"The Costs of Remoteness, Evidence From German Division and Reunification" by Redding and Sturm (*AER*, 2008)

MIT Spatial Economics Reading Group Presentation

Adam Guren

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Testing the New Economic Geography

- The New Economic Geography literature has been a theoretical success
- However, it has been very difficult to test these theories in an empirically-credible way
- Strategies attempted include:
  - Test the home market effect
  - Constructing "market potential" measures to examine firm location and other predictions. Try to IV for market access
  - Test factor price predictions of models
  - Regional responses to trade liberalization (Hanson, 1996)
  - Davis and Weinstein (2002) on Japan bombing find some support for increasing returns explanations using a natural experiment, but not a direct test
  - See Ch. 12 of Combes, Mayer and Thisse (2008) book for overview of what has been done

Redding and Sturm Overview

- Redding and Sturm (2008), however, manage to conduct a more direct test of a New Economic Geography model and find quite compelling support for it:
  - They use a **natural experiment** for identification: the division and reunification of Germany
  - They **calibrate** a multi-city economic geography model based on Helpman (1998) and simulate division
  - They test an **equilibrium outcome** of the model: population flows due to differential losses/gains in market access for West German cities near the East German border
  - They test whether the effect **decreases over time**
  - They test whether the effect is **stronger for smaller cities**, which rely less on home markets and more on demand from near-bye markets
  - In every case they find fairly strong support for the model

Outline of the Rest of the Presentation

- Theoretical framework (briefly)
- Main empirical results
- Robustness checks and responding to counter arguments
- Conclusion

Helpman (1998)

- Krugman (1991) with a different centrifugal force
  - Krugman had immobile peasants in agricultural sector. Their demand for manufactures provides centrifugal force
  - Helpman turns to urban economics literature in which main focus of congestion is **limited stock of housing**, which gets bid up as people enter the city
  - We get **asymmetric cities**, but all mobile workers do not end up in one location
- Key modeling trick is Cobb-Douglas utility and assumption that everyone owns equal fraction of housing stock in the country. This lets us solve for expenditures on differentiated goods easily
- Surprisingly, despite the similarity of their models, Helpman's results are the opposite of Krugman's: agglomeration occurs when transport costs are high, not low (due to untraded nature of homogenous good)

Multi-City Generalization

- Redding and Sturm create and calibrate a multi-city version of Helpman's model
  - C cities each with housing stock H_c (or nontraded amenity)
  - L consumers who supply a unit of labor inelastically and spend a fraction μ of income on CES aggregate of differentiated goods with elasticity of substitution σ and $1-\mu$ on housing
  - Iceberg trade costs T_{ic} from city i to c
  - Drawbacks: every consumer owns share of *city*'s housing stock, housing supply inelastic
- **Spatial indifference equates real wages**:

$$\omega_c = \frac{w_c}{\left(P_c^M\right)^{\mu}\left(P_c^H\right)^{1-\mu}} = \omega \ \ \forall c \tag{1}$$

where P_c^M and P_c^H are price indices for manufactures and housing

Working Through the Model

- Standard demand for each variety:

$$x_{ic} = p_i^{-\sigma} \left(T_{ic}\right)^{1-\sigma} \left(\mu E_c\right) \left(P_c^M\right)^{\sigma-1}$$

- Use Cobb-Douglas to get expenditures, assuming all individuals own equal share of housing stock:

$$E_c = w_c L_c + \left(1-\mu\right) E_c = \frac{w_c L_c}{\mu}$$

- Price indices are standard. Note $P_c^H = \frac{(1-\mu)E_c}{H_c}$ from C-D
- Production is as in standard New Trade model. Get constant markup $p_i = \left(\frac{\sigma}{\sigma-1}\right) w_i$ and free entry condition $\bar{x} = \sum_c x_{ic} = F\left(\sigma - 1\right)$
- Set supply equal to demand to get a **wage equation**:

$$\left(\frac{\sigma w_i}{\sigma - 1}\right)^{\sigma} = \frac{1}{\bar{x}} \sum_c \left(w_c L_c\right) \left(\frac{P_c^M}{T_{ic}}\right)^{\sigma-1} \tag{2}$$

The Key Equations

- Now plug price indices and wage equation into spatial indifference and reexpress to get their **key equation**

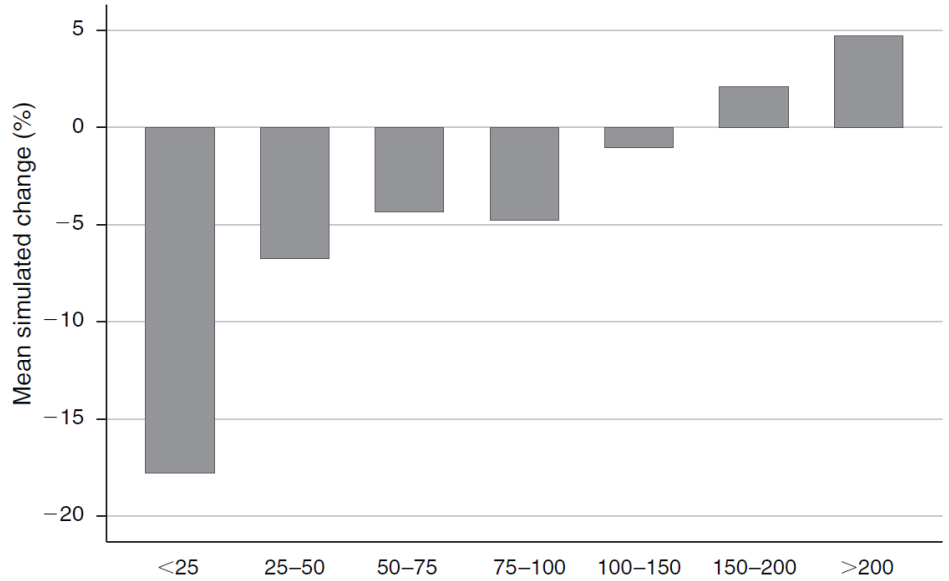
$$L_c = \chi \left(FMA_c\right)^{\frac{\mu}{\sigma(1-\mu)}} \left(CMA_c\right)^{\frac{\mu}{(1-\mu)(\sigma-1)}} H_c \tag{3}$$

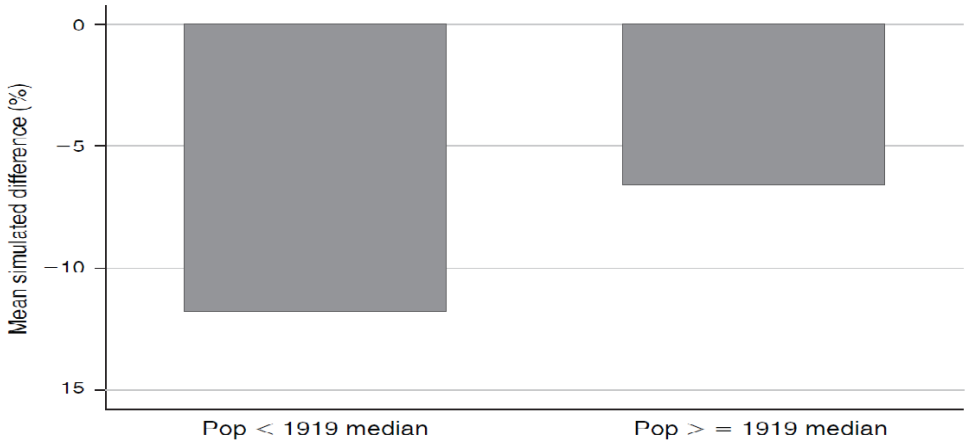
- This relates city size to the size of its housing stock, firm market access, and consumer market access.
- **Firm Market Access** $FMA_c = \sum_c \left(w_c L_c\right) \left(\frac{P_c^M}{T_{ic}}\right)^{\sigma-1}$ from RHS of wage equation. Note wage equation can be rewritten $w_c = \xi \left[FMA_i\right]^{1/\sigma}$ so firm market access determines the wage that firms can pay while making zero profits
- **Consumer market access** $CMA_c = \sum n_i \left(p_i T_{ic}\right)^{1-\sigma}$ $= \left(P_c^M\right)^{1-\sigma}$ is the cost of living

Calibration and Simulation

- They close the model with labor market clearing. No closed form solutions but can be simulated as with most NEG models
- They use the key equation to **calibrate the model to the observed pre-war city populations**
  - Take reasonable parameter values from the trade and economic geography literatures
  - Put in population sizes to get housing stocks H_c, assumed to be constant over time (strong assumption)
- Then **simulate division** by setting transport costs to East Germany to ∞
  - Population change should be negative close to border and monotonically increasing, as cities close to border lose most market access
  - Effect should be largest for small cities that depend on other cities for demand for their goods

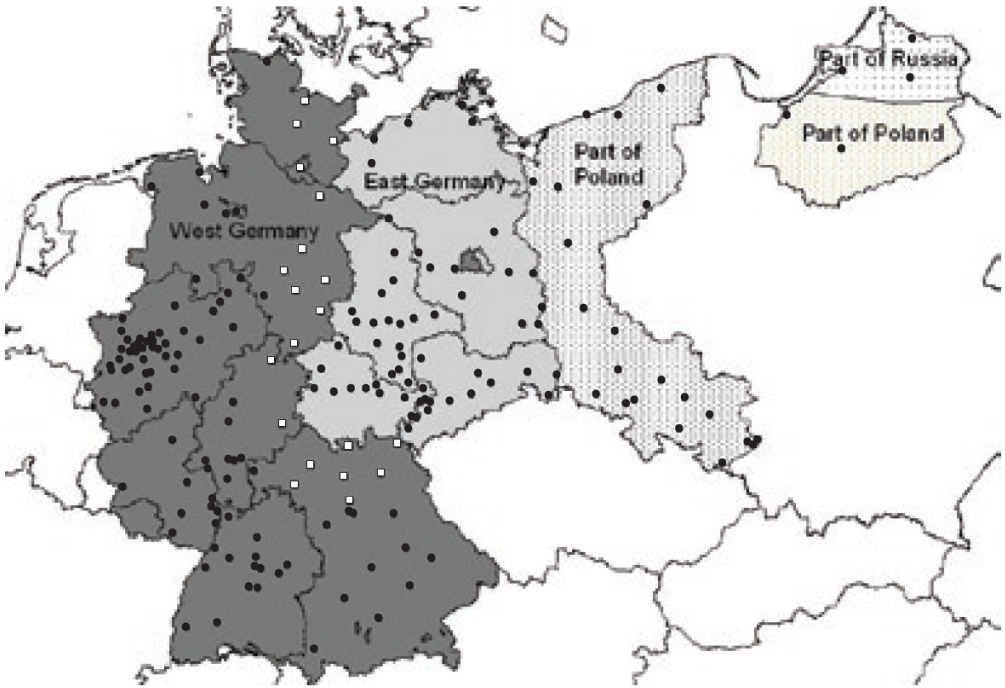
Simulation Figures





German Division

- Treatment: 20 West German cities within 75 km of East German border
- Control: 99 other West German Cities



- Choose cities $>$ 20k in 1919. Use census data from 1919, 1925, 1933, 1939, 1950, 1960, 1970,1980, 1992, 2002

Is This a Valid Natural Experiment?

- Redding and Sturm argue **yes**
  - Division largely determined by military and political considerations of Allied powers
  - Division happened very quickly and border sealed fairly suddenly, although there was a period of migration and limited commerce
  - No clear differences within West Germany in terms of institutions or other similar factors that plague cross-country analyses
  - Following cities over time so no clear differences in endowments or natural advantage
  - Large loss of market access gives statistical power
  - Try to address a number of other potential explanations (will come back to these later)
- Nonetheless we have to be somewhat skeptical
  - Unobserved heterogeneity between < 75 km from border and > 75 km from border is major worry (among several)

Differences-in-Differences Graph

- Treatment and control seem to have common pre-trends
- But treatment lose considerable population relative to control

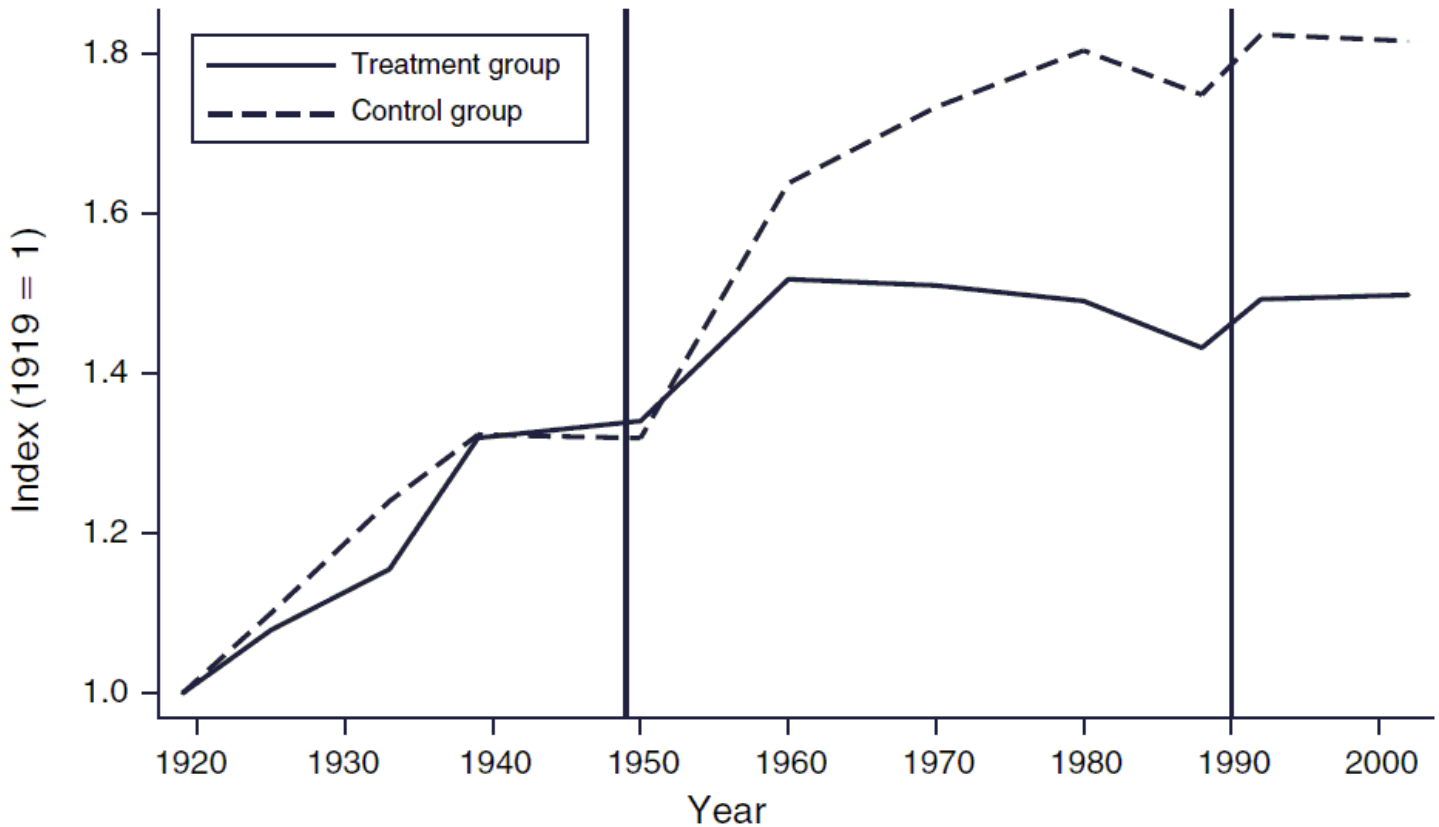


FIGURE 3. INDICES OF TREATMENT AND CONTROL CITY POPULATION

Regression Results

$$\text{PopGrowth}_{ct} = \beta \text{Border}_c + \gamma \left(\text{Border}_c \times \text{Division}_t\right) + d_t + \varepsilon_{ct}$$

	Population growth			
	(1)	(2)	(4)	(5)
Border × division	−0.746***		−1.097***	−0.384
	(0.182)		(0.260)	(0.252)
Border × year 1950–60		−1.249***		
		(0.348)		
Border × year 1960–70		−0.699**		
		(0.283)		
Border × year 1970–80		−0.640*		
		(0.355)		
Border × year 1980–88		−0.397***		
		(0.147)		
Border	0.129	0.129	0.233	−0.009
	(0.139)	(0.139)	(0.215)	(0.148)
Year effects	Yes	Yes	Yes	Yes
City sample	All cities	All cities	Small cities	Large cities
Observations	833	833	420	413
R^2	0.21	0.21	0.23	0.30

Main Results: Discussion

- .75 percent smaller annualized growth rate translates to cumulative reduction of border cities versus non-border cities of about one third
- Declines in strength over time and concentrated in small cities, as predicted by the model
- I removed column 3, which includes the one strange result: when border distance and division are interacted, the effect is stronger for cities 25-50km from the border than cities 0-25km
  - This difference is not significant
  - They attribute this to subsidies to immediate border regions
- These results appear robust to various reestimations and nonparametric estimation

Concerns About Other Explanations For Results

- There are many potential concerns about whether market access is causing the result. They focus on four:
  1. Border cities could be specialized in industries that declined post-war
  2. Border cities could differ in terms of war devastation and refugee migration
  3. Effect is caused by West Germany integrating with Western Europe post-war
  4. Fear of further armed conflict and safety moved people from border
- They also show that the model can quantitatively explain the data
- I think overall they do a good job of addressing potential concerns

Quantitative Analysis of Model

- First, instead of choosing the parameters and simulating the division, they try to find the **parameter values of the model in which the simulation most closely matches the moments of the data** on the division
- They do a grid search over 97,336 possible parameter values and find a narrow range of parameter values in which the model fits well for both small and large cities
- They argue the parameter values that fit Germany's division are reasonable given the literature on each particular parameter
- There are clearly a lot of idiosyncratic factors in the data, but they think their model fits quite well

City Structure and War Devastation

- To assuage concerns that observables city characteristics are driving their result, they combine their differences-in-differences methodology with **matching**
  - They match on population, the size of the workforce, employment across 28 sectors, and restrict the match to be between 100 and 175 km from the border
  - Adding match fixed effects they find large, negative, and significant coefficients in all cases
- To address concerns that the border cities may have been more affected by war devastation and refugees, they **add measures of war disruption** interacted with year
  - Specifically rubble per capita, the percentage of dwellings destroyed, and inflows of Eastern German refugees
  - In all cases the coefficient sizes are reduced marginally but are still significant. War disruption significantly increases growth from 1950-60 (as in Davis and Weinstein) but has no significant effect otherwise

Western Integration and Fear of Further Conflict

- To address concerns that integration with Western Europe could be driving their results, they **add similar variables for the western border**
  - While some of these coefficients enter significantly, it does not change their results for the border with East Germany
- They make a number of arguments to address concerns that **fear of further conflict** may have pushed people away from the border
  - Refer to historical accounts of political and military strategy and opinion polls in West Germany
  - Add a dummy for the area where any Warsaw Pact attack was expected to occur and find no impact
  - Analysis for centrally-planned East Germany does not show a similar effect
  - Argue this would show up in big cities more likely to be attacked, but their effect is strongest in small cities

Reunification

- For reunification, get **similar results with smaller magnitudes**. They argue this makes sense because it takes time to reestablish market access, whereas economic relationships were abruptly cut off at division

TABLE 7—THE IMPACT OF REUNIFICATION

	Population growth			
	(1)	(2)	(3)	(4)
Border × division	−0.477***	−0.127	−0.223	−0.007
	(0.156)	(0.128)	(0.202)	(0.136)
Border	−0.141	−0.141	−0.236	−0.064
	(0.106)	(0.106)	(0.168)	(0.108)
Year effects	Yes	Yes	Yes	Yes
City sample	All	All	Small cities	Large cities
Year sample	1950–1988 & 1992–2002	1980–1988 & 1992–2002	1980–1988 & 1992–2002	1980–1988 & 1992–2002
Observations	595	238	120	118
R^2	0.30	0.15	0.21	0.14

Note: Negative coefficient means population growth slower during division

What Do We Take Away From This Paper?

- I think this is a very strong paper
  - It is the best direct test of the New Economic Geography that I have seen
  - The authors account for most reasonable econometric concerns and potential alternate causes and build a convincing case for their interpretation
  - It is certainly very interesting
- However, even if we believe the paper, there is still one gnawing question: In a country with such good transportation infrastructure how can the transport costs of a distance of less than 100 km reduce population sizes so dramatically? Can this explain everything?
- They claim the model can account for the data quantitatively, but there are **other spatial economic explanations** for their results than solely transportation costs for final goods

Back to Marshall

- Marshall argued that there were **three reasons for agglomeration** of production:
  1. **Labor market pooling** (Krugman monograph, 1991)
  2. **Proximity to specialized inputs** (Krugman and Venables, 1995)
  3. **Informational externalities** (external economies)
- The type of supply and demand linkages that Redding and Sturm want to focus on are one aspect of Marshall's second explanation
- There is no real way to separate these factors given their identification strategy
- Perhaps we should interpret the paper as evidence for some combination of the above that provides compelling support for the approach of spatial economics more broadly