The Spatial Structure of US Metropolitan Employment: New Insights from LODES Data

Robert Manduca
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A old question in urban geography

Are jobs mostly here?

Or mostly here?
A old question in urban geography

Understanding the spatial distribution of jobs within metro areas is:

- Of longstanding theoretical interest to regional scientists, geographers, urban planners
- Important for many areas of urban policy

This project: Use LODES data to shed new light on this old question
Plan for today

Some theoretical background

Why the LODES data are well suited to this analysis

Two findings/applications:

• Document regularities in the spatial distribution of jobs within metro areas
• Introduce an algorithm for identifying and classifying business districts
Setting up
Some theoretical background

In regional science and geography, three broad perspectives on urban form. Are jobs in cities:

Centralized? (Alonso 1964)
Some theoretical background

In regional science and geography, three broad perspectives on urban form. Are jobs in cities: Clustered? (Fujita and Ogawa 1982, Garreau 1991)
In regional science and geography, three broad perspectives on urban form. Are jobs in cities: Dispersed? (Gordon and Richardson 2001, Lang 2003)
Understanding patterns in the location of jobs matters for policy and planning

We need to know where jobs are for:

• Transportation planning
• Housing markets
• Employment policy
• etc.
Today, few argue that US cities are truly monocentric. But there is considerable debate about whether employment in cities is more polycentric or more dispersed. LODES data offer a new window onto this question thanks to their high spatial resolution and their large coverage.
Appealing features of the LODES data

High spatial resolution - Census block, vs tract in most previous studies

- 11,155,486 blocks in the United States
- Approx. 150 blocks per Census tract

Coverage:

- Cover 96% of private sector employees
- Approximately 86% of total civilian employment
Details of today’s data set

Use counts of jobs by block from the Workplace Area Characteristics file for 2014

Limit to “primary jobs,” one job per person

Residential population by block from 2010 Census

Today focus on the 100 largest Metropolitan Statistical Areas (MSAs) by population

- All US metros over 500,000 people
- Collectively have 204 million residents, 86 million jobs (66% and 69% of US total)
- Analysis is complete for all metro- and micropolitan areas in the country.
Systematic patterns in the spatial distribution of employment
Visualizing the WAC jobs
Jobs appear substantially more clustered than residents
Jobs appear substantially more clustered than residents

Dotmap of employment

Dotmap of population

Phoenix

Phoenix
Jobs appear substantially more clustered than residents

Dotmap of employment

Los Angeles

Dotmap of population

Los Angeles
Preliminary observations

Jobs don’t appear to be centralized → MSAs are not monocentric

But jobs do seem to be concentrated, especially compared to residents

- Residents are spread out, present across most of the MSAs
- Jobs are at high densities in a few places, most blocks have no jobs at all

Suggests that jobs may be neither dispersed nor centralized
Quantifying the spatial distributions of jobs and residents

Jobs and residents by distance from CBD

Cumulative distribution of employment and population by distance from CBD, Boston–Cambridge–Newton, MA–NH MSA
Quantifying the spatial distributions of jobs and residents

Jobs and residents by distance from CBD

Jobs and residents by density and cumulative area

Cumulative distribution of employment and population by distance from CBD, Boston–Cambridge–Newton, MA–NH MSA

Cumulative distribution of employment and population by cumulative land area, Boston–Cambridge–Newton, MA–NH MSA
Quantifying the spatial distributions of jobs and residents

Jobs and residents by distance from CBD

Jobs and residents by density and cumulative area

Distance concentration of population and employment, largest 100 MSAs

Density concentration of population and employment, largest 100 MSAs
What we have seen

Jobs are *concentrated* but not *centralized* - evidence for the polycentric view?

The spatial distributions of jobs and residents are fundamentally different:

- Residents form a more or less continuous surface over most parts of each MSA (no MSA is missing residents on more than 18% of built land area)
- Jobs follow a more bimodal distribution (all MSAs are missing jobs on at least 50% of their built land area)

Relatively little overlap between employment and population

Next: we can take advantage of this to identify employment centers
A new algorithm for identifying and classifying business districts
Identifying business districts

People often think about employment as being concentrated into discrete areas:

- Midtown Manhattan
- Tysons Corner Virginia
- The Chicago Loop

But systematically identifying employment centers using quantitative data is challenging
Previous methods of identifying subcenters have major limitations

Most common approach:

- Choose a raw employment density threshold
- Group adjacent blocks/tracts/neighborhoods whose densities exceed that threshold into a common subcenter
- Doesn’t translate well from one city to another - the threshold that works for Manhattan might be different from that for Houston

Other methods: Decide what density is “typical” at a given distance from downtown, look for places that exceed it

- Requires strong assumptions about urban form
Can we do better?

Examination of block-level data suggests that most jobs are concentrated at high densities in blocks with few residents. We can use this regularity to identify employment centers more easily and effectively than standard methods.

- Identify subcenters by comparing number of jobs and residents rather than counting jobs alone.
Step 1: Divide blocks into categories based on the ratio of jobs to residents:

- Employment blocks have at least twice as many jobs as residents
- Residential blocks have at least twice as many residents as jobs
- Mixed blocks have similar numbers of each
There are strong regularities in the fraction of jobs and built land in each category across very different MSAs

Employment blocks
There are strong regularities in the fraction of jobs and built land in each category across very different MSAs.

...adding mixed blocks
There are strong regularities in the fraction of jobs and built land in each category across very different MSAs...

...adding residential blocks
An iterative process:

• Begin by choosing a seed block and assigning a business district number
• Identify all other employment blocks within a 15-meter (50 ft) buffer of the seed block and assign to the district
• Iterate through each of those blocks and identify any further employment blocks within 15 meters of them
• Continue until there are no further employment blocks within 15 meters of any blocks in the district
• Pick a new seed block and repeat until all employment blocks are assigned
Features of this method

Conceptually straightforward and fast to implement

Identifies districts of many different densities simultaneously and inductively

Avoids “false positives,” high-density areas that are predominantly residential

Districts are collections of blocks, so calculating size and composition is straightforward

Comparable across cities
Business districts of New York City
Compare to the previous, density threshold approach
District statistics make it easy to map metro employment structure, and compare across cities.
District statistics make it easy to map metro employment structure, and compare across cities.
The 10 largest business districts in the US

<table>
<thead>
<tr>
<th>Rank</th>
<th>Name</th>
<th>Jobs</th>
<th>Square Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Midtown Manhattan, NY</td>
<td>1,112,861</td>
<td>2.70</td>
</tr>
<tr>
<td>2</td>
<td>Chicago Loop, IL</td>
<td>413,306</td>
<td>1.89</td>
</tr>
<tr>
<td>3</td>
<td>Downtown Washington, DC</td>
<td>359,459</td>
<td>3.82</td>
</tr>
<tr>
<td>4</td>
<td>Lower Manhattan, NY</td>
<td>330,343</td>
<td>0.93</td>
</tr>
<tr>
<td>5</td>
<td>Downtown San Francisco, CA</td>
<td>314,206</td>
<td>1.89</td>
</tr>
<tr>
<td>6</td>
<td>Downtown Los Angeles, CA</td>
<td>303,711</td>
<td>8.42</td>
</tr>
<tr>
<td>7</td>
<td>Northern San Jose, CA</td>
<td>276,294</td>
<td>28.19</td>
</tr>
<tr>
<td>8</td>
<td>Downtown Boston, MA</td>
<td>263,831</td>
<td>1.08</td>
</tr>
<tr>
<td>9</td>
<td>Southern Orlando, FL</td>
<td>243,343</td>
<td>34.29</td>
</tr>
<tr>
<td>10</td>
<td>Las Vegas Strip, NV</td>
<td>239,982</td>
<td>11.31</td>
</tr>
</tbody>
</table>
Categorizing business districts
Employment in US is concentrated but not centralized

- Unlike residents, jobs have a bimodal spatial distribution
- All 100 MSAs have a similar allocation of jobs and land across employment, mixed, and residential blocks.

We can systematically identify business districts as clusters of contiguous employment blocks

Are there meaningful differences among business districts?
Four categories of business districts, based on size and density

Two types of large districts:

• Urban core: large and dense - >5 blocks, >75% of jobs at >10,000 jobs/km (40 jobs/acre, 25k jobs/square mile)
• Suburban strip: large but sparse - >5 blocks, <75% of jobs at >10,000 jobs/km
10,000 jobs/km²: a low-rise, but walkable, commercial district
10,000 jobs/km²: a low-rise, but walkable, commercial district

### Village Commercial

<table>
<thead>
<tr>
<th>Land Use Mix</th>
<th>Residential Mix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>0%</td>
</tr>
<tr>
<td>Employment</td>
<td>61%</td>
</tr>
<tr>
<td>Mixed Use</td>
<td>7%</td>
</tr>
<tr>
<td>Open Space/Civic</td>
<td>32%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Residential Mix</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SF Large Lot</td>
<td>0%</td>
</tr>
<tr>
<td>SF Small Lot</td>
<td>0%</td>
</tr>
<tr>
<td>Townhome</td>
<td>0%</td>
</tr>
<tr>
<td>MultiFamily</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Built Environment</th>
<th>Employment Mix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intersections per mi²</td>
<td>Office 49%</td>
</tr>
<tr>
<td>Average Floors</td>
<td>Retail 51%</td>
</tr>
<tr>
<td>Floors Range</td>
<td>Industrial 0%</td>
</tr>
<tr>
<td>Total Net FAR</td>
<td></td>
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<table>
<thead>
<tr>
<th>Gross Density Range (per acre)</th>
<th>Average Density (per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household 0-5</td>
<td>Household 2</td>
</tr>
<tr>
<td>Employee 1-60</td>
<td>Employee 40</td>
</tr>
</tbody>
</table>

**Description**

Equivalent to the center of a small town or district, or a lower-intensity employment-focused transit-oriented development, Village Commercial contains a mix of buildings set in a walkable context. Typical structures are between 2 and 5 stories tall, with some ground-floor retail, and offices, services, and some residential on upper floors.
Four categories of business districts, based on size and density

Two types of large districts:

- Urban core: large and dense - >5 blocks, >75% of jobs at >10,000 jobs/km (40 jobs/acre, 25k jobs/square mile)
- Suburban strip: large but sparse - >5 blocks, <75% of jobs at >10,000 jobs/km

Two types of small districts:

- Independent center: small but high employment - <5 blocks, >500 jobs
- Scattered: small with few jobs - <5 blocks, <500 jobs
Classified business districts - New York
Classified business districts - San Francisco
Classified business districts - Buffalo
Classified business districts - Provo
National breakdown of jobs across categories

<table>
<thead>
<tr>
<th>Block Type</th>
<th>% of 100 MSA Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Core</td>
<td>16.1%</td>
</tr>
<tr>
<td>Suburban</td>
<td>43.7%</td>
</tr>
<tr>
<td>Independent</td>
<td>10.1%</td>
</tr>
<tr>
<td>Scattered</td>
<td>6.9%</td>
</tr>
<tr>
<td>Mixed</td>
<td>12.8%</td>
</tr>
<tr>
<td>Residential</td>
<td>10.4%</td>
</tr>
</tbody>
</table>
But breakdown of jobs across block type varies a lot by MSA.
But breakdown of jobs across block type varies a lot by MSA.
The Central Business District is a core concept in urban economics, but imperfectly operationalized:

- 1982 Economic Census based on interviews with local leaders (Glaeser and Kahn 2001, Baum-Snow 2007)
- City Hall as the CBD (Ottensman 2016)
- Prominent landmarks, e.g. the Empire State Building (Haughwort et al. 2008)

The largest urban core business district in each MSA typically includes the historical downtown, matches Google Maps well (but is transparent)
Summing Up
What we’ve seen

US metro employment is concentrated not centralized
Consistent allocation of land area to jobs and housing across very different cities

These systematic patterns can be used as the basis of a simple yet effective subcenter identification algorithm

Business districts can be categorized based on size and density, and MSAs vary dramatically in what types of business districts they have

• But suburban employment is the dominant form across the country
The spatial structure of US metropolitan employment: New insights from administrative data

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Thank you!

Questions?