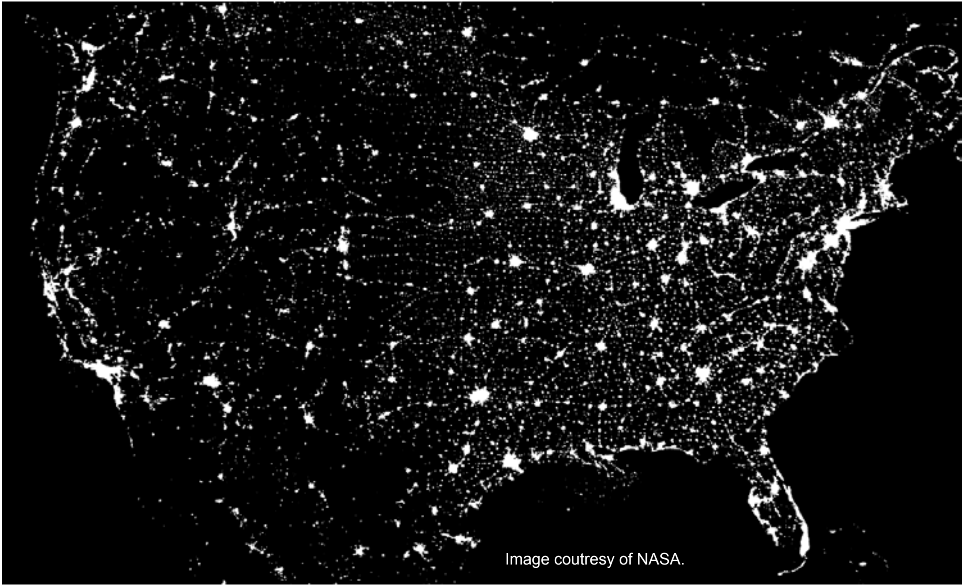
The Earth at Night



The US at Night



The US 'at night' (1940)

MAP OF THE UNITED STATES SHOWING POPULATION DISTRIBUTION IN 1940

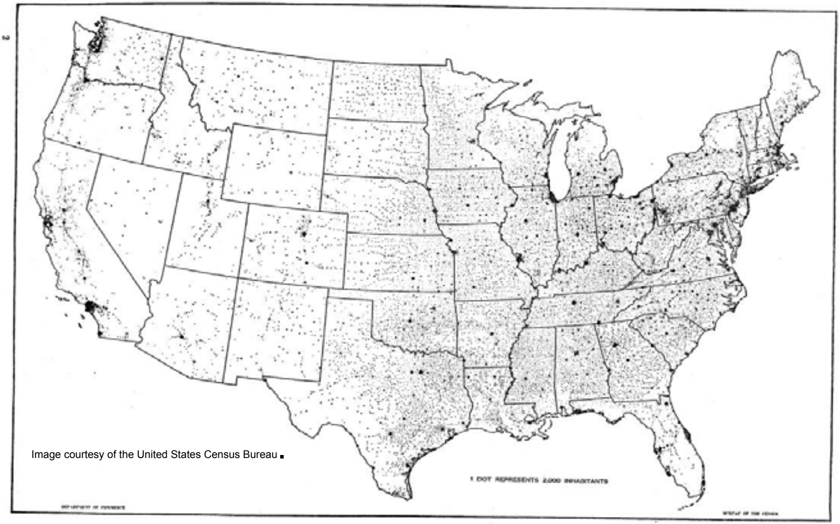


Image courtesy of the United States Census Bureau.

Growth occurs in pre-existing agglomerations: Burchfield et al (2006, QJE)

Figures removed due to copyright restrictions.

See figures IIa, IIb, III, and VI in "Causes of Urban Sprawl: A Portrait from Space."

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Geographic Concentration of Industry: Ellison and Glaeser (JPE, 1997)

- EG (1997) asks: Just how concentrated is economic activity within any given industry in the US?
- Key point: What is the right null hypothesis?
  - If output, within an industry, is highly concentrated in a small number of plants, then that industry will look very concentrated spatially, simply by nature of the small number of plants. (Consider extreme case of one plant.)
- EG develop an index (denoted γ and now known as 'the EG index') of localization that considers as its null hypothesis the random location of plants within an industry. They call this a "dartboard approach".
  - We don't have time to go into the definition of γ, but see the paper for that.
  - See also Duranton and Overman (ReStud, 2005) on an axiomatic approach to generalizing the EG index to correct for the lumpiness of 'locations' in the data.

EG (1997): Results

- For industries that we might expect to be highly localized:
  - Autos: $\gamma = 0.127$
  - Auto parts: $\gamma = 0.089$
  - Carpets (ie Dalton, GA): $\gamma = 0.378$
  - Electronics (ie Silicon Valley): $\gamma = 0.059 - 0.142$
- For industries that we might expect to be highly localized:
  - Bottled/canned soft drinks: $\gamma = 0.005$
  - Newspaper: $\gamma = 0.002$
  - Concrete: $\gamma = 0.012$
  - Ice: $\gamma = 0.012$

EG (1997): Results

, PDJH UHPRYHG GXH WR FRS\ULJKW UHVWULFWLRQV

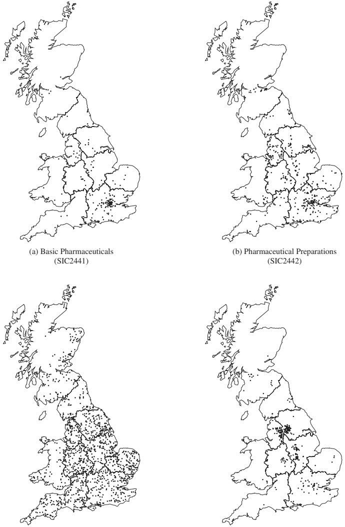
6HH)LJXUH DQG 7DEOH IURP *HRJUDSKLF &RQFHQWUDWLRQV LQ 8 6 0DQXIDFWXULQJ ,QGXVWULHV $ 'DUWERDUG $SSURDFK

EG (1997): Results

Image removed due to copyright restrictions.

See Figure 1 and Table 4 from "Geographic Concentrations in U.S. Manufacturing Industires: A Dartboard Approach."

Duranton and Overman (ReStud, 2005)



(a) Basic Pharmaceuticals (SIC2441)

(b) Pharmaceutical Preparations (SIC2442)

(c) Other Agricultural and Forestry Machinery (SIC2932)

(d) Machinery for Textile, Apparel and Leather Production (SIC2954)

FIGURE 1

Maps of four illustrative industries

Duranton, G. & Overman, H.G. (2005. testing for localization using micro-geographic data [online]. London: LSE Research Online. Available at: http://eprints.lse.ac.uk/archive/00000581.

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Why is output so agglomerated?

Three broad explanations:

1. Some production input is exogenously agglomerated.
    - Natural resources (as in the wine industry in EG (1997))
    - Institutions
2. Some consumption amenity is exogenously or endogenously agglomerated
    - Nice places to live (for place-based amenities that are non-tradable)
    - People (i.e. workers) just like to live near each other
    - Some non-tradable amenities that are endogenously provided but with IRTS in those goods' production functions (e.g. opera houses)
3. Some production input agglomerates endogenously
    - Some positive externality (i.e. spillover) that depends on proximity. This almost surely explains Silicon Valley, Detroit, Boston biotech, carpets in Dalton, etc.
    - This is what is usually meant by the term, 'agglomeration economies'
    - This source of agglomeration has attracted the greatest interest among economists.

What are sources of possible agglomeration economies?

- The literature on this is enormous
  - Probably begins in earnest with Marshall (1890)
  - Recent survey in Duranton and Puga (2004, *Handbook of Urban and Regional Econ*)

- Typically 3 forces for potential agglomeration economies:
  1. Thick input markets (reduce search costs and idiosyncratic risk)
  2. Increasing returns to scale combined with trade costs (on either inputs or outputs) that scale with remoteness
  3. Knowledge spillovers

Empirical work on the causes of agglomeration

- Recent surveys on this in:
  - Redding (2010, J Reg. Sci. survey)
  - Rosenthal and Strange (2004, *Handbook of Urban and Regional Econ*)
  - Head and Mayer (2004, *Handbook of Urban and Regional Econ*)
  - Overman, Redding and Venables (2004, *Handbook of International Trade*)
  - Combes et al textbook, *Economic Geography*

- Broadly, three approaches:
  1. Estimating agglomeration economies directly
  2. Estimating agglomeration economies from the extent of agglomeration in an observed spatial equilibrium.
  3. Testing for multiple equilibria (which is often a consequence of agglomeration economies)

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Estimating agglomeration economies directly

- A large literature has argued that if agglomeration economies exist then units of production (and factors) should be more productive if they are surrounded by other producers
- Two recent, excellent examples:
  - Henderson (2003, JUE) on across-firm (within-location) externalities
  - Moretti (2004, AER) on local (within-city) human capital externalities
- A central challenge with this approach is an analogy to the challenge that faces the 'peer effects' literature (e.g. Manski, 1993): does one unit actually affect a proximate unit, or are proximate units just similar on unobservable dimensions?
- Greenstone, Hornbeck and Moretti (JPE, 2010) consider a natural experiment approach to this question.
  - See also Greenstone and Moretti (2004) on how the same natural experiment affected total county land values (i.e. a measure of the welfare effects of agglomeration economies).

Greenstone, Hornbeck and Moretti (2010)

- GHM look at the effect that 'million dollar plants' (huge industrial plants) have on incumbent firms in the vicinity of the new MDP
- Consider the following example (from paper):
  - BMW did worldwide search for new plant location in 1991. 250 locations narrowed to 20 US counties. Then announced 2 finalists: Omaha, NB and Greenville-Spartanburg, SC. Finally, chose Greenville-Spartanburg.
  - Why? BMW says:
    - Low costs of production: low union density, supply of quality workers, numerous global firms in area (including 58 German companies), good transport infrastructure (rail, air, highway, port access), and access to key local services.
    - Subsidy ($115 million) received from local government.
- GHM obtain list of the winner and loser counties for 82 MDP openings and compare winners to losers (rather than comparing winners to all 3,000 other counties, or to counties that look similar on observables).

TABLE 3

County and Plant Characteristics by Winner Status, 1 Year Prior to a Million Dollar Plant Opening

	All Plants					Within Same Industry (Two-Digit SIC)				
	Winning Counties (1)	Losing Counties (2)	All U.S. Counties (3)	*t*-Statistic (Col. 1 − Col. 2) (4)	*t*-Statistic (Col. 1 − Col. 3) (5)	Winning Counties (6)	Losing Counties (7)	All U.S. Counties (8)	*t*-Statistic (Col. 6 − Col. 7) (9)	*t*-Statistic (Col. 6 − Col. 8) (10)
	A. County Characteristics									
No. of counties	47	73				16	19			
Total per capita earnings ($)	17,418	20,628	11,259	**−2.05**	**5.79**	20,230	20,528	11,378	−.11	**4.62**
% change, over last 6 years	.074	.096	.037	−.81	1.67	.076	.089	.057	−.28	.57
Population	322,745	447,876	82,381	−1.61	**4.33**	357,955	504,342	83,430	−1.17	**3.26**
% change, over last 6 years	.102	.051	.036	**2.06**	**3.22**	.070	.032	.031	1.18	1.63
Employment-population ratio	.535	.579	.461	−1.41	**3.49**	.602	.569	.467	.64	**3.63**
Change, over last 6 years	.041	.047	.023	−.68	**2.54**	.045	.038	.028	.39	1.57
Manufacturing labor share	.314	.251	.252	**2.35**	**3.12**	.296	.227	.251	1.60	1.17
Change, over last 6 years	−.014	−.031	−.008	1.52	−.64	−.030	−.040	−.007	.87	**−3.17**
	B. Plant Characteristics									
No. of sample plants	18.8	25.6	7.98	−1.35	**3.02**	2.75	3.92	2.38	−1.14	.70
Output ($1,000s)	190,039	181,454	123,187	.25	**2.14**	217,950	178,958	132,571	.41	1.25
% change, over last 6 years	.082	.082	.118	.01	−.97	−.061	.177	.182	−1.23	**−3.38**
Hours of labor (1,000s)	1,508	1,168	877	1.52	**2.43**	1,738	1,198	1,050	.92	1.33
% change, over last 6 years	.122	.081	.115	.81	.14	.160	.023	.144	.85	.13

Note.—For each case to be weighted equally, counties are weighted by the inverse of their number per case. Similarly, plants are weighted by the inverse of their number per county multiplied by the inverse of the number of counties per case. The sample includes all plants reporting data in the ASM for each year between the MDP opening and 8 years prior. Excluded are all plants owned by the firm opening an MDP. Also excluded are all plants from two uncommon two-digit SIC values so that subsequently estimated clustered variance matrices would always be positive definite. The sample of all U.S. counties excludes winning counties and counties with no manufacturing plant reporting data in the ASM for 9 consecutive years. These other U.S. counties are given equal weight within years and are weighted across years to represent the years of MDP openings. Reported *t*-statistics are calculated from standard errors clustered at the county level. *t*-statistics greater than 2 are reported in bold. All monetary amounts are in 2006 U.S. dollars.

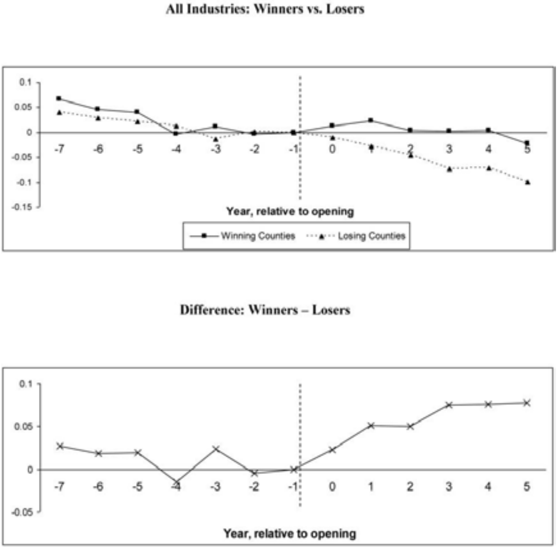

FIG. 1.—All incumbent plants' productivity in winning versus losing counties, relative to the year of an MDP opening. These figures accompany table 4.

Greenstone, Hornbeck and Moretti (2010)

TABLE 5
CHANGES IN INCUMBENT PLANT PRODUCTIVITY FOLLOWING AN MDP OPENING

	All Counties: MDP Winners − MDP Losers		MDP Counties: MDP Winners − MDP Losers		All Counties: Random Winners
	(1)	(2)	(3)	(4)	(5)
A. Model 1					
Mean shift	.0442*	.0435*	.0524**	.0477**	− 0.0496***
	(.0233)	(.0235)	(.0225)	(.0231)	(.0174)
				[$170 m]	
R^2	.9811	.9812	.9812	.9860	~0.98
Observations (plant by year)	418,064	418,064	50,842	28,732	~400,000
B. Model 2					
Effect after 5 years	.1301**	.1324**	.1355***	.1203**	−.0296
	(.0533)	(.0529)	(.0477)	(.0517)	(.0434)
				[$429 m]	
Level change	.0277	.0251	.0255	.0290	.0073
	(.0241)	(.0221)	(.0186)	(.0210)	(.0223)
Trend break	.0171*	.0179**	.0183**	.0152*	− 0.0062
	(.0091)	(.0088)	(.0078)	(.0079)	(.0063)
Pre-trend	−.0057	−.0058	−.0048	−.0044	−.0048
	(.0046)	(.0046)	(.0046)	(.0044)	(.0040)
R^2	.9811	.9812	.9813	.9861	~.98
Observations (plant by year)	418,064	418,064	50,842	28,732	~400,000
Plant and industry by year fixed effects	Yes	Yes	Yes	Yes	Yes
Case fixed effects	No	Yes	Yes	Yes	NA
Years included	All	All	All	$-7 \leq \tau \leq 5$	All

NOTE.—The table reports results from fitting several versions of eq. (8). Specifically, entries are from a regression of the natural log of output on the natural log of inputs, year by two-digit SIC fixed effects, plant fixed effects, and case fixed effects. In model 1, two additional dummy variables are included for whether the plant is in a winning county 7 to 1 years before the MDP opening or 0 to 5 years after. The reported mean shift indicates the difference in these two coefficients, i.e., the average change in TFP following the opening. In model 2, the same two dummy variables are included along with pre- and post-trend variables. The shift in level and trend are reported, along with the pre-trend and the total effect evaluated after 5 years. In cols. 1, 2, and 5, the sample is composed of all manufacturing plants in the ASM that report data for 14 consecutive years, excluding all plants owned by the MDP firm. In these models, additional control variables are included for the event years outside the range from $\tau = -7$ through $\tau = 5$ (i.e., −20 to −8 and 6 to 17). Column 2 adds the case fixed effects that equal one during the period that τ ranges from −7 through 5. In cols. 3 and 4, the sample is restricted to include only plants in counties that won or lost an MDP. This forces the industry by year fixed effects to be estimated solely from plants in these counties. For col. 4, the sample is restricted further to include only plant by year observations within the period of interest (where τ ranges from −7 to 5). This forces the industry by year fixed effects to be estimated solely on plant by year observations that identify the parameters of interest. In col. 5, a set of 47 plant openings in the entire country were randomly chosen from the ASM in the same years and industries as the MDP openings (this procedure was run 1,000 times, and reported are the means and standard deviations of those estimates). For all regressions, plant by year observations are weighted by the plant's total value of shipments 8 years prior to the opening. Plants not in a winning or losing county are weighted by their total value of shipments in that year. All plants from two uncommon two-digit SIC values were excluded so that estimated clustered variance-covariance matrices would always be positive definite. In brackets is the value in 2006 U.S. dollars from the estimated increase in productivity: the percentage increase is multiplied by the total value of output for the affected incumbent plants in the winning counties. Reported in parentheses are standard errors clustered at the county level.

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Greenstone, Hornbeck and Moretti (2010)

TABLE 6

Changes in Incumbent Plant Output and Inputs Following an MDP Opening

	Output (1)	Worker Hours (2)	Machinery Capital (3)	Building Capital (4)	Materials (5)
Model 1: mean shift	.1200***	.0789**	.0401	.1327*	.0911***
	(.0354)	(.0357)	(.0348)	(.0691)	(.0302)
Model 2: after 5 years	.0826*	.0562	−.0089	−.0077	.0509
	(.0478)	(.0469)	(.0300)	(.0375)	(.0541)

Note.—The table reports results from fitting versions of eq. (8) for each of the indicated outcome variables (in logs). See the text for more details. Standard errors clustered at the county level are reported in parentheses.

* Significant at the 10 percent level.

** Significant at the 5 percent level.

*** Significant at the 1 percent level.

Greenstone, Hornbeck and Moretti (2010)

TABLE 7
Changes in Incumbent Plant Productivity Following an MDP Opening for Incumbent Plants in the MDP's Two-Digit Industry and All Other Industries

	All Industries (1)	MDP's Two-Digit Industry (2)	All Other Two-Digit Industries (3)
		A. Model 1	
Mean shift	.0477**	.1700**	.0326
	(.0231)	(.0743)	(.0253)
	[$170 m]	[$102 m]	[$104 m]
R^2	.9860	.9861	
Observations	28,732	28,732	
		B. Model 2	
Effect after 5 years	.1203**	.3289	.0889*
	(.0517)	(.2684)	(.0504)
	[$429 m]	[$197 m]	[$283 m]
Level change	.0290	.2814***	.0004
	(.0210)	(.0895)	(.0171)
Trend break	.0152*	.0079	.0147*
	(.0079)	(.0344)	(.0081)
Pre-trend	−.0044	−.0174	−.0026
	(.0044)	(.0265)	(.0036)
R^2	.9861	.9862	
Observations	28,732	28,732	

Note.—The table reports results from fitting versions of eq. (8). As a basis for comparison, col. 1 reports estimates from the baseline specification for incumbent plants in all industries (baseline estimates for incumbent plants in all industries, col. 4 of table 5). Columns 2 and 3 report estimates from a single regression, which fully interacts the winner/loser and pre/post variables with indicators for whether the incumbent plant is in the same two-digit industry as the MDP or a different industry. Reported in parentheses are standard errors clustered at the county level. The numbers in brackets are the value (2006 U.S. dollars) from the estimated increase in productivity: the percentage increase is multiplied by the total value of output for the affected incumbent plants in the winning counties.

* Significant at the 10 percent level.

** Significant at the 5 percent level.

*** Significant at the 1 percent level.

Greenstone, Hornbeck and Moretti (2010)

TABLE 8

Changes in Incumbent Plant Productivity Following an MDP Opening, by Measures of Economic Distance between the MDP's Industry and Incumbent Plant's Industry

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CPS worker transitions	.0701***						.0374
	(.0237)						(.0260)
Citation pattern		.0545***					.0256
		(.0192)					(.0208)
Technology input			.0320*				.0501
			(.0173)				(.0421)
Technology output				.0596***			.0004
				(.0216)			(.0434)
Manufacturing input					.0060		−.0473
					(.0123)		(.0289)
Manufacturing output						.0150	−.0145
						(.0196)	(.0230)
R^2	.9852	.9852	.9851	.9852	.9851	.9852	.9853
Observations	23,397	23,397	23,397	23,397	23,397	23,397	23,397

Note.—The table reports results from fitting versions of eq. (9), which is modified from eq. (8). Building on the model 1 specification in col. 4 of table 5, each column adds interaction terms between winner/loser and pre/post status with the indicated measures of how an incumbent plant's industry is linked to its associated MDP's industry (a continuous version of results in table 7). These industry linkage measures are defined and described in table 2, and here the measures are normalized to have a mean of zero and a standard deviation of one. The sample of plants is that in col. 4 of table 5, but it is restricted to plants that have industry linkage data for each measure. For assigning this linkage measure, the incumbent plant's industry is held fixed at its industry the year prior to the MDP opening. Whenever a plant is a winner or loser more than once, it receives an additive dummy variable and interaction term for each occurrence. Reported in parentheses are standard errors clustered at the county level.

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** Significant at the 5 percent level.

*** Significant at the 1 percent level.

TABLE 9

CHANGES IN COUNTIES' NUMBER OF PLANTS, TOTAL OUTPUT, AND SKILL-ADJUSTED WAGES FOLLOWING AN MDP OPENING

	A. CENSUS OF MANUFACTURES		B. CENSUS OF POPULATION
	Dependent Variable: Log(Plants) (1)	Dependent Variable: Log(Total Output) (2)	Dependent Variable: Log(Wage) (3)
Difference-in-difference	.1255**	.1454	.0268*
	(.0550)	(.0900)	(.0139)
R^2	.9984	.9931	.3623
Observations	209	209	1,057,999

NOTE.—The table reports results from fitting three regressions. In panel A, the dependent variables are the log of number of establishments and the log of total manufacturing output in the county, based on data from the Census of Manufactures. Controls include county, year, and case fixed effects. Reported are the county-level difference-in-difference estimates for receiving an MDP opening. Because data are available every 5 years, depending on the census year relative to the MDP opening, the sample years are defined to be 1–5 years before the MDP opening and 4–8 years after the MDP opening. Thus, each MDP opening is associated with one earlier date and one later date. The col. 1 model is weighted by the number of plants in the county in years −6 to −10, and the col. 2 model is weighted by the county's total manufacturing output in years −6 to −10. In panel B, the dependent variable is log wage and controls include dummies for age by year, age squared by year, education by year, sex by race by Hispanic by citizen, and case fixed effects. Reported is the county-level difference-in-difference estimate for receiving an MDP opening. Because data are available every 10 years, the sample years are defined to be 1–10 years before the MDP opening and 3–12 years after the MDP opening. As in panel A, each MDP opening is associated with one earlier date and one later date. The sample is restricted to individuals who worked more than 26 weeks in the previous year, usually work more than 20 hours per week, are not in school, are at work, and work for wages in the private sector. The number of observations reported refers to unique individuals: some Integrated Public Use Microdata Series county groups include more than one Federal Information Processing Standard (FIPS), so all individuals in a county group were matched to each potential FIPS. The same individual may then appear in more than one FIPS, and observations are weighted to give each unique individual the same weight. Reported in parentheses are standard errors clustered at the county level.

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Market Access Approaches

- A large literature has considered how the economic activity of a region depends on that of other, nearby regions.
- A very common approach (to the challenge of parameterizing how one region affects another) is to work with the concept of 'market access'. We will cover this approach now.
- MA is usually defined in the context of a one-sector Krugman (1980) model but an observationally equivalent expression would derive in *any* one-sector gravity model (including neoclassical models without any externalities). So while the MA approach is interesting it doesn't directly map to the estimation of agglomeration externalities.
- However, we will also discuss recent approaches that add agglomeration externalities on top of a one-sector gravity model such that there is now a genuine agglomeration externality that can be estimated.

Redding and Venables (JIE, 2004): Set-up

- Consider a (one-sector) gravity model with:

$$X_{od} = A_o c_o^{-\theta} \tau_{od}^{-\theta} P_d^{\theta} X_d = S_o S_d \tau_{od}^{-\theta} \quad (1)$$

- Where c_o is the cost of a unit input bundle in country o, τ is the trade cost and P_d is the consumer price index in d. S_o and S_d are origin and destination-specific fixed-effects, respectively.

- Now suppose that $c_o = w_o^{\beta} v_o^{\alpha} P_o^{\gamma}$ where w_o is the price of immobile factors, $v_o = v$ is the price of mobile factors and P_o is the price index of a basket of intermediate inputs.

Redding and Venables (JIE, 2004): Set-up

- Market clearing implies:

$$Y_o c_o^{\theta} = \sum_d \tau_{od}^{-\theta} P_d^{\theta} X_d$$

So:

$$w_o^{1+\theta} = \beta A_o L_o^{-1} v^{-\alpha\theta} P_o^{-\gamma\theta} \sum_d \tau_{od}^{-\theta} P_d^{\theta} X_d$$

- RV (2004) think of this as:

$$\ln w_o = \delta + \delta_1 \ln SA_o + \ln MA_o + \varepsilon_o$$

- With $SA_o \equiv P_o^{-\gamma\theta}$ as 'supplier access' and $MA_o \equiv \sum_d \tau_{od}^{-\theta} P_d^{\theta} X_d$ as 'market access'. What is in ε_o?
- RV (2004) show how *SA* and *MA* can be computed using estimates of the gravity equation (1).

Redding and Venables (JIE, 2004): Results

First, look only at MA. FMA is MA but leaving out country's own term in MA.

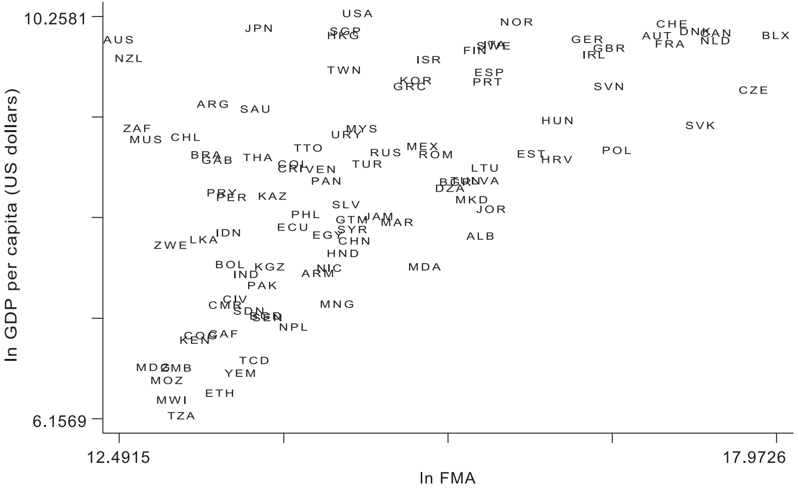


Fig. 1. GDP per capita and FMA.

Redding and Venables (JIE, 2004): Results

First, look only at MA. DMA(1) is country's own MA with τ_{oo} set to cost of shipping 100 km.

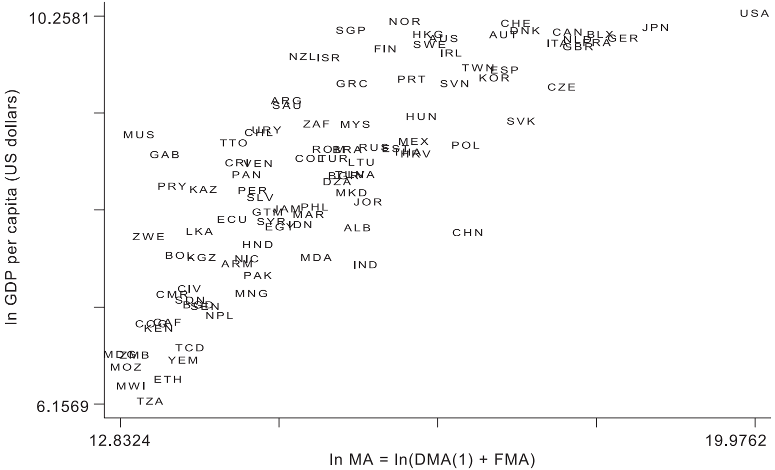


Fig. 2. GDP per capita and MA = DMA(1) + FMA.

Redding and Venables (JIE, 2004): Results

First, look only at MA. DMA(2) is country's own MA with τ_{oo} set to average cost of traveling distance in country of similar area but circular in shape.

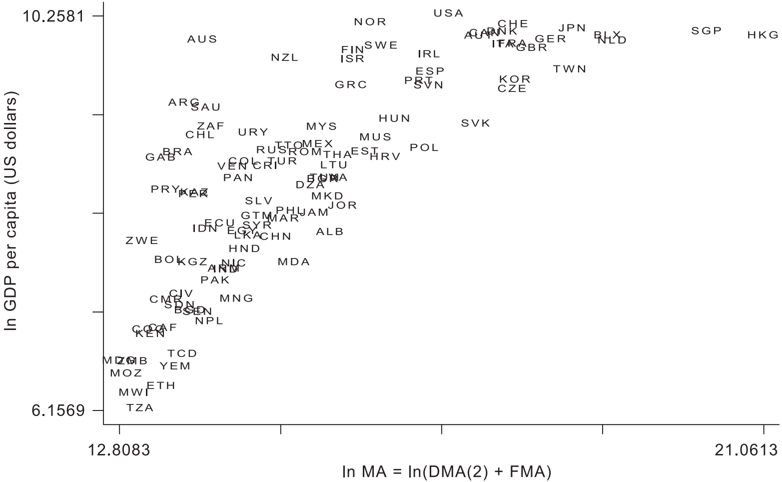


Fig. 3. GDP per capita and MA = DMA(2) + FMA.

Redding and Venables (JIE, 2004): Results

First, look only at MA. DMA(3) is country's own MA with τ_{oo} set as in DMA(2) but with half the distance elasticity as for τ_{od}.

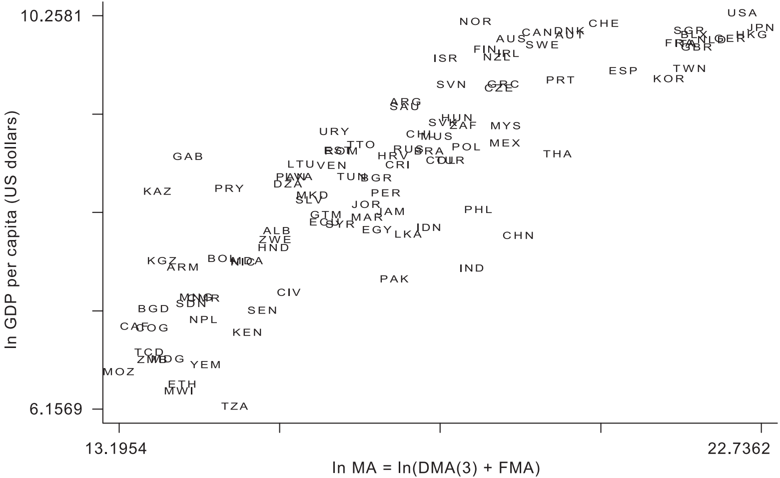


Fig. 4. GDP per capita and MA = DMA(3) + FMA.

Redding and Venables (JIE, 2004): Results

First, look only at MA. Controlling for institutions etc. IVs in columns (2) and (4) are distance to US, Belgium and Japan

Table 3
Economic geography, physical geography, institutions, and GDP per capita

ln(GDP per capita)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Observations	91	91	91	91	101	101	69	69
Year	1996	1996	1996	1996	1996	1996	1996	1996
$\ln(FMA_i)$	0.215**	0.229**	–		0.148**	–	0.269**	0.189**
	[0.063]	[0.083]			[0.061]		[0.112]	[0.096]
$\ln(MA_i = DMA_i(3) + FMA_i)$	–	–	0.307**	0.256**		0.337**		
			[0.066]	[0.124]		[0.063]		
ln(hydrocarbons per capita)	0.019	0.019	0.018	0.019	–	–	0.026	0.026
	[0.015]	[0.015]	[0.021]	[0.024]			[0.018]	[0.018]
ln(arable land area per capita)	−0.050	−0.050	0.161	0.126	–	–	−0.078	−0.107
	[0.066]	[0.070]	[0.103]	[0.136]			[0.085]	[0.088]
Number of minerals	0.016**	0.016	−0.017	−0.013	–	–	0.015	0.012
	[0.008]	[0.010]	[0.013]	[0.015]			[0.014]	[0.014]
Fraction land in geographical tropics	−0.057	−0.041	0.128	0.056	–	–	0.175	0.077
	[0.239]	[0.257]	[0.293]	[0.347]			[0.294]	[0.286]
Prevalence of malaria	−1.107**	−1.097**	−1.008**	−1.052**	–	–	−1.105**	−1.163**
	[0.282]	[0.284]	[0.376]	[0.403]			[0.318]	[0.325]
Risk of expropriation	−0.445**	−0.441**	−0.181	−0.236	–	–	−0.361**	−0.376**
	[0.091]	[0.093]	[0.129]	[0.172]			[0.116]	[0.116]
Socialist rule 1950–1995	−0.210	−0.218	−0.050	−0.056	–	–	−0.099	−0.069
	[0.191]	[0.192]	[0.208]	[0.214]			[0.241]	[0.248]
External war 1960–1985	−0.052	−0.051	0.001	−0.012	–	–	−0.078	−0.093
	[0.169]	[0.174]	[0.312]	[0.307]			[0.209]	[0.210]
Full sample	yes	yes	yes	yes	yes	yes		
Non-OECD							yes	
Non-OECD + OECD FMA								yes
Regional dummies					yes	yes		
Sargan (*p*-value)	–	0.980	–	0.721	–	–	–	–
Estimation	OLS	IV	OLS	IV	OLS	OLS	OLS	OLS
R^2	0.766	0.766	0.842	0.839	0.688	0.837	0.669	0.654
$F(\cdot)$	47.77	53.00	59.07	64.76	58.00	67.53	18.23	17.80
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

First-stage estimation of the trade equation using Tobit (column (3) in Table 1). Bootstrapped standard errors in square parentheses (200 replications). FMA_i is Foreign Market Access obtained from the trade equation estimation and defined in Eq. (17); $DMA_i(3)$ is our preferred measure of Domestic Market Access that uses internal area information but allows the coefficient on internal distance to be lower than that on external distance in the trade equation estimation. See Appendix A for definitions of and sources for the control variables. The availability of the hydrocarbons per capita and risk of expropriation data reduces the sample size in columns (1)–(4) to 91 observations. The regional dummies in columns (5) and (6) are Sub-Saharan Africa, North Africa and the Middle East, Latin America and the Caribbean, Southeast Asia, Other Asia, and Eastern Europe and the former USSR. The excluded category is the industrialized countries of North America, Western Europe, and Oceania. See Appendix A for the country composition of each regional grouping. The excluded exogenous variables in columns (2) and (4) are log distance from the US, log distance from Belgium (as a central point in the European Union), and log distance from Japan. Sargan is a Sargan test of the model's overidentifying restrictions. In column (7), FMA is computed using all countries, estimation on the non-OECD. In column (8), FMA is computed excluding non-OECD countries, estimation on the non-OECD.

*Denotes statistical significance at the 10% level. ** Denotes statistical significance at the 5% level.

Redding and Venables (JIE, 2004): Results

Now, look only at SA. SA is just price index for (tradable) intermediates so first look directly at that.

Table 4

Supplier access and the relative price of machinery and equipment

ln(machinery and equipment relative price)	(1)	(2)	(3)
Observations	46	46	45
Year	1985	1985	1985
$\ln(\text{FSA}_i)$	− 0.150** [0.060]	–	–
$\ln(\text{SA}_i = \text{DSA}_i(3) + \text{FSA}_i)$	–	− 0.070** [0.030]	− 0.083** [0.025]
Estimation	OLS	OLS	OLS
R^2	0.260	0.192	0.283
$F(\cdot)$	19.31	14.08	30.78
Prob>F	0.000	0.001	0.000

First-stage estimation of the trade equation using Tobit (column (3) in Table 1). Bootstrapped standard errors in square parentheses (200 replications). FSA_i is Foreign Supplier Access obtained from the trade equation estimation and defined in Eq. (18). $\text{DSA}_i(3)$ is our preferred measure of Domestic Supplier Access that uses internal area information but allows the coefficient on internal distance to be lower than that on external distance in the trade equation estimation.

*Denotes statistical significance at the 10% level. **Denotes statistical significance at the 5% level.

Redding and Venables (JIE, 2004): Results

Finally, look at MA and SA together. These cannot be separately identified very precisely (due to multicollinearity) but theory imposes a restriction on the sum of their coefficients conditional on outside estimate of α (γ in my notation) and σ ($\theta + 1$ in my notation).

Table 5

Market access, supplier access, and GDP per capita

ln(GDP per capita)	(1)	(2)	(3)	(4)	(5)	(6)
Observations	101	101	91	101	101	91
Year	1996	1996	1996	1996	1996	1996
α		0.5	0.5		0.5	0.5
σ		10	10		10	10
$\ln(FMA_i)$	–	0.320	0.143	–	–	–
$\ln(FSA_i)$	0.532**	0.178**	0.080**	–	–	–
	[0.114]	[0.039]	[0.039]			
$\ln(MA_i) = \ln(DMA_i(3) + FMA_i)$	–	–	–	–	0.251	0.202
$\ln(SA_i) = \ln(DSA_i(3) + FSA_i)$	–	–	–	0.368**	0.139**	0.112**
				[0.034]	[0.012]	[0.022]
Control variables	no	no	yes	no	no	yes
Estimation	OLS	OLS	OLS	OLS	OLS	OLS
R^2	0.377	0.360	0.765	0.696	0.732	0.848
$F(\cdot)$	57.05	54.56	47.21	250.07	285.69	60.40
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000

First-stage estimation of the trade equation using Tobit (column (3) in Table 1). Bootstrapped standard errors in square parentheses (200 replications). See notes to previous tables for variable definitions. Columns (3) and (6) include the baseline set of control variables from columns (1) and (4) of Table 3. In columns (2), (3), (5), and (6), we assume specific values for the share of intermediate inputs in unit costs (α) and the elasticity of substitution (σ), implying a linear restriction on the market and supplier access coefficients.

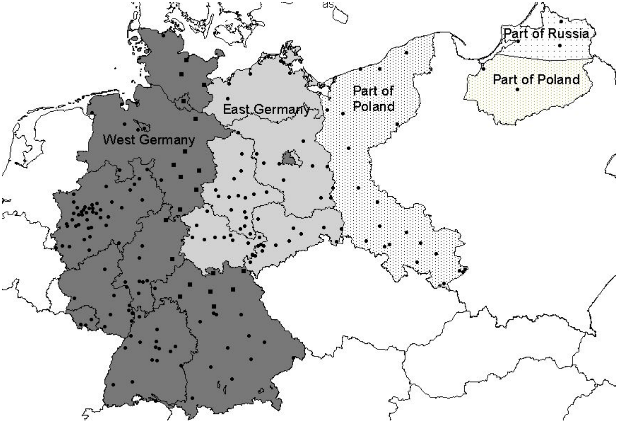
*Denotes statistical significance at the 10% level. **Denotes statistical significance at the 5% level.

Redding and Sturm (AER, 2008)

- RS (2008) extend the approach in RV (2004) and look at the effect of a quasi-experimental change in the proximity of regions to other regions: the division of Germany.
- Similar model to RV (2004) but with:
  - Simpler production structure: no intermediates
  - Free labor mobility
  - Housing amenity valued in consumption, exogenously supplied to each region

Redding and Sturm (AER, 2008): Results

Map 1: The Division of Germany after the Second World War



Notes: The map shows Germany in its borders prior to the Second World War (usually referred to as the 1937 borders) and the division of Germany into an area that became part of Russia, an area that became part of Poland, East Germany and West Germany. The West German cities in our sample which were within 75 kilometers of the East-West German border are denoted by squares, all other cities by circles.

Figure from Redding, Stephen J., and Daniel M. Sturm. "The Costs of Remoteness: Evidence from German Division and Reunification." *American Economic Review* 98, no. 5 (2008): 1766–1797. Courtesy of American Economic Association. Used with permission.

Redding and Sturm (AER, 2008): Results

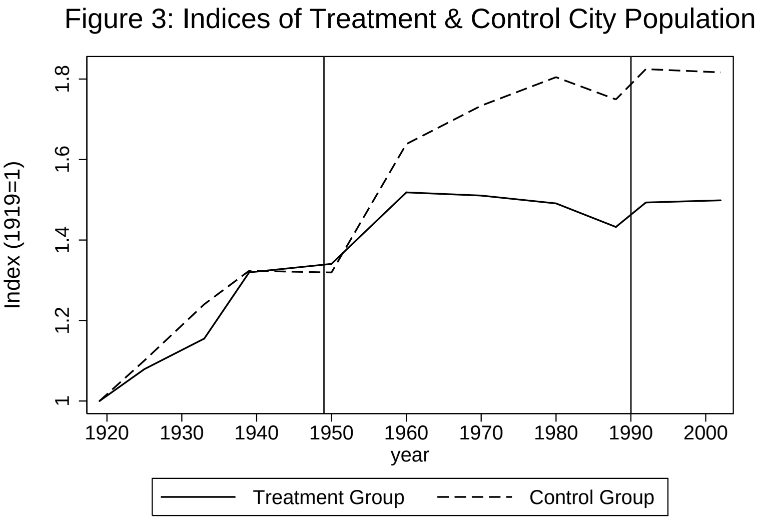
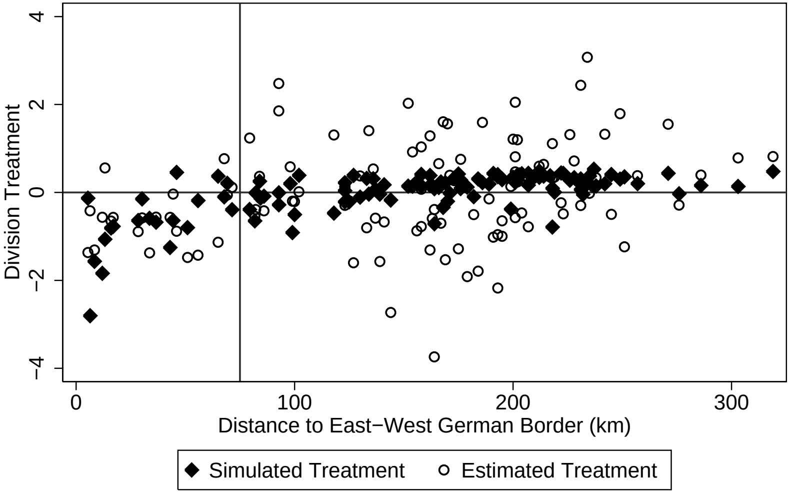


Figure from Redding, Stephen J., and Daniel M. Sturm. "The Costs of Remoteness: Evidence from German Division and Reunification." *American Economic Review* 98, no. 5 (2008): 1766–1797. Courtesy of American Economic Association. Used with permission.

Figure 7: Simulated and Estimated Division Treatments

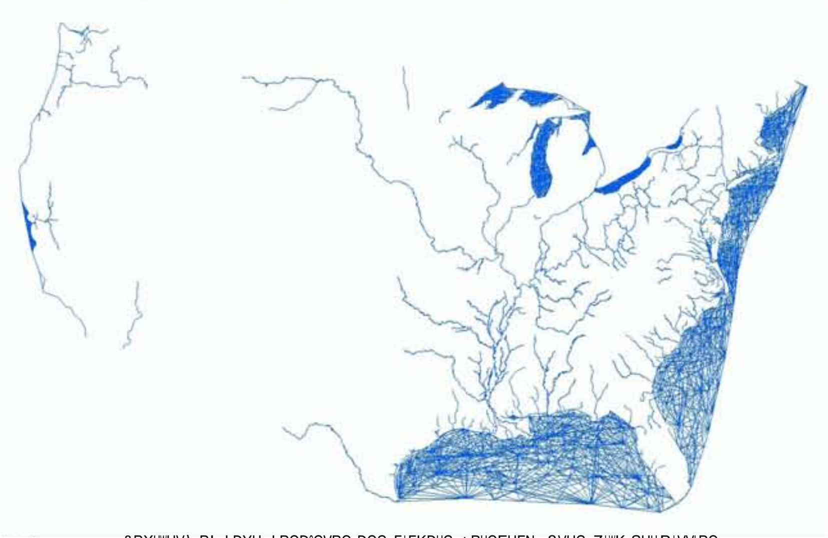


Donaldson and Hornbeck (2013)

- DH (2013) also pursue a MA approach, in the context of studying the impact of railroads on the US economy (1870-1890)
- MA is not the focus here. Instead, the goal is to develop a regression approach for the study of railroad access on local prosperity (as measured through land values) that is robust to econometric spillovers. MA delivers this.

Donaldson and Hornbeck (2013): Setup

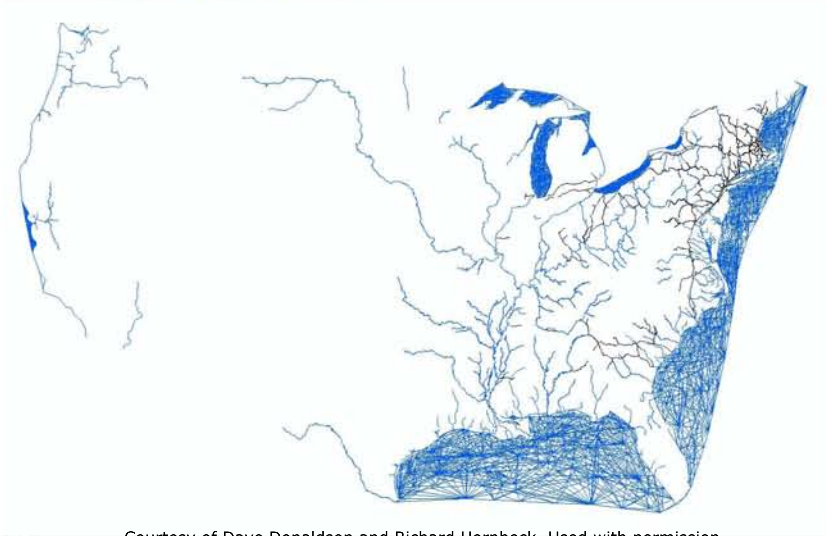
Navigable waterways and canals, 1840



&RXUWHV\ RI 'DYH 'RQDOGVRQ DQG 5LFKDUG +RUQEHFN 8VHG ZLWK SHUPLVVLRQ

Donaldson and Hornbeck (2013): Setup

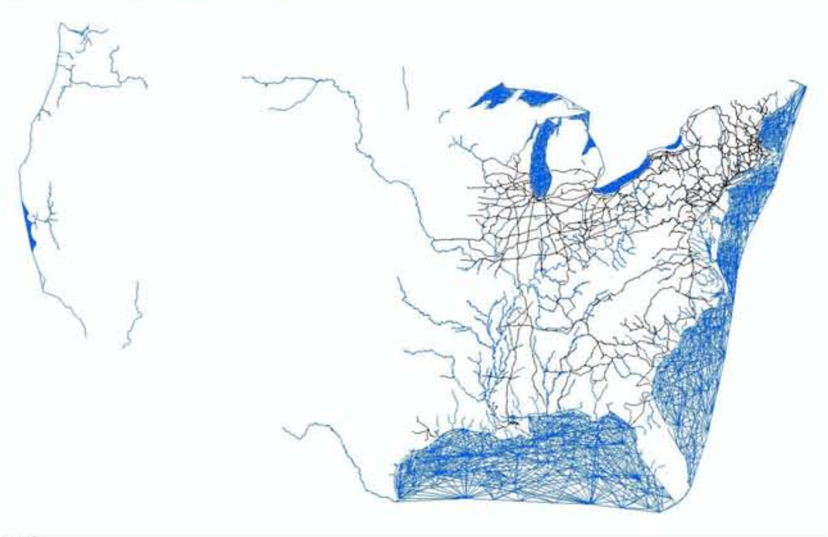
Waterways and railroads, 1850



Courtesy of Dave Donaldson and Richard Hornbeck. Used with permission.

Donaldson and Hornbeck (2013): Setup

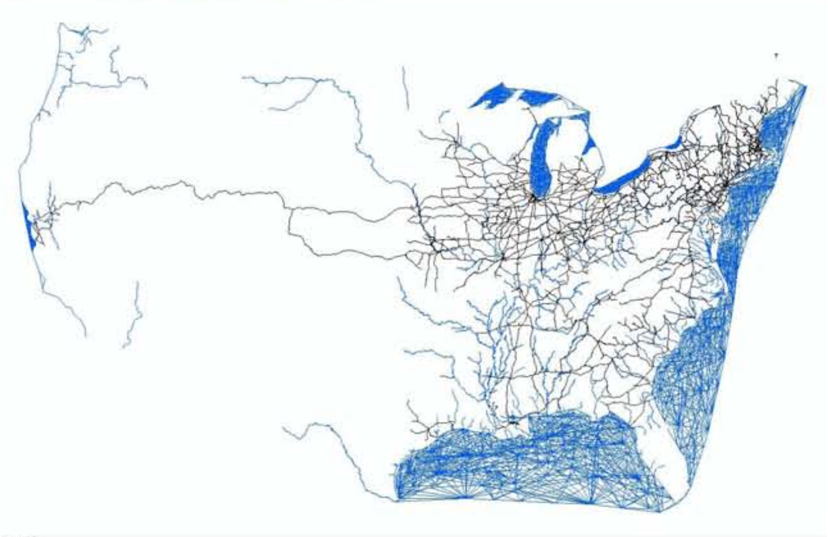
Waterways and railroads, 1860



Courtesy of Dave Donaldson and Richard Hornbeck. Used with permission.

Donaldson and Hornbeck (2013): Setup

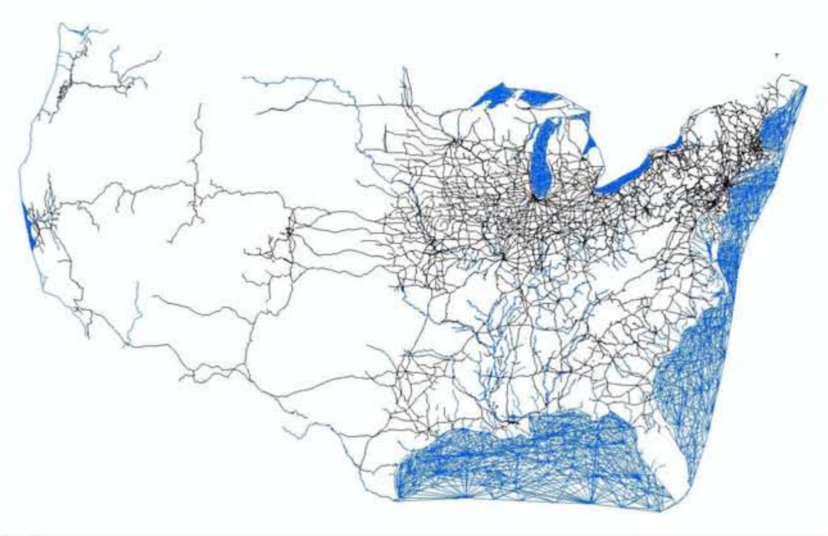
Waterways and railroads, 1870



Courtesy of Dave Donaldson and Richard Hornbeck. Used with permission.

Donaldson and Hornbeck (2013): Setup

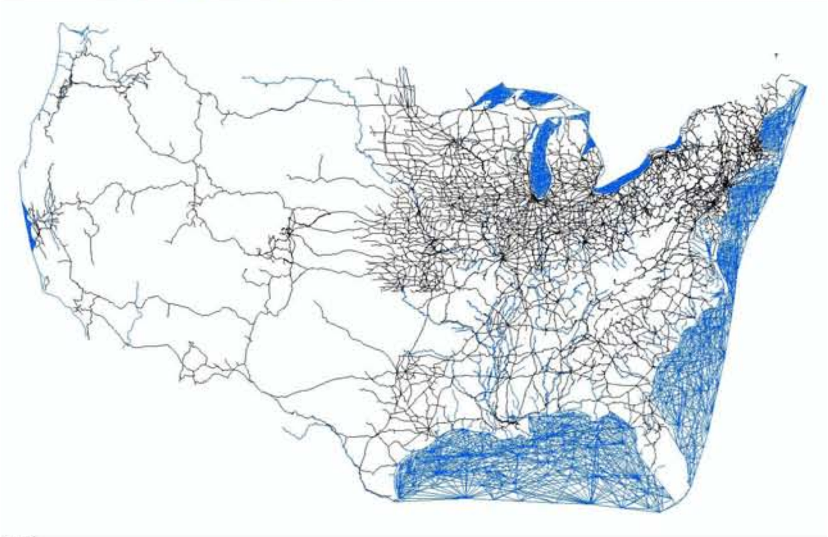
Waterways and railroads, 1880



Courtesy of Dave Donaldson and Richard Hornbeck. Used with permission.

Donaldson and Hornbeck (2013): Setup

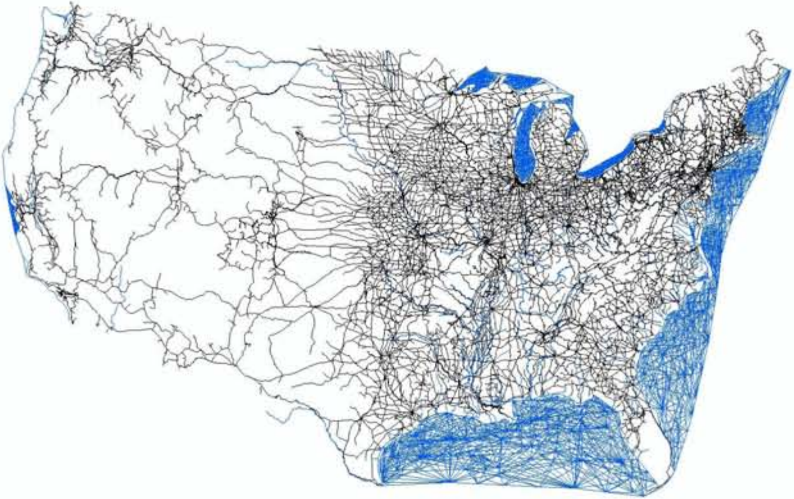
Waterways and railroads, 1887



Courtesy of Dave Donaldson and Richard Hornbeck. Used with permission.

Donaldson and Hornbeck (2013): Setup

Waterways and railroads, 1911



Donaldson and Hornbeck (2013): Results

Table 3. Market Access Elasticity: Robustness to Direct Controls for Railroads

	Log Land Value		Log MA	Log Land Value	
Dependent variable:	(1)	(2)	(3)	(4)	(5)
Log Market Access	1.477**			1.443**	1.455**
(based on population)	(0.254)			(0.240)	(0.251)
Any Railroad Track		0.359**	0.223**	0.037	0.044
		(0.116)	(0.020)	(0.098)	(0.092)
Railroad Track Length					- 0.032
(units = 100km)					(0.070)
Number of Counties	2,161	2,161	2,161	2,161	2,161
R-squared	0.587	0.544	0.665	0.587	0.587

Ahlfeldt, Redding, Sturm and Wolf (2013)

- ARSW (2013) develop a similar approach to RS (2008) but to the case of the division (and reunification) of Berlin. So this is about the importance of proximity at a very different spatial scale (neighborhoods rather than regions).
- Paper looks at the effect of the loss of access/proximity to the downtown region (CBD/"Mitte"), which was in East Berlin, on neighborhoods of West Berlin. And then the reverse for reunification.

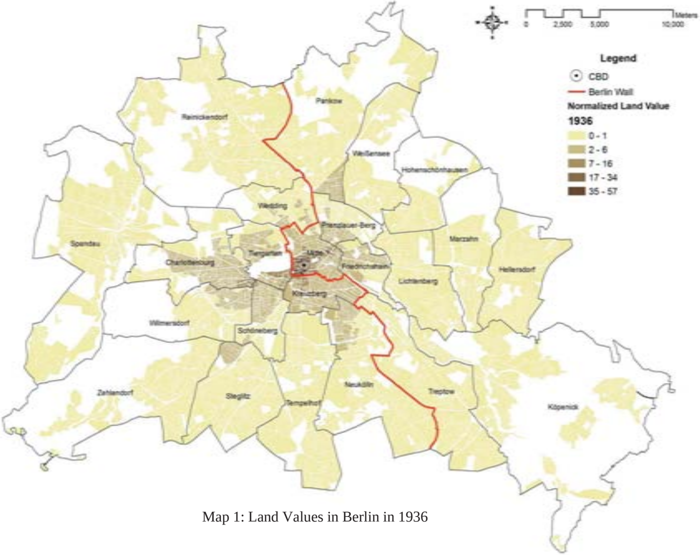
Ahlfeldt, Redding, Sturm and Wolf (2013)

- Model is similar to RS (2008) but with some alterations:
  - Commuting costs that vary with distance. This is modeled in the standard 'logit' fashion where workers' places of residence are fixed but they then receive exogenous utility shocks for each location and they choose the utility maximizing work location (as a function of the utility shocks, the wage, and the commuting cost).
  - No trade costs (the logic here is that most of what was produced in Berlin was exported to the rest of the 'world' anyway.
  - Consumer amenities that depend on an exogenous local term (as in RS, 2008) and a distance-weighted sum of all other regions' populations.
  - Production externalities that depend on an exogenous local term and a distance-weighted sum of all other regions' employment .

Ahlfeldt, Redding, Sturm and Wolf (2013)

- Basic estimation strategy:
  - Basic principle is that this is a model with a parameter for agglomeration externalities. ARSW then let the data, when fed through the model, identify that parameter. Analogous to approach summarized in Glaeser and Gottlieb (JEL, 2010)—more detail in Glaeser's 2009 book of lectures on urban economics—or Allen and Arkolakis (2013).
  - Formulate moments based on the identifying assumption that the (unobserved) production/consumption amenities (for each location) don't change over time in a way that is correlated with distance to the CBD.
  - This effectively says that the only effect of distance-to-the-CBD is working through the model's 3 distance-dependent terms (production externalities, consumption externalities, and commuting costs).
  - Remarkably, there is sufficient variation in these 3 terms to allow identification of 3 separate parameters.

Ahlfeldt, Redding, Sturm and Wolf (2013)



Map 1: Land Values in Berlin in 1936

Ahlfeldt, Redding, Sturm and Wolf (2013)

Figure 1: Greater Berlin Land Rents 1936

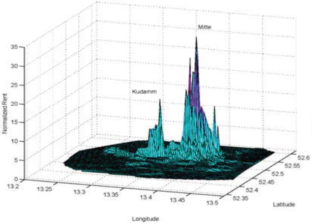


Figure 2: West Berlin Land Rents 1936

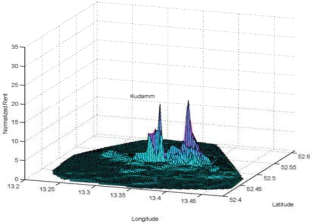


Figure 3: West Berlin Land Rents 1986

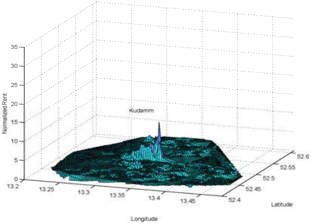


Figure 4: Greater Berlin Land Rents 2006

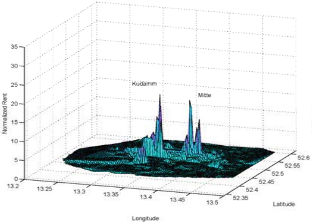
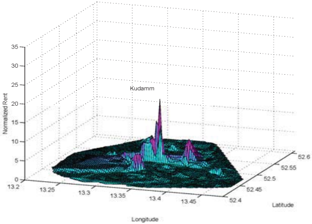
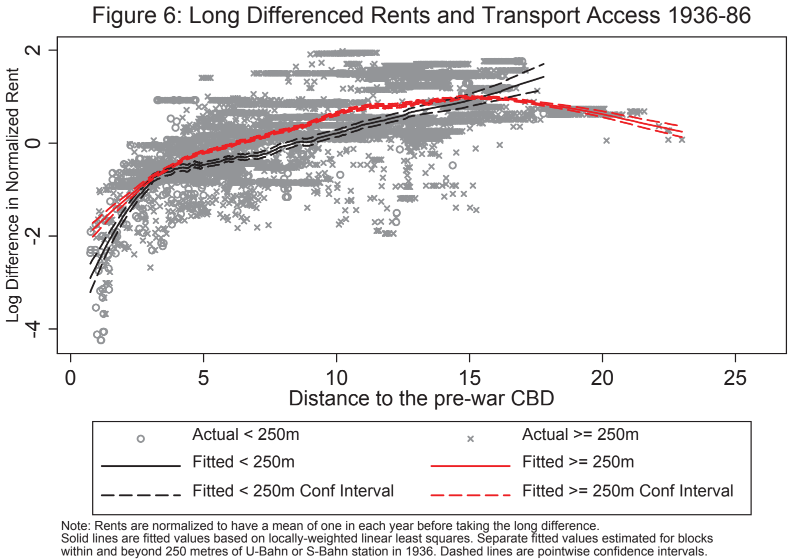


Figure 5: West Berlin Land Rents 2006

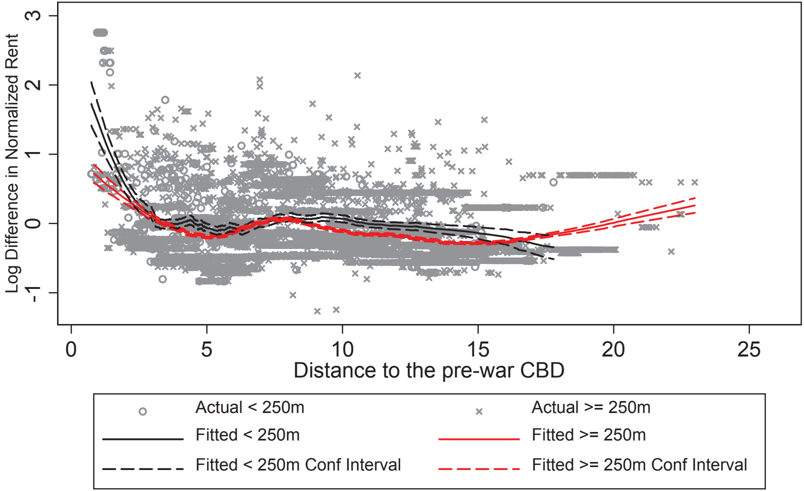


Ahlfeldt, Redding, Sturm and Wolf (2013)



Ahlfeldt, Redding, Sturm and Wolf (2013)

Figure 7: Long Differenced Rents and Transport Access 1986-2006



Note: Rents are normalized to have a mean of one in each year before taking the long difference.
Solid lines are fitted values based on locally-weighted linear least squares. Separate fitted values estimated for blocks within and beyond 250 metres of U-Bahn or S-Bahn station in 1936. Dashed lines are pointwise confidence intervals.

Ahlfeldt, Redding, Sturm and Wolf (2013)

Table 3: Generalized Method of Moments (GMM) Results

	1936-1986		1986-2006	
	One-step Coefficient	Two-step Coefficient	One-step Coefficient	Two-step Coefficient
Productivity Elasticity (λ)	0.1261***	0.1455***	0.1314***	0.1369***
	(0.0156)	(0.0165)	(0.0062)	(0.0031)
Productivity Decay (δ)	0.5749***	0.6091***	0.5267***	0.8791***
	(0.0189)	(0.1067)	(0.0128)	(0.0025)
Commuting Decay (κ)	0.0014**	0.0010*	0.0009	0.0005
	(0.0006)	(0.0006)	(0.0024)	(0.0016)
Commuting Heterogeneity (ε)	4.8789***	5.2832***	5.6186***	6.5409***
	(0.0423)	(0.0074)	(0.0082)	(0.0031)
Residential Elasticity (η)	0.2212***	0.2400***	0.2232***	0.215***
	(0.0038)	(0.0037)	(0.0093)	(0.0041)
Residential Decay (ρ)	0.2529***	0.2583***	0.5979***	0.5647***
	(0.0087)	(0.0075)	(0.0124)	(0.0019)

Note: Generalized Method of Moments (GMM) estimates using twelve moment conditions based on the difference between the distance-weighted and unweighted mean and variance of production fundamentals and residential fundamentals. Distance weights use the distance of each West Berlin block from the pre-war CBD, inner boundary between East and West Berlin, and outer boundary between West Berlin and its East German hinterland. One-step estimates use the identity matrix as the weighting matrix. Two-step estimates use the efficient weighting matrix. Standard errors in parentheses. See the text of the paper for further discussion.

Ahlfeldt, Redding, Sturm and Wolf (2013)

Table 4: Production Externalities, Residential Externalities and Commuting Costs by Travel Time

	Production Externalities ($1 \times e^{-\delta\tau}$)	Residential Externalities ($1 \times e^{-\rho\tau}$)	Commuting Costs ($1 \times \varepsilon^{-\kappa\tau}$)
0 minutes	1.000	1.000	1.000
1 minute	0.553	0.663	0.999
2 minutes	0.306	0.439	0.998
3 minutes	0.169	0.291	0.997
4 minutes	0.094	0.193	0.996
6 minutes	0.029	0.085	0.994
8 minutes	0.009	0.037	0.992
10 minutes	0.003	0.016	0.990
12 minutes	0.001	0.007	0.988
14 minutes	0.000	0.003	0.986
22 minutes	0.000	0.000	0.978
30 minutes	0.000	0.000	0.970

Note: Proportional reduction in production and residential externalities with travel time and proportional increase in commuting costs with travel time. Results based on median GMM parameter estimates: δ=0.5920, ρ=0.4115, κ=0.0010.