Urban growth shadows

David Cuberes, Klaus Desmet, and Jordan Rappaport

June 27, 2021

Main ideas and results

Is the proximity of a large urban center beneficial or harmful to a location's economic growth?

Main ideas and results

Is the proximity of a large urban center beneficial or harmful to a location's economic growth?

- "Urban shadow"

Main ideas and results

Is the proximity of a large urban center beneficial or harmful to a location's economic growth?

- "Urban shadow"
- Urban acces

Main ideas and results

Is the proximity of a large urban center beneficial or harmful to a location's economic growth?

- "Urban shadow"
- Urban acces

The empirical analysis identifies two distinct time periods. Between 1840 and 1920, urban shadows dominated, and since then, between 1920 and today, urban access has taken over.

Commuting Cost

- The authors show that the long-run behavior of just one variable - commuting cost - can account for many of the observed patterns in the data, including the changing relative strength of urban shadows and urban access over time and space.

Commuting Cost

- The authors show that the long-run behavior of just one variable - commuting cost - can account for many of the observed patterns in the data, including the changing relative strength of urban shadows and urban access over time and space.
- To understand the role of commuting costs and shipping costs in shaping the relative strength of urban shadows and urban access, the authors develop a simple model of two cities.

Commuting Cost

- The authors show that the long-run behavior of just one variable - commuting cost - can account for many of the observed patterns in the data, including the changing relative strength of urban shadows and urban access over time and space.
- To understand the role of commuting costs and shipping costs in shaping the relative strength of urban shadows and urban access, the authors develop a simple model of two cities.
- What is the role of commuting cost in the interaction between large and small cities?

Baseline specification

For each 20-year period, the authors regress annual average population growth, g_ℓ, on the set of indicators, $\boldsymbol{I}_\ell^{\tilde{L}} = [I_\ell^{\tilde{L},\tilde{d}_1}, I_\ell^{\tilde{L},\tilde{d}_2}, ..., I_\ell^{\tilde{L},\tilde{d}_D}]$, along with a fifth-order polynomial of a location's initial population, $\boldsymbol{L}_\ell = [\log(L_\ell), (\log(L_\ell))^2, ..., \log(L_\ell)^5]$, and a set of geographic attributes with 47 variables, $\boldsymbol{x}_\ell$.

$$g_\ell = \boldsymbol{I}_\ell^{\tilde{L}} \boldsymbol{\beta} + L_\ell \boldsymbol{\gamma} + \boldsymbol{x}_\ell \boldsymbol{\delta} + \epsilon_\ell$$

Results: Two distinct subperiods

Table 1
Population Growth and the Presence of a Moderately Large Neighbor.

	Average Annual Population Growth of Small and Medium Locations (Quintiles 1–4)								
Distance to Nearest Neighbor with Pop ≥ 95th Pctile	(1) 1840-1860	(2) 1860-1880	(3) 1880-1900	(4) 1900-1920	(5) 1920-1940	(6) 1940-1960	(7) 1960-1980	(8) 1980-2000	(9) 2000-2017
1 to 50 km	-0.63*	-0.77***	-1.10***	-0.04	0.28**	1.11***	1.19***	0.50***	0.41**
	(0.35)	(0.28)	(0.21)	(0.14)	(0.12)	(0.15)	(0.19)	(0.14)	(0.20)
50 to 100 km	-0.67***	-0.41**	-0.86***	-0.28***	-0.07	0.16*	0.21*	0.26***	0.11
	(0.24)	(0.20)	(0.18)	(0.09)	(0.07)	(0.08)	(0.11)	(0.09)	(0.09)
100 to 150 km	-0.30***	-0.11	-0.63***						0.03
	(0.12)	(0.17)	(0.15)						(0.07)
Additional Controls	48	52	52	52	52	52	52	52	52
N	691	1,328	1,844	2,110	2,357	2,387	2,283	2,104	1,895
Adjusted R^2	0.846	0.778	0.718	0.521	0.393	0.352	0.376	0.412	0.298
Incremental R^2	0.002	0.002	0.008	0.002	0.003	0.028	0.033	0.010	0.004

Each column presents the results from a regression of average annual population growth of those with population at or below the 80th percentile over the enumerated period on categorical indicators if the nearest neighbor with population at or above the 95th percentile is within the enumerated distance bin. All regressions include a constant and control for initial population and additional geographic, weather, and topographical control variables, as described in the text. Standard errors, in parentheses, are robust to spatial correlation based on Conley (1999). The incremental R^2 refers to the difference between the R^2 of the regression and the R^2 of a regression on only the additional control variables. * $p < .10$, ** $p < .05$, *** $p < .01$

Stylized fact 1

Urban Shadows and Urban Access

Urban shadows and urban access. Between **1840 and 1920 urban shadows** dominated the U.S. economic geography, with locations in the vicinity of large places growing relatively **slower**, whereas between **1920 and 2017 urban access** dominated, with locations in the vicinity of large places growing relatively **faster**.

Recent weakening of urban access

Table 2
Population Growth and the Presence of a Moderately Large Neighbor, 1960 Borders.

	Average Annual Population Growth of Small and Medium Locations (Quintiles 1–4)		
Distance to Nearest Neighbor with Pop ≥ 95th Pctile	(1) 1960-1980	(2) 1980-2000	(3) 2000-2017
1 to 50 km	1.19***	1.43***	0.60***
	(0.19)	(0.30)	(0.12)
50 to 100 km	0.21*	0.59***	0.14**
	(0.11)	(0.23)	(0.06)
100 to 150 km		0.24	
		(0.20)	
150 to 200 km		0.13	
		(0.12)	
Additional Controls	52	52	52
N	2,283	2,282	2,283
Adjusted R^2	0.376	0.426	0.310
Incremental R^2	0.033	0.047	0.019

Metropolitan areas are delineated using the OMB standards following the 1960 decennial census. Non-metropolitan counties are delineated using their borders in 1960. Each column presents the results from a regression of average annual population growth of those with population at or below the 80th percentile over the enumerated period on categorical indicators if the nearest neighbor with population at or above the 95th percentile is within the enumerated distance bin. All regressions include a constant and control for initial population and additional geographic, weather, and topographical control variables, as described in text. Standard errors, in parentheses, are robust to spatial correlation based on Conley (1999). The incremental R^2 refers to the difference between the R^2 of the regression and the R^2 of a regression on only the additional control variables. * $p < .10$, ** $p < .05$, *** $p < .01$.

Stylized fact 2

Recent Weakening of Urban Access

Urban access weakened circa 2000. In particular, during the period 2000-2017 benefits from urban access are less pronounced that during the periods from 1960 to 1980 and 1980-2000.

Geographic reach: stylized fact 3

How does the geographic reach of urban shadows and urban access has changed over time?

Geographic reach of shadows and access

Over the period 1920-2017 there is strong evidence of the geographic reach of urban access expanding, with the benefits from access being very local between 1920-1940 and much more far-reaching in 2000-2017. Over the period 1840-1920 the evidence is mixed, though there is weak evidence of the geographic reach of urban shadows expanding between the late 19th century and early 20th century.

Size of large neighbors: stylized fact 4

How does the strength of urban shadows and urban access depends on the relative size of neighbors?

Size of Large Neighbor

Urban shadows and urban access tend to strengthen in the size of the large neighbor. That is, the larger the neighbor, the stronger urban shadows and urban access.

Commuting cost: 1840-2017

One important force that is bound to have shaped spatial growth dynamics in the hinterland of large population clusters are commuting costs. The authors are more interested in the improvements of short-distance transportation. The main innovations of short-distance transportation technology in the U.S. over the past centuries are:

Commuting cost: 1840-2017

One important force that is bound to have shaped spatial growth dynamics in the hinterland of large population clusters are commuting costs. The authors are more interested in the improvements of short-distance transportation. The main innovations of short-distance transportation technology in the U.S. over the past centuries are:

- 1820-1840: Omnibus, a horse-drawn vehicle carrying twelve passengers

Commuting cost: 1840-2017

One important force that is bound to have shaped spatial growth dynamics in the hinterland of large population clusters are commuting costs. The authors are more interested in the improvements of short-distance transportation. The main innovations of short-distance transportation technology in the U.S. over the past centuries are:

- 1820-1840: Omnibus, a horse-drawn vehicle carrying twelve passengers
- 1850-1900: Street-car or trolley, which allowed for smoother travel and larger capacity than an omnibus.

Commuting cost: 1840-2017

One important force that is bound to have shaped spatial growth dynamics in the hinterland of large population clusters are commuting costs. The authors are more interested in the improvements of short-distance transportation. The main innovations of short-distance transportation technology in the U.S. over the past centuries are:

- 1820-1840: Omnibus, a horse-drawn vehicle carrying twelve passengers
- 1850-1900: Street-car or trolley, which allowed for smoother travel and larger capacity than an omnibus.
- 1900 - 1920: automobile and high reduction of the street railway's cost.

Commuting cost: 1840-2017

One important force that is bound to have shaped spatial growth dynamics in the hinterland of large population clusters are commuting costs. The authors are more interested in the improvements of short-distance transportation. The main innovations of short-distance transportation technology in the U.S. over the past centuries are:

- 1820-1840: Omnibus, a horse-drawn vehicle carrying twelve passengers
- 1850-1900: Street-car or trolley, which allowed for smoother travel and larger capacity than an omnibus.
- 1900 - 1920: automobile and high reduction of the street railway's cost.
- 1950 : construction of suburban rail terminals.

Are transportation innovations the only factor that decreases the commuting costs? What about **spatial clustering**, **congestion**, and the **opportunity cost of time**?

Commuting costs: Stylized fact 5

How does the variation in local commuting infrastructure affects local population growth?

Urban Shadows and local commuting infrastructure

In the early 19th century, urban shadows were stronger when large locations disposed of better commuting infrastructure in the form of streetcars.

Two-city spatial model

The authors develop a two-city spatial model with commuting costs, moving costs and trade costs that is able to account for the main stylized facts identified in the data. The basic tradeoff the model captures is easy to understand:

Two-city spatial model

The authors develop a two-city spatial model with commuting costs, moving costs and trade costs that is able to account for the main stylized facts identified in the data. The basic tradeoff the model captures is easy to understand:

- the smaller city may suffer when its residents prefers to move to the more productive neighbor,

Two-city spatial model

The authors develop a two-city spatial model with commuting costs, moving costs and trade costs that is able to account for the main stylized facts identified in the data. The basic tradeoff the model captures is easy to understand:

- the smaller city may suffer when its residents prefers to move to the more productive neighbor,
- the smaller city may thrive as its residents can access the neighbor's higher productivity, either through commuting or through trade.

Setup

Setup

- L individuals that are part of city k or ℓ (exogenous production points).

Setup

- L individuals that are part of city k or ℓ (exogenous production points).
- Each resident has one unit of time, which she divides between work and commuting.

Setup

- L individuals that are part of city k or ℓ (exogenous production points).
- Each resident has one unit of time, which she divides between work and commuting.
- Individuals can choose to move and reside in the other city (utility cost $\mu d_{\ell k}$).

Setup

- L individuals that are part of city k or ℓ (exogenous production points).
- Each resident has one unit of time, which she divides between work and commuting.
- Individuals can choose to move and reside in the other city (utility cost $\mu d_{\ell k}$).
- Inter-city distance, $d_{\ell k}$, is big enough so that there is at least some empty land between the two cities.

Setup

- L individuals that are part of city k or ℓ (exogenous production points).
- Each resident has one unit of time, which she divides between work and commuting.
- Individuals can choose to move and reside in the other city (utility cost $\mu d_{\ell k}$).
- Inter-city distance, $d_{\ell k}$, is big enough so that there is at least some empty land between the two cities.
- Land is owned by absentee landlords.

Technology

- Each city produces a different good, and labor is the only factor of production.

Technology

- Each city produces a different good, and labor is the only factor of production.
- When a good of city ℓ is shipped to city k, a share γ_t is lost per unit of distance, so $1 - \gamma_t d_{\ell k}$.

Technology

- Each city produces a different good, and labor is the only factor of production.
- When a good of city ℓ is shipped to city k, a share γ_t is lost per unit of distance, so $1 - \gamma_t d_{\ell k}$.
- Technology is linear, with one unit of labor producing A_ℓ units of good at ℓ and A_k at point k.
- To produce, an individual needs to commute from his residence to one of the two production points.

Possible Equilibriums

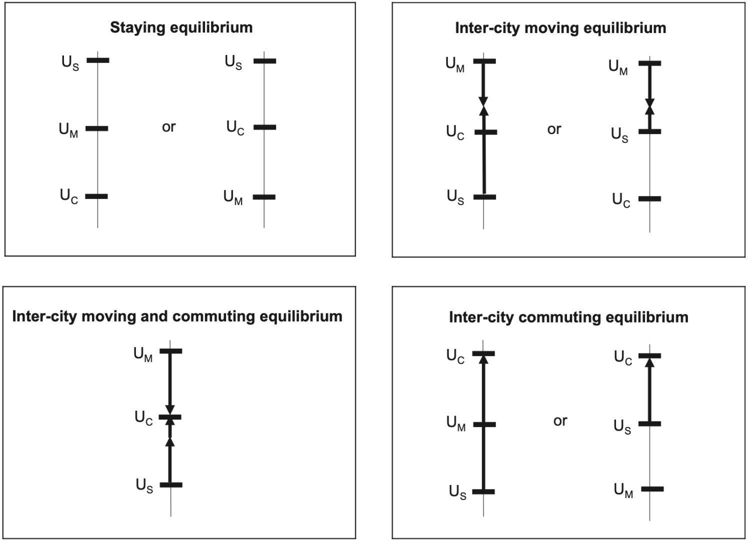

Fig. 1. Equilibrium Description. Given initial conditions, this figure graphically illustrates the four possible equilibrium configurations. Horizontal lines denote th initial utility levels for the different choices: U_S refers to the utility of an individual staying and working in her own city, U_M refers to the utility of an individua moving to the other city and working there, and U_C refers to the utility of an individual commuting to the other city. In the top-left corner individuals do not gai from either moving or commuting to the other city, so we have a *staying equilibrium*. In the top-right corner and bottom-left corner individuals get a higher utilit from moving than from commuting or staying. If moving leads the utility to equalize to that of staying, we get a *moving equilibrium*, whereas if it leads the utility t equalize to that of commuting, we get a *moving and commuting equilibrium*. In the bottom-right corner individuals get a higher utility from commuting, so we have *commuting equilibrium*.

Results

- Result 1: A gradual decrease in the commuting costs first shift the economy from a staying eq. to an inter-city moving eq., with some residents of the smaller city moving to the high-productivity city. Later as the commuting costs continues to drop, the economy shifts to an inter-city moving and commuting eq, and then to an inter-city commuting eq.
- Result 2: When the larger city is geographically farther away, commuting costs need to drop more before individuals from the smaller city want to move to the bigger city, and they also need to drop more before they find it profitable to commute to the bigger city.
- Result 3: The larger cities exert a stronger gravitational pull on their hinterland, as they start casting their urban shadows at higher levels of commuting costs.

Conclusions

- As cost of commuting drops, individuals first have an incentive to move from smaller closeby cities to larger urban centers.

Conclusions

- As cost of commuting drops, individuals first have an incentive to move from smaller closeby cities to larger urban centers.
- Falling commuting cost first hurt, and then help, the growth of smaller locations in the vicinity of large urban centers.

Conclusions

- As cost of commuting drops, individuals first have an incentive to move from smaller closeby cities to larger urban centers.
- Falling commuting cost first hurt, and then help, the growth of smaller locations in the vicinity of large urban centers.
- A single variable - commuting costs - is able to capture the growth patterns of small cities in the hinterland of large urban clusters over the time period stretching from 1840 to 2017.

Conclusions

- As cost of commuting drops, individuals first have an incentive to move from smaller closeby cities to larger urban centers.
- Falling commuting cost first hurt, and then help, the growth of smaller locations in the vicinity of large urban centers.
- A single variable - commuting costs - is able to capture the growth patterns of small cities in the hinterland of large urban clusters over the time period stretching from 1840 to 2017.
- Using an alternative conceptual framework that introduces trade between cities, we show that the rise and decline of urban shadows is also consistent with the observed faster drop in shipping costs than in commuting costs.