Location, Relocation and the Journey to Work

by David Levinson
University of California at Berkeley
Department of Civil Engineering/
Institute of Transportation Studies

Presented to Western Regional
Science Association
February 22-26, 1995,
San Diego, California
Introduction

Subject:
• The influence of land use patterns on commuting
• The influence of job-housing tenure on commuting

Facts:
• While congestion is rising,
• commuting distance is increasing,
• commuting durations are holding steady

Approaches:
• Minimum Required Commute (Wasteful Commuting)
• Jobs-Housing Balance
• Gravity Model/Accessibility
• Regression Model
Policy Issue: Should land use be regulated to change behavior?

Justifications:
- Congestion
- Air Pollution
- Energy Use
- Quality of Life
- Equity/Spatial Mismatch
Counter-Argument:

- Individual Rights
- Transportation (Land Use) Already Subsidized
- Government Intervention Counter-Productive
- Congestion Acceptable (Min. Req. Commute)
- Energy Use a Market Issue
- There is no “Spatial Mismatch”
Accessibility

• A continuous variable which is measured by counting the number of activities (e.g. jobs) available at a given distance from an origin (e.g. the home), and discounting that number by the intervening travel time.
Accessibility to Jobs and Houses

\[ AJ_i = \text{accessibility to jobs from zone } i \]
\[ AJ_i = \sum_{j=1}^{J} (\text{JOB}_j \times f(c_{ij})) \]

\[ AH_i = \text{accessibility to houses from zone } i \]
\[ AH_i = \sum_{j=1}^{J} (\text{HOUSE}_j \times f(c_{ij})) \]

- \( \text{JOB}_j \) = number of jobs in zone \( j \)
- \( \text{HOUSE}_i \) = number of houses in zone \( i \)
Impedence Function ($f(c_{ij})$)

for auto trips

\[ f(c_{ij}) = \exp(-0.97 - 0.08 c_{ija}) \]
\[ c_{ija} = \text{peak hour auto travel time between zones i and j} \]

for transit trips

\[ f(c_{itj}) = \exp(-1.91 - 0.08 c_{ijt}) \]
\[ c_{ijt} = \text{peak hour transit travel time between zones i and j} \]
Hypotheses

Location:

• It is hypothesized that living in an area with relatively high jobs accessibility is associated with shorter trips, as is working in an area of relatively high housing accessibility.
• (the doubly-constrained gravity model)

Relocation:

• 1. commuting is a diseconomy, so the opportunity to relocate can be used to save time.
• 2. the areas of highest growth (and the most recent relocations) for both jobs and housing are in the outer suburbs, areas of below average jobs accessibility compared to housing.
Data

Location:
• MWCOG Household Travel Survey (1987-88)
  – 8,000 households and 55,000 trips
• Accessibility Measures

Relocation:
• MCPD Travel Panel Survey,
• Bethesda CBD Workplace Survey,
• Census Update Survey
Jobs and Housing Accessibility and Commuting Duration

In the gravity model implicitly being tested here, average commute to work time is determined by three factors:

1) a propensity function which relates willingness to travel with travel cost or time, (individual demand)
2) the opportunities available at any given distance or time from the origin, (market “supply”) and
3) the number of competing workers. (market demand)

Propensity = f (t_{ij}, Income, Mode, Gender...)

It is hypothesized that this underlying preference is relatively undifferentiated based solely on location.
Geographic Factors

1) distance between the home and the center of the region (Di0) (the zero mile marker at the ellipse in front of the White House),
2) distance between workplace and the center (Dj0),
3) accessibility to jobs from the home (AiE),
4) accessibility to other houses from the home (AiR),
5) accessibility to other jobs from the workplace (AjE),
6) and accessibility to houses from workplace (AjR).
<table>
<thead>
<tr>
<th></th>
<th>Trip-End</th>
<th>Home-End</th>
<th>Work-End</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Origin)</td>
<td>(Destination)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessibility to Jobs</td>
<td>AiE</td>
<td>negative</td>
<td>AjE</td>
</tr>
<tr>
<td></td>
<td>positive</td>
<td></td>
<td>positive</td>
</tr>
<tr>
<td>Accessibility to Houses</td>
<td>AiR</td>
<td>positive</td>
<td>AjR</td>
</tr>
<tr>
<td></td>
<td>negative</td>
<td></td>
<td>negative</td>
</tr>
<tr>
<td>Distance from Center</td>
<td>Di0</td>
<td>positive</td>
<td>Dj0</td>
</tr>
<tr>
<td></td>
<td>negative</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Elasticities of Travel Time with respect to Accessibility

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>AUTO COMMUTERS</th>
<th>ELASTICITY</th>
<th>AUTO COMMUTERS</th>
<th>ELASTICITY</th>
<th>TRANSIT COMMUTERS</th>
<th>ELASTICITY</th>
<th>TRANSIT COMMUTERS</th>
<th>ELASTICITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>AiEa</td>
<td>AUTO COMMUTERS</td>
<td>-0.22</td>
<td>AiEt</td>
<td>-0.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AiRa</td>
<td>AUTO COMMUTERS</td>
<td>0.19</td>
<td>AiEt</td>
<td>0.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AjEa</td>
<td>AUTO COMMUTERS</td>
<td>0.24</td>
<td>AjEt</td>
<td>-0.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AjRa</td>
<td>AUTO COMMUTERS</td>
<td>-0.25</td>
<td>AjEt</td>
<td>-0.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Di0</td>
<td>AUTO COMMUTERS</td>
<td>0.25</td>
<td>Di0</td>
<td>0.31</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dj0</td>
<td>AUTO COMMUTERS</td>
<td>-0.16</td>
<td>Dj0</td>
<td>-0.09</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VARIABLES</td>
<td>TRANSIT</td>
<td>AUTO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>------------------</td>
<td>----------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AiEt, AiEa</td>
<td>-1.15E-03</td>
<td>-8.68E-05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.27) **</td>
<td>(-4.86) ***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AiRt, AiRa</td>
<td>1.12E-03</td>
<td>1.18E-04</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.85)</td>
<td>(2.75) ***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AjEt, AjEa</td>
<td>-1.14E-03</td>
<td>7.13E-05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.56) **</td>
<td>(4.21) ***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AjRt, AjRa</td>
<td>1.05E-03</td>
<td>-1.47E-04</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.75)</td>
<td>(-3.26) ***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Di0</td>
<td>1.71</td>
<td>0.63</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(9.71) ***</td>
<td>(5.82) ***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dj0</td>
<td>-1.67</td>
<td>-0.55</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-5.63) ***</td>
<td>(-3.77) ***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONSTANT</td>
<td>44.12</td>
<td>23.29</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(9.21) ***</td>
<td>(4.61) ***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample Size</td>
<td>346</td>
<td>1950</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adj. r-squared</td>
<td>0.38</td>
<td>0.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>12.96</td>
<td>22.79</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significance F</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Relocation and the Journey to Work

1) Interaction of Changing Jobs and Moving Homes
   - Tenure Should be Correlated

2) Factors Influencing Length of Residence
   - Demographics (Age), Housing Type

3) Relocation and Commuting
   - Offsetting Factors -
     change to reduce commute duration
     renters & part-timers vs. career
     but old-timers have better sites already
Accessibility and Housing Value

Urban Economics suggests trade-off time & money
- finding supported for auto accessibility
- not for transit accessibility
Conclusions

• Relocation - People strive to maintain same commute duration on average.
• It is suburbanization of jobs (not housing) which leads to constant or declining commuting durations.
• Location matters, important explanatory variable, but
• Density and J/H Balance (Accessibility) weak policy variables to influence commuting. ...
• Ignores self-selection process - creating more high density housing won’t create more young or old who wish to live in high density urban areas.