Glaeser and Kahn (2001): Decentralized Employment, and the Transformation of the American City

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Overview

- Two waves of decentralization: residences and employment.
- Glaeser and Kahn (2001) focus on the latter.
- Propose a measure of employment decentralization.
- Test some predictions of the monocentric city model.
- Look at effects of city and industry correlates.
- Primary conclusions:
  - Household location preferences are very important.
  - The efficiency of cities in facilitating the exchange of ideas seems to be a primary force against decentralization.

Data

U.S. Department of Commerce Regional Economic Information System (REIS):

- County-level data on population and employment by industry.
- Allows measurement of decentralization of employment.

U.S. Department of Commerce Zip Code Business Patterns 1996:

- Firm counts by firm employment size at the zip code level.
- 454 three-digit SIC industries.
- Excludes self-employed workers, most government employees, etc.

Other sources:

- 1995 National Personal Transportation Survey: Worker commuting patterns.
- 1990 Census microdata: Location of household head.
- U.S. Census website: Percentage of employees using computers.

Basic Facts

- In 1940, only one of the top 10 American cities had density below 10,000 people per square mile (Los Angeles). In 1990, seven are below 7,500.
- In 1940, most urban jobs appear to have been close to the city center. In 1996, on average only 16% of jobs are within three miles of the city center.
- In 1990, 86.5% of Americans drive to work, up from 64% in 1960.
- Figure 1: The distributions of employment and population with respect to distance are very close and very decentralized.
- Figure 4: New York, Chicago, and Los Angeles compared.
- Figure 2: Decentralization over time.

What are the implications of decentralization for the predictions of the monocentric city model?

What factors are driving the trend toward decentralization?

The Monocentric City Model

Alonso (1964) developed the monocentric city model to study agricultural land use but it was quickly extended to include production, transportation, housing, etc. This description follows Anas, Arnott, and Small (1998).

- The city is modeled as a circle having a central business district (CBD) of radius x_c at the center.
- The CBD is surrounded by residental area.
- We focus on a closed city (fixed population) with N identical households.
- Households receive utility $u(z, L)$ where z is a numeraire good and L is the size of the residential lot on which the household lives.
- Households at x pay transportation costs $T(x)$.
- Households have exogenous income y which is spent on the numeraire good z, transportation $T(x)$, and land rent $r(x)$.

The Monocentric City Model: Bid Rent

The residental bid rent $b(x, \bar{u})$ at x is defined to be the maximum rent per unit of land area that a household can pay while holding utility constant at $\bar{u}$:

$$b(x, \bar{u}) = \max_{z,L} \frac{y - T(x) - z}{L} \quad \text{s.t.} \quad u(z, L) \geq \bar{u}. \tag{1}$$

Invoking the Envelope Theorem, we have

$$\frac{\partial b(x, \bar{u})}{\partial x} = -\frac{T'(x)}{L[y - T(x), \bar{u}]}$$

where $L[\cdot]$ is the function giving the optimal choice of L from (1). Thus, a household that is moved a small distance ∂x away from the CBD must be compensated by a rent reduction of the same amount: $L\partial b = -T'(x)\partial x$.

Households will receive the same utility in equilibrium and the rent function $r(x)$ will equal the bid rent function for the equilibrium level of utility $\bar{u}$.

The Monocentric City Model: Equilibrium

We need two additional equilibrium conditions:

- An arbitrage condition at the city boundary x^* (which is endogenous) in that the residental rent there must equal r_A, the location-specific opportunity cost of using land.

- All N households must be located within the city:

$$\int_{x_c}^{x^*} \frac{\phi(x)}{L[y - T(x), u]} dx = N$$

  where $1/L$ is the household density and $\phi(x)$ denotes the density of residental land use.

The above two conditions determine x^* and $\bar{u}$ in equilibrium.

Empirical Predictions of the Monocentric City Model

As one moves away from the city center:

- Commute times should rise because *all* employment is at the city center.
- Housing prices should decline in order to compensate distant households for longer commute times (higher transportation costs).
- Income should rise because the rich demand more land (or because the poor use time-intensive public transportation).

Rethinking the Monocentric Model

- The monocentric city model is becoming a less representative model in light of the recent trend towards decentralization.
- The fundamental assumption of a central business district no longer holds.
- Transportation costs or commute times may no longer increase with distance from the city center.
- As such, it is no longer clear whether the other two predictions of the model still hold.

An exponential density model:

$$\ln\left(\frac{\text{Employment}}{\text{Sq. mi.}}\right) = \alpha^{e}_{\text{MSA}} + \beta^{e}_{\text{MSA}} \cdot (\text{Distance from CBD}) + \varepsilon$$

$\beta < 0$ indicates decreasing employment density (centralization) while $\beta > 0$ indicates a very decentralized city. Figure 3 plots the distribution of β^{e}_{MSA}.

Rethinking the Monocentric Model: Housing Prices

The monocentric city model predicts that **housing prices should decline** with distance from the CBD. This is driven by the transportation costs of households who must commute to the CBD. When the city is decentralized, transportation costs are no longer directly related to distance to the CBD.

Empirical model:

- $\mathbb{E}[\ln(\text{Median house price})] = \alpha^p_{\text{MSA}} + \beta^p_{\text{MSA}} \cdot (\text{Distance to CBD})$.
- Zip code level observations.

Results:

- Significant and strongly positive correlation between β^p_{MSA} and β^e_{MSA} (see Figure 7).
- The predictions still hold strongly in more concentrated cities.
- In decentralized cities the price gradient is still slightly negative.

Rethinking the Monocentric Model: Commute Time

The monocentric city model predicts that **commute times should increase** with distance from the CBD. This is by assumption since all employment is located at the city center. When the city is decentralized, workers may commute instead to locations in the city's periphery. The link between distance and commute time is no longer clear.

Empirical model:

- $\mathbb{E}[\ln(\text{Average commute time})] = \alpha^t_{\text{MSA}} + \beta^t_{\text{MSA}} \cdot (\text{Distance to CBD})$.
- The zip code residental file of the 1990 Census contains the Average commute time at the zip code level.

Results:

- There is a slight positive relationship with employment density (Figure 8).
- This is not surprising: if employment is centralized then commute times are long but if employment centers are in the suburbs then commute times are shorter.

Rethinking the Monocentric Model: Income

The monocentric city model predicts that **income rises** with distance from the CBD. We might expect this relationship to disappear in decentralized cities.

Empirical model:

- $\mathbb{E}[\ln(\text{Median household income})] = \alpha^{y}_{\text{MSA}} + \beta^{y}_{\text{MSA}} \cdot (\text{Distance to CBD})$.

Results

- Figure 9 plots β^{y}_{MSA} against β^{e}_{MSA} and we find a negative correlation.
- In more decentralized cities, poverty is more decentralized.

Explaining Decentralization Across MSAs

- Population and employment.
  - Figure 10 plots employment-distance density vs. population-distance density.
  - Strongly positive relationship.
  - Causality?

- City age and decentralization.
  - Figure 11 plots city age vs. population-distance gradients.
  - Surprisingly weak correlation.
  - Figure 12 plots housing stock age-distance gradients vs. population-distance gradients.
  - There is no guarantee that older cities will not decentralize.

Explaining Decentralization Across MSAs

Table 7 presents a set of regressions which analyze the determinants of concentration across MSAs.

Two measures of decentralization are used: log-level employment slope (1)–(3) and the share of jobs outside of a three mile ring (4)–(6).

- MSA-level characteristics (regressions 1 and 3)

- Demographics and industry controls (regressions 2 and 5)
  - Demographics are weak predictors—occasionally the signs flip.
  - Manufacturing's share of labor strongly predicts decentralization.
  - The share of labor devoted to services strongly predicts centralization.

- Political jurisdictions (regressions 3 and 6).
  - We might expect MSAs that are more politically fragmented to be more decentralized (Tiebout).
  - There is some support for this here.

Explaining Decentralization Across Industries

Two measures of industrial decentralization:

- β^{e}_{IND}, the employment density–distance elasticity at the industry level (Histogram in Figure 5, Regressions in Table 8a).
- The share of three-digit SIC industries outside of a three-mile radius from the city center (Table 8b).

Covariates:

- Worker national suburbanization (strongly positive)
- Input suburbanization (unclear)
- Firm size (unclear).
- Manufacturing indicator (strongly positive).
- Employee education (college education negative, high school positive).
- Percent of workers using computers (weakly negative).

Summary of Findings

- Strong trend toward decentralization of cities.
- City age and demographics are poor predictors of centralization.
- City area and population are positively correlated with decentralization.
- The locational preferences of workers are very important.
- Intellectual intensity of an industry is strongly correlated with centralization.

Discussion

- The exponential regression model
  - This model still resembles a monocentric city with various levels of very regular dispersion.
  - For $\beta < 0$, we have some sort of CBD and for $\beta > 0$ we have an "inverted" city.
  - The exponential density may be a poor approximation if decentralization is irregular.

- Subcenter definition (Anas et al., 1998)
  - Sensitivity of subcenter definition (or density) to level of granularity (MSA, county, zip code, tract, block, . . .).
  - It would be interesting to carry out a similar analysis using fractal dimension as the dependent variable.

References

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