Lecture 2
Geography

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History of Economic Growth and Crises
13 January 2022

Outline of the course

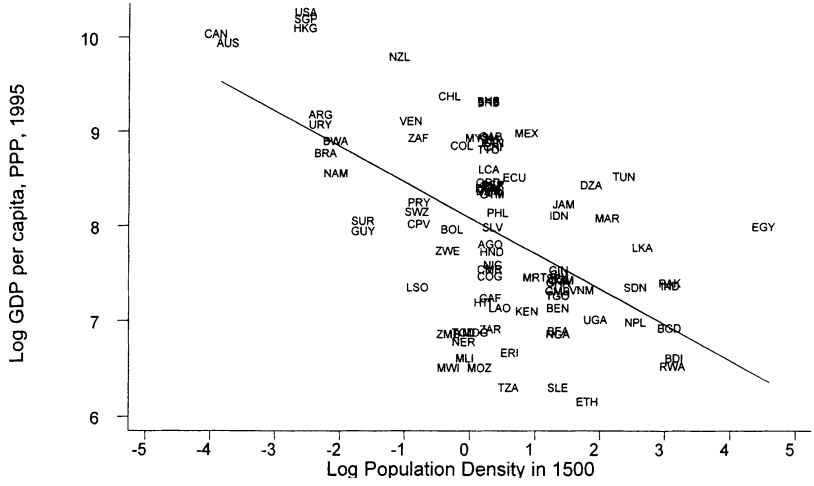
1. The Malthusian Era
2. Fundamental causes of growth
    1. **Geography and luck**
        1. Models of spatial distribution of production: unique vs. multiple equilibria?
        2. Empirical example: Tennessee Valley Authority
        3. Papers for Essays: Portage, TseTse
    2. Culture
    3. Institutions
3. Innovation and crises
4. Unleashing talent

Geography as destiny?

- The simplest version
  - climate, topography, disease environment and the like affect work effort and productivity, transportation costs etc.
- More nuanced versions exist
  - Diamond (1997): Eurasia became powerful due to suitable environmental factors that were amplified by positive feedback loops. [see the National Geography TV version (!) in YouTube.]

Population density 1500 and GDP per capita 1995

Acemoglu, Johnson, Robinson (2002)



Among the former European colonies, there is a negative relationship between log population density in 1500 and income per capita today. Similar pattern exists for urbanization rates in 1500 (another proxy for income). They are robust to controlling for many things and for excluding the "neo-Europes" from the sample.

Unique vs. multiple equilibria

- This lecture will be about economic geography
  - a good starting point to think about multiple equilibria
  - instead of countries, we focus on locations within countries
  - useful because culture and institutions vary less

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  - if it is a prominent feature of the world, understanding history is much more important than in a unique equilibrium world
  - it will also have very different implications for policy
- Economic geography particularly interesting because "locational fundamentals" provide a powerful reason for unique equilibrium

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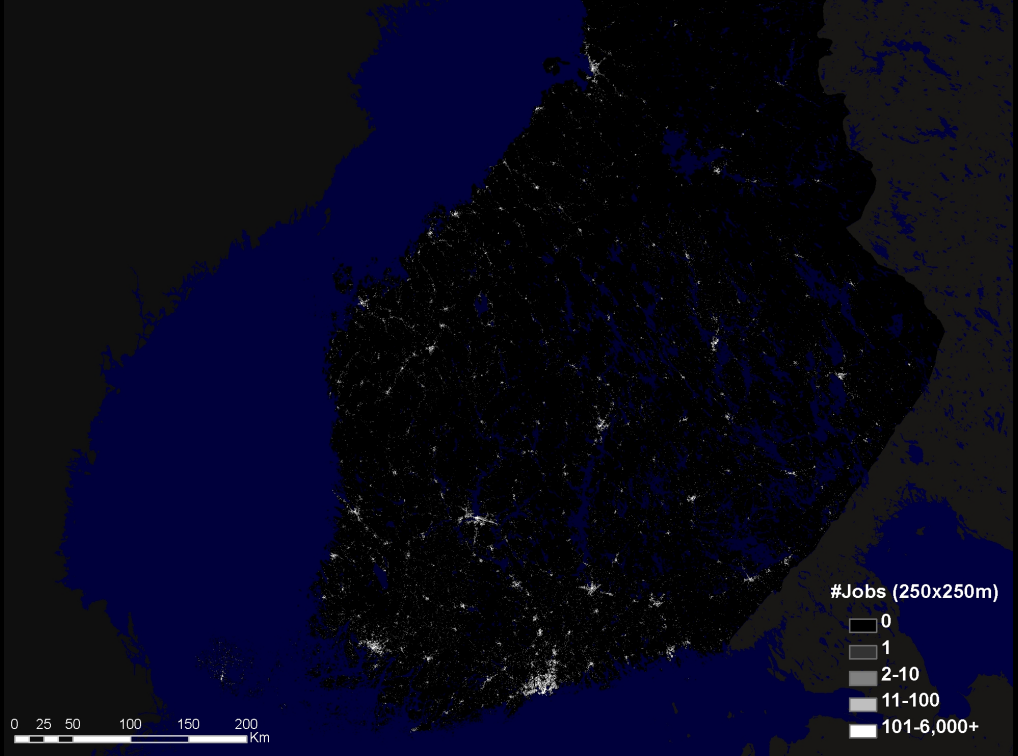
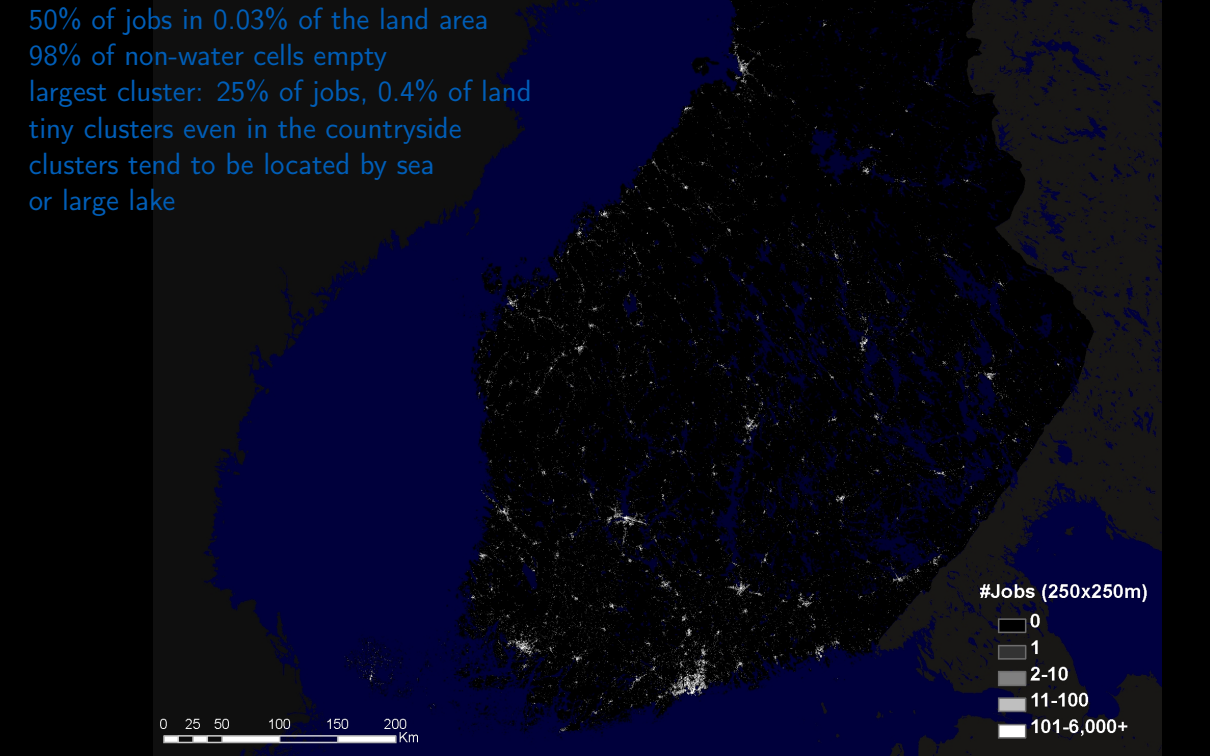
- Next slide: spatial distribution of jobs in Finland in 2010 using 250×250m grid


#Jobs (250x250m)
0
1
2-10
11-100
101-6,000+
0 25 50 100 150 200
Km


50% of jobs in 0.03% of the land area
98% of non-water cells empty
largest cluster: 25% of jobs, 0.4% of land
tiny clusters even in the countryside
clusters tend to be located by sea
or large lake
#Jobs (250x250m)
0
1
2-10
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0 25 50 100 150 200
Km

Multiple equilibria in spatial structure: an example

Krugman (1991): Geography and Trade

- Imagine a country with two locations: East and West
- Agriculture divided 50/50 between East and West
- Manufacturing: can be produced in East, West or both
  - production only in East/West $\rightarrow$ transportation costs
  - production in both $\rightarrow$ fixed setup cost
  - monopolistic competition (each firm produces own variety)

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- A numerical example
  - fixed-cost of opening a plant: 4
  - transportation cost per unit: 1
  - total demand for a variety: 10
  - 60% of labor force farmers
    - splitted manufacturing: local demands 5 and 5
    - concentrated manufacuring: local demands 7 and 3

Multiple equilibria in spatial structure: an example

Krugman (1991): Geography and Trade

Distribution of manufacturing employment	Cost for a typical firm		
	East	Both	West
East only	**7**	8	11
50/50 split	9	**8**	9
West only	11	8	**7**

There are three equilibria. Suppose that all other manufacturing firms are already in the East (first row). If one firm now locates to East, it will pay the fixed costs 4 once and transportation cost of 3. If it locates in both, it will pay the fixed costs twice and no transportation costs, $2 \times 4 = 8$. If it locates to west, it will pay $4+7=11$. So, everyone locates in the East because everyone else locates in the East. The case for everyone locating in the West is symmetrical (last row). But if manufacturing is initially splitted 50/50, the cost minimizing startegy for everyone is to have two plants. Homework: what happens when tranportation costs change? Are the equilibria stable?

"Transformation costs" can take many forms

Marshall (1890): The Principles of Economics

"When an industry has thus chosen a locality for itself, it is likely to stay there long: so great are the advantages which people following the same skilled trade get from near neighbourhood to one another. The mysteries of the trade become no mysteries; but are as it were in the air [...] if one man starts a new idea, it is taken up by others and combined with suggestions of their own; and thus it becomes the source of further new ideas. And presently subsidiary trades grow up in the neighbourhood, supplying it with implements and materials, organizing its traffic [...] Employers are apt to resort to any place where they are likely to find a good choice of workers with the special skill which they require; while men seeking employment naturally go to places where there are many employers who need such skill as theirs"

"Transformation costs" can take many forms

Marshall (1890) as summarized by Ed Glaeser

- Proximity decreases the cost of moving
  - ideas
  - goods
  - people

"Transformation costs" can take many forms

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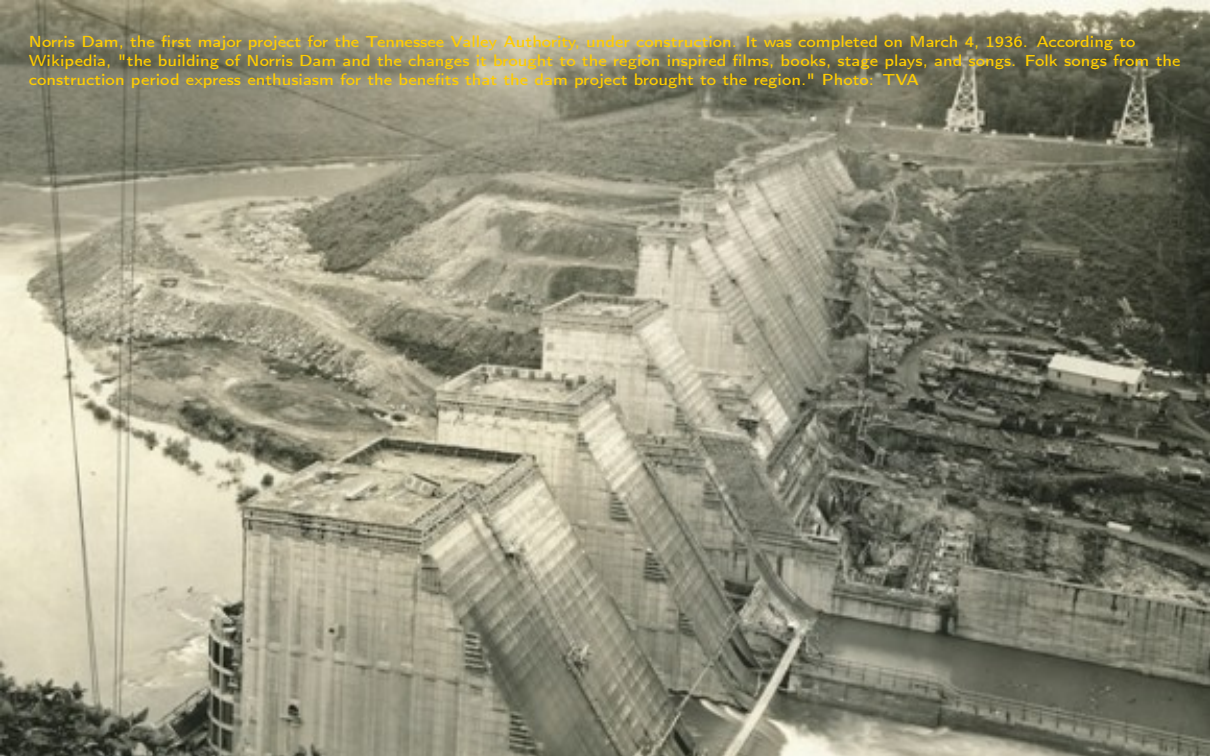
  - ideas
  - goods
  - people
- These gains are often referred to as agglomeration economies
  - population density increases productivity

Implications of multiple equilibria

- Currently rich and poor areas were not destined to be so
  - "historical accidents" matter
- Geography may work through favorable initial conditions
  - e.g. most great cities located by a river
- One-off shocks may have long-term effects
  - wars, natural disasters, "Big Push" development policies...



Norris Dam, the first major project for the Tennessee Valley Authority, under construction. It was completed on March 4, 1936. According to Wikipedia, "the building of Norris Dam and the changes it brought to the region inspired films, books, stage plays, and songs. Folk songs from the construction period express enthusiasm for the benefits that the dam project brought to the region." Photo: TVA

Tennessee Valley Authority (TVA)

Kline, Moretti (2014)

President Franklin D. Roosevelt signing the TVA Act in 1933

- TVA is a federally owned corporation created in 1933
  - Objective: modernize the Tennessee Valley's economy
  - Area: 163 counties inc. entire Tennessee, and parts of Kentucky, Alabama, and Mississippi
- Large investments in public infrastructure projects
  - series of hydroelectric dams
  - 650-mile navigation canal
  - extensive road network
  - construction of new schools and flood control systems

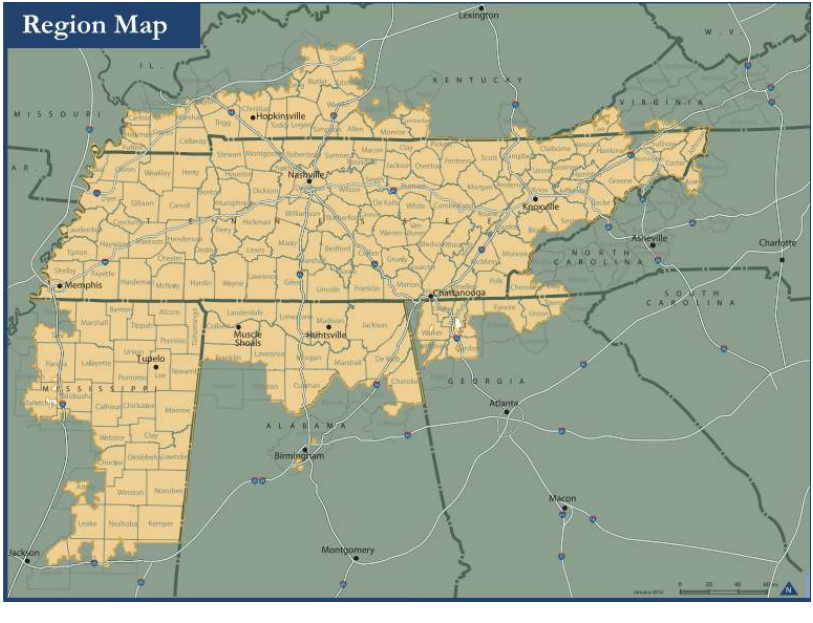
Tennessee Valley Authority (TVA)

Kline, Moretti (2014)

- Use TVA to test a version of the "Big Push" argument
  - hypothesis: sufficiently large public investments may push the economy to a new equilibrium
  - traditional BP models focus on consumption externalities
  - KM's version works through agglomeration economies
- Roadmap
  - description of TVA
  - a reduced-form evaluation of local impacts
  - structural model to assess national effects

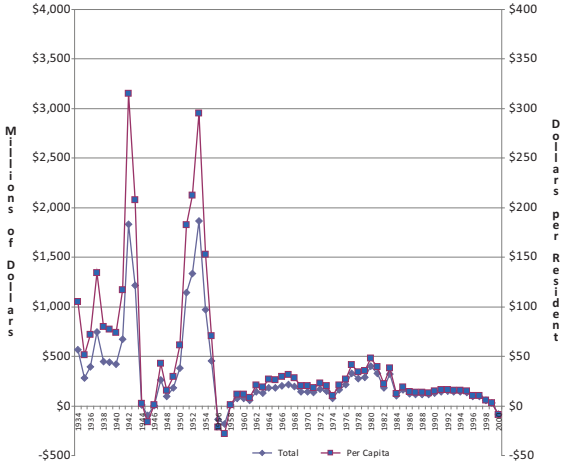
TVA service area

Kline, Moretti (2014)



Federal transfers: timeline

Kline, Moretti (2014)



- 73% of the federal transfers occured in 1940–1958
- In the early 1950s, per household transfer roughly 10% of average household income
- In 1959, TVA power generation system made self-financing $\rightarrow$ federal subsidies declined sharply

Proposed Authorities

Kline, Moretti (2014)

- TVA was ment to be merely the first such programs
  - Roosevelt: "If we are successful here we can march on"
- Senate bill 1937
  - proposed the creation of seven new authorities
  - failed (even though were considered likely to pass)
- Congress in 1945
  - 10 bills proposing programs comparable to the TVA
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  - 10 bills proposing programs comparable to the TVA
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- Proposed authorities useful for identifying the impact of TVA
  - credible counterfactuals because modeled on the TVA

Evaluating the long-term effects of TVA

Kline, Moretti (2014)

- The challenge
  - TVA different already before the program details
  - differences smaller between TVA and proposed authorities
- Solution: compare changes in TVA counties to changes in
  - rest of the country
  - rest of the South
  - proposed authorities
- ... and control for pre-program differences

Identification

Kline, Moretti (2014)

- Identifying assumption:
  - if TVA would not have existed, average outcomes in the TVA-counties would have *changed* similarly as average outcomes in the non-TVA counties (that had similar observable characteristics in 1920 and 1930)
- Is this plausible?
  - proposed authorities seem quite compelling (to me)
  - impact of TVA on other policies: defined as part of the "treatment"
  - TVA does not "affect" pre-TVA outcomes ▸ details

Data

Kline, Moretti (2014)

- KM create a county-level panel for 1900–2000
  - aggregate from various microdata
  - published tables from the Population Census, Manufacturing Census, Agricultural Census
  - topographic variables
- Quality issues for early years
  - substantial measurement error likely, particularly for wages

Impact during and after the federal subsidies

Kline, Moretti (2014)

	(1)	(2)	(3)	(4)	(5)	(6)
	Entire U.S.		South		Proposed authorities	
Outcome	1940–1960	1960–2000	1940–1960	1960–2000	1940–1960	1960–2000
Population	0.037	−0.008	0.042	−0.000	0.028	−0.013
Average manufacturing wage	−0.005	0.014*	−0.003	0.010	0.007	0.012
Agricultural employment	0.106***	−0.134***	0.106***	−0.130***	0.119***	−0.166***
Manufacturing employment	0.114***	0.033**	0.116***	0.035*	0.097**	0.032**
Value of farm production	0.076*	−0.030	0.081**	−0.044	0.118**	−0.033
Median family income	N/A	0.017	N/A	0.016	N/A	0.019*
Average agricultural land value	0.027	−0.017	0.018	−0.015	0.029	−0.021
Median housing value	0.019	−0.003	0.010	0.005	0.020	0.003

Estimates interpreted as average differences in 10-year growth rates experienced by TVA counties relative to non-TVA counties. **During the period of generous federal funding, growth rate of employment in both agriculture and manufacturing is about 10 percentage points larger in the TVA region**. These are remarkably large employment effects, probably explained by an increase in labor demand due to the rapid electrification of the region and the addition of new transportation infrastructure. **In the second period employment growth in agriculture falls behind, reversing the gains of the previous period**. This is consistent with the end of federal investment, and the lack of important agglomeration economies in agriculture. By contrast, even after the end of federal outlays, **manufacturing employment keeps growing significantly faster in TVA counties** (although less fast than in the early period).

Reduced form impacts on the TVA area: summary

Kline, Moretti (2014)

- TVA dramatically accelerated the pace of industrialization
  - shift of employment from agriculture to manufacturing
- Limited long-run effect on local wage rates, housing values
  - suggests that workers capable of moving into manufacturing ... and an elastic supply of housing and land

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- Limited long-run effect on local wage rates, housing values
  - suggests that workers capable of moving into manufacturing ... and an elastic supply of housing and land
- Manufacturing grows even after cutting down the subsidies
  - agglomeration effects in manufacturing (but not in agriculture)

The effect of TVA on the national economy

Kline, Moretti (2014)

- Did TVA affect also the national economy?
  - economists typically critical to place-based policies
  - workhorse models: such policies only move production around
    $\rightarrow$ should focus on people rather than places
- Empirical challenge
  - no plausible control group for the entire U.S. exist

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- Empirical challenge
  - no plausible control group for the entire U.S. exist
- Solution: structural model to
  - rationalize the reduced-form effects
  - derive conditions for TVA to increase aggregate output
  - estimate parameters and perform cost-benefit analysis

The model: a roadmap

Kline, Moretti (2014)

- Spatial equilibrium
  - wages such that workers indifferent across locations
- Production
  - TFP depends on the density of manufacturing workers
- The impact of TVA
  - direct effect: increase in local productivity due to improved infrastructure
    - e.g. availability of electricity, roads canals
  - indirect effect: increase in local productivity due to higher population density
    - agglomeration economies
- Key point
  - aggregate increase only in the presence of specific nonlinearities in agglomeration economies

An aside: exam requirements for this part

- You only need to get the intuition
  - the concept of spatial equilibrium, why nonlinearities in agglomeration forces are required for positive aggregate effects, basic empirical conclusions
- No need to memorize the exact structure of the model or to work through the math

Assumptions of the model: spatial equilibrium

Kline, Moretti (2014)

- Counties defined as small open economies (price-takers) that differ in
  - local amenities
  - "fundamentals" (unobs. locational productivity advantages)
  - endogenous agglomeration externalities

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  - endogenous agglomeration externalities
- Capital and labor perfectly mobile; workers have homogeneous preferences
  $\rightarrow$ utility equalized across counties

$$\ln w_{it} + M_{it} = \bar{u}_t$$

where w_{it} is wages at location i in year t, M_{it} is local amenities and $\bar{u}_t$ is utility

- low wages can be compensated with high amenties
- workers migrate until wages are such that this holds
- in equilibrium, **everyone is indifferent across locations** (otherwise they would move)

Assumptions of the model: production and wages

Kline, Moretti (2014)

- Production function for manufacturing assumed to be

$$Y_{it} = A_{it} K_{it}^{\alpha} F_i^{\beta} L_{it}^{1-\alpha-\beta}$$

where A_{it} is local TFP, K_{it} is local capital stock, F_i is a fixed factor ("fundamentals") and L_{it} number of manufacturing workers

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- Key property: all factors are *complements* with each other and with TFP
  - this implies that if K_i increases, the marginal product of labor increases, thus wages increase, and worker migrate into i until we get back to $\ln w_{it} + M_{it} = \bar{u}_t$
  - similarly if A increases, the marginal product of capital and labor increase, and this will lead to increasing capital stock and in-migration of labor

Assumptions of the model: local productivity

Kline, Moretti (2014)

- Local productivity in manufacturing assumed to be

$$\ln A_{it} = g\left(\frac{L_{it-1}}{R_i}\right) + \delta_t D_i + \eta_i + \gamma_t + \epsilon_{it}$$

- That is, local TFP is assumed to depend on
  - past density of manufacturing employment: $\frac{L_{it-\mathbf{1}}}{R_i}$
    (technological externalities/thick labor markets; R_i is square milage)
  - additional investment from TVA: D_i
    (0/1 for TVA participation, note that δ_t varies over time)
  - time-invariant suitability of the county for manufacturing: η_i
    (e.g. proximity to a body of water)
  - calendar year: γ_t
    (captures overall changes in technology etc.)
  - idiosyncratic shocks: ϵ_{it}
    (changes in local infrastructure, regulatory environment etc.)

Implications of the model

Kline, Moretti (2014)

- The steady-state impact of a marginal increase in productivity due to TVA on manufacturing output in county i

$$\frac{dY_i}{d\delta} = \frac{1}{1-\alpha} Y_i \left(D_i + \frac{1-\alpha-\beta+\sigma_i}{L_i} \frac{dL_i}{d\delta} \right)$$

- Direct impact of TVA: $\frac{1}{1-\alpha} D_i$
  - larger than 1 and increases with capital share α, because productivity improvements increase steady-state capital stock
    - recall that D_i is a 0/1 variable for the location being part of the TVA

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  - larger than 1 and increases with capital share α, because productivity improvements increase steady-state capital stock
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- Indirect effect
  - through increasing manufacturing labor: $dL_i/d\delta$
  - ... and through local agglomeration elasticity, $\sigma_i = g' \left(\frac{L_i}{R_i} \right) \frac{L_i}{R_i}$
- Impact on national output: sum over all counties

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Kline, Moretti (2014)

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- Indirect effect due to labor reallocation is ambiguous
  - moving a worker from i to j raises aggregate output iff

$$\frac{Y_i}{L_i}(1-\alpha-\beta+\sigma_i) < \frac{Y_j}{L_j}(1-\alpha-\beta+\sigma_j)$$

  - depends on average labor productivity, $\frac{Y_i}{L_i}$, and agglomeration elasticity, σ_i, in each county

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- That is, aggregate productivity can increase if
  - workers are pushed to higher productivity places
  - and/or agglomeration economies increase *more* in j than they decrease in i (this is what nonlinearities in $g(\cdot)$ mean)

Implications of the model

Kline, Moretti (2014)

- Case 1: amenities equal across the two communities
  - thus wages and productivity must also be equal
  - reallocation from i to j raises output if $\sigma_i < \sigma_j$
  - if $\sigma_i = \sigma_j$ benefits in j equal loses in i (no aggregate effect)

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- Case 2: amenities differ, $\sigma_i = \sigma_j$
  - aggregate output can be raised by moving workers to lower amenity areas where wages (and thus productivity) are higher
  - but: creates a utility cost that perfectly offsets the value of increases in aggregate output

Empirical results

Kline, Moretti (2014)

- Predictions from the structural model closely in line with the reduced-form estimates
  - suggests that the required (strong) assumptions are reasonable
- The key results
  - agglomeration economies have a constant elasticity wrt manufacturing density
    $\rightarrow$ policies that just reallocate manufacturing unlikely to increase aggregate welfare
- Implies a **unique steady-state** because
  - TVA investment depreciates over time, $A_i \downarrow$
  - production function includes locational fundamentals

Conclusions

Kline, Moretti (2014)

- KM find important agglomeration economies in manufacturing
  - but no indication for agglomeration economies in agriculture
- In KM's model, multiple equilibria requires nonlinearities in the agglomeration forces
  - empirical estimates do not provide support for the existence of such nonlinearities
- National impact due to improving (aggregate) infrastructure, *not* from labor reallocation
  - "although agglomeration economies represent an important market failure at the local level, this failure does not provide a rationale for federal intervention [...] We caution, however, that [...] our results are specific to the manufacturing sector and a period of U.S. history"

Papers for the essays

- Bleakley and Lin (2012): Portage and Path Dependence. *QJE* 127(2): 587–644
  - This paper documents the continuing importance historical portage sites for the current economic geography of the U.S. (even though their original advantages have long since become obsolete).
- Alsan (2015): The Effect of the TseTse Fly on African Development. *American Ecoomic Review* 105 (1): 382-410
  - This paper finds support to the hypothesis that parasites transfered by the TseTse fly reduced the ability of Africans to generate an agricultural surplus historically. This resulted in less (precolonial) political centralization, which may affect economic performance still today.

Appendix

Pre-TVA averages (1930) back

Kline, Moretti (2014)

	TVA	Non-TVA	Non-TVA South	Non-TVA proposed authorities
1930 characteristics				
Log population	9.991	9.977	9.989	9.940
Log employment	8.942	8.967	8.959	8.908
Log # of houses	8.445	8.508	8.455	8.466
Log average manufacturing wage	1.406	1.802	1.545	1.685
Manufacturing employment share	0.075	0.090	0.080	0.077
Agricultural employment share	0.617	0.455	0.541	0.510
% White	0.813	0.885	0.722	0.830
% Urbanized	0.153	0.280	0.233	0.216
% Illiterate	0.088	0.045	0.092	0.060
% of Whites foreign born	0.002	0.059	0.013	0.020
Log average farm value	5.252	5.646	5.386	5.552
Log median housing value	9.271	9.581	9.360	9.452
Log median contract rent	8.574	9.030	8.679	8.834
% Own radio	0.079	0.296	0.114	0.210
Max elevation (meters)	1,576.190	2,364.531	1,068.943	1,758.893
Elevation range (max–min)	1,127.761	1,521.322	712.336	1,083.293
% Counties in South	1.000	0.342	1.000	0.554

TVA counties were significantly more agricultural, rural, and had lower manufacturing wages, housing values, agricultural

Pre-TVA trends (1920–30) back

Kline, Moretti (2014)

	TVA	Non-TVA	Non-TVA South	Non-TVA proposed authorities
Changes 1920–1930				
Log population	0.051	0.049	0.067	0.004
Log employment	0.082	0.096	0.111	0.045
Log # of houses	0.078	0.092	0.108	0.046
Log average manufacturing wage	0.117	0.217	0.108	0.172
Manufacturing employment share	−0.010	−0.035	−0.018	−0.018
Agricultural employment share	−0.047	−0.036	−0.047	−0.046
% White	0.012	−0.011	−0.010	0.000
% Urbanized	0.047	0.064	0.080	0.042
% Illiterate	−0.030	−0.014	−0.029	−0.019
% of Whites foreign born	−0.001	−0.023	−0.016	−0.012
Log average farm value	−0.013	−0.076	0.025	−0.182
# of Observations	163	2,326	795	828
# of States	6	46	14	25

This backwardness in levels coincides with some trend differences consistent with simple models of regional convergence (e.g., Barro and Sala-i-Martin 1991). In particular, the TVA region exhibited greater growth in manufacturing share than

Placebo test: "Effect" on the pre-TVA outcomes

Kline, Moretti (2014, QJE)

Outcome	(1) Point estimate (unadjusted)	(2) Clustered std. err.	(3) Point estimate (controls)	(4) Clustered std. err.	(5) Spatial HAC	(6) N
Panel C: TVA region versus proposed authorities						
Population	0.026	(0.019)	0.011		(0.016)	926
Total employment	−0.012	(0.017)	0.006		(0.015)	926
Housing units	−0.014	(0.016)	0.006		(0.013)	926
Average manufacturing wage	0.012	(0.015)	0.008		(0.017)	734
Manufacturing share	0.007	(0.006)	0.005		(0.006)	926
Agricultural share	−0.005	(0.006)	0.004		(0.006)	926
Average agricultural land value	0.080***	(0.026)	0.017		(0.018)	908

Estimates interpreted as average differences in 10-year growth rates experienced by TVA counties relative to non-TVA counties between 1900–1940. Only the change in agricultural land values statistically different (before adjusting for observables). Results using only the U.S. South and adjusted estimates for the entire U.S. are similar, see Table II in the paper.

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