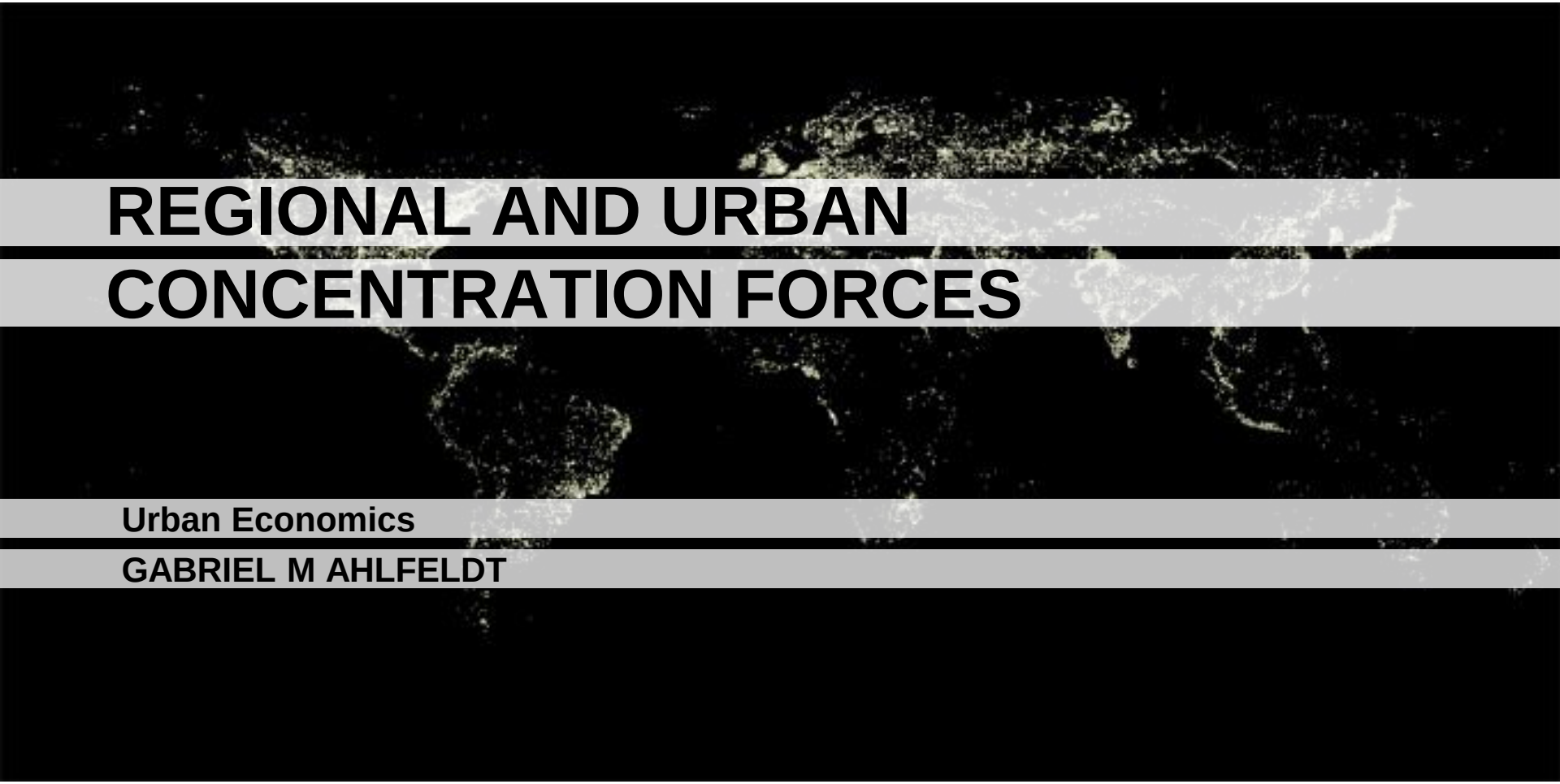


# REGIONAL AND URBAN CONCENTRATION FORCES

Urban Economics

GABRIEL M AHLFELDT

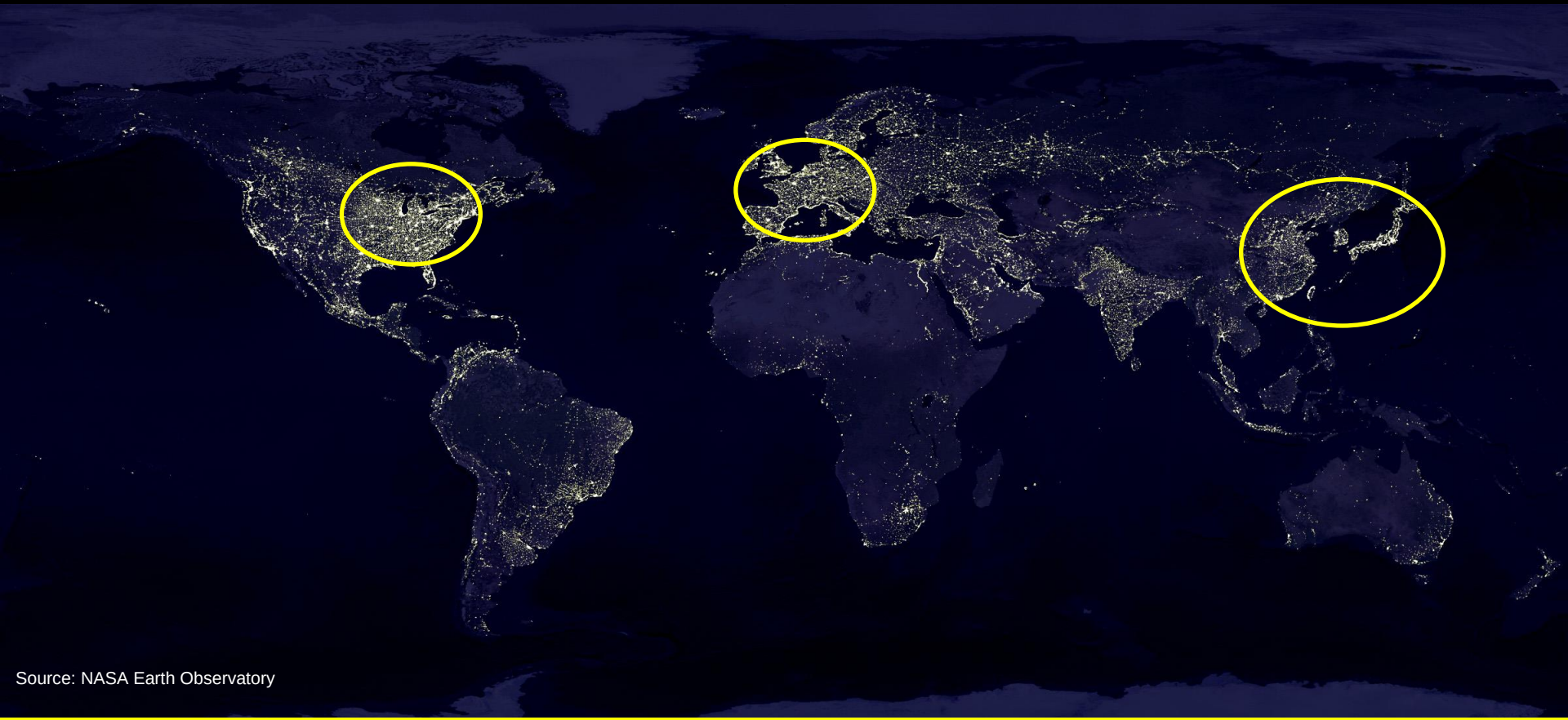
# I COURSE COMPONENTS

the idea

- Block I
  - Introduction to Urban and Regional Economics and Course Overview
  - **Topic I: Regional and urban concentration forces**
  - Topic II: The empirics of agglomeration
  - Topic III: Costs and benefits of agglomeration
- Block 2
  - Topic IV: Monocentric city I (household location choice)
  - Topic V: Monocentric city II (household location choice)
  - Topic VI: Firm location choice
  - Topic VII: The urban economy in general equilibrium
- Block 3
  - Topic VIII: The vertical dimension of cities
  - Topic IX: Suburbanization and gentrification
  - Topic X: Spatial inequalities

# I INTRODUCTION

## the idea



Source: NASA Earth Observatory

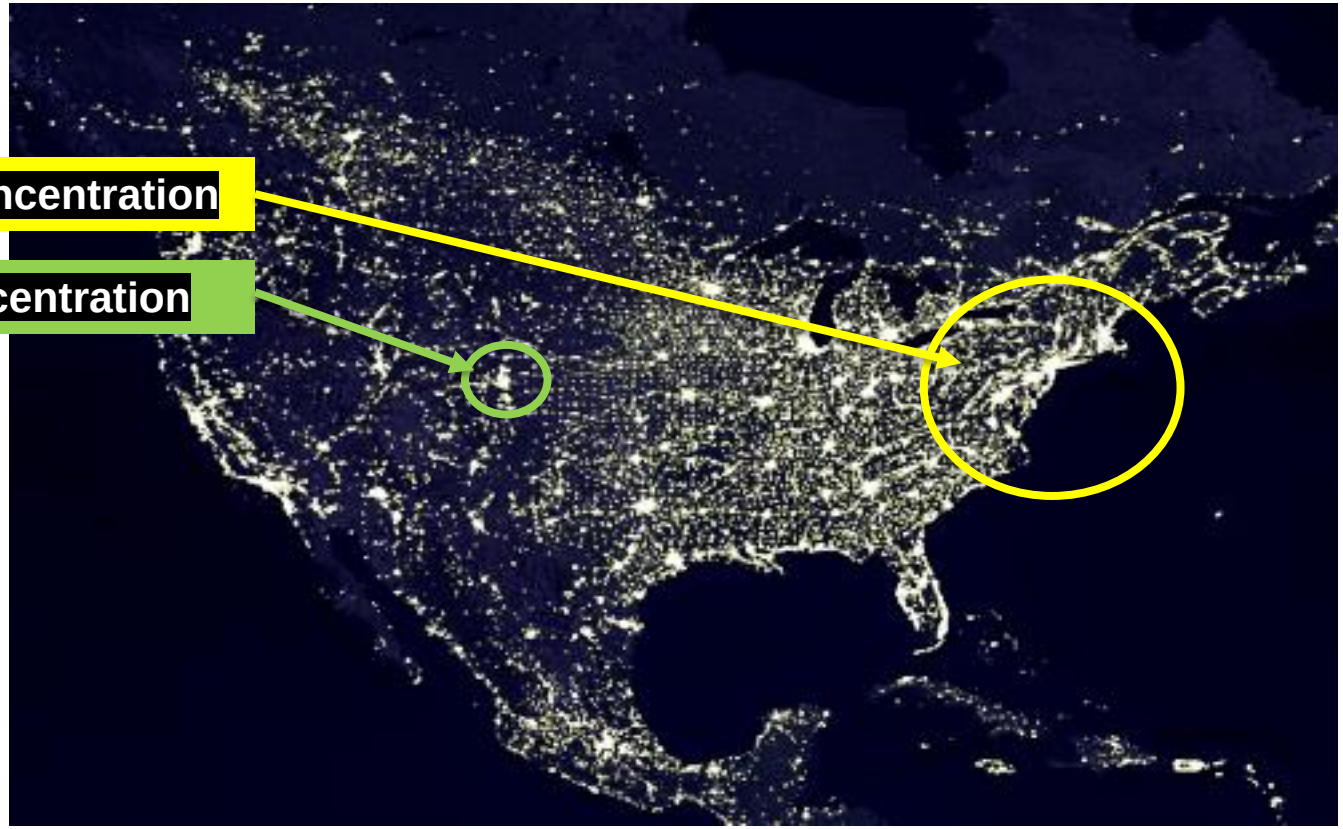
**More than 50% of the world population lives in cities on only 2.7% land (GRUMP)**

**Spatial distribution of economic activity is highly unequal**

# I INTRODUCTION

the idea

- Spatial concentration in regions vs. spatial concentration in cities / metro areas




Source: NASA Earth Observatory

# I INTRODUCTION

## the idea

- Spatial concentration in regions vs. spatial concentration in cities / metro areas


Source: NASA Earth Observatory

# I INTRODUCTION

the idea

- Spatial concentration in regions vs. spatial concentration in cities / metro areas

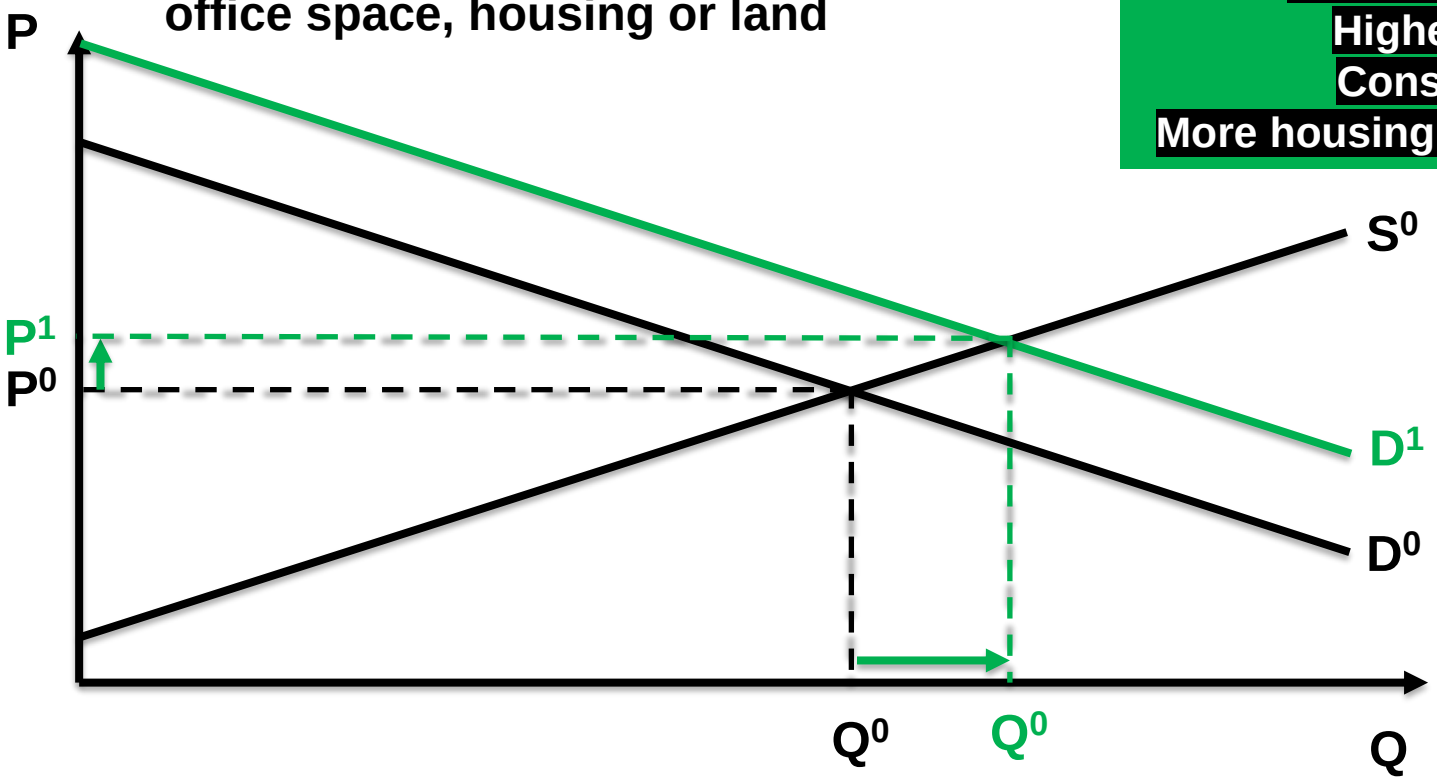

Source: NASA Earth Observatory

# I INTRODUCTION

the idea

- **Determinants of regional and urban concentration determine demand within a *real estate market***
  - **Consider a local market for office space, housing or land**

**More residents and firms:**
**More demand c.p.**
**Higher prices**
**Construction**
**More housing and office space**



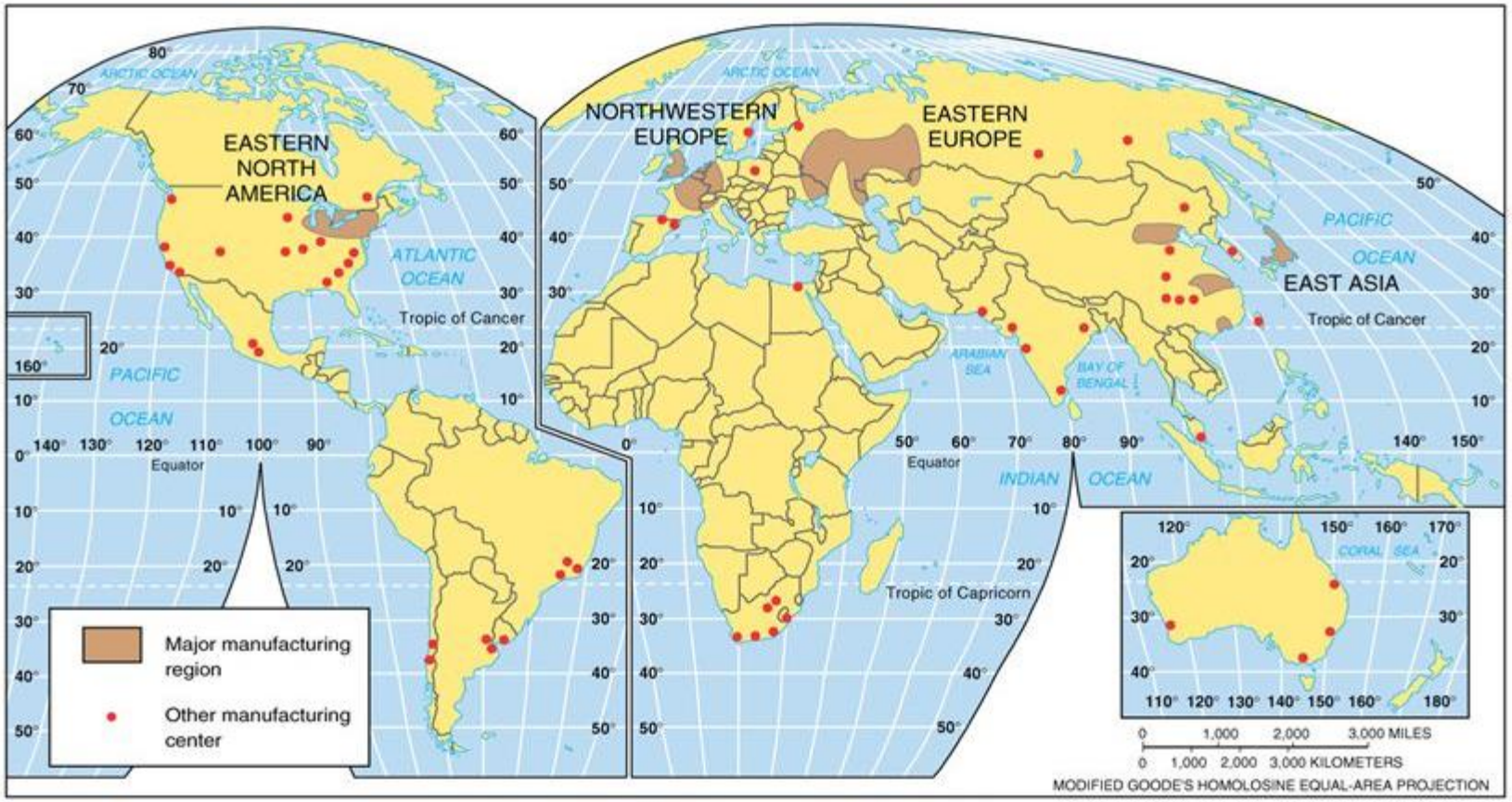
# II WHY DO LARGE INDUSTRIAL REGIONS EXIST?

the idea

- **1) Why do large industrial regions exist?**
  - **Location fundaments**
  - **Transport costs (Krugman)**
- **2) Why do firms and workers cluster in cities?**
  - **Location fundamentals**
  - **Classic location theory (Weber)**
  - **Agglomeration theory (Marshall)**

# II LARGE INDUSTRIAL REGIONS OF THE WORLD

spatial concentration in regions

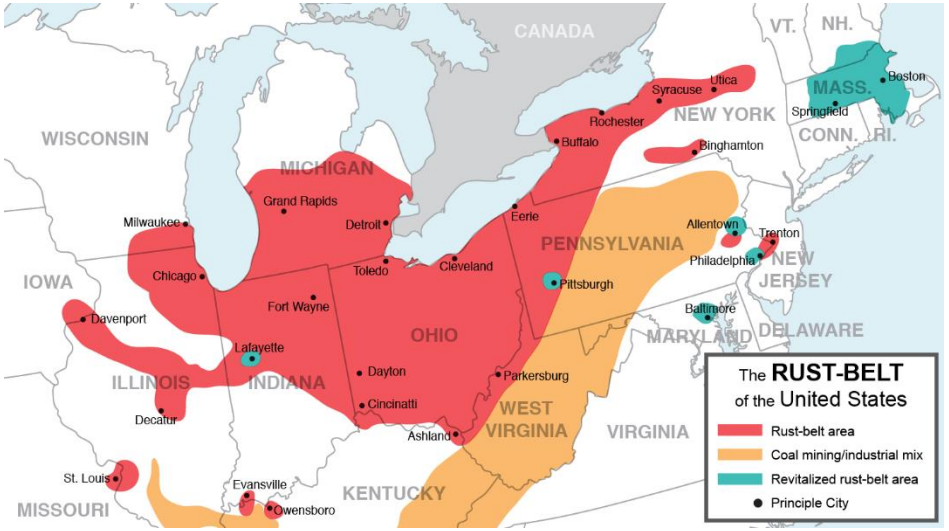


# II LOCATION FUNDAMENTALS

spatial concentration in regions

- **Some locations have high „fundamental value“**
- **Industrial regions often close to natural resources, e.g. coal**
- **Emergence of such clusters often dates back to industrial revolution (1760-1860)**
  - **Coal critical input into industrial production**
- **Access to natural resources historically important**

**Q: How relevant are transport cost (goods/inputs) today ?**

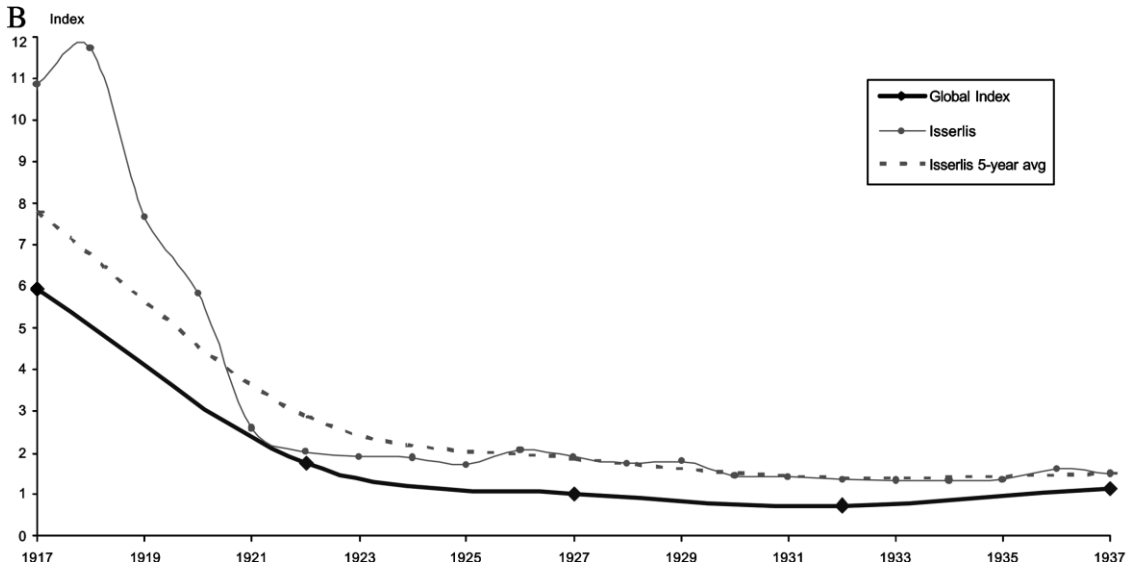


# II TRANSPORT COST

spatial concentration in regions

**Transport cost decreased rapidly from 1870 to 1930**

**Since then very stable at low levels!**


**Q: How to get spatial concentration at the regional level with low transport cost?**

(c) Mohammed, Williamson (2004)

# II PAUL KRUGMAN

spatial concentration in regions

- **Nobel Prize in Economics in 2008**
- **Columnist for The New York Times**
- **Centenary Professor at the *London School of Economics***
  - **Among the most influential economists in the world**

***"By 2005 or so, it will become clear that the Internet's impact on the economy has been no greater than the fax machine's"***

**Paul Krugman, 1998**

- **Did not win the Nobel Prize for predicting technology but for *New Economic Geography* and *New Trade…***

# II CORE-PERIPHERY MODEL

spatial concentration in regions

- **Krugman's (1991) seminal paper**
  - **Increasing returns and Economic geography**
- **Ingredients:**
  - **Increasing returns at the level of the firm**
  - **Transport (trade) costs**
  - **Factor mobility**

**Increasing returns create an incentive to agglomerate production**

**Transport cost create an incentive to produce close to customers**

**With increasing returns and low transport cost manufactures concentrate in a "core" from where they supply the agricultural "periphery"**

# II A SIMPLE VERSION OF THE C-P MODEL

spatial concentration in regions

- Two regions: E and W
- Mobile firms
  - 6 immobile farmers, three in each region
  - 4 mobile workers, distribution depends on scenario
- Total population is 10
  - Each worker demands one unit of good inelastically
- Fixed cost for each manufacturing plant is 4
  - No variable cost
- Trade cost for manufactured good (produce shipped for free)
  - 0 within region; 1 per unit of manuf. goods across regions

**Q: Where are the "increasing returns"?**

# II CASE C

spatial concentration in regions

**More cases in the appendix: Check them out as homework**

- **Mobile workers are in E and W**

| | Production in E | | Production in E & W | | Production in W | |
|---|---|---|---|---|---|---|
| | E | W | E | W | E | W |
| **Farmers** | 3 | 3 | 3 | 3 | 3 | 3 |
| **Workers** | 2 | 2 | 2 | 2 | 2 | 2 |
| **Population** | 5 | 5 | 5 | 5 | 5 | 5 |
| **Goods shipped** | 5 | | 0 | | 5 | |
| **Fixed plant cost** | 4 | | 8 | | 4 | |
| **Shipping cost** | 5 | | 0 | | 5 | |
| **Total cost** | 9 | | 8 | | 9 | |

**Case C: Cost-minimizing option is concentration of production in E and W**

**=> Dispersion**

# II CASE F

spatial concentration in regions

- **All mobile workers in E and W & <u>trade cost diminishes to 0.5</u>**

| | Production in E | | Production in E & W | | Production in W | |
|---|---|---|---|---|---|---|
| | E | W | E | W | E | W |
| **Farmers** | 3 | 3 | 3 | 3 | 3 | 3 |
| **Workers** | 2 | 2 | 2 | 2 | 2 | 2 |
| **Population** | 5 | 5 | 5 | 5 | 5 | 5 |
| **Goods shipped** | 5 | | 0 | | 5 | |
| **Fixed plant cost** | 4 | | 8 | | 4 | |
| **Shipping cost** | 2.5 | | 0 | | 2.5 | |
| **Total cost** | 6.5 | | 8 | | 6.5 | |

**Case F: Cost-minimizing option is concentration of production in E OR W**

**=> Agglomeration (unlike C!!!)**

**Small shocks (butterfly) can cause agglomeration in either region**

# II SUMMARY OF PREDICTIONS

spatial concentration in regions

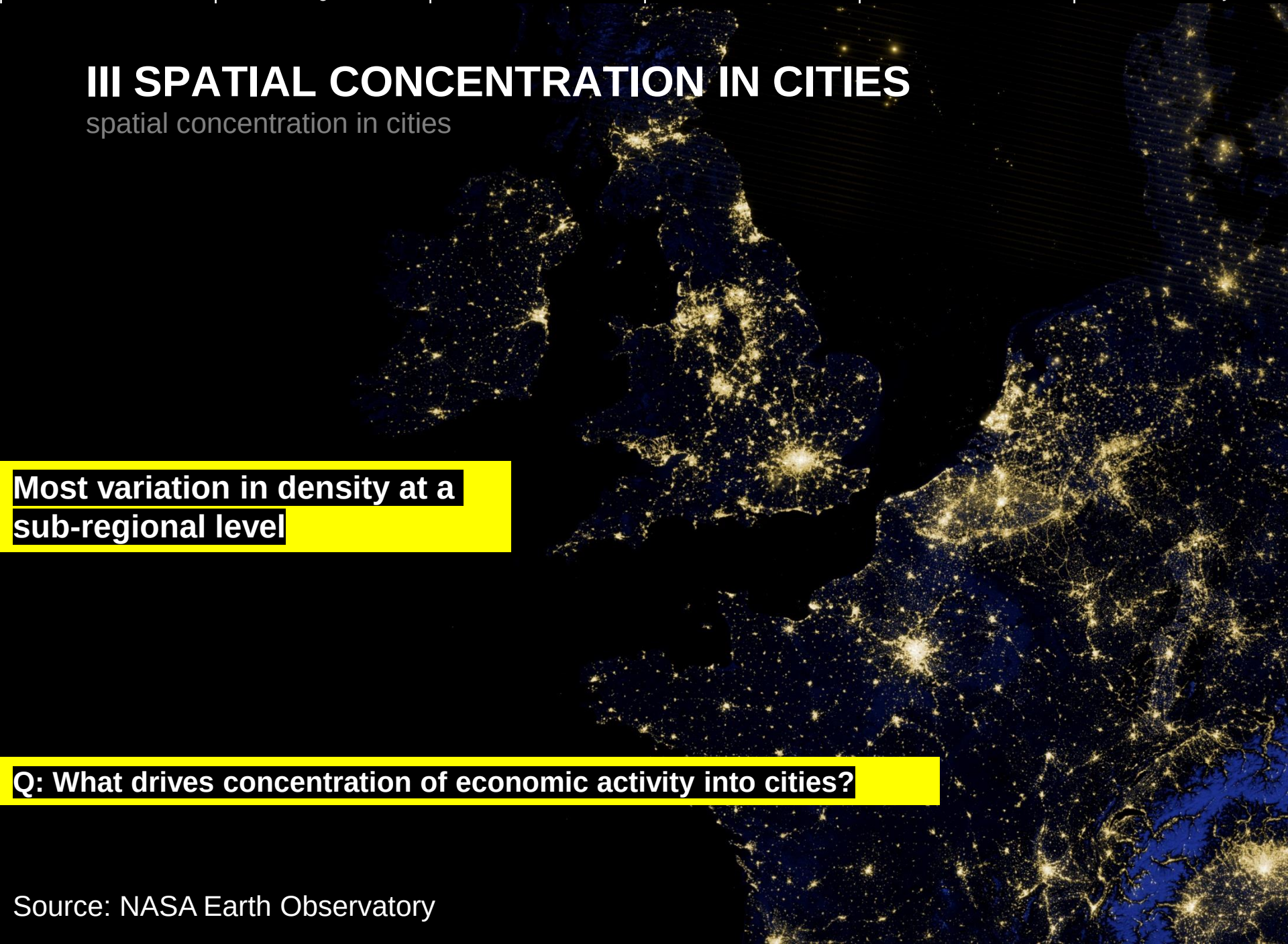
- **For high transportation costs dispersion is the only outcome**
- **For low transportation costs agglomeration is the only outcome**
- **For intermediate transportation costs, both outcomes may be possible**
- **A priori, agglomeration can take place in any region, leaving a strong role to chance, history and expectations**
  - Note that Krugman's Core-Periphery model is much richer.
    Manufacturing workers move to regions with high wages.
    Competition among firms affects prices and wages.
    Market access affects firms' ability to pay high nominal wages.

**But main insights regarding the interplay of increasing transport costs and agglomeration remain the same**

**=> We can rationalize spatial concentrations in regions today**

# III SPATIAL CONCENTRATION IN CITIES

spatial concentration in cities



**Most variation in density at a sub-regional level**

**Q: What drives concentration of economic activity into cities?**

Source: NASA Earth Observatory

# III WHY DO CITIES EXIST

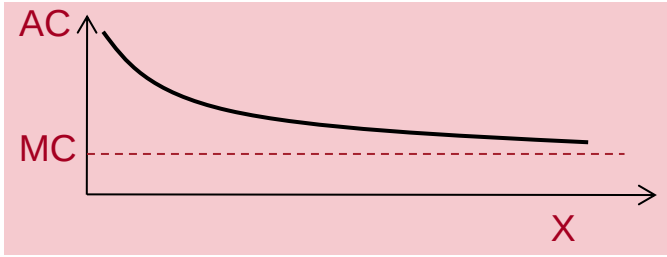
spatial concentration in cities

- 1) Why do large industrial regions exist?
  - Location fundaments
  - Transport costs (Krugman)
- **2) Why do firms and workers cluster in cities?**
  - **Location fundamentals**
  - **Agglomeration theory (Marshall)**

# III TRADING CITIES

spatial concentration in cities

- **A1 Comparative** advantages (factor productivity)
  - Differences in geography, institutions, traditions, etc.
  - Cities/regions/countries specialize and **trade**
- **A2 Scale economies** in **exchange**
  - Indivisible inputs – trucks, ships, etc.
  - Worker specialization
    (including complementary services (insurance, etc.)
- Favourable **geography**
  - E.g. natural harbour, rail lines, etc.
- **Concentration of trade workers (due to high wages)**
  - Bidding up of land price, lower land consumption, higher densities
- Dominating concentration force **before industrial revolution**
  - Athens, ... , New York

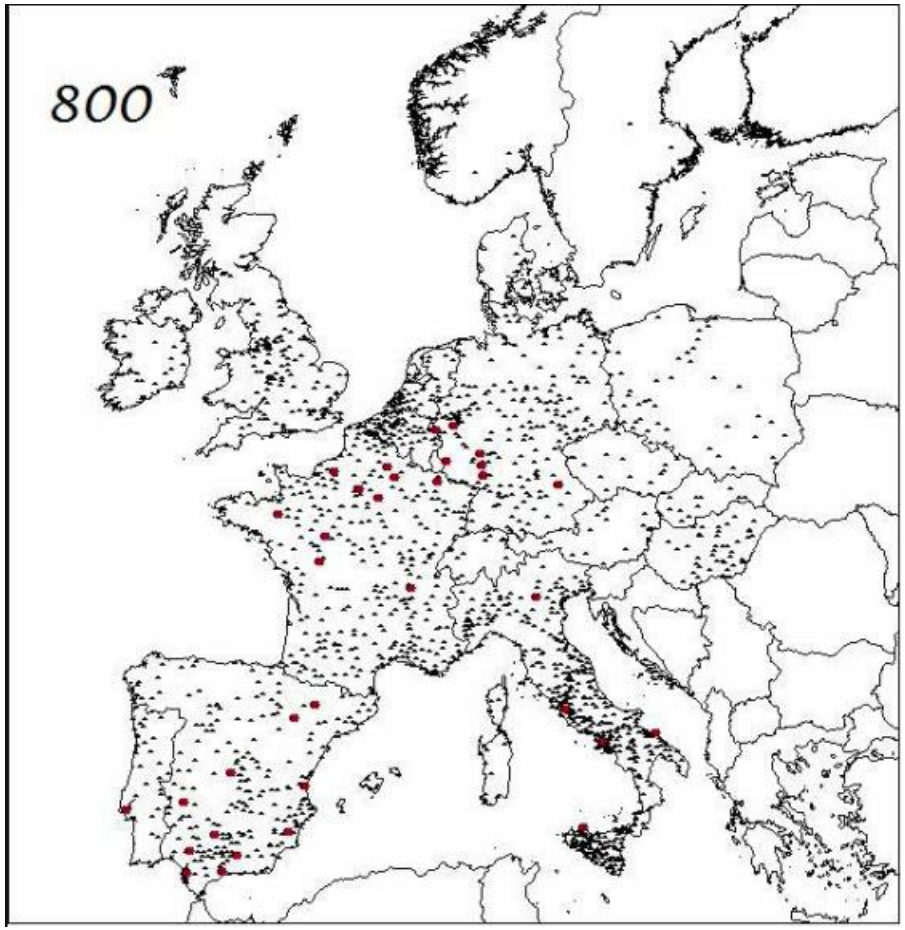



***Location fundamentals!***

# III BOSKER & BURINGH (2017)

spatial concentration in cities

- **City formation in 900-1800 Europe**



# III BOSKER & BURINGH (2017)

spatial concentration

- **Determinants of city formation in 900-1800 Europe**
  - **Factors that matters for city foundation**
    - **Being close to**
      - **Sea or river**
      - **Roman road or road hub**
    - **Having a large city within 20km**
      - **Bad ⇒ "spatial" competition**
    - **Having a large city within 20-100km**
      - **Good ⇒ Trade**

**1st nature geography**

**2nd nature geography**

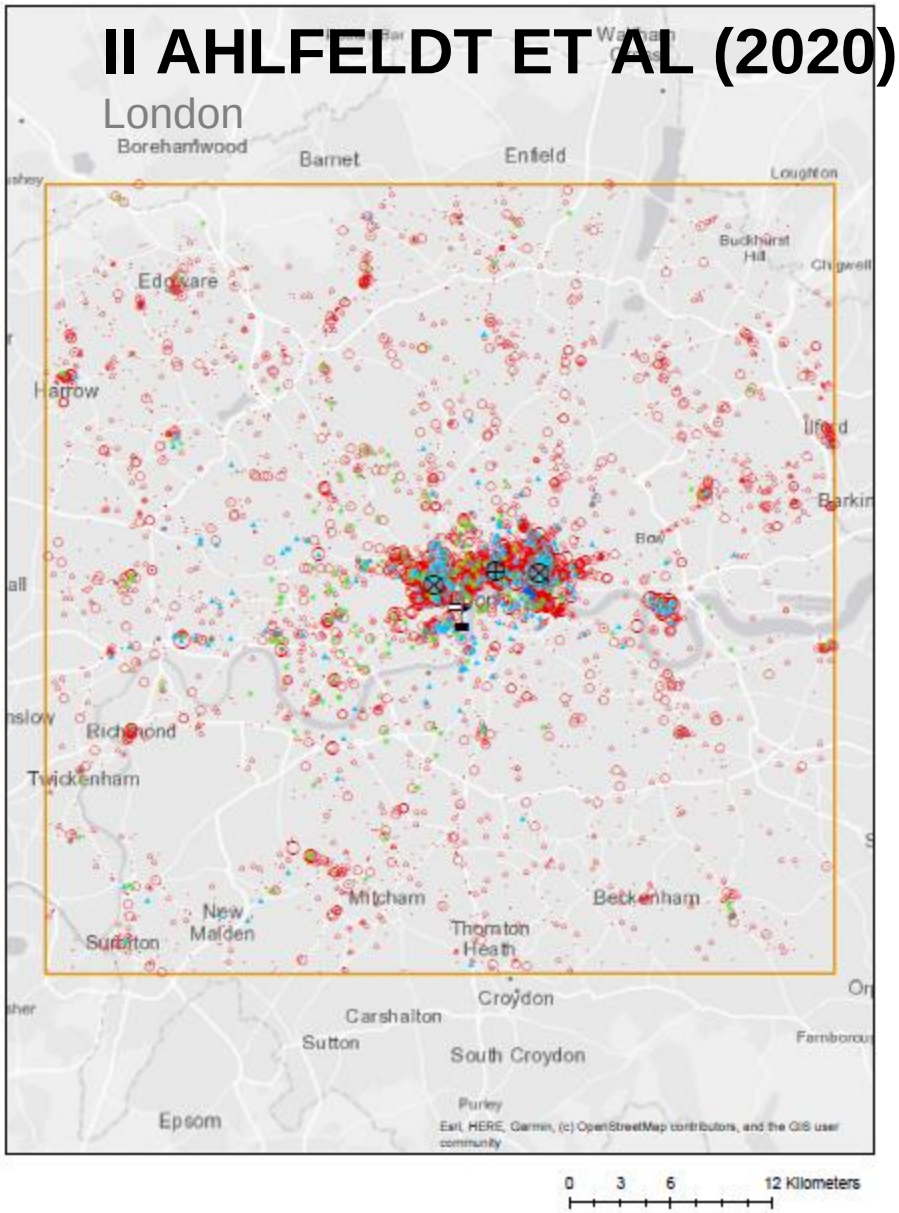
**Q: What sort of spatial competition?**

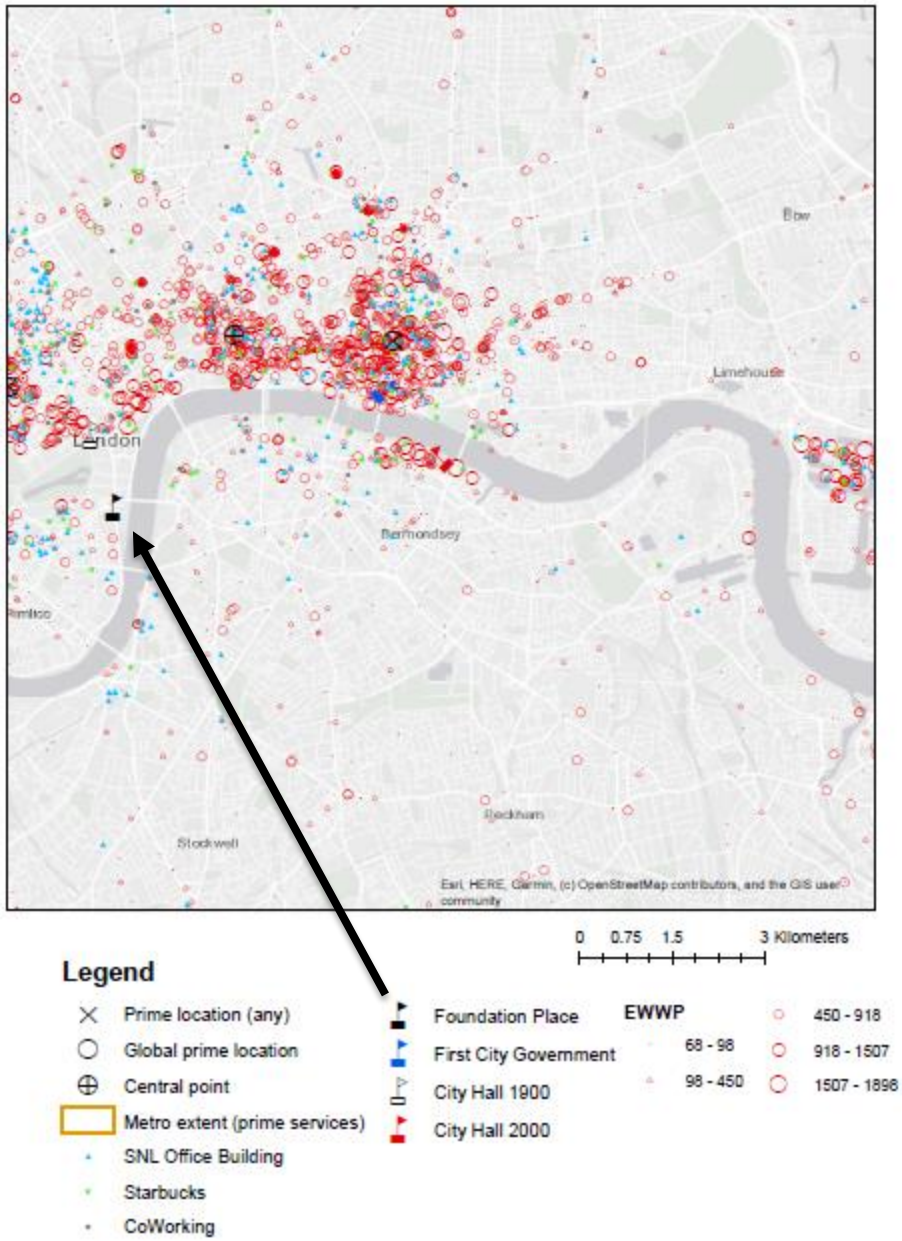
**Table 1**
Main results.

| | | 1 |
|---|---|---|
| | $P(city\ t \mid no\ city\ t-1)$ | BASELINE |
| $X_i$ | sea | 0.007*** |
| | | [0.00] |
| | river | 0.012*** |
| | | [0.00] |
| | hub | 0.069*** |
| | | [0.00] |
| | road | 0.004*** |
| | | [0.00] |
| | ln elevation | +0.00 |
| | | [0.98] |
| | ruggedness | 0.0001*** |
| | | [0.00] |
| | $P$(cultivation) | 0.0002** |
| | | [0.02] |
| $X_{it-1}$ | city >= 10k? $(t-1)$ | |
| | 0–20 km | −0.0005*** |
| | | [0.00] |
| | 20–50 km | 0.0002** |
| | | [0.02] |
| | 50–100 km | 0.0002*** |
| | | [0.00] |
| | $P(city\ t \mid no\ city\ t-1)$ unconditional | 0.0005 |
| | NUTS2/century FE | Yes |
| | Nr observations | 2,588,903 |
| | $p$-value [20–100 km > 0?] | [0.00] |
| | # NUTS regions | 247 |
| | % w/ useful variation | 23.6 |
| | % obs. in these NUTS | 28.9 |

# II AHLFELDT ET AL (2020)

London



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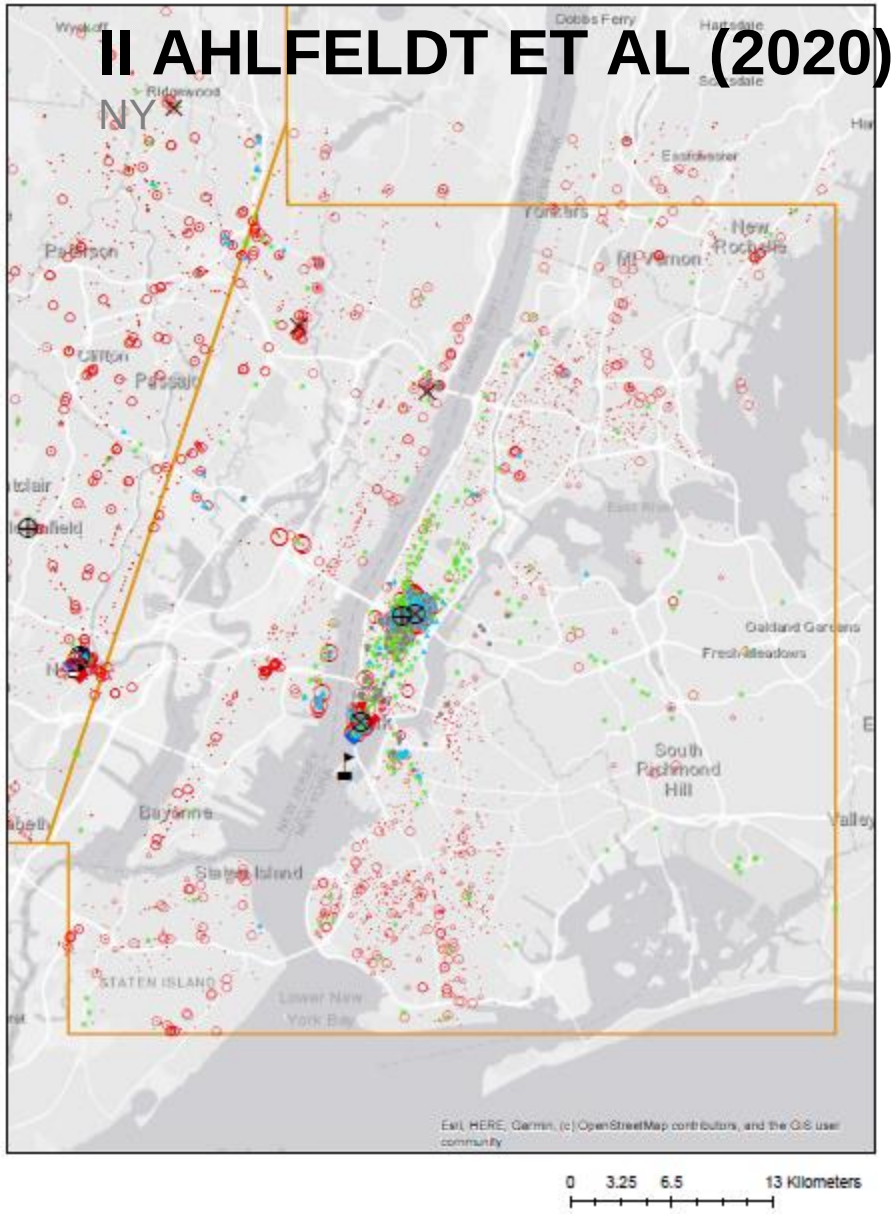
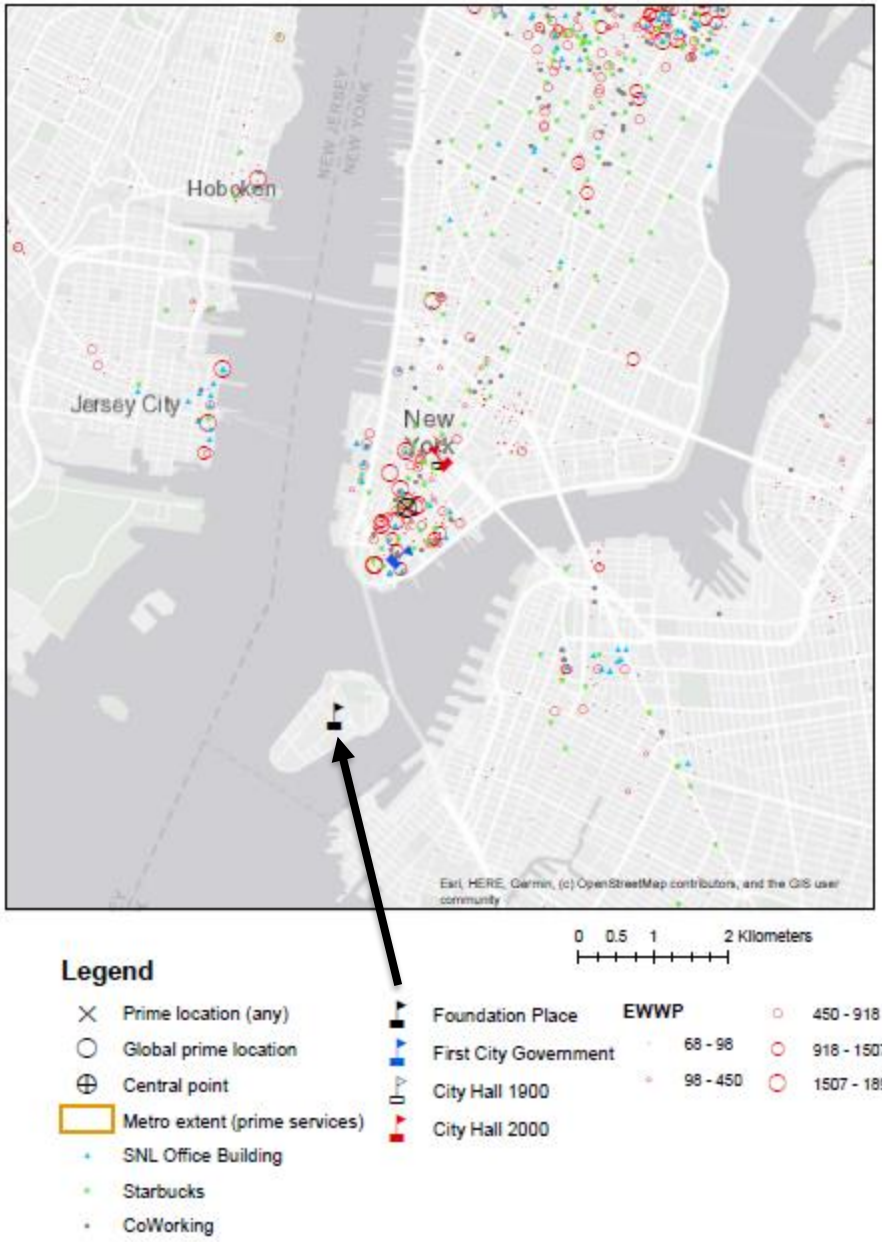
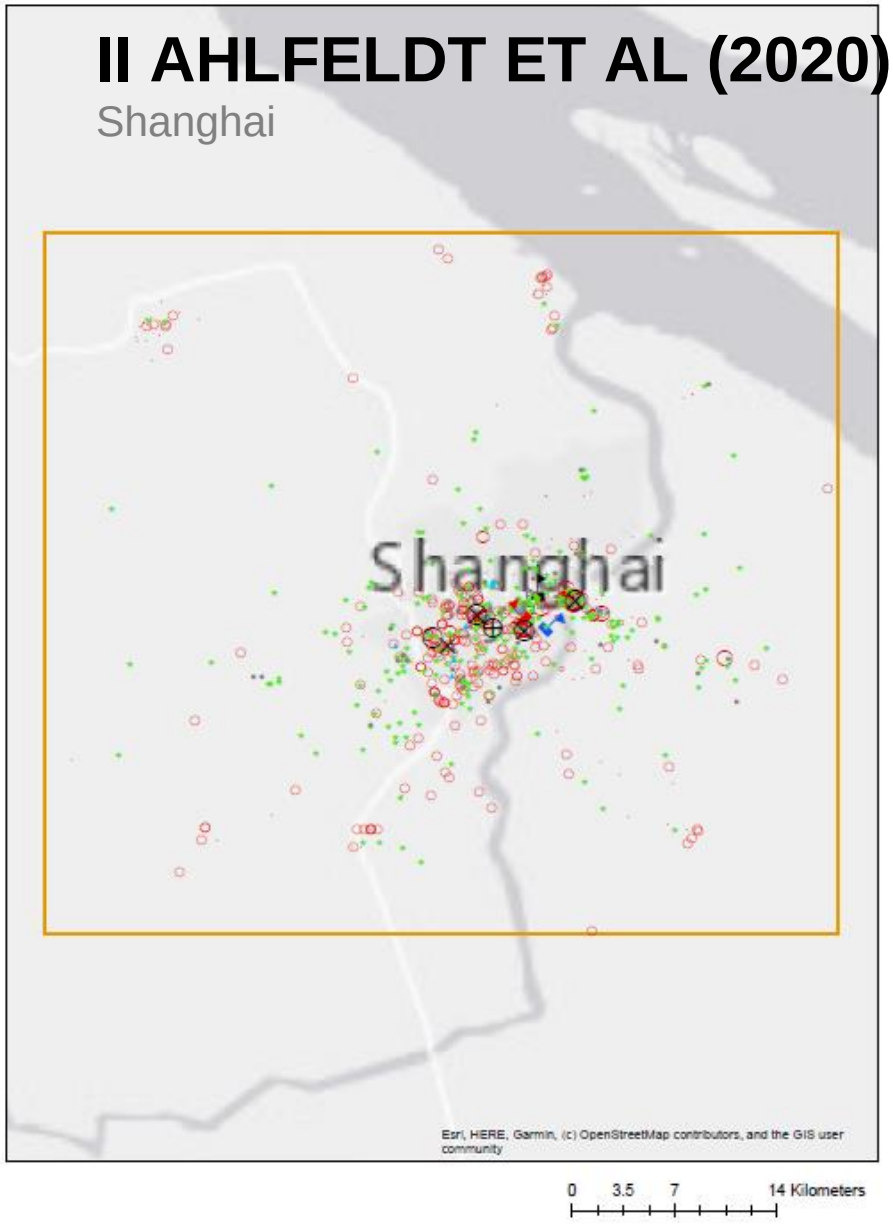
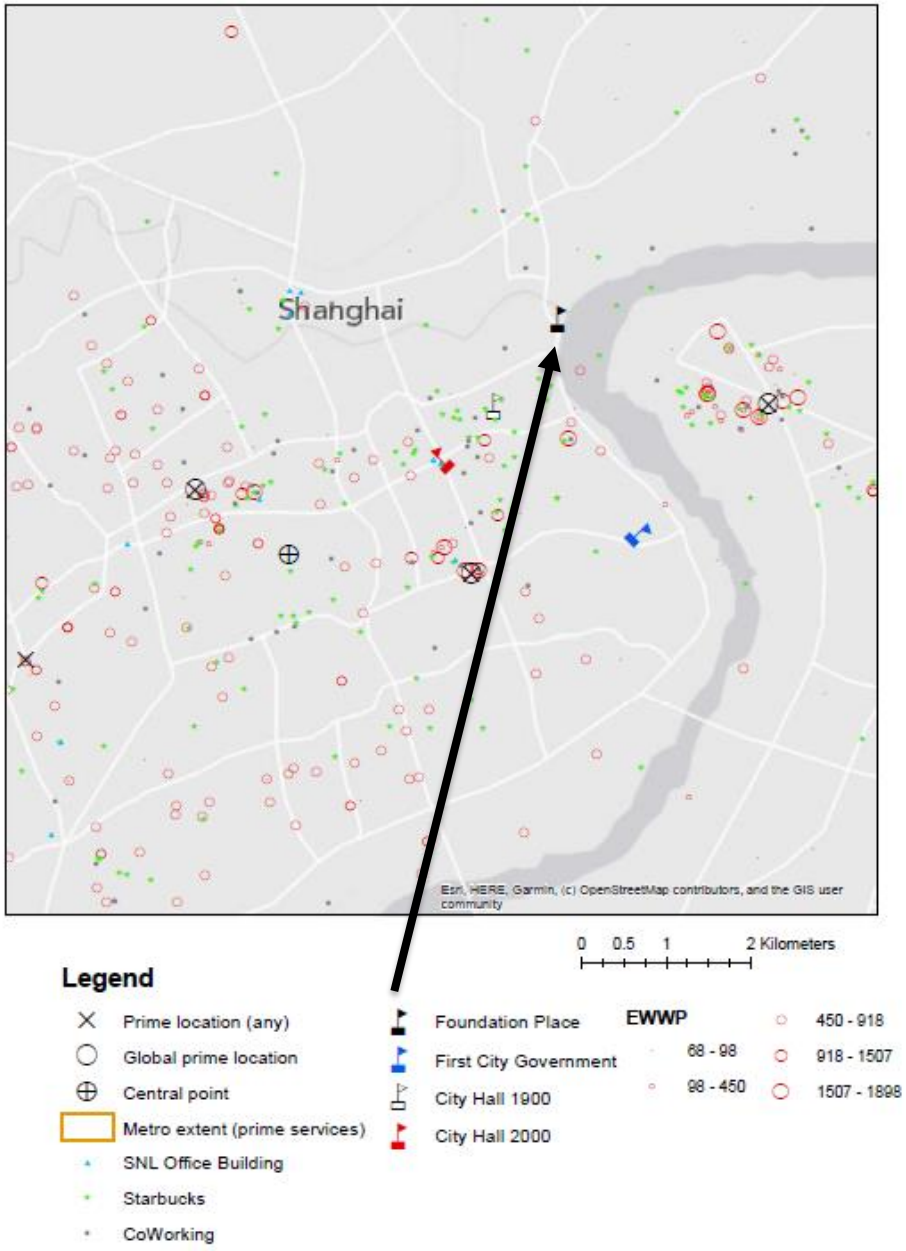


# II AHLFELDT ET AL (2020)

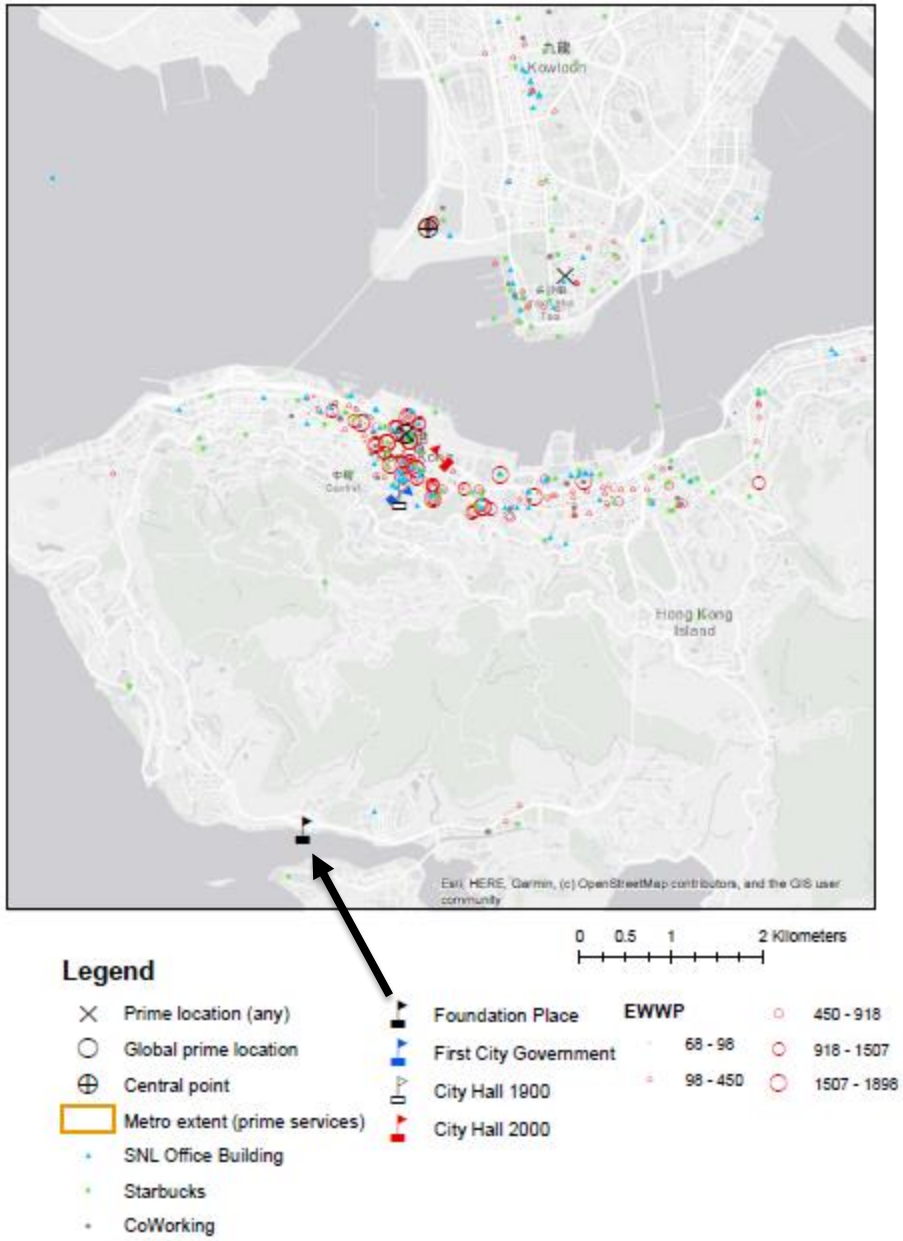
Shanghai



# II AHLFELDT ET AL (2020)

Hong Kong

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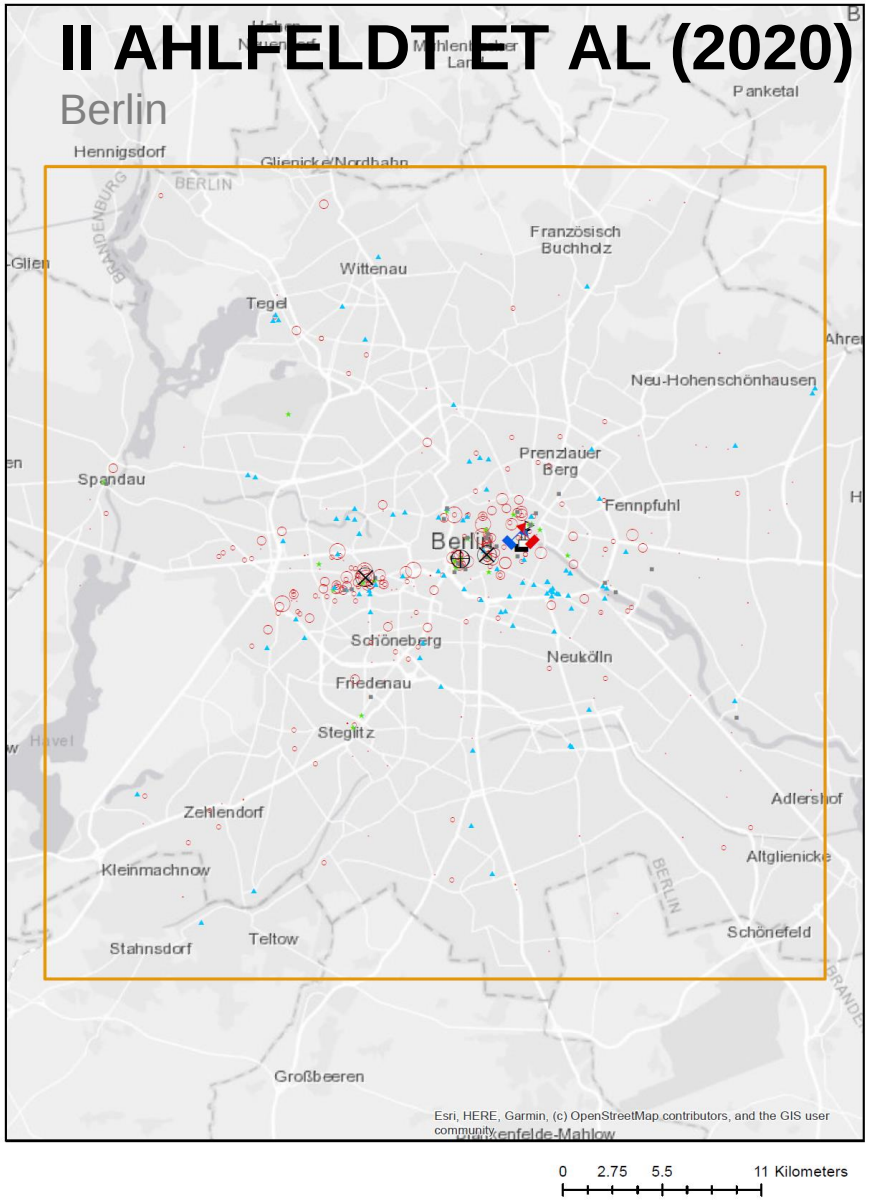
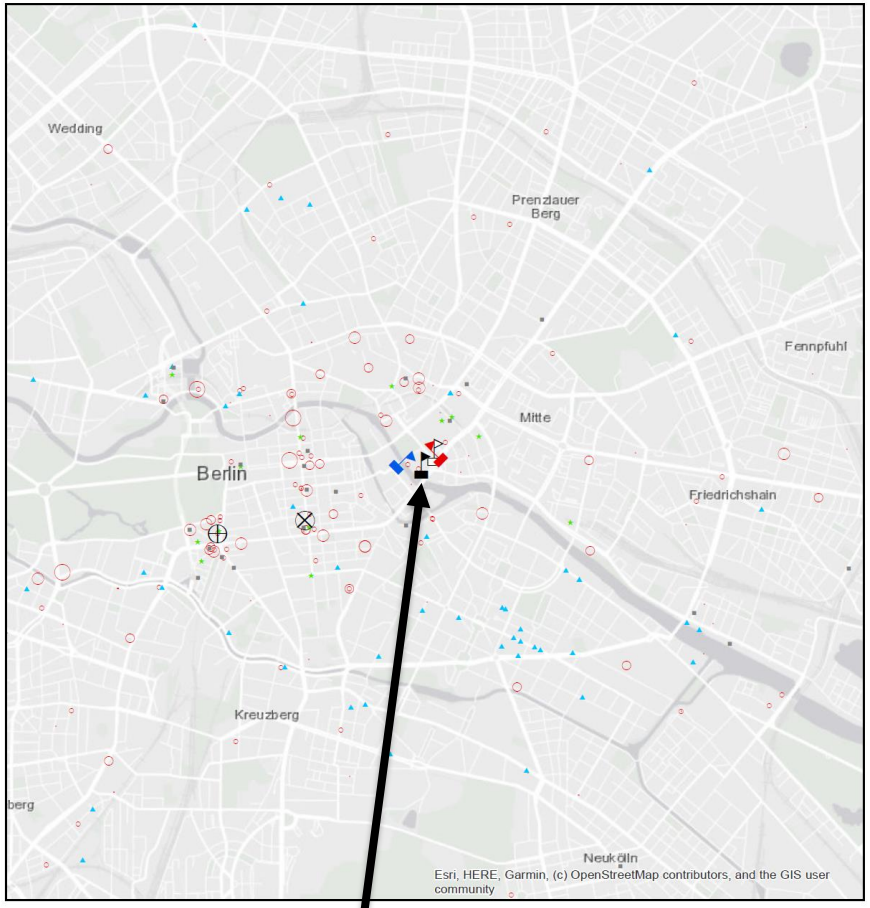



**Legend**

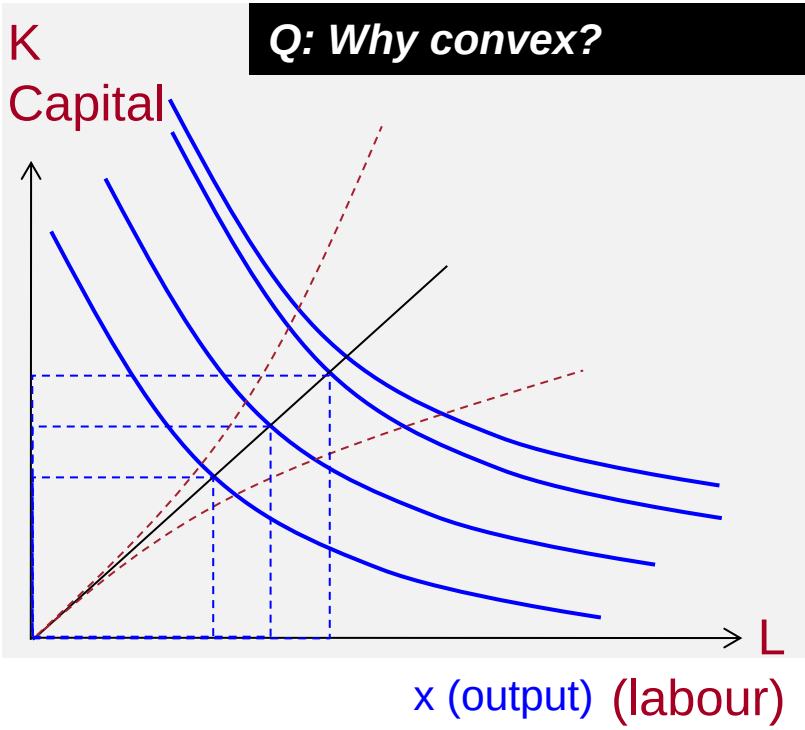
- Prime location (any)
- Global prime location
- Central point
- Metro extent (prime services)
- SNL Office Building
- Starbucks
- CoWorking
- Foundation Place
- First City Government
- City Hall 1900
- City Hall 2000

**EWWP**

- 68 - 98
- 98 - 450
- 450 - 918
- 918 - 1507
- 1507 - 1898

# III FACTORY CITIES

spatial concentration in cities

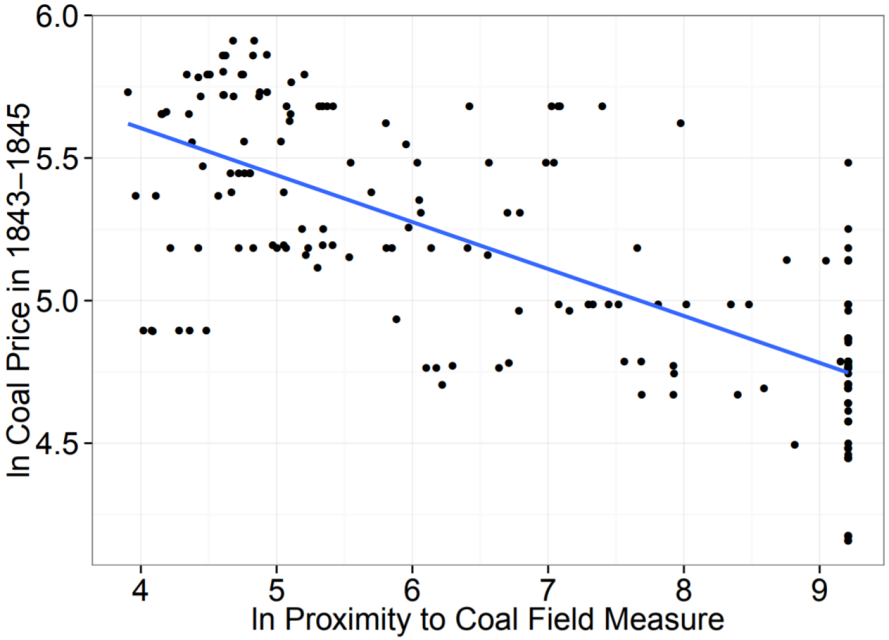


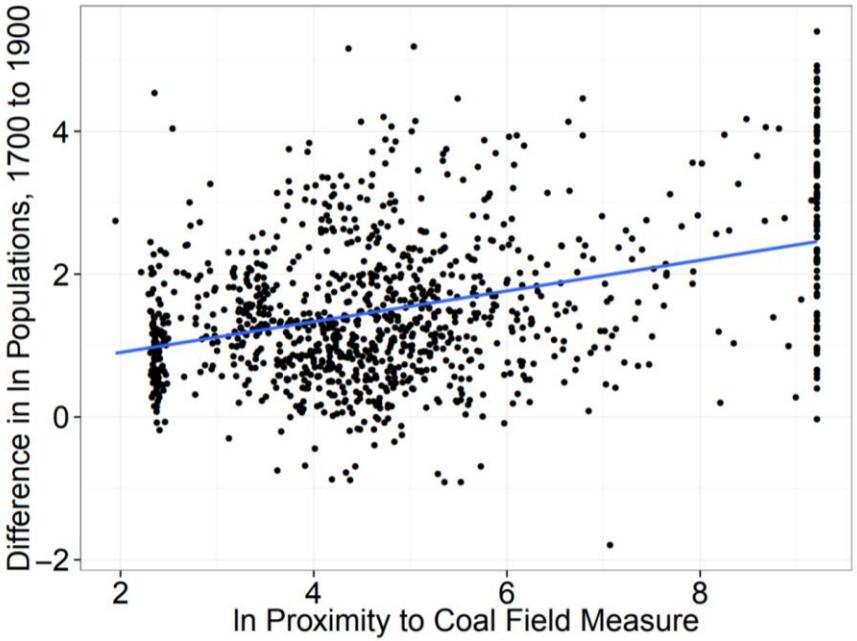

- **A1 Economies of scale** in **production**
  - Indivisible inputs – machines – fixed cost
  - Worker specialization
- Higher **productivity**
  - Higher wages
  - More worker within commuting range
  - Higher rents
- Factory towns
  - **Trade industrial** for **agricultural products** with their hinterlands (and with other factory cities, see C-P model)
  - Von Thuenen **transport cost** determines the **market area**
- Dominating **concentration force** during **industrialization**

**Q: Where did factory cities emerge?**

# III FERNIHOUGH & O'ROURKE (2014)

spatial concentration in cities



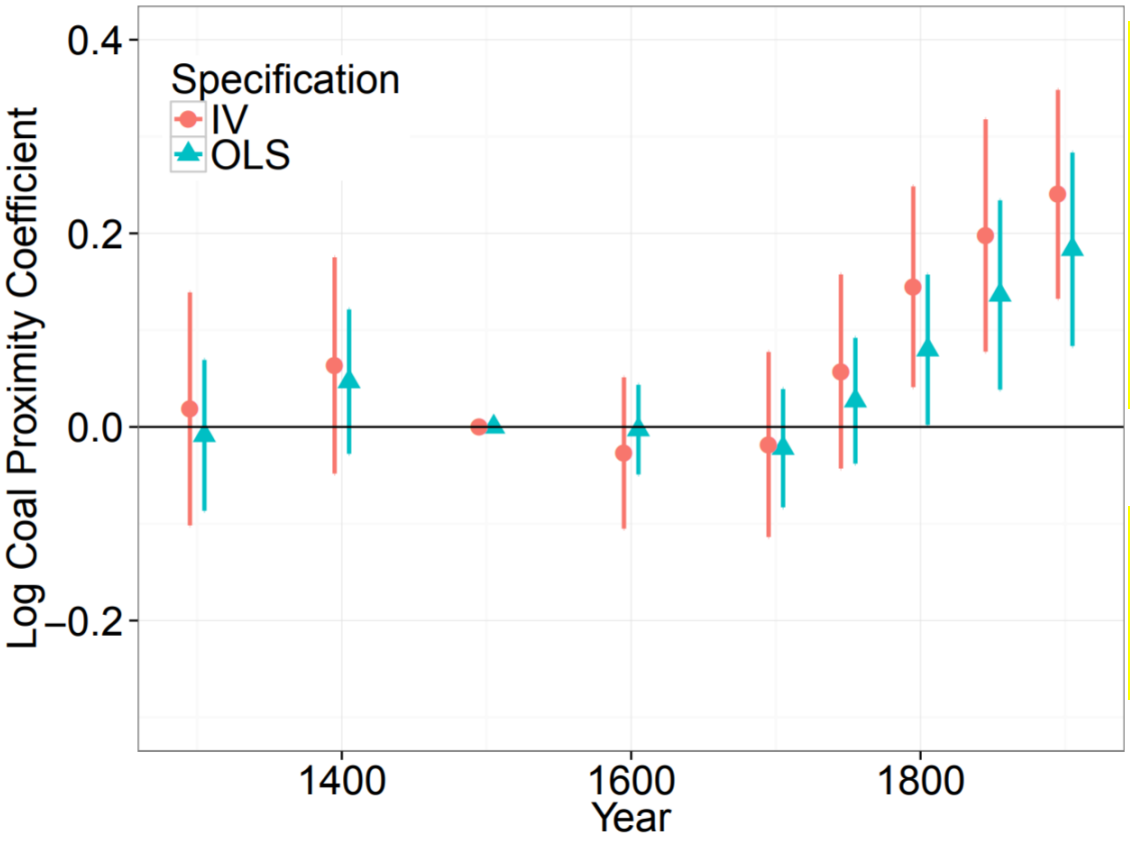

**Coal was much cheaper close to coal fields up until mid-19th century**

**Proximity to coal really "fuled" growth of "factory cities during 18th and 19th century**

# III FERNIHOUGH & O'ROURKE (2014)

spatial concentration in cities

(a) Model without Controls.




**"Cloal proximity effect" really emerges in the 19th century**

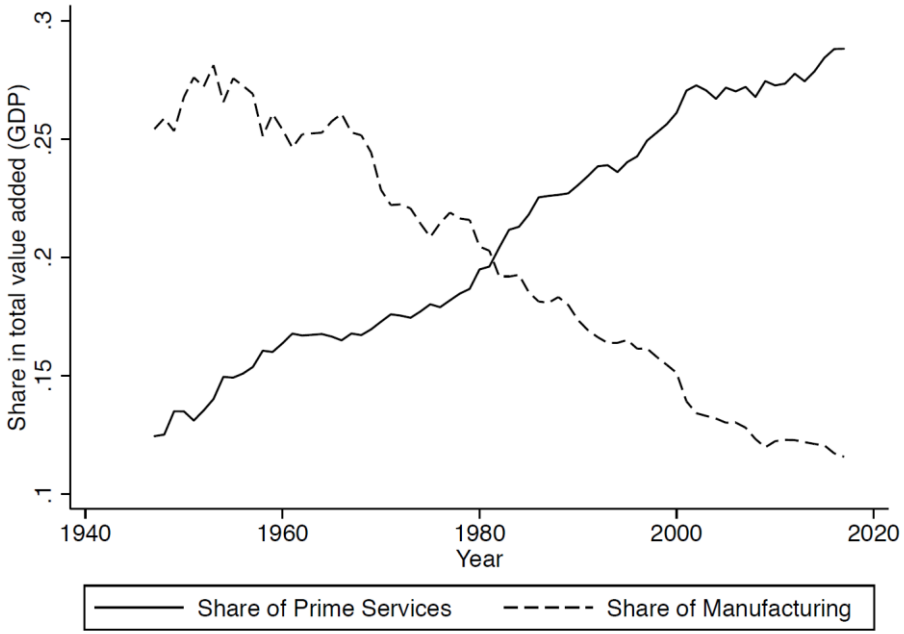
**But then, remember, from 1870s onwards transport cost radically declined …**

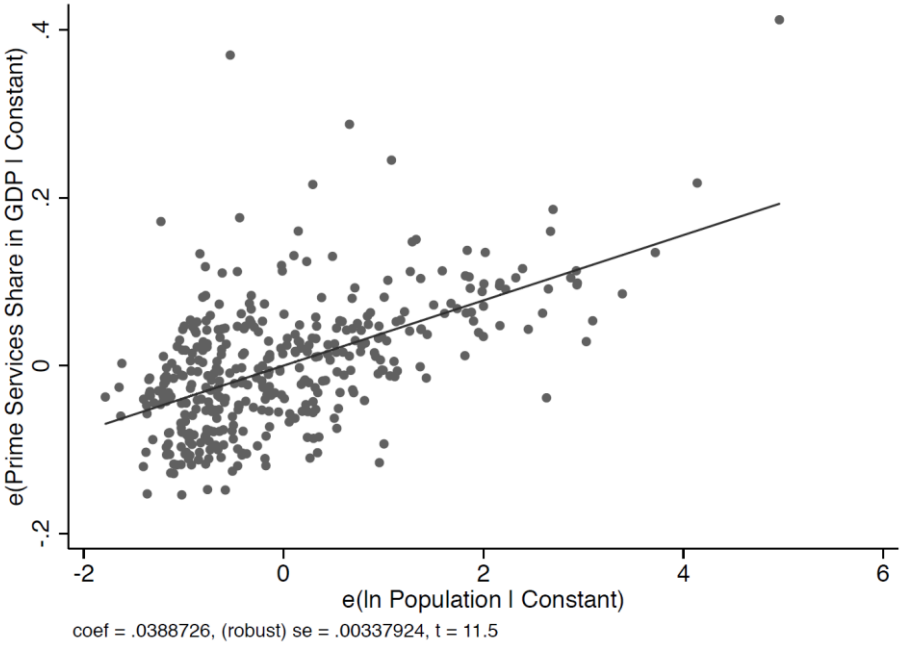
**Q: How important is manufacturing in "urban" production today?**

# III MANUFACTURING VS. "PRIME" SERVICES

spatial concentration in cities

Source: Ahlfeldt et al (2020)



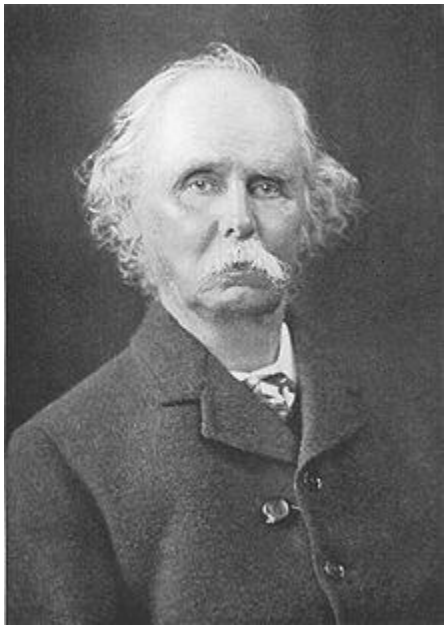

**Manufacturing decline vs. "knowledge-based tradable" (prime) services**

**Prime services particularly relevant in large agglomerations**

**Need explanations to rationalize existence of cities that apply to services**

# III AGGLOMERATION ECONOMIES

spatial concentration within cities



- **Alfred Marshall (1890) "*Principle of economics*"**
- **There are** city-specific costs
  - Congestion
  - Higher rents
  - Higher wages
    - Required to compensate for rents in equilibrium
- Firms in cities must be more **productive** to compensate for these costs
  - Emphasis is on **external returns** (coming from outside the firm)
    - As opposed to *internal returns* in the CP model
- Cities benefit from co-location of goods/services, people, and ideas

**Transport of people is expensive over short distances due to time value**

# III LOCALISATION VS. URBANISATION ECONOMIES

spatial concentration within cities

- Two basic types of place-specific returns to scale – **agglomeration economies** – external to firm (for more, see *Topic II*)
  - **1) Localization economies**
    - Related to **specialization** within industries in clusters
      - automobile in Detroit
      - Finance in London
  - **2) Urbanization economies (Jacobs (1969)**
    - Related to interactions across (complementary) sectors (**diversity**)
      - Various services related to production activity, e.g. legal, real estate, leisure, etc.
- Different from location-specific internal returns
  - Returns due to investments into single large factories

# III AGGLOMERATION ECONOMIES

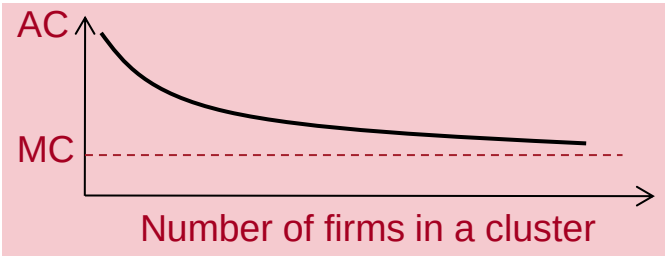
spatial concentration within cities

- **Summary of "Marshallian" externalities**
  - Sometimes referred to MAR externalities (Marshall-Arrow-Romer)
- **Shared inputs (proximity of goods)** **Q: Intuition?**
  - Cheaper intermediate inputs and services (suppliers close by)
- **Labour market pooling (proximity of people)** **Q: Intuition?**
  - Sorting (more productive workers in cities)
  - Matching (better worker-firm match)
  - Learning (workers learn from each other)
- **Knowledge spillovers (proximity of ideas)** **Q: Intuition?**
  - Access to non-codified knowledge
  - Leads to innovation and productivity

# III SHARED INPUTS

spatial concentration within cities

- A1 Conventional inputs
  - Raw material, labour, capital – reasonably **mobile (Weber model, see appendix)**
- **A2 Non-traded local** (intermediate) **inputs**
  - Specialized, locally constrained inputs (very high Weber transport cost)
    - Producers of specialist legal services and software for financial industries
    - Specialist testing firms for industrial components with expensive equipment, etc.
  - **Indivisible inputs** – high fixed cost relative to marginal cost
  - Access only via location in the city
  - Spread fixed cost across firms in the city
- Services will be offered at lower costs in cluster

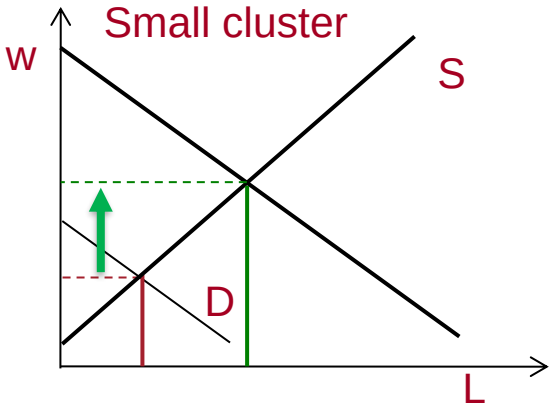


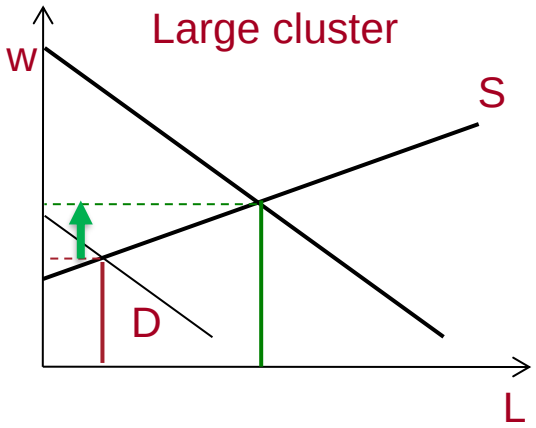

**Cost accessing intermediate inputs lower in clusters**

# III LABOUR MARKET POOLING I

spatial concentration within cities

- Labour acquisition cost
  - Hire qualified workers relatively quick and cheap in “thick markets”– elastic supply




Increase in labour demand leads to **small** increase in **quantity** and **large** increase in **price**

Increase in labour demand leads to **large** increase in **quantity** and **small** increase in **price**

# III LABOUR MARKET POOLING II

spatial concentration within cities

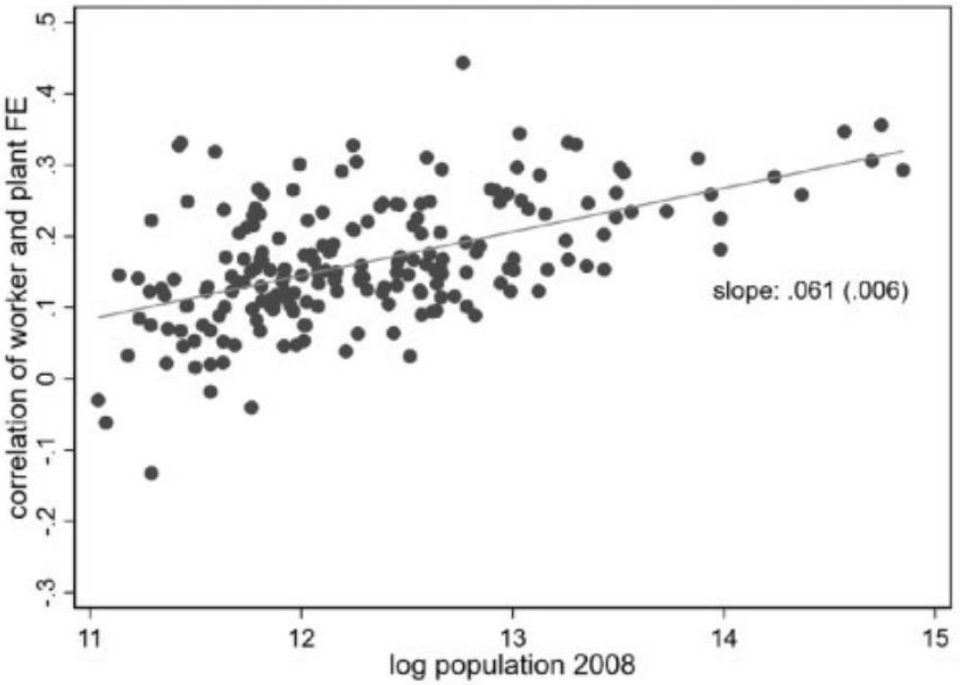
- **Matching**

Measure of "quality of the match"

$corr(\alpha_i, \beta_f)$

$\ln wage_{ift} = \alpha_i + \beta_f + \gamma_t + \varepsilon_{ift}$

Worker i and firm f fixed effects (FE)

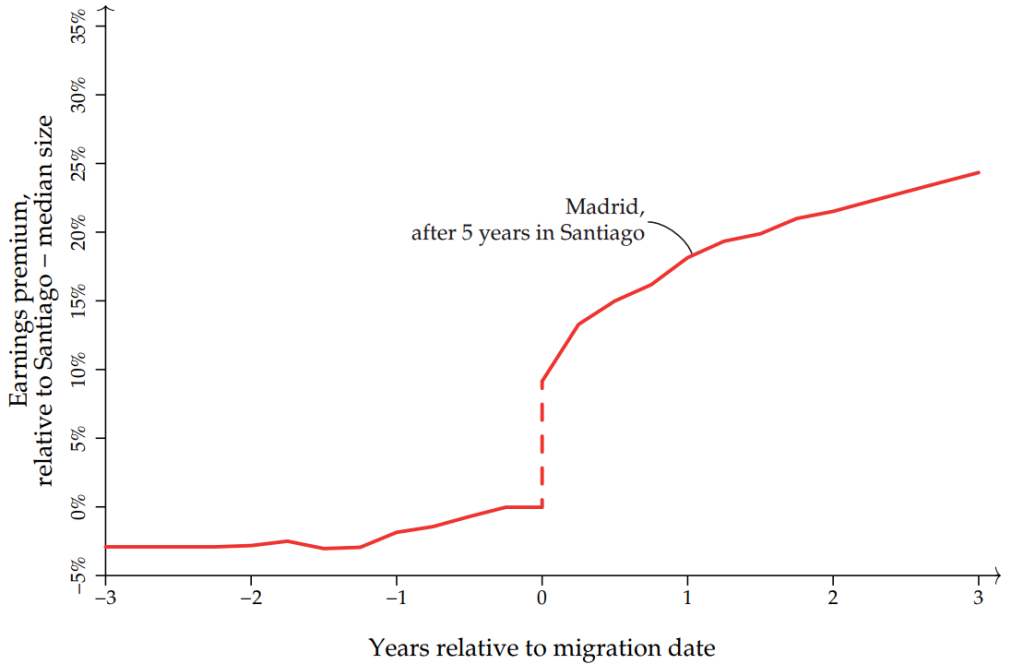



- **Positive assortative matching (Dauth et al. 2022)**
  - **More productive firms match to more productive workers**
  - **More efficient matches in bigger cities**

# III LABOUR MARKET POOLING II

spatial concentration within cities

- **Learning** in larger cities
  - Workers learn from other workers a wider variety of experiences and skills
  - Learn faster in bigger cities (De La Roca and Puga, 2017)



# II KNOWLEDGE SPILL-OVERS

spatial concentration within cities

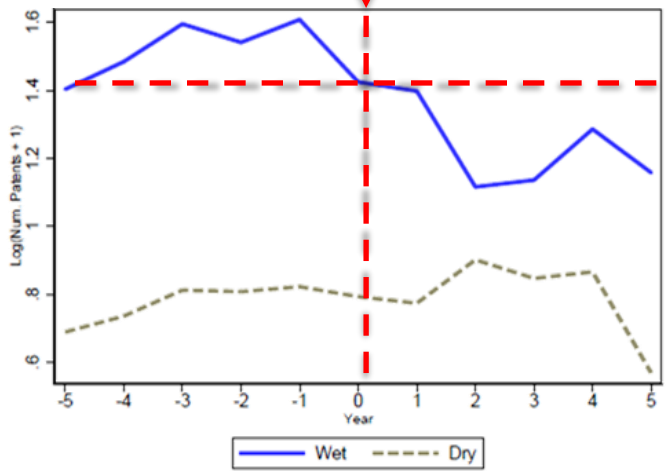

- **Interactions among different firms**
  - Jacobs (1969)
    - Knowledge is difficult to write down and exchange
    - Tacit knowledge is inherently non-rival in nature (usually possible to adapt ideas to different applications)
- **Transmission via face-to-face contacts and probabilistic encounters**
  - Von Hipple (1994), Davis and Dingle (2019)
    - "Sticky knowledge" (high context, uncertain knowledge) transmitted via face-to-face interaction
    - Business meetings and events, after-work encounters (coffee/pub/restaurant)
- Examples of information shared on non-market basis (externality)
  - Market trends, strategic decisions by competitors
  - Products, production process, technology, etc.

**Access via location in specialized clusters, e.g. "City", "Silicon Valley"**

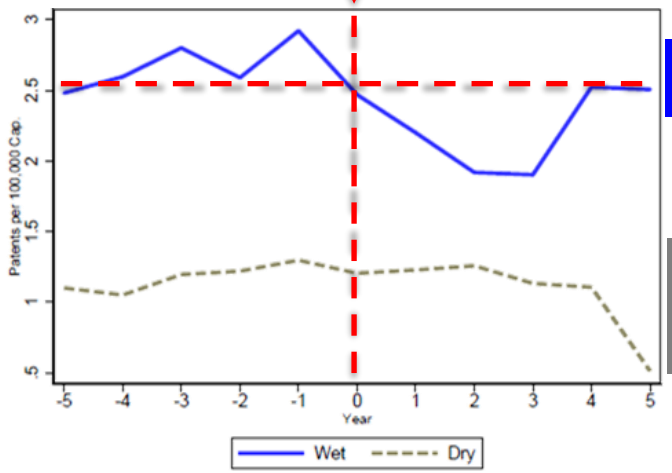
# II ANDREWS (2020)

Informal Social Interactions, Alcohol Prohibition, and Invention

**State-level prohibition**




(a) *log*(Num. Pat + 1), Raw Data




(b) Patents per Capita, Raw Data

Pohibition is new

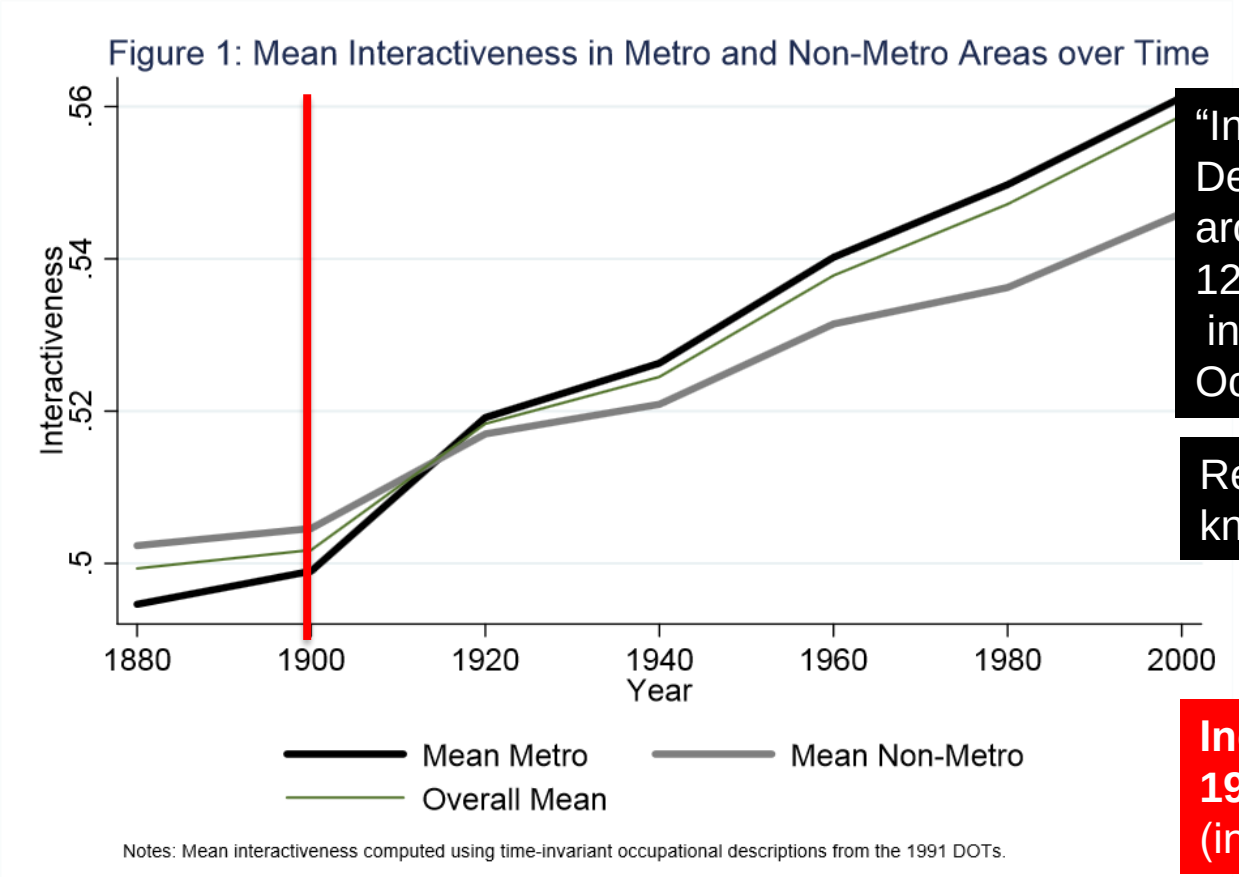
Prohibition already in place

*Notes:* Mean patenting in wet (blue solid line) and dry (brown dashed line) counties. Counties are listed as wet if they have been wet for at least 5 years before the enactment of state-level prohibition, and vice versa for the dry counties. The x-axis shows the number of years since the enactment of state-level prohibition. The year in which state-level prohibition is enacted is normalized to year 0. Everything left of year 0 shows pre-prohibition means; everything to the right shows post-prohibition means. The y-axis plots the dependent variable. Panel (a) uses $log(Num.Patents + 1)$ as the dependent variable. Panel (b) uses $\frac{Num.Patents}{TotalPop.}$ as the dependent variable.

**Prohibition disrupts saloon-based social interactions that foster innovation**

# III INTERACTIVENESS OF CITIES

spatial concentration within cities




"Interactiveness" of occupations Definded using 3,000 verbs from around 12,000 occupational descriptions in the Dictionary of Occupational Titles (DOTs)

Related to matching, learning and knowledge spillovers?

**Michaels, Rauch, Redding (2018)**

**Increasing "interactiveness" from 1900 onwards, especially in cities** (in line with shift to "prime services"

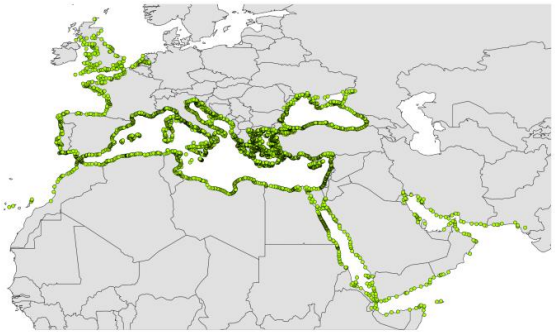
**As the economy is becoming more "interactive", productivity advantages of clusters/cities should increase, and so should demand for real estate**

# III HORNBECK, MICHAELS, RAUCH (2024)

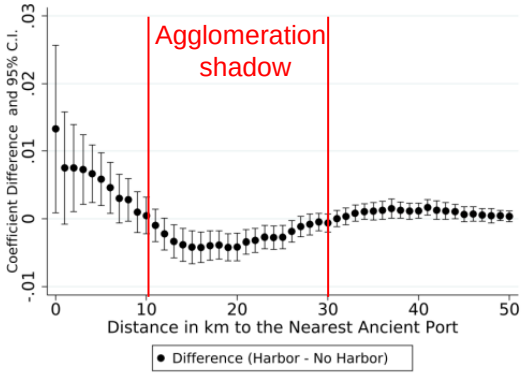
agglomeration shadow

- **Agglomeration shadow**
  - Agglomeration crowds out development beyond some distance
- **Bosker & Buringh (2017) result point to "agglomeration shadow"**
  - Seeds don't convert into cities within 20km
  - Hard to disentangle agglomeration shadow from ***correlated*** fundamentals
- HMR (2024) show that city activity is lower at 10-30km of harbours
  - Can compare proximity to ports w & w/o harbours (similar fundamentals)

**Ancient port locations**



**Probability of city density (relative to counterfactual)**



# SUMMARY

Conclusion

- **Incentives for spatial clustering in regions**
  - Increasing returns and low transport cost (for goods)
- **Incentives for spatial clustering in cities**
  - External returns of high transport cost (for people)
- **Incentives for clustering map to demand for real estate**
  - Shift the demand curve
- **Changes in the origin of productivity determine future demand for real estate**
  - Transport costs are already low
  - Ongoing trend towards „interactiveness“
  - Markets will grow where locations offer gains from „agglomeration“
    - In particular those related to „knowledge“
- **Next: The empirics of agglomeration**
  - Quantifying productivity advantages of places and analysing the sources


THANKS

# READINGS AND REFERENCES

- Core readings:
  - O'Sullivan Chapter 1-3
  - McDonald/McMillen Chapter 1-4
- Complementary readings and references:

  - Ahlfeldt, Albers, Behrens (2020): Prime locations (including Global Cities Appendix) available at www.ahlfeldt.com (publications => discussion papers)
  - Andrews (2020): Bar Talk: Informal Social Interactions, Alcohol Prohibition, and Invention. Working paper
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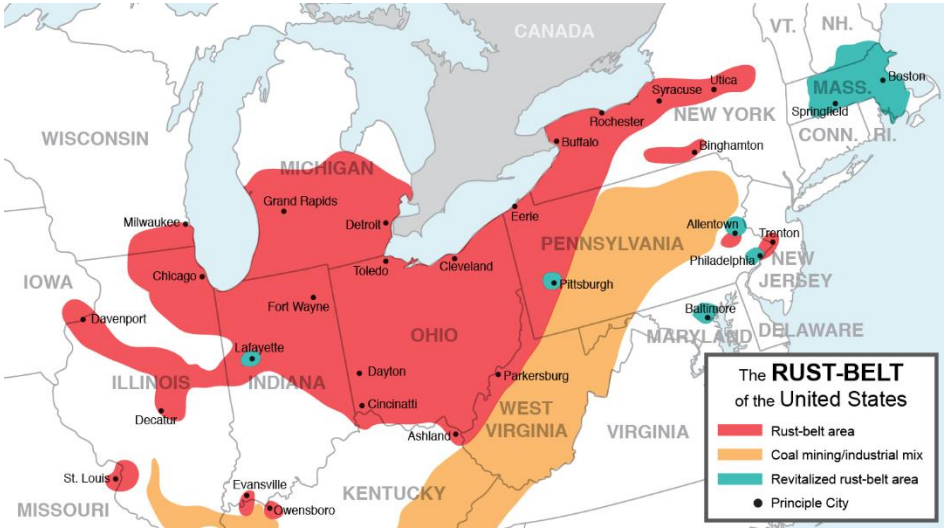
  - Weber, Alfred (1909): Theory of the location of Industries. The University of Chicago Press.

# APPENDIX:
# WHY DO LARGE INDUSTRIAL CLUSTERS EXIST?

spatial concentration in regions

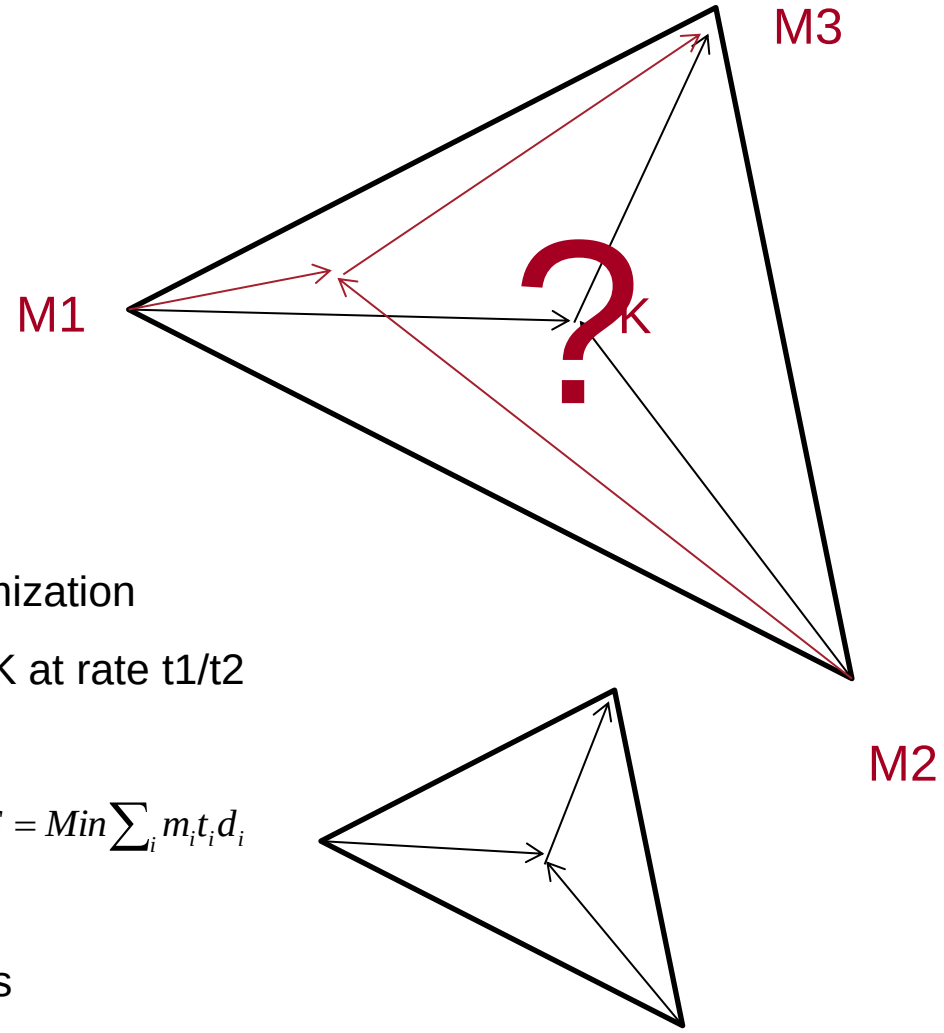
- **US manufacturing is concentrated in small part of NE and eastern part of MW**
  - **In 1870 Manufacturing Belt represented 44% of resource extraction in US**
  - **In 1910 share fell to 27%, nevertheless, the Belt comprised 70% of industrial employment (on 15% of US territory)**
- **Other examples**
  - **Kanto region in Japan**
  - **Ruhr region in Germany**
  - **Yangtze River Delta**
    **Pearl River Delta**
    **Bohai Economic Rim**



# APPENDIX: WEBER LOCATION-PRODUCTION MODEL

Classical model of location

- Access / **transport cost** matter
  - **M3 Market** – customers
  - **M1/M2 Inputs** – production factors
- Simple world
  - A1 Homogenous space
  - A2 All prices exogenous
  - A3 Profit maximization = cost minimization
- Transport inputs m1/m2 from M1/M2 to K at rate t1/t2
- Transport output m3 to M3 at rate t3
- **Optimum location minimizes costs** $TC = Min \sum_i m_i t_i d_i$
  - Higher weights to important factors
- **Lower transport cost** in **denser** regions
  - Higher profits/productivity/wages/rents




***Spatial concentration reduces aggregated transport cost***

# II CASE A

spatial concentration in regions

- **All mobile workers in E**

| | Production in E | | Production in E & W | | Production in W | |
|---|---|---|---|---|---|---|
| | E | W | E | W | E | W |
| **Farmers** | 3 | 3 | 3 | 3 | 3 | 3 |
| **Workers** | 4 | 0 | 4 | 0 | 4 | 0 |
| **Population** | 7 | 3 | 7 | 3 | 7 | 3 |
| **Goods shipped** | 3 | | 0 | | 7 | |
| **Fixed plant cost** | 4 | | 8 | | 4 | |
| **Shipping cost** | 3 | | 0 | | 7 | |
| **Total cost** | 7 | | 8 | | 11 | |

**Case A: Cost-minimizing option is concentration of production in E**

**=> Agglomeration**

**Case B: If all mobile workers are in W, efficient production is in W**

**=> Agglomeration**

# II CASE C

spatial concentration in regions

- **Mobile workers are in E and W**

| | Production in E | | Production in E & W | | Production in W | |
|---|---|---|---|---|---|---|
| | E | W | E | W | E | W |
| **Farmers** | 3 | 3 | 3 | 3 | 3 | 3 |
| **Workers** | 2 | 2 | 2 | 2 | 2 | 2 |
| **Population** | 5 | 5 | 5 | 5 | 5 | 5 |
| **Goods shipped** | 5 | | 0 | | 5 | |
| **Fixed plant cost** | 4 | | 8 | | 4 | |
| **Shipping cost** | 5 | | 0 | | 5 | |
| **Total cost** | 9 | | 8 | | 9 | |

**Case C: Cost-minimizing option is concentration of production in E and W**

**=> Dispersion**

# II CASE D

spatial concentration in regions

- **All mobile workers in E & <u>trade cost diminishes to 0.5</u>**

| | Production in E | | Production in E & W | | Production in W | |
|---|---|---|---|---|---|---|
| | E | W | E | W | E | W |
| **Farmers** | 3 | 3 | 3 | 3 | 3 | 3 |
| **Workers** | 4 | 0 | 4 | 0 | 4 | 0 |
| **Population** | 7 | 3 | 7 | 3 | 7 | 3 |
| **Goods shipped** | 3 | | 0 | | 7 | |
| **Fixed plant cost** | 4 | | 8 | | 4 | |
| **Shipping cost** | 1.5 | | 0 | | 3.5 | |
| **Total cost** | 5.5 | | 8 | | 7.5 | |

**Case D: Cost-minimizing option is concentration of production in E**

**=> Agglomeration (like A)**

**Case E: If all mobile workers are in W, efficient production is in W**

**=> Agglomeration (like B)**

# II CASE F

spatial concentration in regions

- **All mobile workers in E and W & trade cost diminishes to 0.5**

| | Production in E | | Production in E & W | | Production in W | |
|---|---|---|---|---|---|---|
| | E | W | E | W | E | W |
| **Farmers** | 3 | 3 | 3 | 3 | 3 | 3 |
| **Workers** | 2 | 2 | 2 | 2 | 2 | 2 |
| **Population** | 5 | 5 | 5 | 5 | 5 | 5 |
| **Goods shipped** | 5 | | 0 | | 5 | |
| **Fixed plant cost** | 4 | | 8 | | 4 | |
| **Shipping cost** | 2.5 | | 0 | | 2.5 | |
| **Total cost** | 6.5 | | 8 | | 6.5 | |

**Case F: Cost-minimizing option is concentration of production in E or W**

**=> Agglomeration (unlike C!!!)**

**Small shocks (butterfly) can cause agglomeration in either region**

# II CASE G

spatial concentration in regions

- **All mobile workers in E & <u>trade cost increases to 2</u>**

| | Production in E | | Production in E & W | | Production in W | |
|---|---|---|---|---|---|---|
| | E | W | E | W | E | W |
| **Farmers** | 3 | 3 | 3 | 3 | 3 | 3 |
| **Workers** | 4 | 0 | 4 | 0 | 4 | 0 |
| **Population** | 7 | 3 | 7 | 3 | 7 | 3 |
| **Goods shipped** | 3 | | 0 | | 7 | |
| **Fixed plant cost** | 4 | | 8 | | 4 | |
| **Shipping cost** | 6 | | 0 | | 14 | |
| **Total cost** | 10 | | 8 | | 18 | |

**Case G: Cost-minimizing option is concentration of production in E & W**

**=> Dispersion (unlike C!!!)**

**Case H: If all mobile workers are in W, efficient production is in W & W**

**=> Dispersion (unlike C!!!)**

# II CASE I

spatial concentration in regions

- **All mobile workers in E and W & <u>trade cost increases to 2</u>**

| | Production in E | | Production in E & W | | Production in W | |
|---|---|---|---|---|---|---|
| | E | W | E | W | E | W |
| **Farmers** | 3 | 3 | 3 | 3 | 3 | 3 |
| **Workers** | 2 | 2 | 2 | 2 | 2 | 2 |
| **Population** | 5 | 5 | 5 | 5 | 5 | 5 |
| **Goods shipped** | 5 | | 0 | | 5 | |
| **Fixed plant cost** | 4 | | 8 | | 4 | |
| **Shipping cost** | 10 | | 0 | | 10 | |
| **Total cost** | 14 | | 8 | | 14 | |

**Case I: Cost-minimizing option is concentration of production in E and W**

**=> Dispersion (like C)**

**No agglomeration of firms**