Employment Decentralization and Commuting in U.S. Metropolitan Areas

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Symposium on the Work of Leon Moses

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9:30-11:15am, and 2:30-4:30pm
Transportation Center
Northwestern University
Evanston, Illinois
Top 49 MSAs
**Doubling population increases commute time by 10%**

<table>
<thead>
<tr>
<th>URBAN AREA</th>
<th>WORKERS</th>
<th>AVERAGE COMMUTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOUISVILLE</td>
<td>0.5 million</td>
<td>22.7 minutes</td>
</tr>
<tr>
<td>PITTSBURG</td>
<td>1.0 million</td>
<td>25.5 minutes</td>
</tr>
<tr>
<td>HOUSTON</td>
<td>2.0 million</td>
<td>28.8 minutes</td>
</tr>
<tr>
<td>CHICAGO</td>
<td>4.0 million</td>
<td>31.0 minutes</td>
</tr>
<tr>
<td>NEW YORK</td>
<td>8.0 million</td>
<td>34.0 minutes</td>
</tr>
</tbody>
</table>

- New York has 16 times more workers than Louisville but only 50% higher commute time

Observed data
## Commuting Patterns

<table>
<thead>
<tr>
<th>Commuting patterns</th>
<th>United States</th>
<th>Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residence</td>
<td>Workplace</td>
<td>2000 Census (%)</td>
</tr>
<tr>
<td>Central city</td>
<td>Central city</td>
<td>27.5</td>
</tr>
<tr>
<td>Central city</td>
<td>Suburb</td>
<td>8.9</td>
</tr>
<tr>
<td>Suburb</td>
<td>Central city</td>
<td>20.2</td>
</tr>
<tr>
<td>Suburb</td>
<td>Suburb</td>
<td>43.4</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100.0</td>
</tr>
</tbody>
</table>
Chicago metro area with counties and central cities

Legend

- Central Cities
  - [Red]
- Counties
  - [Light Purple]

Coordinate System: Albers Conical Equal Area
Projection: Albers
Datum: North American 1983
false easting: 0.0000
false northing: 0.0000
central meridian: -96.0000
standard parallel 1: 45.5000
standard parallel 2: 45.5000
latitude of origin: 33.0000
Units: Meter

Scale: 1:4,800,000
Distance 1: 40,000 Meters
Distance 2: 20,000 Meters
Distance 3: 0 Meters
Distance 4: 40,000 Meters
### Dependent variable: Log (Average commuting time)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>2000</th>
<th>2010</th>
<th>POOLED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>+1.52*</td>
<td>+1.42*</td>
<td>+1.50*</td>
</tr>
<tr>
<td>MSA WORKERS</td>
<td>+0.11*</td>
<td>+0.10*</td>
<td>+0.11*</td>
</tr>
<tr>
<td>LN(% TRANSIT)</td>
<td>+0.02</td>
<td>+0.03**</td>
<td>+0.03*</td>
</tr>
<tr>
<td>LN(% EMP SUB)</td>
<td>-0.23**</td>
<td>-0.22*</td>
<td>-0.22*</td>
</tr>
<tr>
<td>LN(% RES OUT PC)</td>
<td>+0.24**</td>
<td>+0.26*</td>
<td>+0.25*</td>
</tr>
<tr>
<td>YEAR 2010</td>
<td></td>
<td></td>
<td>-0.03*</td>
</tr>
<tr>
<td>ADJ. R-sq. (%)</td>
<td>63.09</td>
<td>70.74</td>
<td>67.94</td>
</tr>
</tbody>
</table>

**Top 49 MSAs**

Significant at: * 1%; ** at 5%; *** at 10%
<table>
<thead>
<tr>
<th>Change in:</th>
<th>% Change in commuting times</th>
</tr>
</thead>
<tbody>
<tr>
<td>1% increase in MSA jobs</td>
<td>+ 0.11%</td>
</tr>
<tr>
<td>1% increase in suburban job share</td>
<td>-0.22%</td>
</tr>
<tr>
<td>1% increase in suburban population share</td>
<td>+0.25%</td>
</tr>
<tr>
<td>Year 2010 (relative to 2000)</td>
<td>-3%</td>
</tr>
</tbody>
</table>
To understand the process of decentralization and commuting, we need a CGE model based on economic theory.

Regional economy, land use and transportation model

Cyclical linking of the RELU and TRAN algorithms in RELU-TRAN
The RELU algorithm

START POINT
p, w, R, V, S, G, g

RELU LOOP

PRICES, p
(w, R) → p

OUTPUTS, X
(p, w, R, S, V) → X

WAGES, w
(p, X, R, S, V) → w

RENTS, R
(p, X, w, S, V) → R

VALUES, V
R → V

STOCKS, S
V → S

p, w, R, V converged?
Excess demands converged?
Economic profits converged?

Update p, w, R, V for next loop

RELU loops converged

The RELU algorithm
Location of Jobs \xrightarrow{\text{Residences}} Location of Residences

Consumers/Workers care about access to jobs:

• Access to jobs for commuting or shopping $\rightarrow$ residence location
  • Access to jobs $\rightarrow$ labor supply of workers

Producers care about access to residences:

• Access to residences $\rightarrow$ wages offered by employers
  • Access to residences $\rightarrow$ pricing of product for sale
Congestion

• Congestion rises when population increases but road capacity remains constant.

• Travel time per mile of road increases on average.

• People try to economize on car miles traveled by:
  1. Switching to public transit
  2. Locating closer to jobs
  3. Making fewer discretionary trips
  4. Making shorter discretionary trips
  5. Trip chaining more

• Producers respond by:
  1. Moving closer to labor and customers
  2. Offering higher wages
Effect of Growth on Residence Location

Resident Population by District (2000-2030)

% increase from 2000

2000
2007
2010
2020
2030

CHICAGO, NORTH
CHICAGO, WEST
CHICAGO, CBD
CHICAGO, SOUTH
NORTHWEST COOK
NORTH COOK
WEST COOK
SOUTH COOK
DU PAGE
KANE
LAKE
McHENRY
WILL
Effect of Growth on Job Locations

Job Growth by District (2000-2030)

% increase from 2000

CHICAGO, NORTH
CHICAGO, WEST
CHICAGO, SOUTH
NORTHWEST COOK
NORTH COOK
SOUTH COOK
DU PAGE
KANE
LAKE
McHENRY
WILL

2000
2007
2010
2020
2030
Undeveloped land area (Urban sprawl)
Historical urban sprawl pattern in the Buffalo-Niagara Falls MSA

Source: Joe the planner blog http://joeplanner.blogspot.com/
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“Sprawl spreads development out over large amounts of land; puts long distances between homes, stores, and job centers; and makes people more and more dependent on driving in their daily lives.

…. Sprawl lengthens trips and forces us to drive everywhere. The average American driver currently spends the equivalent of 55 eight-hour workdays behind the wheel every year.” (Sierra Club).
VMT Traveled without Road Capacity Addition

Aggregate VMT & VMT per capita

% change

2000  2007  2010  2020  2030
-15  -10  -5   0   5   10   15
VMT Traveled With Highway Capacity Additions

Aggregate VMT & VMT per capita

% change

-5 0 5 10 15 20 25 30

2000 2007 2010 2020 2030

total_VMT (%change)Cap additions

VMT per person (%change) Cap additions
Stability of Commuting Time by Car

Average travel time for auto commuters (MIN)
Percent of commuters who use auto

Time (MIN): 50, 50, 50, 50, 50
## Other applications of the model

<table>
<thead>
<tr>
<th>Location</th>
<th>Public transit share in commuting</th>
<th>Employment dispersion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicago, MSA</td>
<td>13%</td>
<td>About 30% of jobs in the 4 largest job centers</td>
</tr>
<tr>
<td>Ile-de-France (Greater Paris)</td>
<td>50%</td>
<td>About 50% of jobs in the City of Paris and 10 surrounding centers</td>
</tr>
<tr>
<td>Los Angeles, MSA</td>
<td>4.5%</td>
<td>About 30% of jobs in the 30 largest job centers</td>
</tr>
</tbody>
</table>
How would new circumferential public transit links affect suburban job concentrations?
Highways and job centers in L.A.

Housing cost elasticity vs. Commuting time elasticity

- Boston, 9.08%
- Chicago, 11.41%
- Houston, 3.24%
- LA, 4.67%
- Miami, 3.83%
- New York, 24%
- Washington, 8.45%

MSAs are shown with public transit shares.