FIRM LOCATION CHOICE

Urban Economics

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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: Hedonic analysis

I INTRODUCTION

roadmap

- **Last time: *The monocentric city model II***
  - **1) Equilibrium conditions**
    - **Additional restrictions**
  - **2) Comparative statics: Income**
    - **What happens if people get richer?**
    - **Where do the rich and the poor live in cities?**
  - **3) Comparative statics: Transport cost**
    - **What happens if transport gets cheaper?**
    - **Did cities decentralize over time?**
  - **4) Other predictions**
    - **Distinguishing between open-city and closed-city case**

I INTRODUCTION

roadmap

- **This time: *Firm location choice***
  - **1) Firms in the monocentric city model**
    - **Firm bid-rent**
    - **Land-use segregation**
  - **2) Agglomeration and decentralization**
    - **Endogenous agglomeration**
    - **Multiple equilibria**
  - **3) Emergence of new clusters**
    - **Sub-centres**
    - **Edge cities**
    - **Historic anchoring**

II THE CBD IN THE MCM

firms in the MCM

Q: Why do firms concentrate in the CBD?

II INTRODUCTION

roadmap

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II FIRM BID-RENT FUNCTION

firms in the MCM

- **To rationalize firm concentration in the CBD in the MCM, we need a force that attracts firms to the CBD**
  - High cost of distance, so that firms outbid residents
- **Some fundamental location factor**
  - Firms need to be close to a natural harbour (trading cities)
  - Firms sell goods at a market place (von Thünen)

Transport cost for goods decreased over time (topic I): Plausible in the *past*

- **An agglomeration effect declining in distance from the CBD**
  - Being located centrally in a labour pool (MAR, (topic I)
  - Knowledge spillovers (MAR, topic I)

Knowledge spillovers very localized (topic II): More plausible *today*

II FIRM PROFITS

firms in the MCM

- **Use the Ahlfeldt & Wendland (2013), henceforth AW, framework to illustrate the firm bid rent**
- Identical services **firms** at location *i* **maximize profits** π_i

$$\pi_i = \chi_i - K_i - \psi_i L_i$$

Output = revenue, since price of good set to 1

Cost of capital K, price of capital set to 1

Cost of land *L*, *Ψ* is the land rent

- Firms occupy land directly: **No developers**
- **Capital** broadly defined, **includes** workers, machines, computers, and **building structure**
  - Could introduce developers providing space in perfect analogy to household bid-rent model

II PRODUCTION FUNCTION

firms in the MCM

- **The production technogloy is Cobb-Douglas**

$$\chi_i = A_i K_i^{\alpha} L_i^{1-\alpha}$$

0<α<1 is capital share at inputs (constant in Cobb-Douglas)

Productivity shifter

  - **Similar results as long as $\chi' > 0, \chi'' < 0$ (diminishing MPs)**

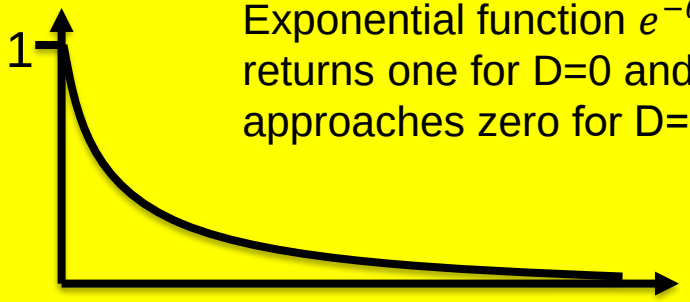
- **Productivity spillovers A_i decline in distance from CBD**

$$A_i = a_i e^{-\theta D_i}$$

Distance from the CBD

Fundamental amenity, let's assume it is "flat"

Θ>0 Determines the decay of the spillover



Exponential function $e^{-\theta D_i}$ returns one for D=0 and approaches zero for D=∞

II PROFIT MAXIMIZATION

firms in the MCM

- **Firms choose inputs to maximize profits**

$$\pi_i = A_i K_i^{\alpha} L_i^{1-\alpha} - K_i - \psi_i L_i$$

Combined profit and production function

- **First-order conditions give**

$$\frac{K_i}{L_i} = \frac{\alpha}{1-\alpha}\psi_i$$

Capital density increases in land rent
Similar to developers's problem, topic IV

- **Recall Micro 101**

$$\frac{\frac{\partial \pi_i}{\partial K_i}}{\frac{\partial \pi_i}{\partial L_i}} = \frac{1-\alpha}{\alpha}\frac{K_i}{L_i} = \frac{\psi_i}{p_k} \longleftarrow =1$$

Check a micro textbook if unclear

II SPATIAL EQUILIBRIUM

firms in the MCM

- **In spatial equilibrium profits are equalized**
  - **Zero profits due to perfect competion, free entry and exit**

$$\pi_i = A_i K_i^{\alpha} L_i^{1-\alpha} - K_i - \psi_i L_i = 0$$

Corresponds to fixed utility in household bid-rent model

- **Plug in first-order condition:** $K_i = \frac{\alpha}{1-\alpha} \psi_i \, L_i$

$$\psi_i = \alpha^{\alpha} A_i^{\frac{1}{1-\alpha}} = c e^{-\frac{\theta}{1-\alpha} D_i}$$

$$\left[\ln \psi_i = c - \frac{\theta}{1-\alpha} D_i \right]$$

c summarizes constants

$$\frac{\partial \psi_i}{\partial D_i} < 0$$

Firm bid-rent decreases in distance from the CBD

Higher office rents compensate for greater productivity near CBD

II LAND PRICE GRADIENTS BY USE

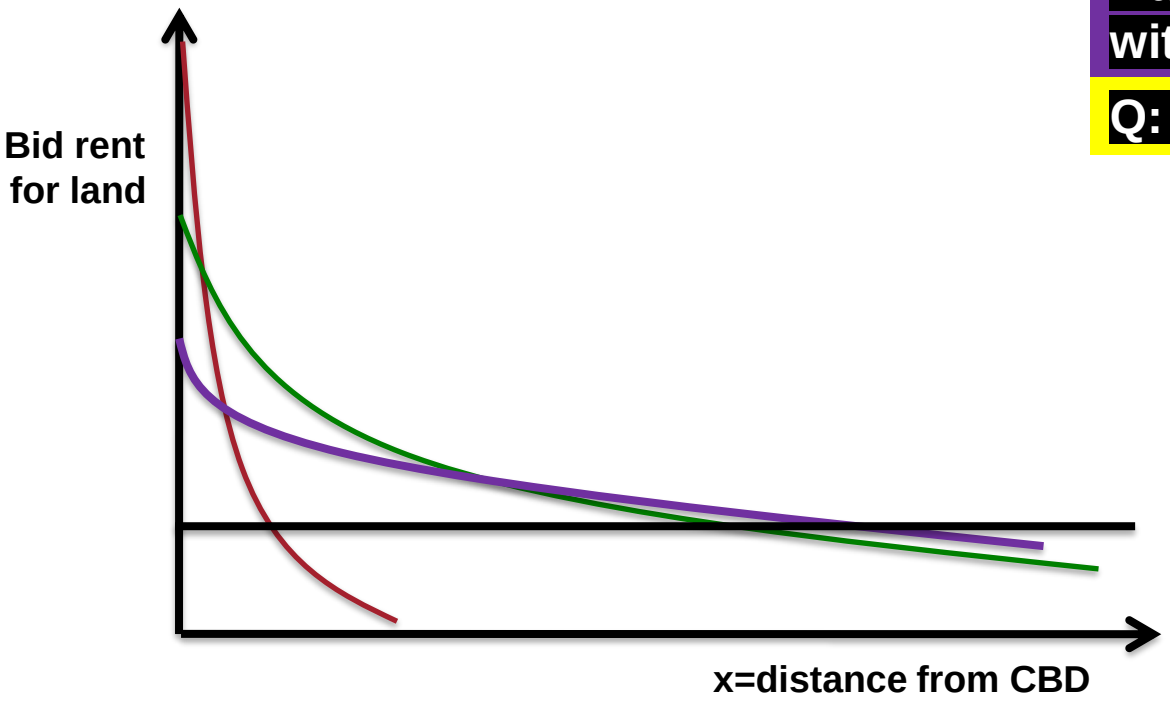
firms in the MCM

Residential land price gradient (topics IV & V)

Commercial land price gradient with large Θ

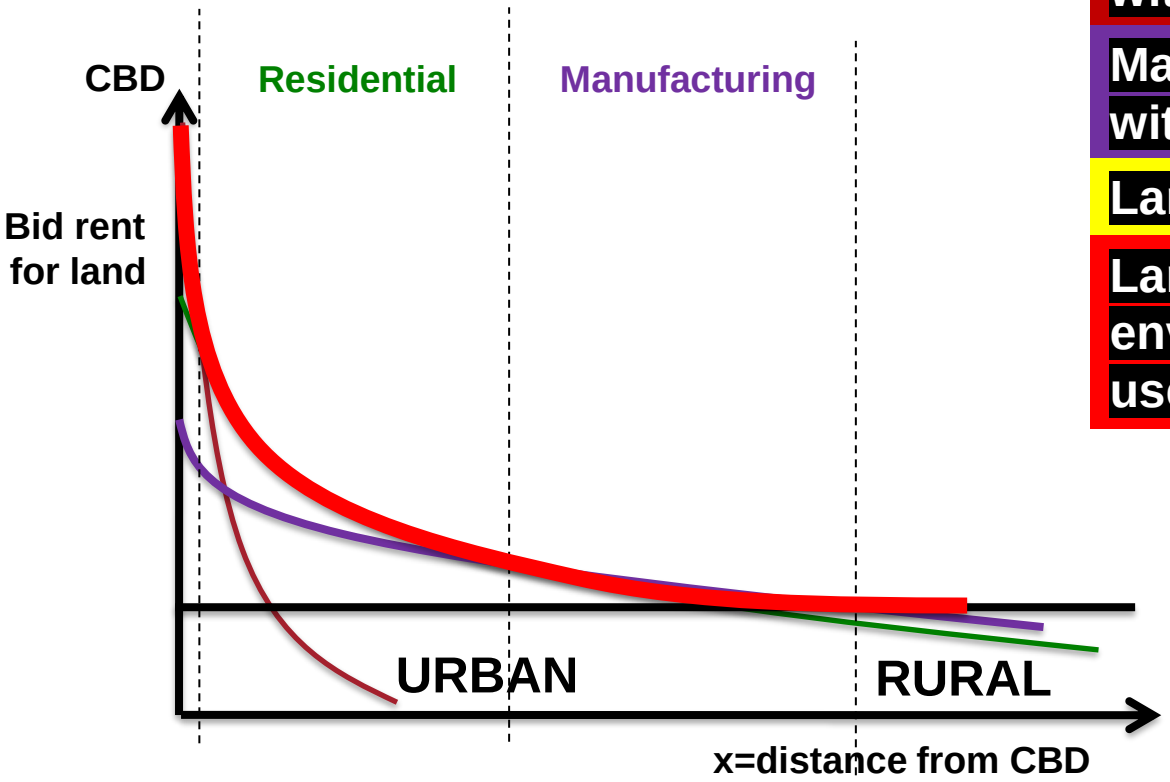
Manufacturing land price gradient with small Θ

Q: Land use pattern?



II LAND PRICE GRADIENTS BY USE

firms in the MCM



Residential land price gradient (topics IV & V)

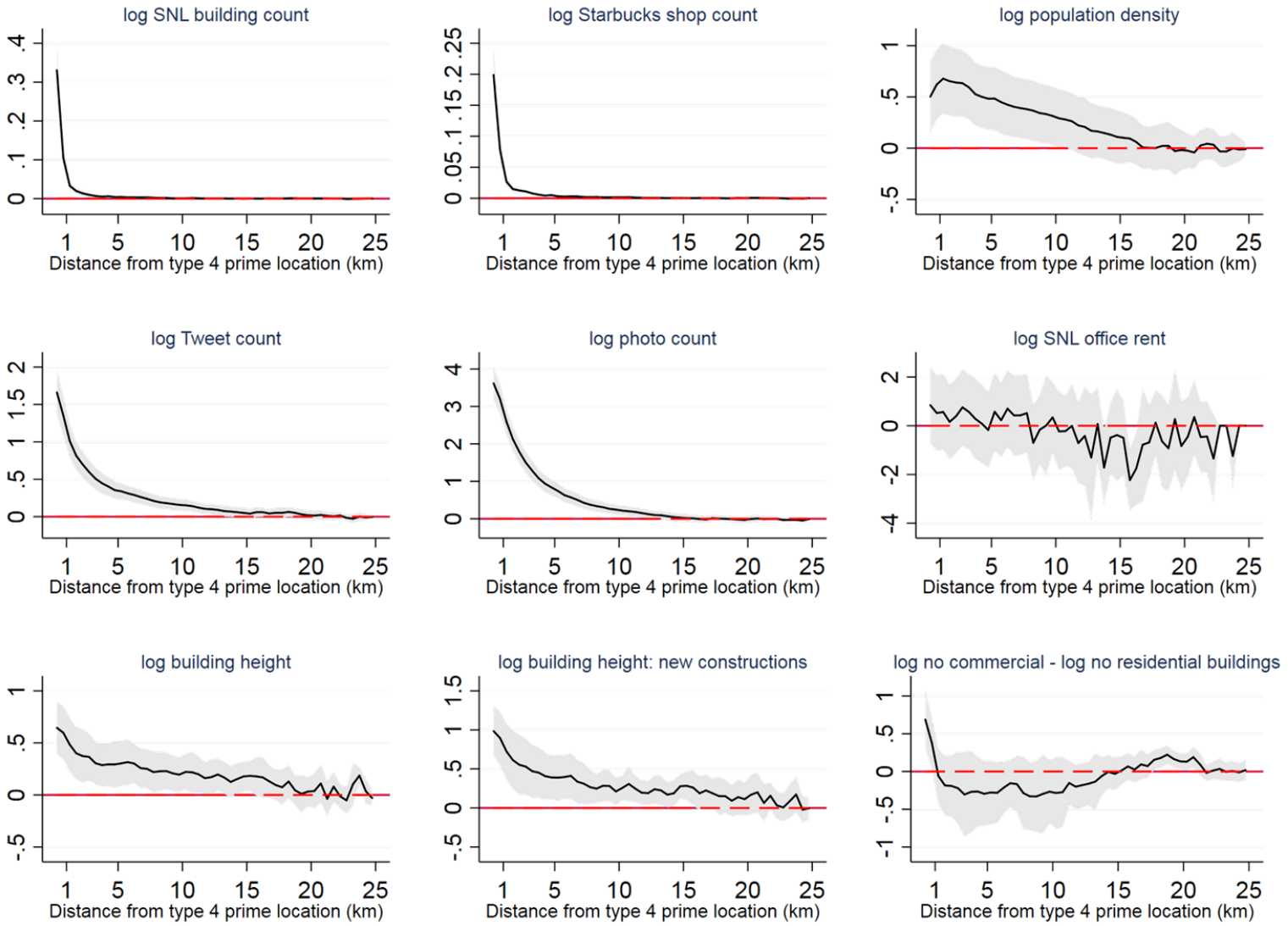
Commercial land price gradient with large Θ

Manufacturing land price gradient with small Θ

Land goes to the highest bidder

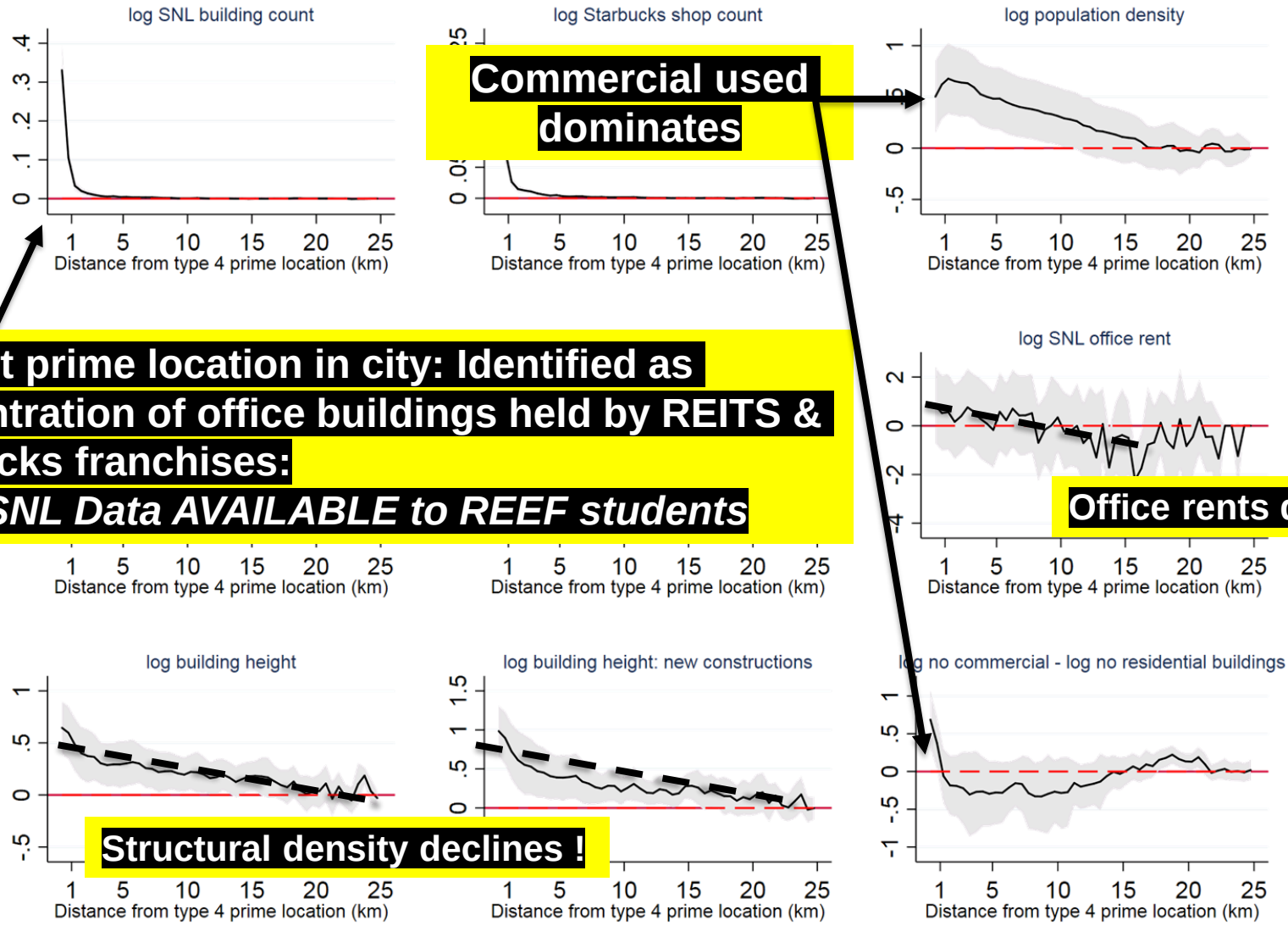
Land price gradient is the envelope of price gradients by use => convexity due to sorting

II PRIME LOCATION GRADIENTS IN 125 CITIES



Ahlfeldt et al. (2018)

II PRIME LOCATION GRADIENTS IN 125 CITIES



Commercial used dominates

Largest prime location in city: Identified as concentration of office buildings held by REITS & Starbucks franchises:

Note: SNL Data AVAILABLE to REEF students

Office rents decline!

Structural density declines !

Ahfleldt et al. (2020)

III EMPLYOMENT CONCENTRATION

agglomeration and decentralization

Q: Can the spatial structure of a city be changed?

III AGGLOMERATION AND DECENTRALIZATION

roadmap

- **This time: *Firm location choice***
  - **1) Firms in the monocentric city model**
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    - **Land-use segregation**
  - **2) Agglomeration and decentralization**
    - **Endogenous agglomeration**
    - **Multiple equilibria**
  - **3) Emergence of new clusters**
    - **Sub-centres**
    - **Historic anchoring**
    - **Edge cities**

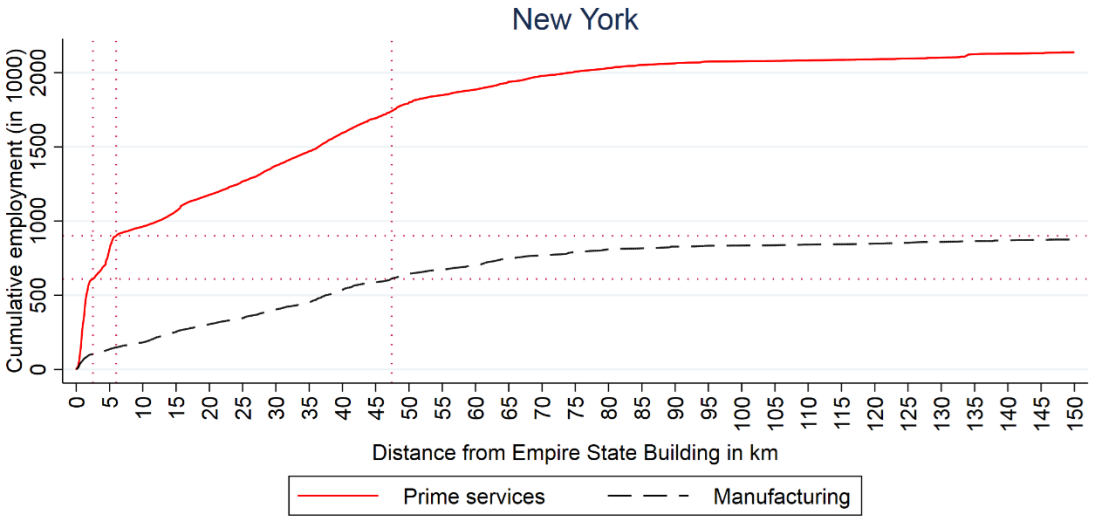
III CBDs DOMINATED BY PRIME SERVICES

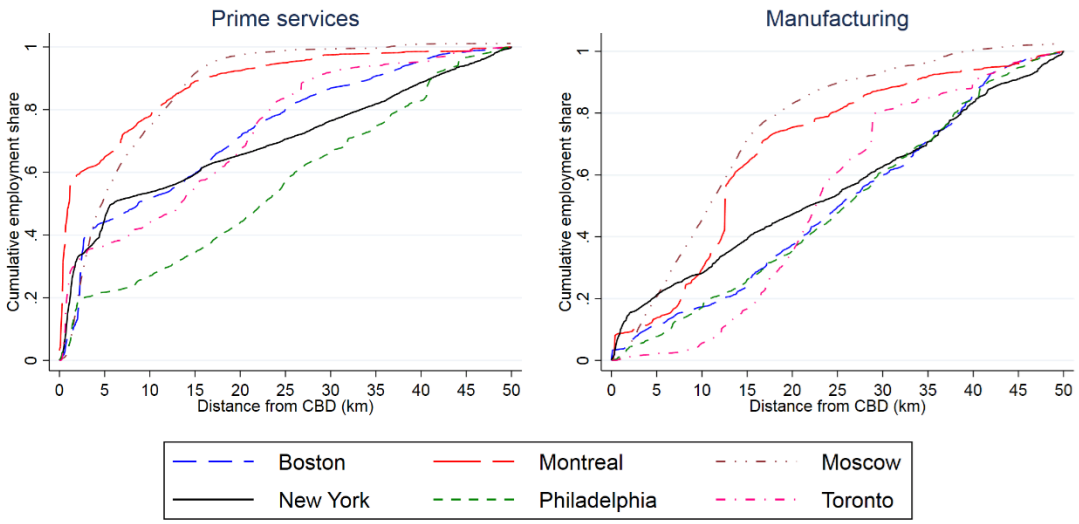
agglomeration and decentralization

Knowledge-basedtradable services highly concentrated in CBDs

Manufacturing employment much more decentralized

Fundamentals not obviously relevant for prime services





Ahlfeldt et al. (2020)

III TRADABLE SERVICES

agglomeration and decentralization

- **An agglomeration economy emerging from the CBD is a <u>simplfying assumption</u>**
- **More realistically firms benefit from each other and, therefore, cluster in the CBD**

CBD is endogenous!

- **To capture the idea AW introduce a <u>bidirectional spillover</u>**

$$A_i = a_i \Lambda_i \Gamma_i$$

Productivity shifter

$$\Lambda_i = e^{-\theta D_i}$$

Exogenous „CBD spillover“

$$\Gamma_i = e^{\beta Z_i}; Z_i = \sum_j \chi_j e^{-\tau d_{ij}}$$

Endogenous bidirectional agglomeration force. Depends on nearby output, weighted by distance

Agglomeration elasticity (strength of the effect)

Agglomeration decay

III BID-RENT WITH BILATERAL AGGLOMERATION

agglomeration and decentralization

- **Commercial bid rent**

Zero-profit condition and first-order condition at location *j* give

$$\chi_j = \frac{1}{1-\alpha}\psi_j L_j$$

$$\psi_i = \alpha^{\alpha} A_i^{\frac{1}{1-\alpha}}$$

$$A_i = a_i \Lambda_i \Gamma_i \longleftarrow \Gamma_i = e^{\beta Z_i}; Z_i = \sum_j \chi_j e^{-\tau d_{ij}}$$

$$\Lambda_i = e^{-\theta D_i}$$

Market potential measure

Commercial bid rent decline in distance from CBD

Commercial bid rent inreases in local economic density

If bilateral agglomeration economies are strong, commercial land prices will be highly spatially correlated!

III BID-RENT WITH BILATERAL AGGLOMERATION

agglomeration and decentralization

- **Commercial bid rent**

$$\psi_i = \alpha^{\alpha} A_i^{\frac{1}{1-\alpha}}$$

$$A_i = a_i \Lambda_i \Gamma_i \longleftarrow \Gamma_i = e^{\beta Z_i}; Z_i = \sum_j \chi_j e^{-\tau d_{ij}}$$

$$\chi_j = \frac{1}{1-\alpha} \psi_j L_j$$

Market potential measure

$$\Lambda_i = e^{-\theta D_i}$$

Distance-weighted land value

$$\ln \psi_i = \mathrm{c} + \frac{\beta}{(1-\alpha)^2} \sum_j \psi_j L_j e^{-\tau d_{ij}} - \frac{\theta}{1-\alpha} D_i$$

Q: Changes over time?

III CBD VS. BILATERAL SPILLOVERS IN BERLIN I

agglomeration and decentralization

- **AW analyse *commercial* land values in 1890-1936 Berlin**
  - Rapid urban growth: Population tripled from 1.5M to 4.5M
  - Transition from "historic" to "modern" CBD / economy

Table 1. Industry employment in 1890 and 1933 (Old-Berlin boundaries)

Area	Year	Manufacturing		Trade and services	
		Employment	Employment share (%)	Employment	Employment share (%)
Total	1890	313,799	42.22	148,139	19.93
	1933	329,352	35.80	396,700	43.01
CBD	1890	117,556	27.11	57,888	13.35
	1933	91,931	34.30	175,972	65.67

Transition resembles many cities in developing world today

Bilateral agglomeration should be increasingly important

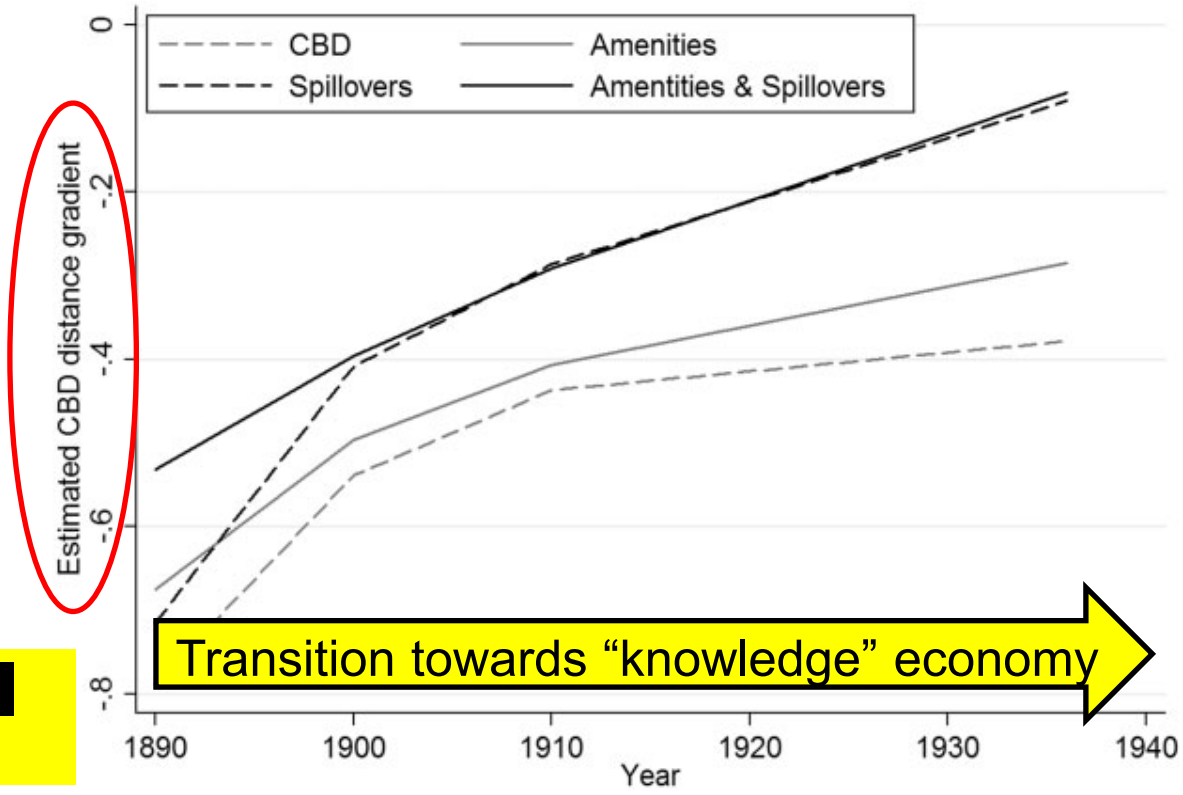
III CBD VS. BILATERAL SPILLOVERS IN BERLIN I

agglomeration and decentralization

- **AW provide a multivariate estimation of strength of *CBD spillover* and *bidirectional agglomeration* forces over time**

$$\psi_i = c e^{-\frac{\theta}{1-\alpha} D_i}$$

$$\ln \psi_i = \ln c - \frac{\theta}{1-\alpha} \ln D_i$$



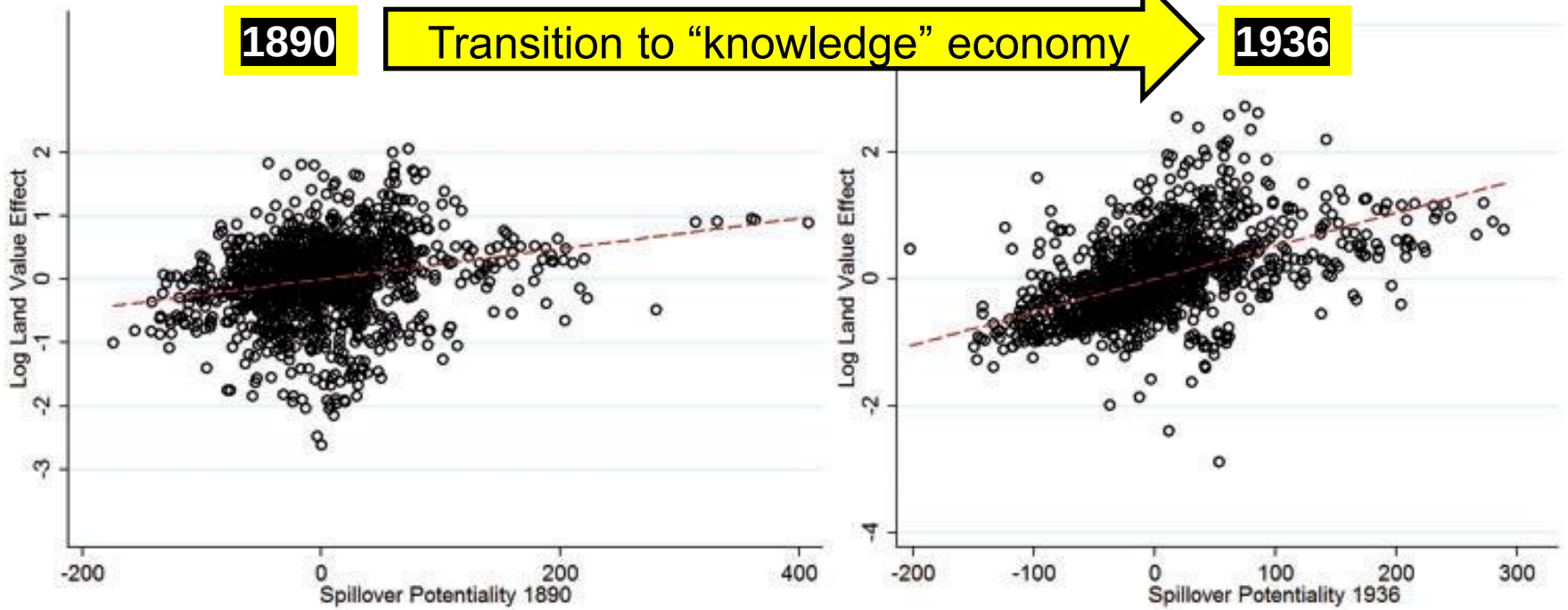
Exogenous „CBD spillover“ becomes less important

III CBD VS. BILATERAL SPILLOVERS IN BERLIN II

agglomeration and decentralization

- **AW provide a multivariate estimation of strength of *CBD spillover* and *bidirectional agglomeration* forces over time**

1890 Transition to "knowledge" economy **1936**

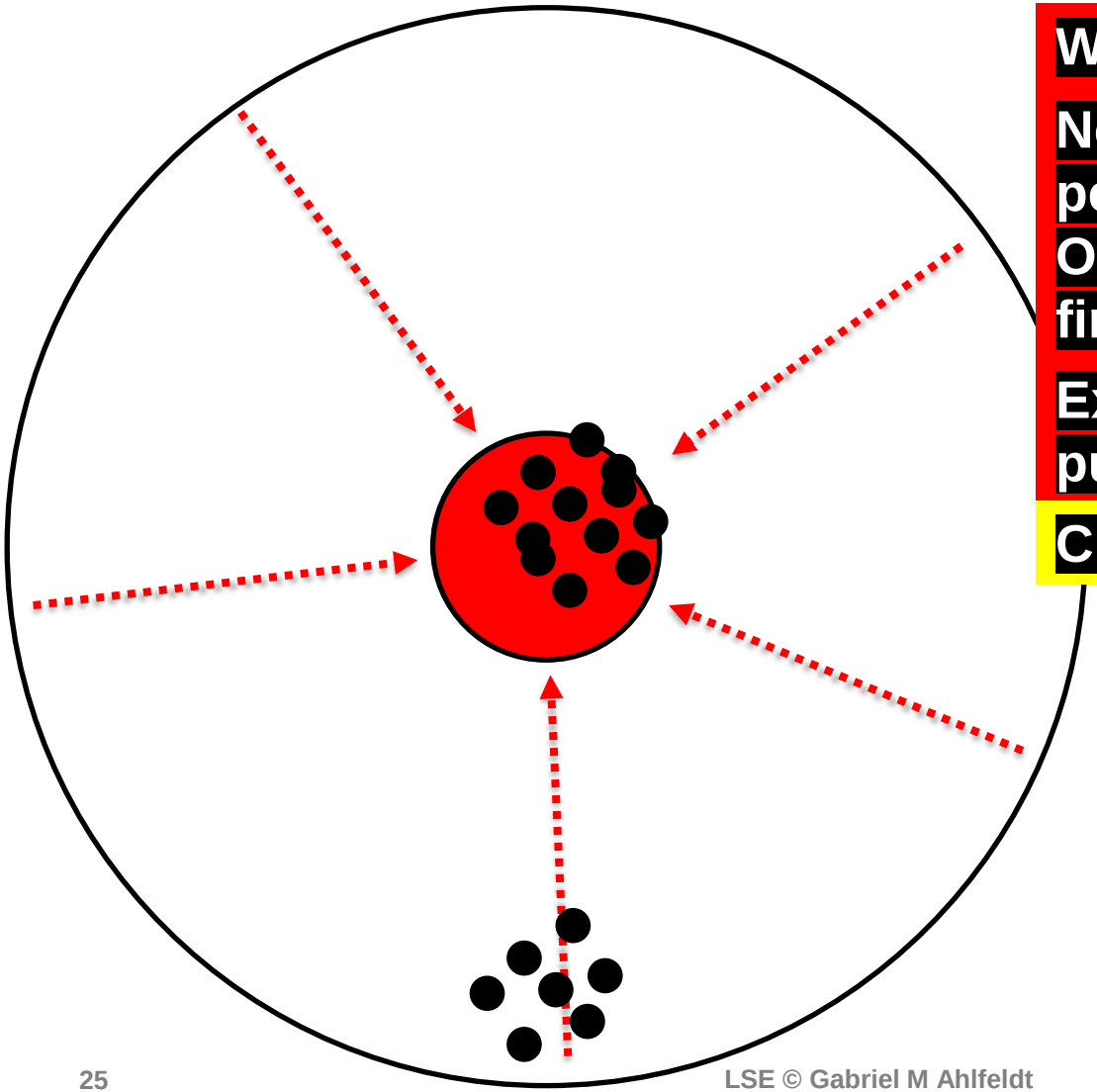


Exogenous „CBD spillover" becomes less important

Agglomeration elasticity β increases from 3.5% to 8.3%

III IMPLICATION FOR URBAN STRUCTURE I

agglomeration and decentralization



With strong CBD spillover

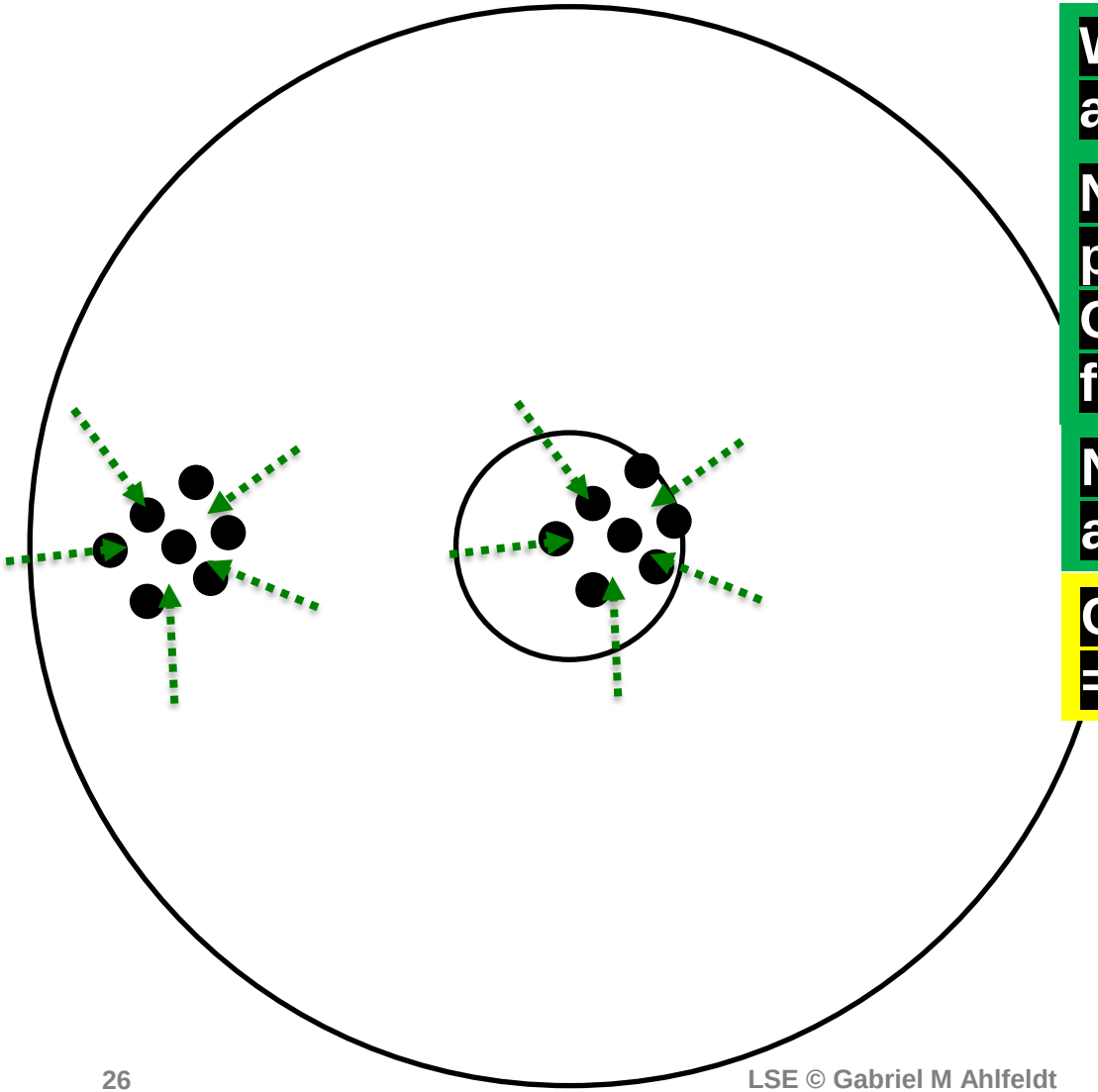
New cluster emerges in periphery (e.g. start-ups)
Or shock relocates existing firms (e.g. disaster)

Exogenous CBD spillover pulls firms into the CBD

City structure remains stable

III IMPLICATION FOR URBAN STRUCTURE II

agglomeration and decentralization



With bidirectional agglomeration force

New cluster emerges in periphery (e.g. start-ups) Or shock relocates existing firms (e.g. disaster)

New cluster generates own agglomeration economies

City structure can change => Multiple equilibria!

III CAUSES OF EMPLOYMENT DECENTRALIZATION

agglomeration and decentralization

- **Manufacturing should decentralize given change in transport, production, and inventory technologies**
- **Tradable services could decentralize since bidirectional agglomeration forces imply multiple equilibria**
- **Driving forces for employment decentralization**
  - Change in transport technology
  - Suburbanization population (jobs follow people)
  - Fiscal and social problems (e.g. US)
  - Ageing/redundant building stock
  - Regulation (e.g. height constraints)
  - …

Q: Is there evidence?

III GLAESER & KAHN (2001)

emergence of new clusters

- **US cities are mostly decentralized (NY is an exception)**
  - **Share of employment within three miles 29% or less**
  - **Employment share of central MSA county falling since 1950**
- **Hard to predict decentralization, but**
  - Manufacturing particularly decentralized
  - Suburbanization associated with decentralized employment
  - Cities specialized in services are relatively centralized
  - Knowledge-based industries more likely in city centre

Evidence supports theoretical expectations

III BAUM-SNOW ET AL (2017)

emergence of new clusters

- **Transport infrastructure in 1990-2010 China decentralizes population and employment**
  - **Radial highways decentralize services activity**
  - **Radial railroad decentralize industrial activity**
    - **20% of industrial activity**
  - **Ring roads decentralize both**
    - **50% of industrial activity**
  - **Radial / ring roads displace 4% / 20% of central city population**

Role for agglomeration spillover?

Identification strategy similar to Baum-Snow (2006), see topic V

IV AGGLOMERATION AND DECENTRALIZATION

roadmap

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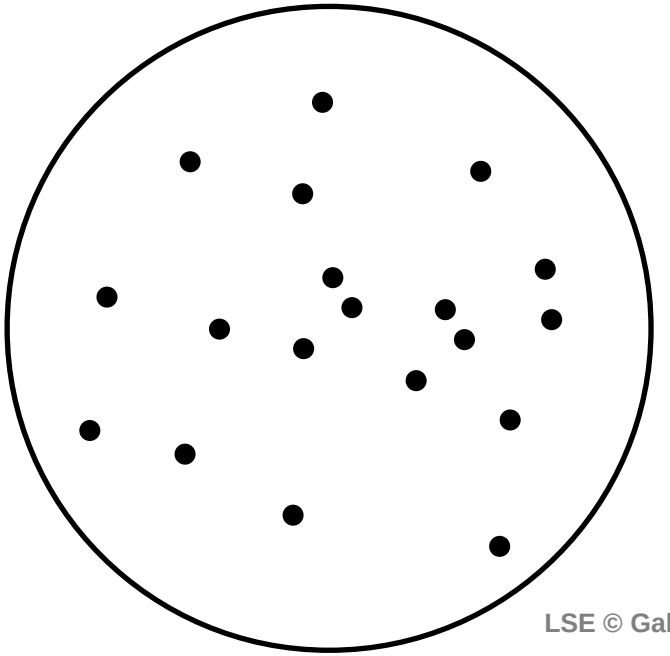
    - **Edge cities**

IV DECENTRALIZED VS. DISPEARSED EMPLOYMENT

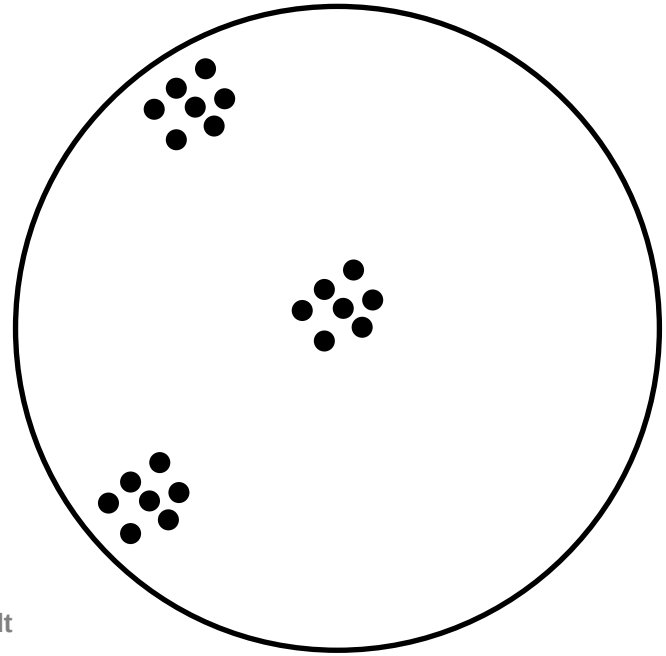
emergence of new clusters

- **Employment <u>decentralized</u> in many cities**
  - **<u>Not</u> necessarily the same as the <u>dispearsed</u> employment**

Decentralised and dispearsed



Decentralised and clustered



IV SUBCENTERS

emergence of new clusters

Q: Why, when, and where do cities develop commercial clusters outside the CBD?

IV MONOCENTRIC VS POLYCENTRIC CITIES

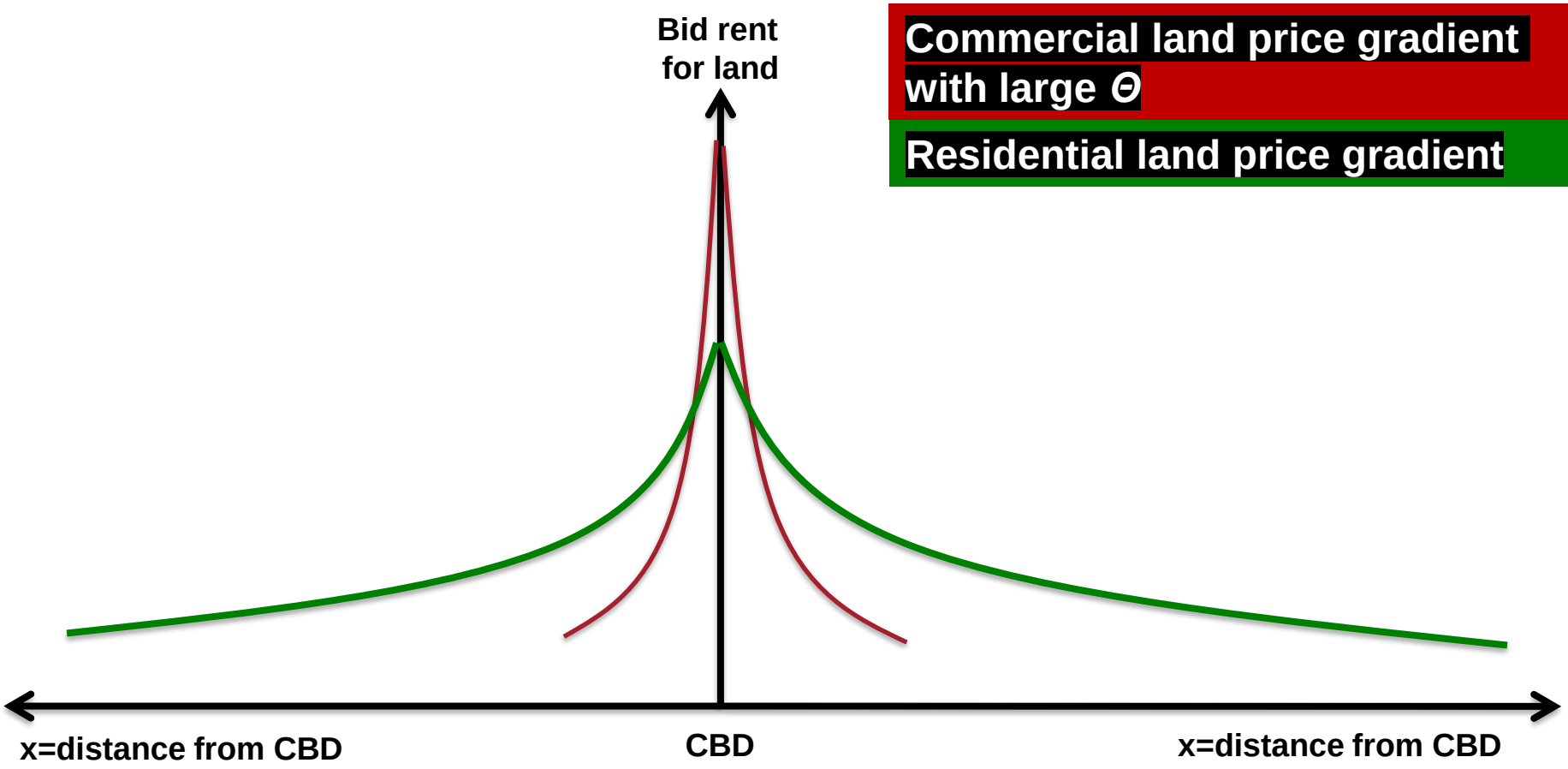
emergence of new clusters

- **(Dis)advantage of large monocentric cities**
  - Large agglomeration economies in CBD
  - Long commuting cost and higher wages as compensation
  - High land prices
- **Large polycentric cities**
  - Have **one or multiple subcentres**
- **Subcentres are clusters of employment that resemble the CBD**
  - Offer some agglomeration benefits
  - Reduce commuting cost and land prices

Polycentric cities combine benefits of large and small cities!

IV LARGE MONOCENTRIC CITY

emergence of new clusters



IV LARGE POLYCENTRIC CITY

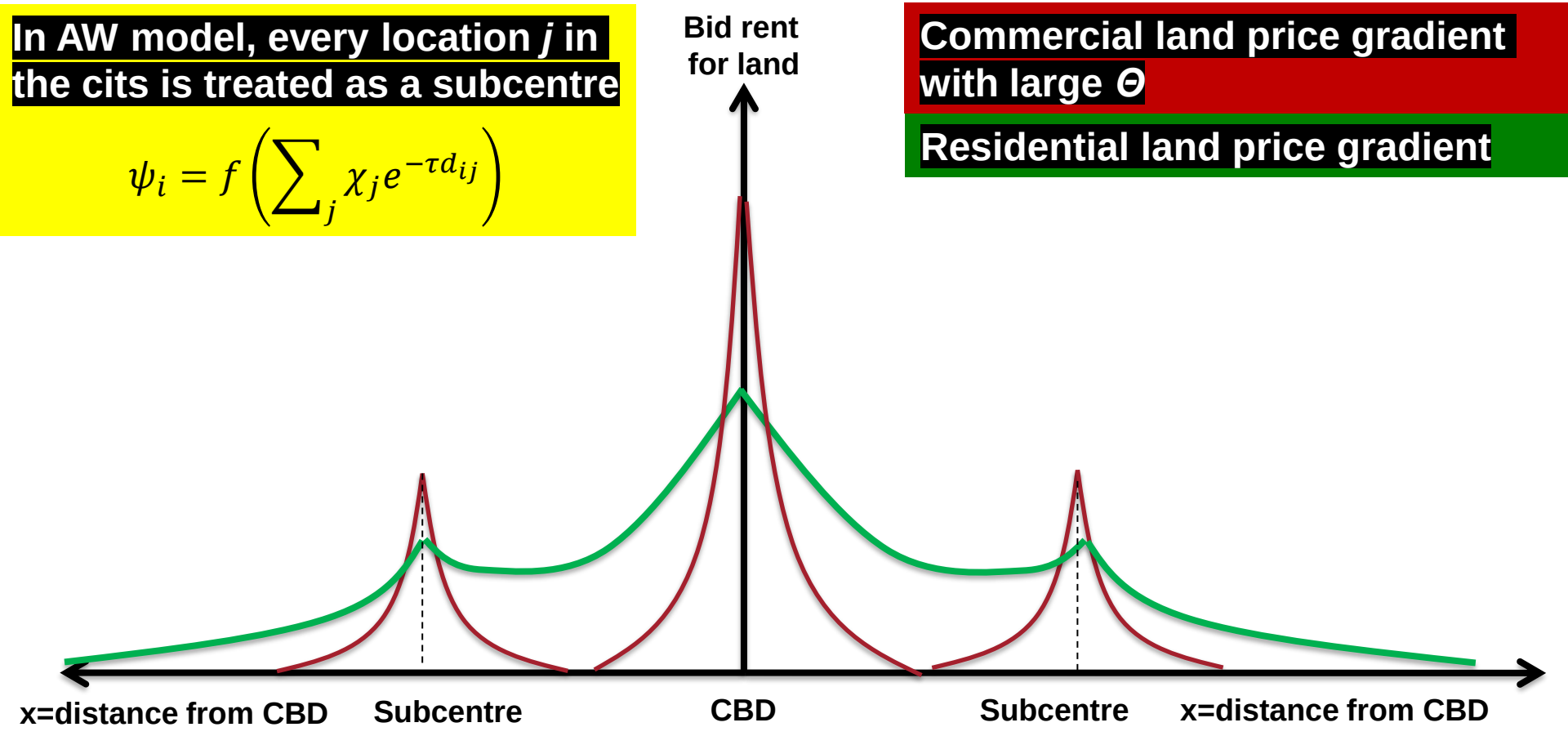
emergence of new clusters

In AW model, every location *j* in the cits is treated as a subcentre

$$\psi_i = f\left(\sum_j \chi_j e^{-\tau d_{ij}}\right)$$

Commercial land price gradient with large *Θ*

Residential land price gradient



IV WHEN DO CITIES DEVELOP SUBCENTRES?

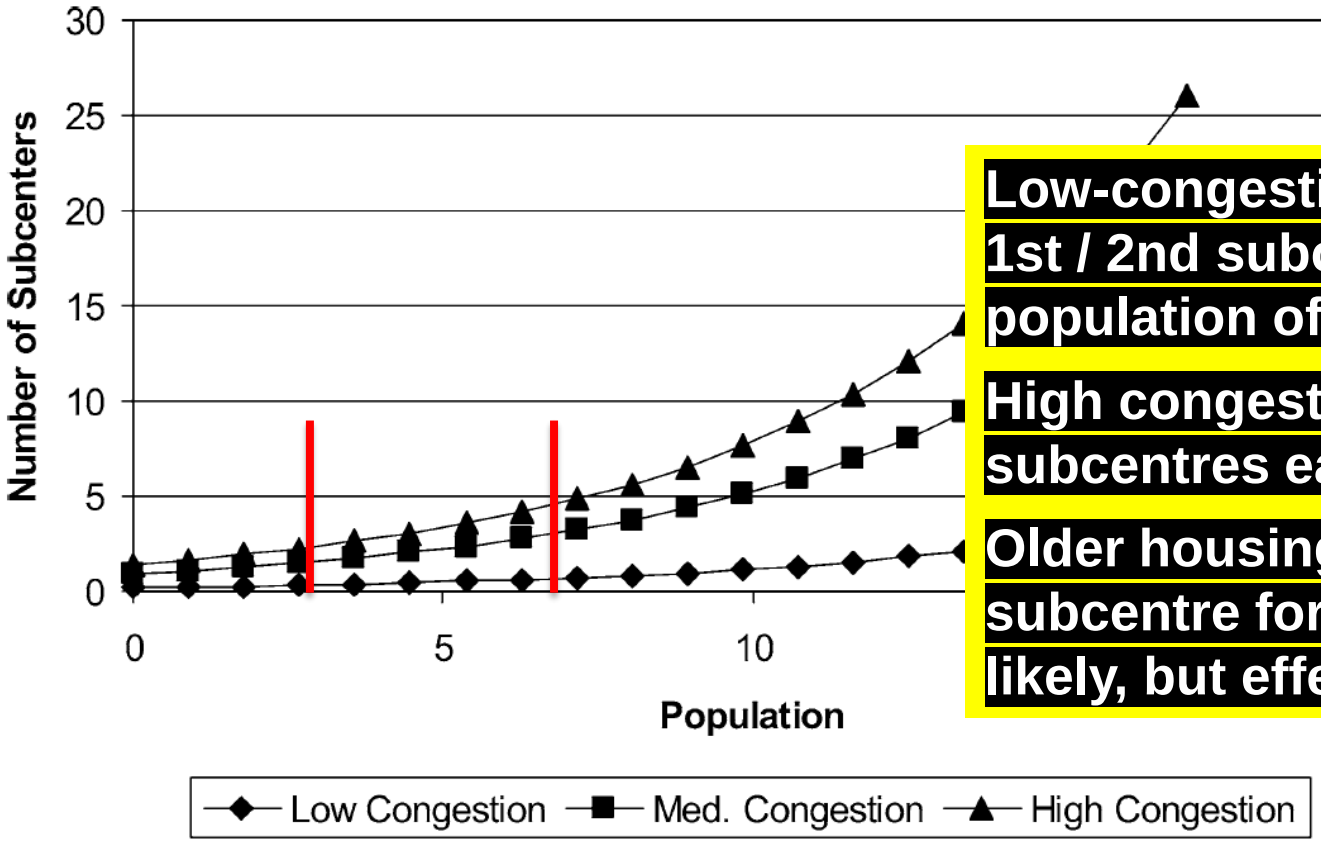
emergence of new clusters

- **Fujita & Ogawa (1982) model: Number of subcentres increases**
  - in population and commuting cost
  - Subcentres emerge endogenously to keep the city efficient
- **McMillen & Smith (2003) test the prediction for US cities**
  - Identify subcentres as peaks in local employment densities
    - McMillen (2001) locally weighted regression approach
  - **Run Poisson regressions (count models)**
    - Anayse determinants of number of subcentres per city

Q: How do city size, congestion levels, and other factors affect the number of subcentres?

IV DETERMINANTS OF SUBCENTRE FORMATION

emergence of new clusters



Low-congestion city develop 1st / 2nd subcenter at a population of 2.68M / 6.74M

High congestion cities develop subcentres earlier

Older housing stock also make subcentre formation more likely, but effect smaller

McMillen & Smith (2003)

Evidence supports theory!

IV WHERE DO SUBCENTERS EMERGE?

emergence of new clusters

- **Subcentres tend to be emerge:**
  - McMillen & Smith (2003) — **Evidence from the US**
    - **close to highway intersections**
    - **In old satalite suburbs**
  - Garcia-López et al (2017) — **Evidence from Paris**
    - **close to regional express rail**
  - Ahlfeldt & Wendland (2013) — **Evidence from Berlin**
    - **close to the CBD if it is historically strong**

IV EMPLOYMENT DENSITY IN NYC

Ahlfeldt et al (2020)

Q: Why did some cities (not) decentralize?

IV LA VS. NYC

Ahlfeldt et al (2020)

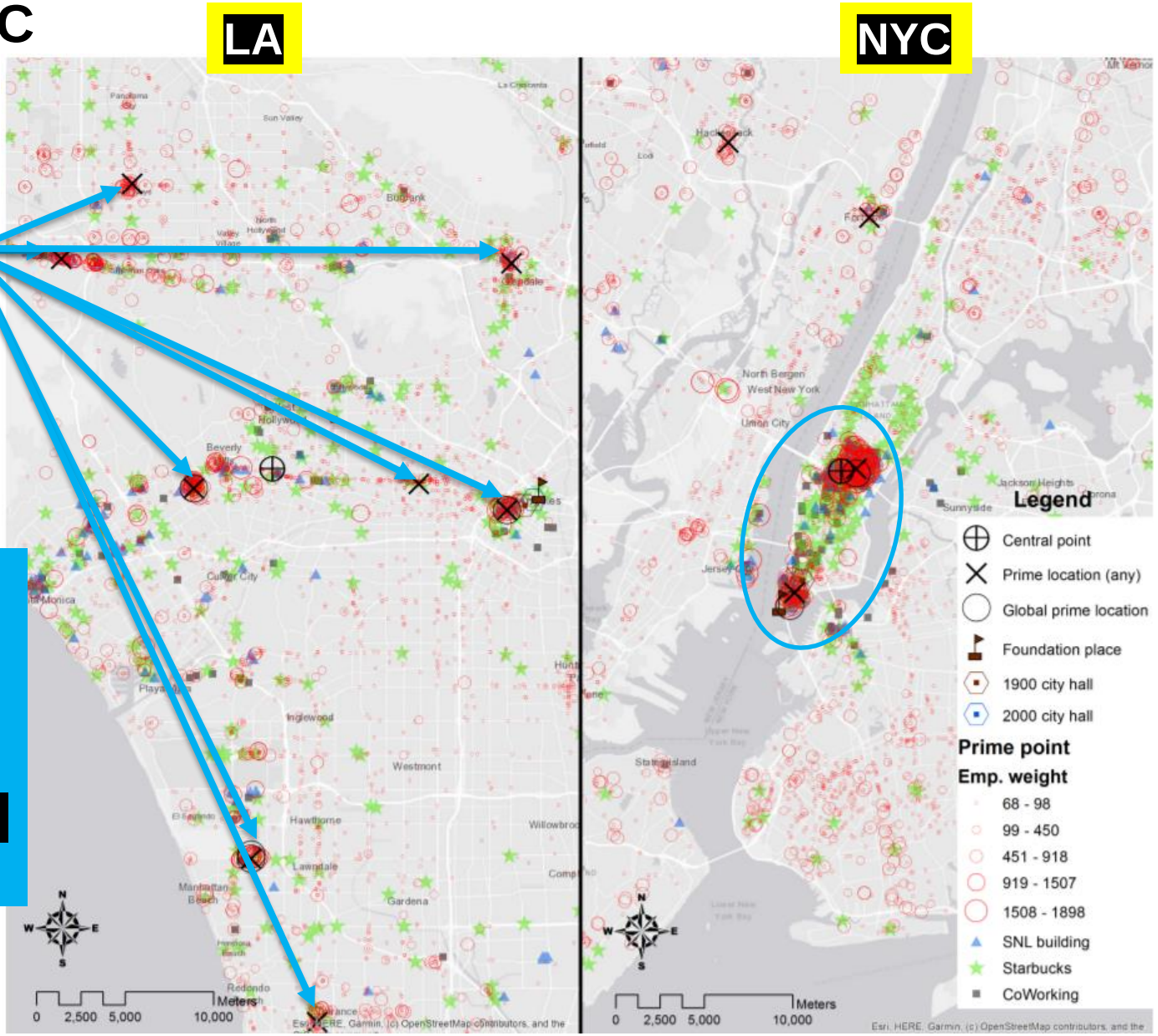
LA has many more remote PLs than NYC, despite similar population

Role for history?

NYC 1900 pop: 3.4M

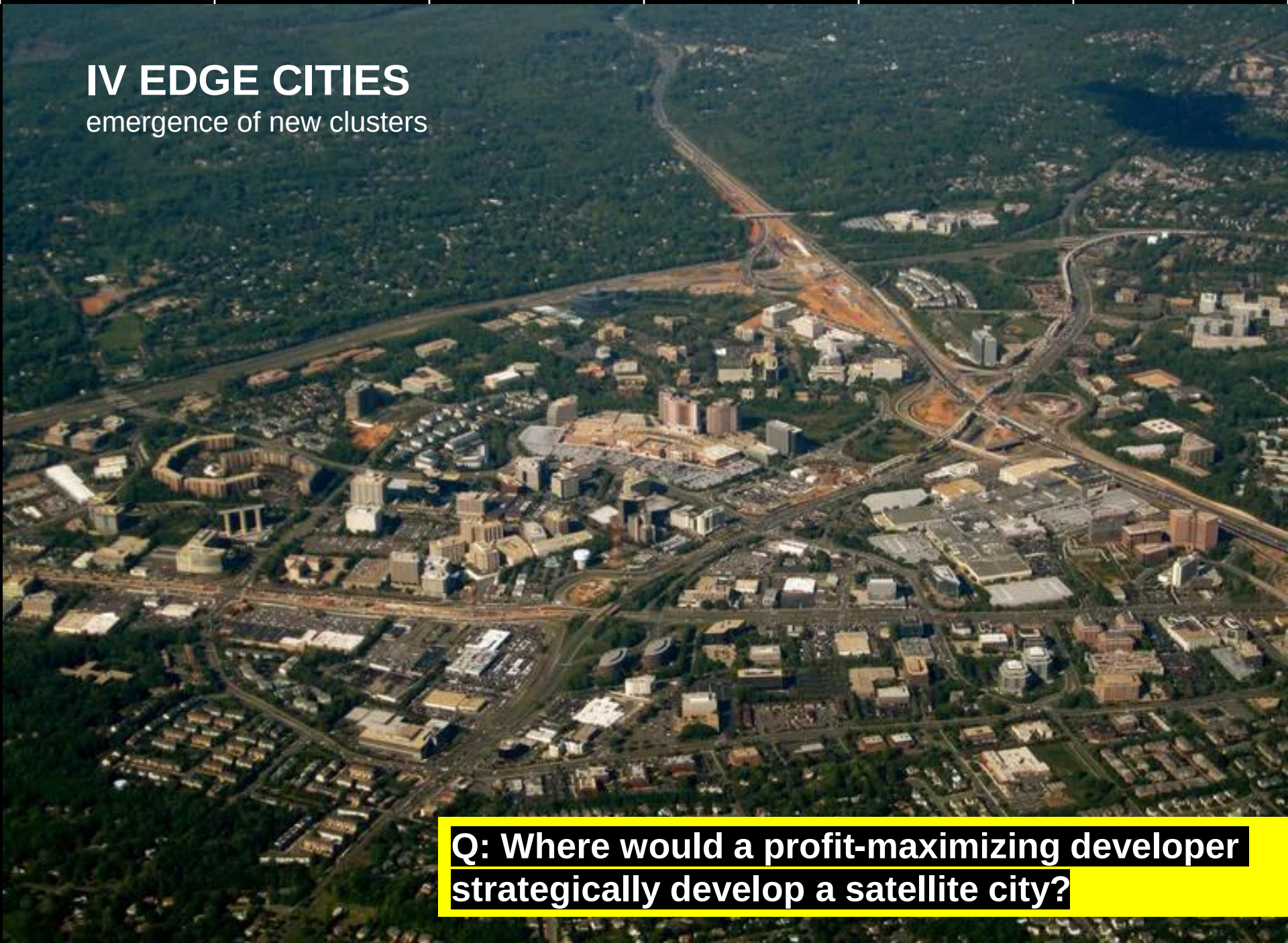
LA 1900 pop: 100k

NYC built a much larger transit network much earlier (1868)



IV EDGE CITIES

emergence of new clusters



Q: Where would a profit-maximizing developer strategically develop a satellite city?

IV EDGE CITIES

emergence of new clusters

- **Term coined by Washington Post journalist and author Joel Garreau in his 1991 book Edge City: Life on the New Frontier.**
  - **New cities in urban periphery built by one developer**
    - Built to host knowledge based tradable services
    - Dominated by class A office stock (shiny offices)
    - Net commuting destination (unlike a residential suburb)
    - Proper city with employment, recreation, entertainment
- **Popping up since 1965: A "new" urban lifestyle (?)**
  - 123 edge cities and 83 up-and-coming places listed by Garreau
  - 24 in greater LA, 23 in metro D.C., and 21 in greater NY

Edge city developed by a single developer (unlike a subcentre)

IV WHY EDGE CITIES?

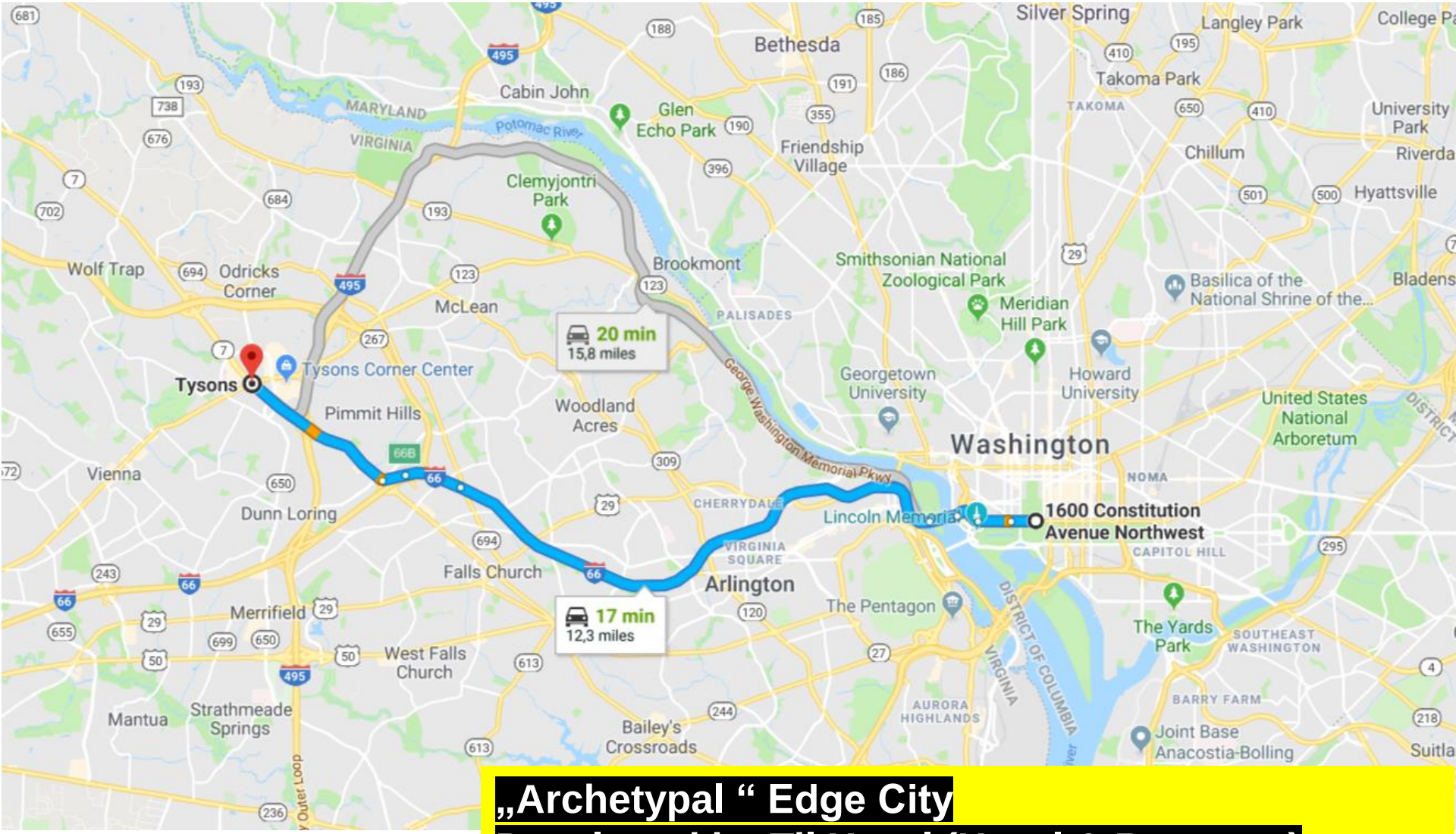
emergence of new clusters

- **Developer aims at creating an attractive edge city**
  - internalizing agglomeration spillovers
  - avoiding social-fiscal problems (poverty, crime…)
  - reducing capacity constraints (congestions).
- **Typical „instruments“**
  - Mixed use space to minimize commuting
  - Optimal road layout and parking capacity (no sunk cost)
  - Non-distorionary taxes (little redistribution)

Developer solves a “coordination problem” inherent to agglomeration
Value of land is low before and high after development ⇒ Profits!

IV TYSON'S CORNER

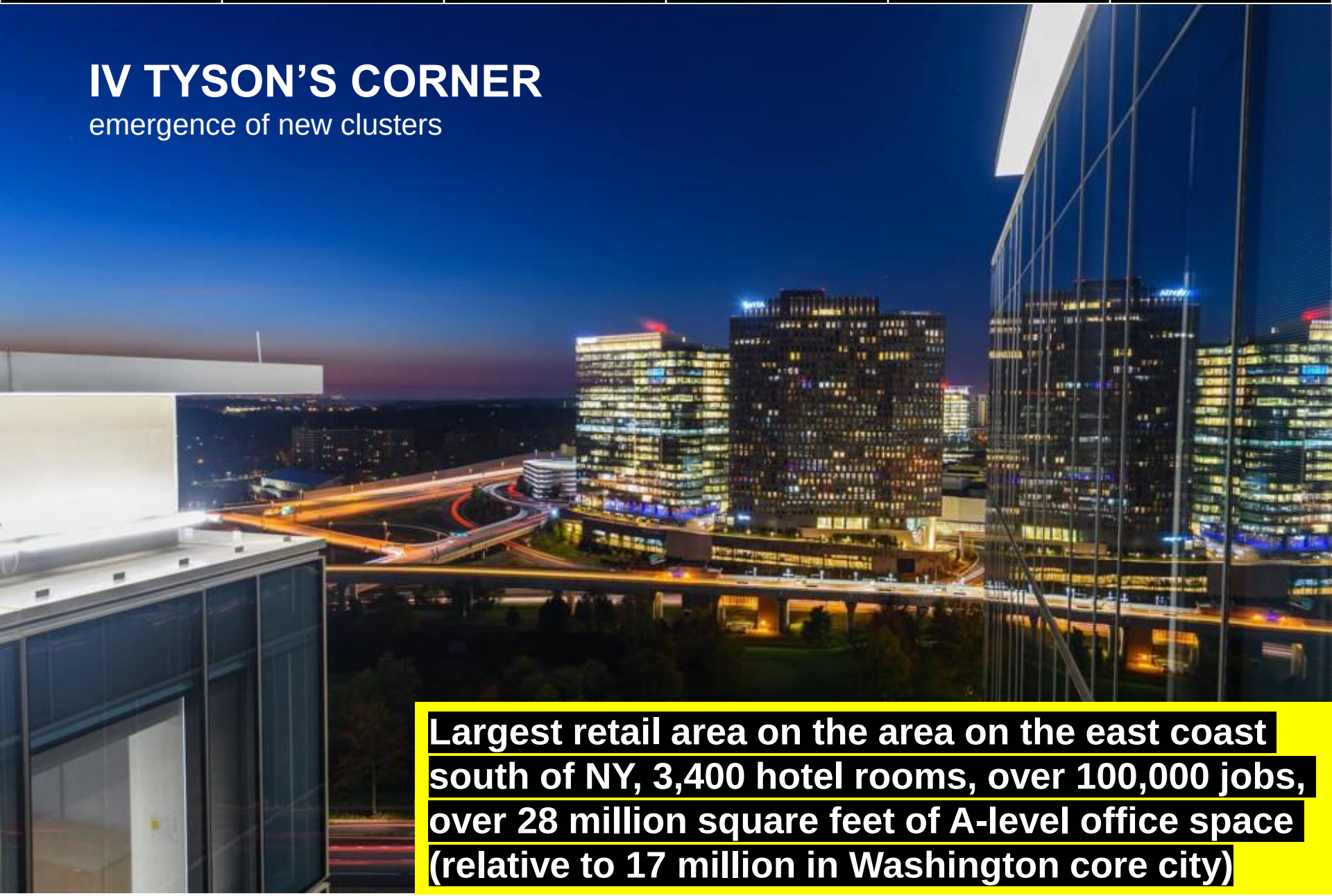
emergence of new clusters



„Archetypal " Edge City
Developed by Til Hazel (Hazel & Peterson)

IV TYSON'S CORNER

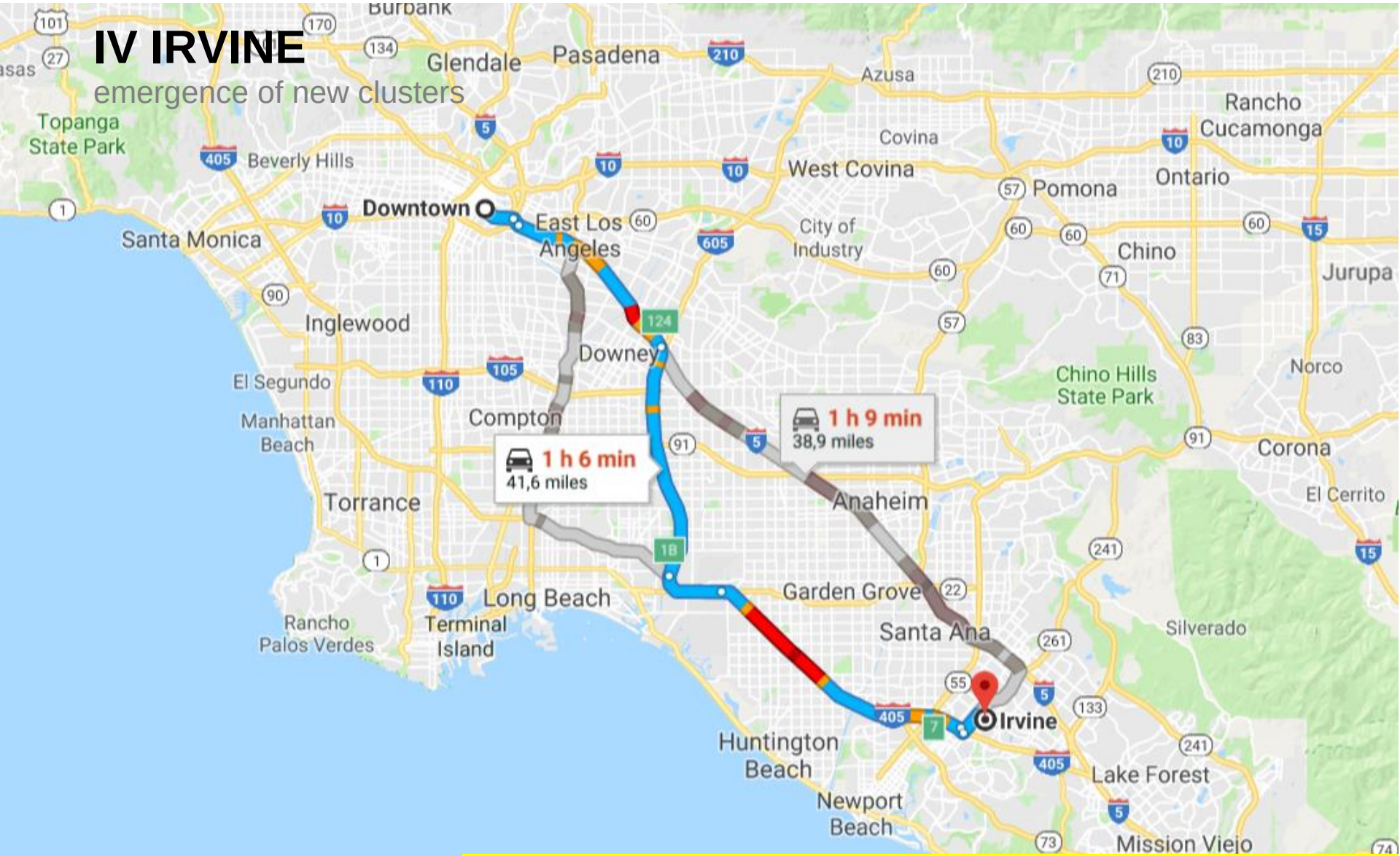
emergence of new clusters



Largest retail area on the area on the east coast south of NY, 3,400 hotel rooms, over 100,000 jobs, over 28 million square feet of A-level office space (relative to 17 million in Washington core city)

IV IRVINE

emergence of new clusters



Developed by Irvine Co. (Hazel & Peterson)

IV IRVINE

emergence of new clusters

Largest Edge City, over 160,000 jobs, over 33 million square feet of A-level office space (relative to 25 million in LA core city)

IV HENDERSON AND MITRA (1996)

emergence of new clusters

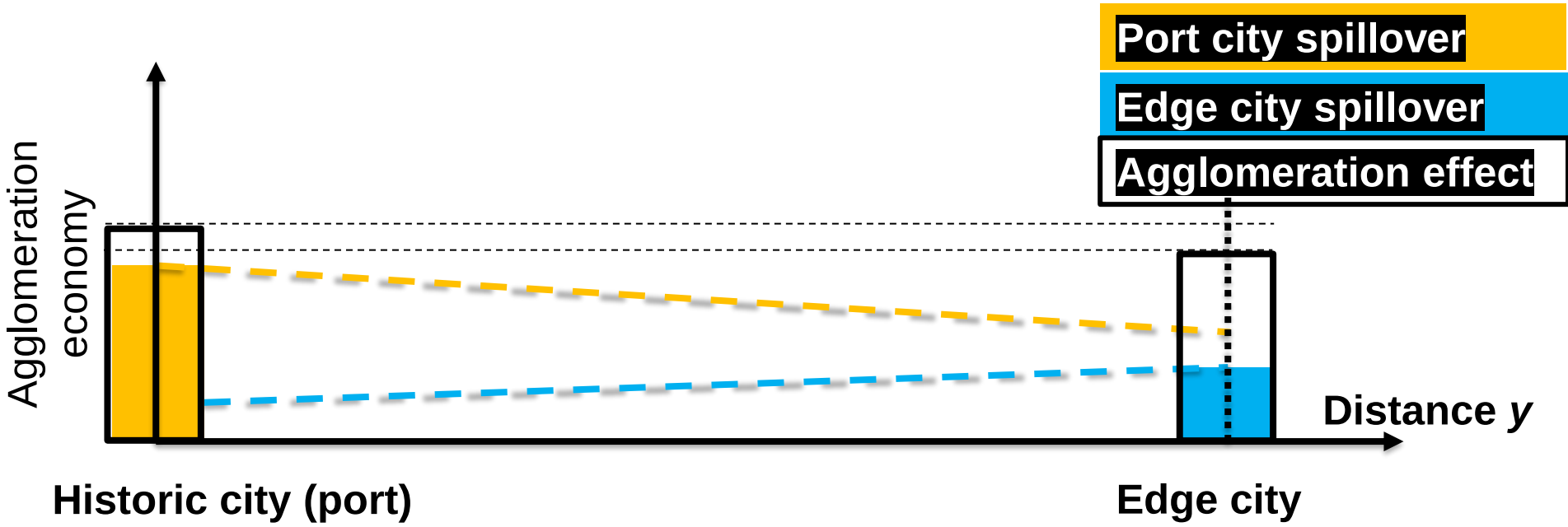
- Edge city developed by one profit-maximizing developer
  - Returns from producing a tradabe services good
  - Faces cost of providing space (constant captial cost p_k)
  - Faces cost of hiring labour: Wages
    - increase in residential rent (workers require compensaiton)
    - increase in number of workers in the metro (congestion)
- Developers chooses
  - capacity K_1 (floor space)
  - workforce *B*
  - location *y* defined in terms of distance from the port city (CBD)

Developer has monopsony power

IV HENDERSON AND MITRA (1996)

emergence of new clusters

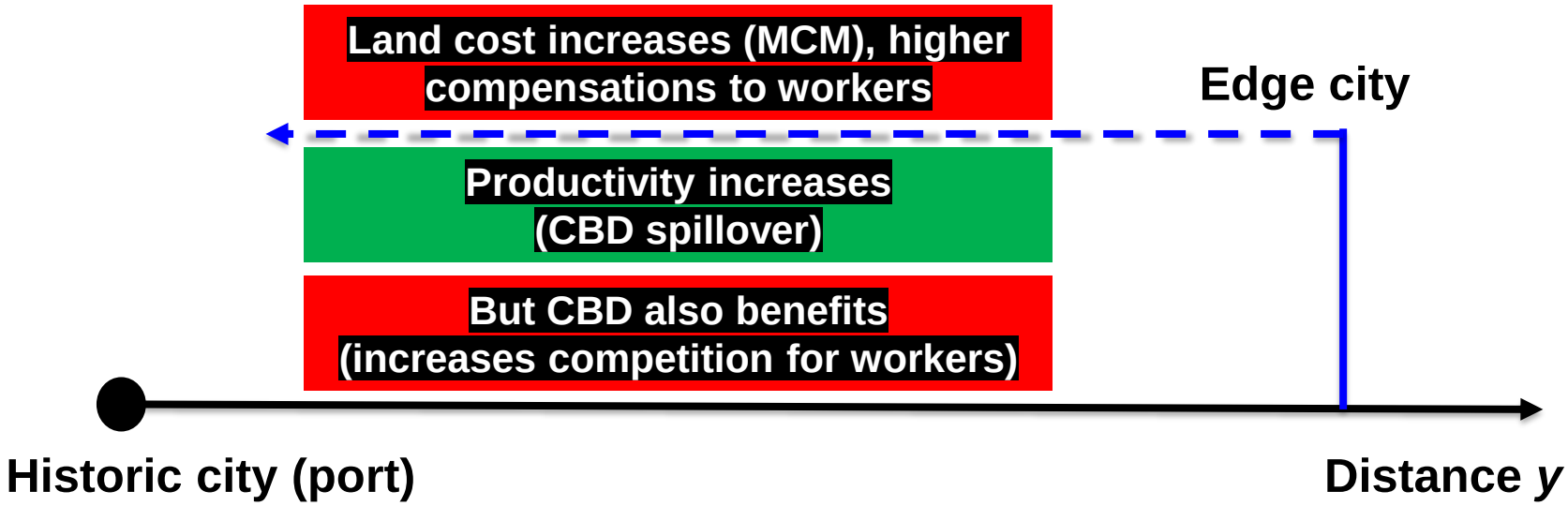
- **Port city and edge city generate agglomeration economies**
  - **Depend on population (A for port city, B for edge city)**
  - **Spillover to each other, declining in distance**



IV HENDERSON AND MITRA (1996)

emergence of new clusters

- Edge city developed by <u>one profit-maximizing developer</u>
  - Must choose the location of the edge city



Developer faces a trade-off when choosing distance from the CBD

<u>Result</u>: Small changes in CBD capacity K_0 can trigger large effects on *y*
Location choice of developer can appear „chaotic“

IV HENDERSON AND MITRA (1996)

emergence of new clusters

- Edge city developed by one profit-maximizing developer
  - Must choose capacity K_1 and employment B of edge city
- Higher CBD capacity K_0 reduces monopsony power
  - CBD pays higher wages (greater agglomeration effect)

Developer needs to consider K_0 when choosing edge city capacity

Result: Smaller edge city (K_1 and B) with larger port city, but K_1 and B may even increase if distance y changes in response to K_0

Model highly sensitive to parameter values („everything goes“)
„Chaotic“ patterns resemble Garreau‘s notion of „randomness
(but „randomness“ and „chaos“ are not the same!)
More in seminar…

SUMMARY

conclusion

- **Firm bid-rent can be derived using zero-profit condition**
  - Historically, transport cost to CBD relevant determinant
  - Agglomeration spillover more plausible determinant today
- **Changes in transport technology lead to employment decentralization**
  - Manufacturing employment decentralizes due to lower transport cost
  - Services can decentralize since agglomeration endogenous
- **Decentralized employment not the same as dispearsed employment**
  - Subcentres emerge endogenously if cities get large
  - Developers strategically build edge cities to make profits
- **Next: Firm location**
  - Determinants of firm locations within cities


THANKS

READING

- Core readings:
  - Ahlfeldt, G., Wendland, N. (2011), How polycentric is a monocentric city?
  - Glaeser, E. L., Kahn, M. E., „Decentralized employment and the transformation of the American city". Brookings-Wharton Papers on Urban Affairs, pp. 1-63.
  - McMillen D. and S.C. Smith, 2003, "The number of subcentres in large urban areas", Journal of Urban Economics 53, 321-338
  - Henderson J.V. and A. Mitra, 1996, "The new urban landscape: Developers and Edge cities", Regional Science and Urban Economics 26, 613-643
- Complementary readings and references:
  - Ahlfeldt, G., Albers, T., Behrens, K. (2020): Prime locations. CEP DP 1725. https://cep.lse.ac.uk/_new/publications/abstract.asp?index=7318
  - Baum-Snow N., Brandt L., Henderson V., Turner, M. and Zhang, Q. (2017): Roads, Railroads, and Decentralization of Chinese Cities. The Review of Economics and Statistics, 99(3)
  - McMillen, D. (2001): Non-parametric subcenter identification. Journal of Urban Economics, 50, 448-473
  - Garcia-López, M., Hémet, C., Viladecans-Marsal, E. (2017): Next train to the polycentric city: The effect of railroads on subcenter formation, Regional Science and Urban Economics, 67, Pages 50-63

III DETERMINANTS OF FIRM LOCATION CHOICE

agglomeration and decentralization

- **In choosig locations, firms consider <u>various factors</u>**
  - Natural amenities
  - Proximity to transport, railway, highway
  - Proximity to consumers and clients
  - Proximity to complementary firms
  - Proximity to workers
  - Land cost and land availability
  - Telecommunication (super-fast broadband)
  - …

Importance of factors is specific to industry sectors, and periods

III CHANGES IN LOCATION FACTORS

agglomeration and decentralization

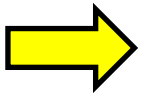
- **Fundamental changes over the past centuries affect choices**
  - **Natural amenities arguably less important**
    - E.g. role of natural habours, proximity to coal fields
  - **Transportation systems have improved**
    - Railways (more than 25,000 km of high-speed rail in China)
    - Subways (Shanghai Metor system has a length of 644 km)
    - Mass-produced cars (as of 2010 1.015 billion cars in the world)
    - Highways (Interstate Highway System has a lenght of 77,556 km)
  - **Clustering of complementary firms more important due to increasing knowledge intenstiy of prodction**

Fundamental changes can reduce the importance of being close to CBD
Likely different reasons for manufacturing and tradable services

III MANUFACTURING

agglomeration and decentralization

- **Historically attractive to be located in the CBD**
  - Being close to natural advantages (waterways)
  - Transport systems (central rail station)
  - Other firms
  - Relatively small establishments, land was affordable
- **<u>Better transportation</u> systems (more efficient and denser)**
  - Access to highways in urban periphery might even be better
- **<u>Change</u> in production and storage <u>technology</u>**
  - Integrated horizontal assembly lines
  - Inventory technology requries large, single-story structure

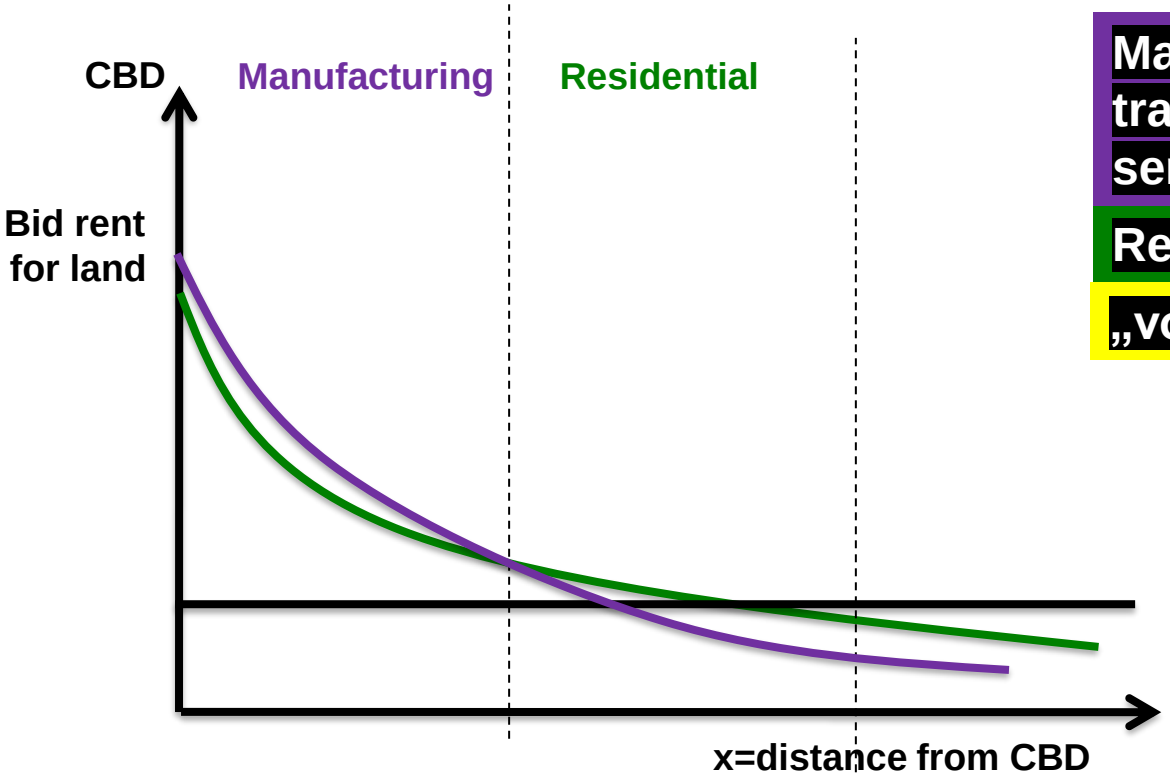


Production requires more land

III HISTORIC BID-RENT MODEL

agglomeration and decentralization

- **How did the CBD come about?**



Manufacturers face *high* transport cost, *small* plants serving *local* markets

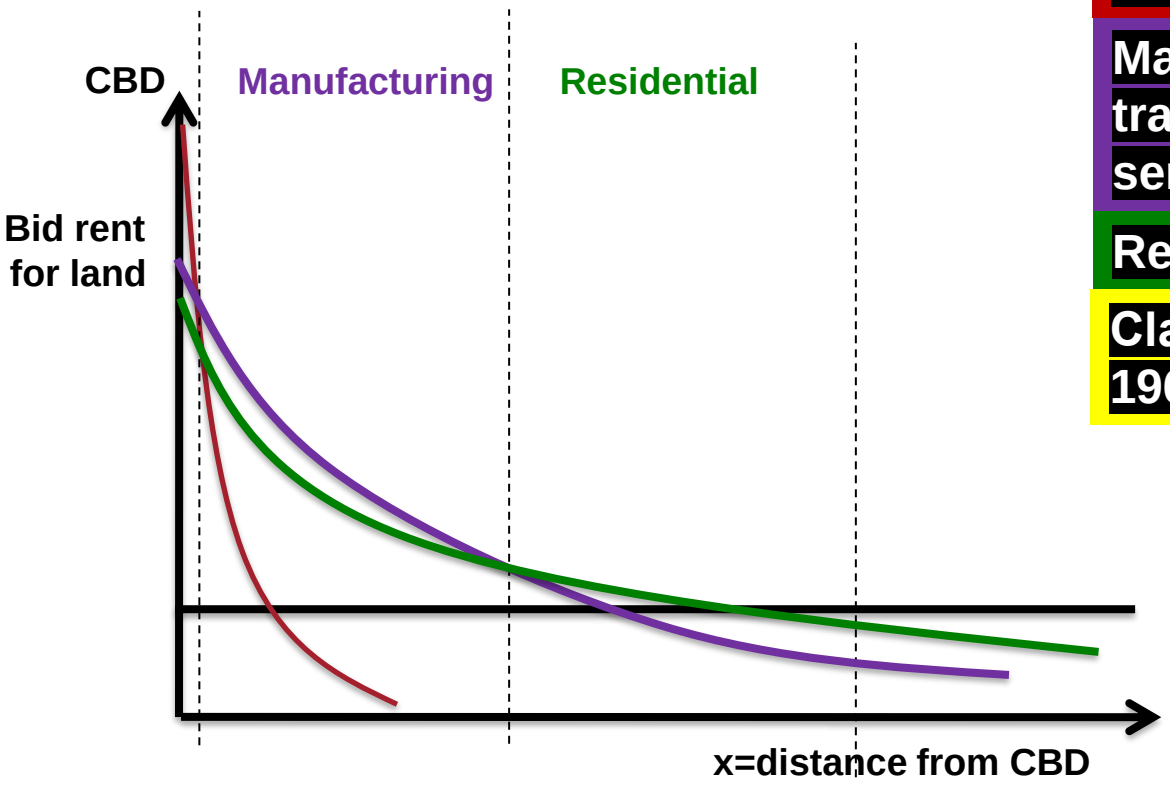
Residential land price gradient

„von Thünen world“

III CLASSIC TEXT-BOOK MODEL

agglomeration and decentralization

- **After emergence of an office sector**



Commercial land price gradient with large *Θ*

Manufacturers face *high* transport cost, *small* plants serving *local* markets

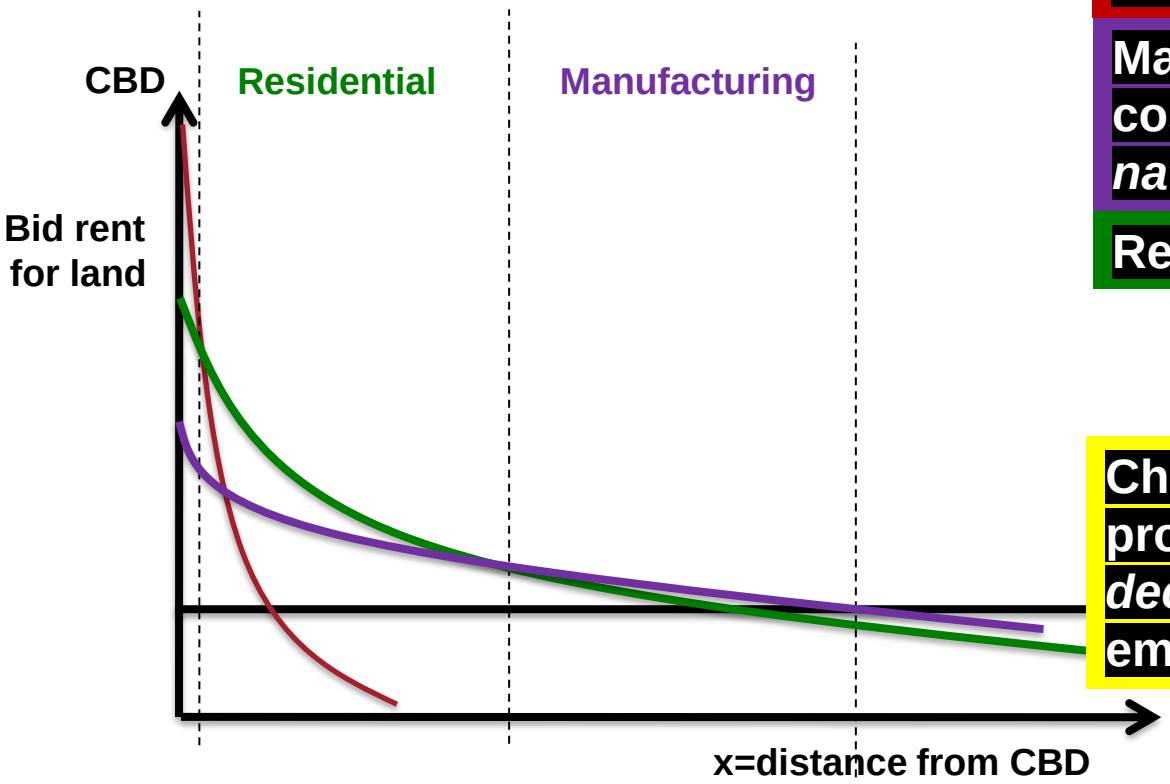
Residential land price gradient

Classic „AMM“ model from 1960/70s

III MODERN TEXT-BOOK MODEL

agglomeration and decentralization

- **After emergence of an office sector**



Commercial land price gradient with large *Θ*

Manufacturers face *low* transport cost, *large* plants serving *national/global* markets

Residential land price gradient

Changes in transportation and production technology lead to *decentralization* of manufacturing employment!

III APPENDIX: AGENT-BASED MODELLING

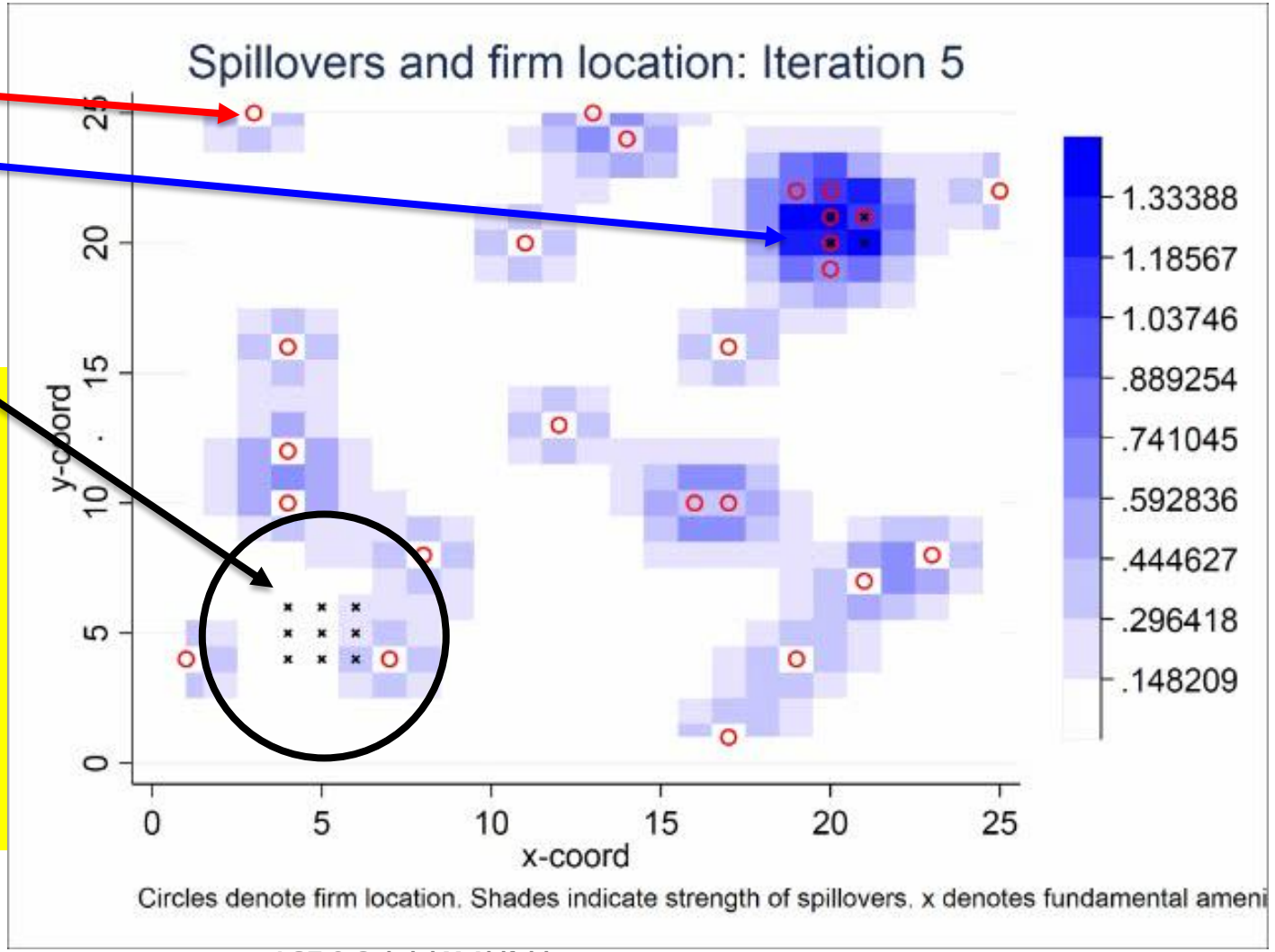
agglomeration and decentralization

Firms

Spillover

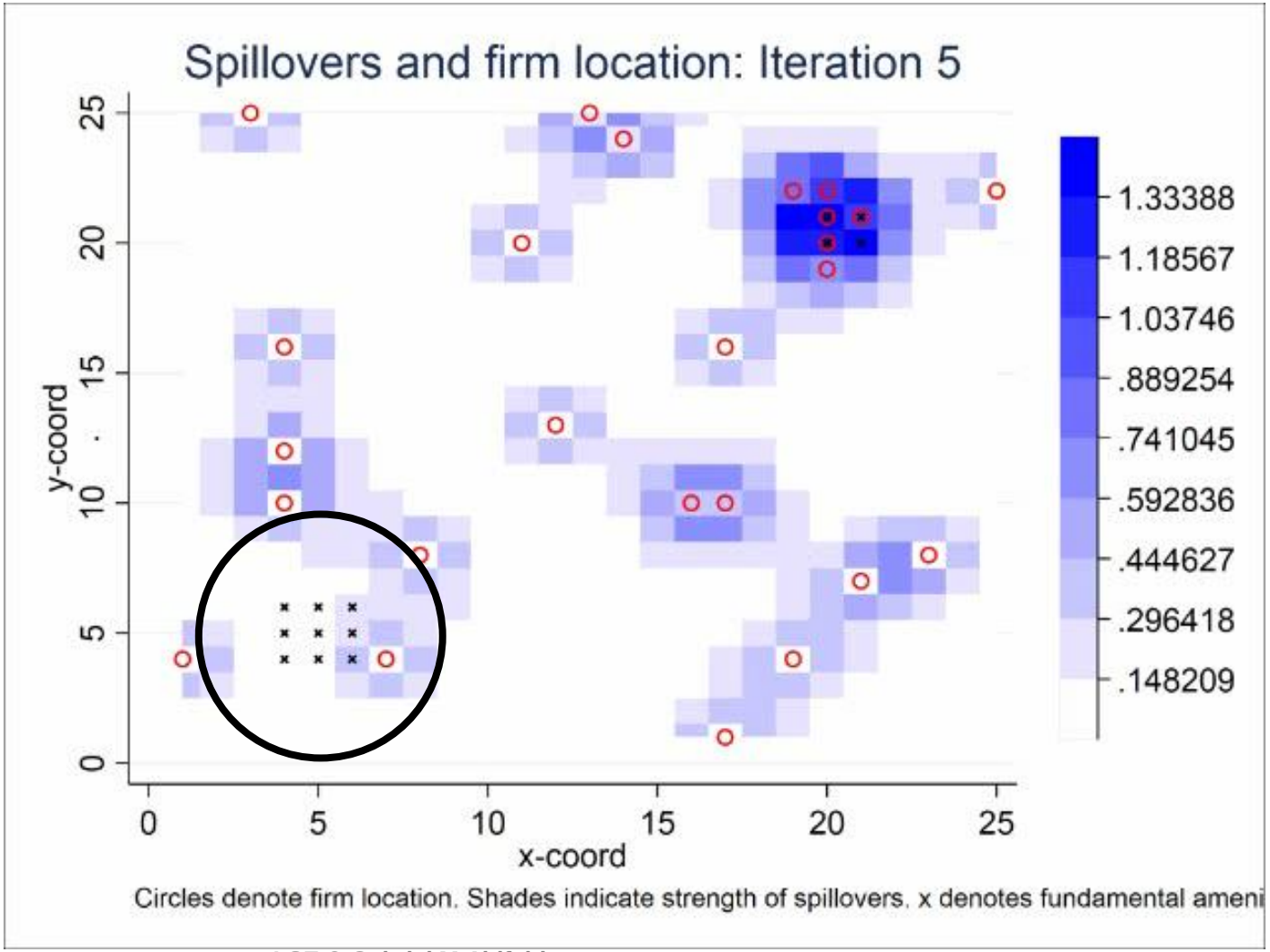
Amenity

Firms make sequential location choices to maximize profits, benefitting from spillovers from other firmst



III ILLUSTRATION USING AGENT-BASED MODELLING

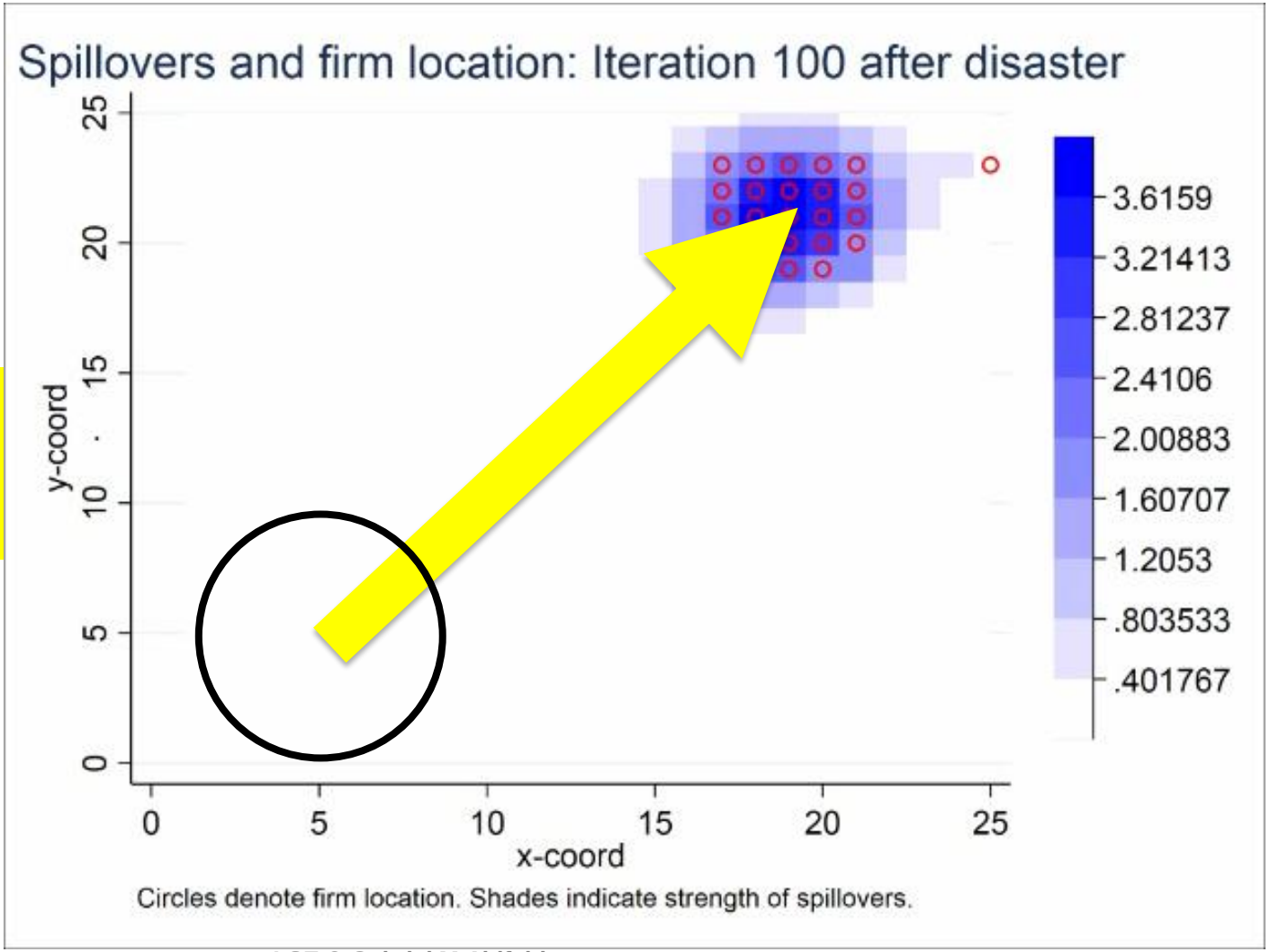
agglomeration and decentralization



III ILLUSTRATION USING AGENT-BASED MODELLING

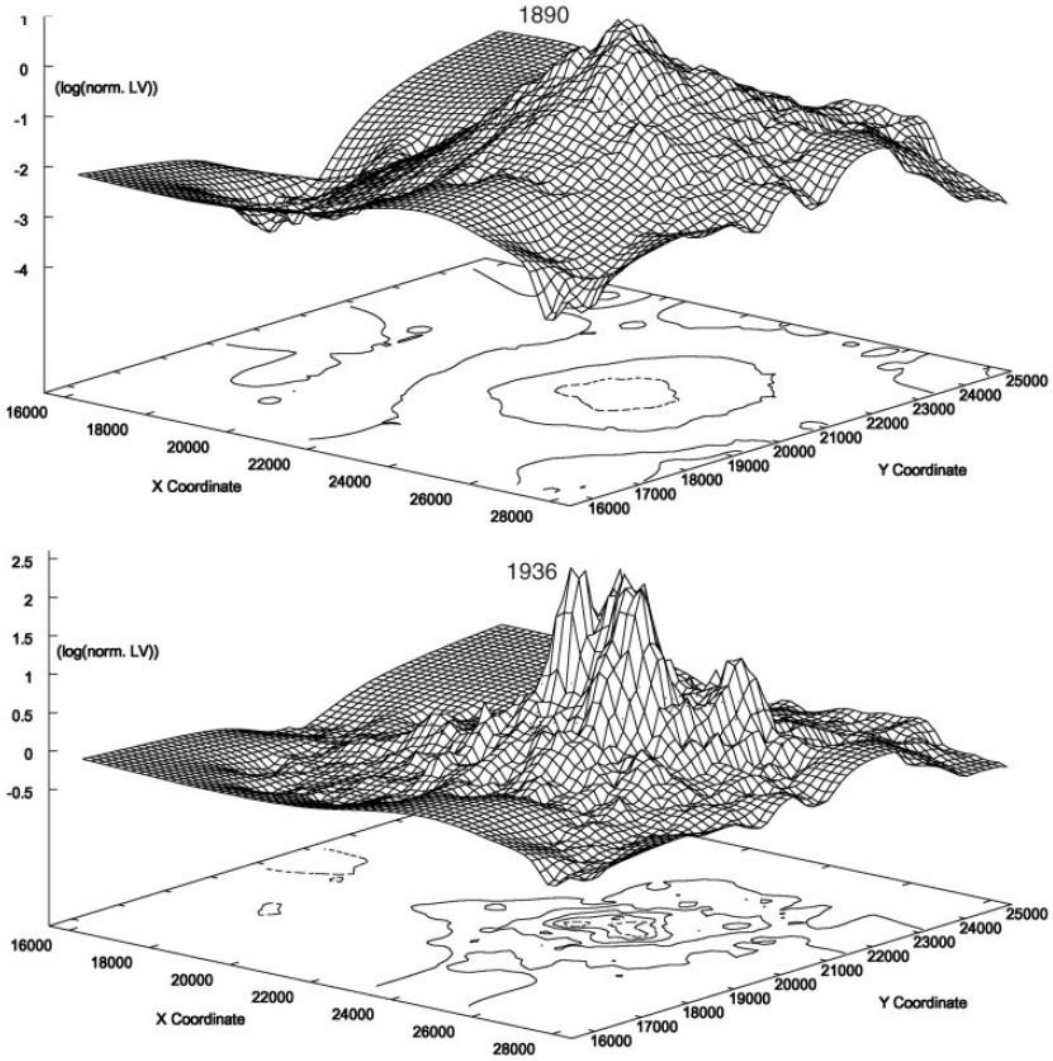
agglomeration and decentralization

Firms have move away from the former CBD!



IV A POLYCENTRIC MONOCENTRIC CITY

emergence of new clusters



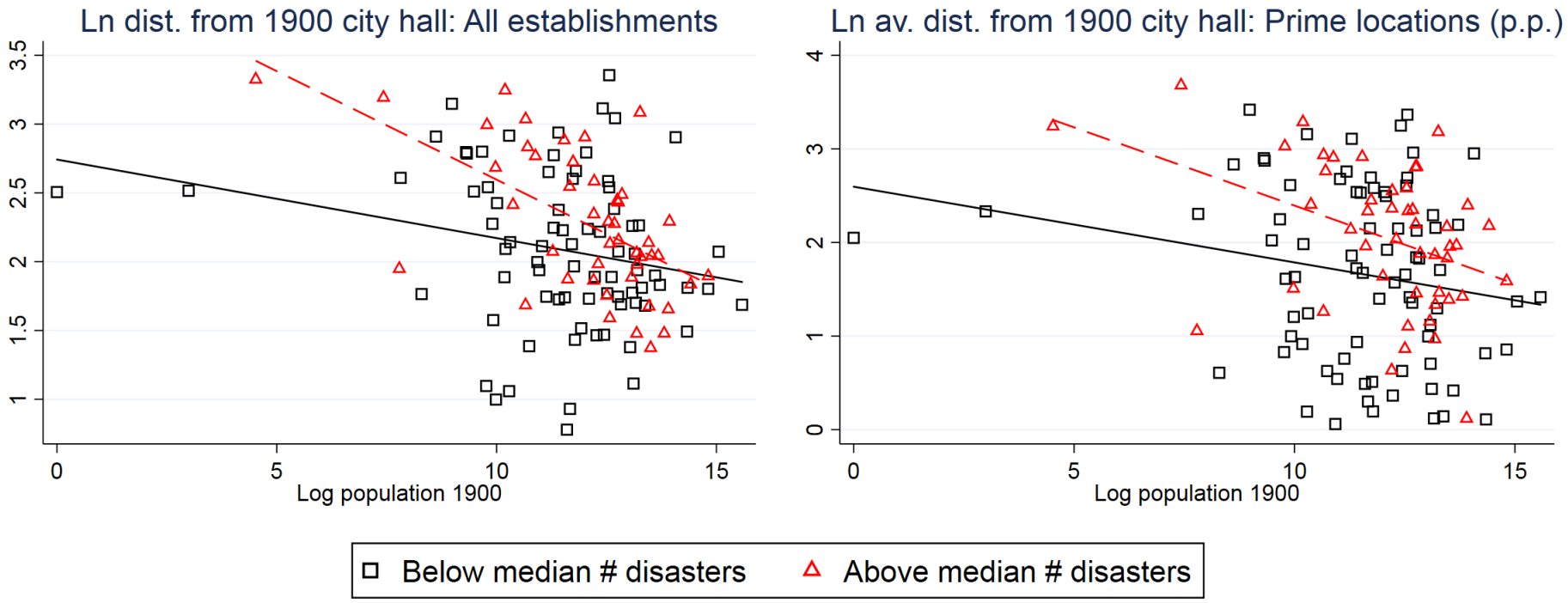
Before transition to knowledge-based economy CBD gradients dominates spatial structure

Transition

After transition, there are several specialised *micro agglomerations* (e.g. for banking, media, lobbying) mostly *close to* the CBD

IV SPATIAL CONCENTRATION VS 1900 POPULATION

emergence of new clusters



Assumption: In 1900 cities were monocentric (large city = large CBD)

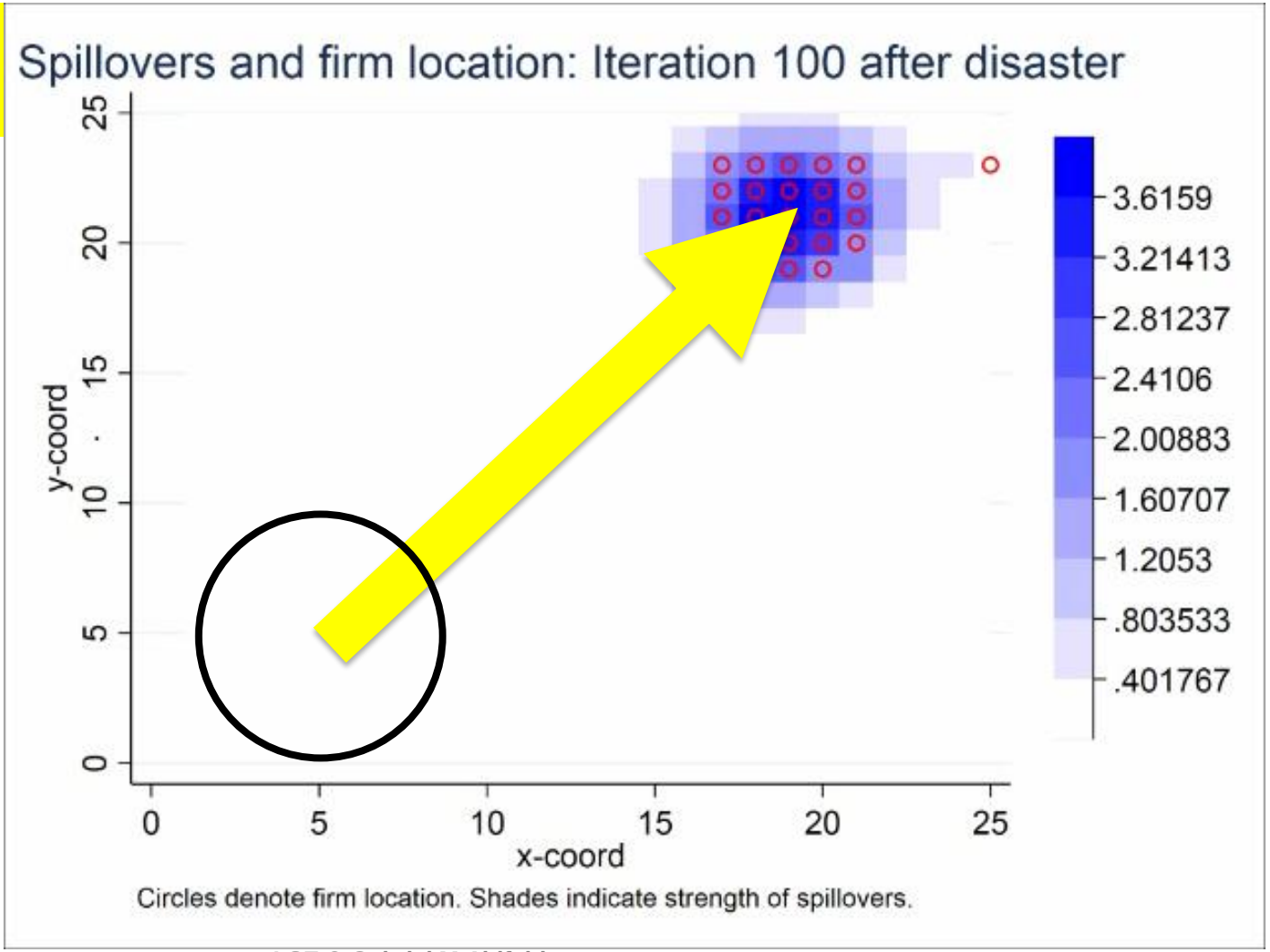
"Hysteresis effect": If cities were large at time of transition (around 1900), economic activity remains anchored close to CBD

Explains differences in city structure
New York vs. Los Angeles
East coast vs. west coast US cities
US vs. European & Asian cities

IV IN LINE WITH AGENT-BASED MODELLING?

emergence of new clusters

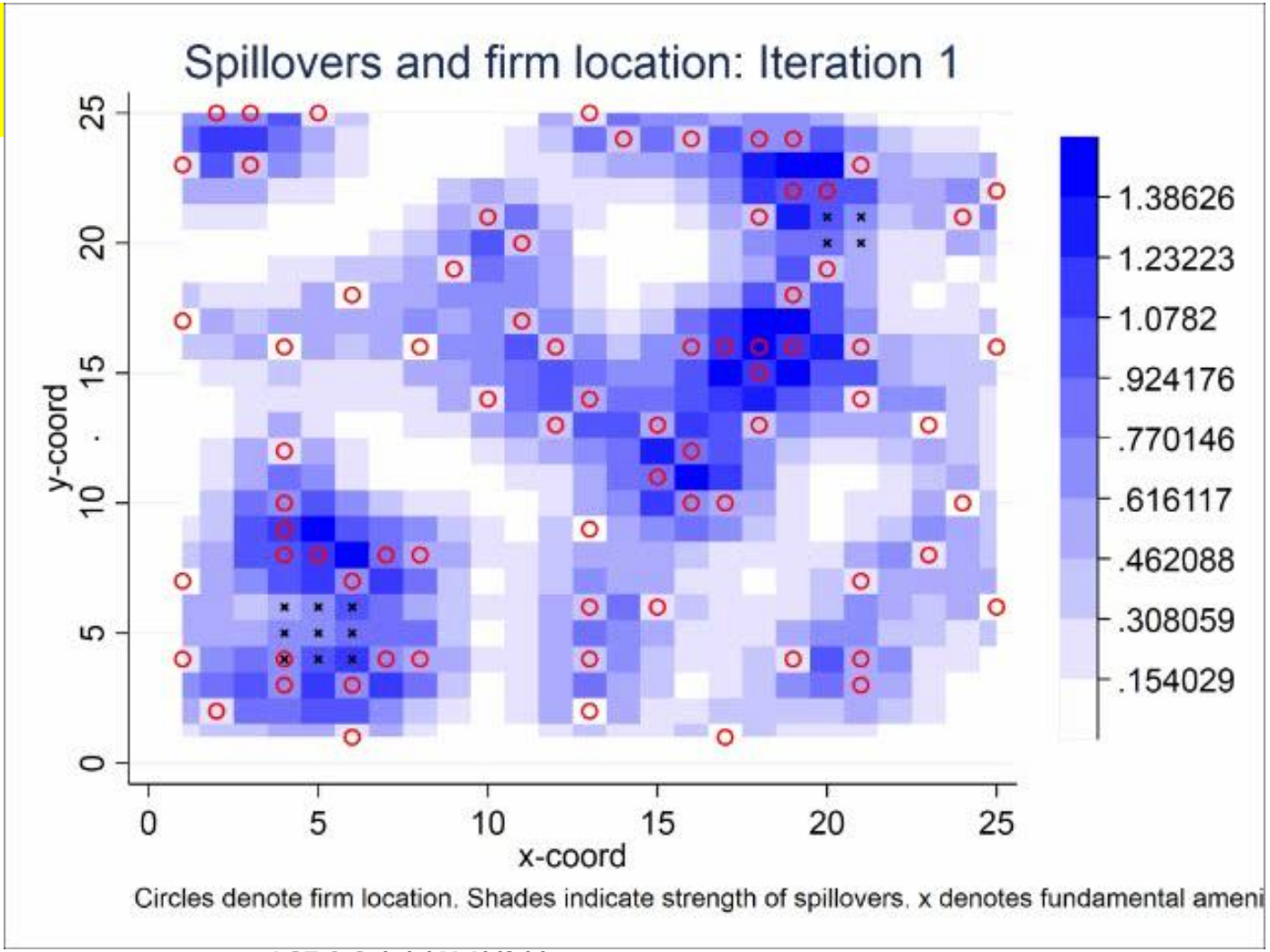
"Small-city" results



IV IN LINE WITH AGENT-BASED MODELLING?

emergence of new clusters

"Big-city" results



IV IN LINE WITH AGENT-BASED MODELLING?

emergence of new clusters

"Big-city" results

In large city, remain anchored close to historic centre