Driverless Cars, Virtual Offices and Their Effects on Local Government Revenues

AGA Atlanta Professional Development Training
The Future: Self-Driving to a City Near You

- Jaguar: I-Pace
- 20,000 cars
- 1 million rides/day
- Delivery: 2020
The Future: Self-Driving to a City Near You

- Chrysler
- 1,000s of vans
- Shared rides
- Delivery: 2020 or sooner
The Future:
Self-Driving to a City Near You

- Discontinued
- Waymo focused on self-driving systems
- Not cars
All Virtual Offices come with Windows or macOS

- Telecommuting rates currently at all-time high
- Push to roll out fiber-optic internet
- Rise of augmented reality and virtual reality computing
The Future: Cost to Local Governments?

• $5 billion FY 2016
  – For 25 largest cities in U.S.
• Parking-related activities, camera and traffic citations, gas taxes, towing, vehicle registration and licensing fees.
• $129 per capita
  • Source: Governing Magazine

Peter Bluestone and Nicholas Warner
Outline of Presentation

• Governing findings
• Other research on commuting costs
• Discuss our research on the effect of driverless cars and virtual offices on property values and why it’s important
• Conclusion
# Revenues All Cities by Source ($ millions)

<table>
<thead>
<tr>
<th>Source</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parking Fees and Taxes</td>
<td>$1,500</td>
</tr>
<tr>
<td>Parking Fines</td>
<td>$1,300</td>
</tr>
<tr>
<td>Gas Taxes</td>
<td>$697</td>
</tr>
<tr>
<td>Licensing/Registration/Ownership Taxes</td>
<td>$677</td>
</tr>
<tr>
<td>Traffic Citations/Camera</td>
<td>$593</td>
</tr>
<tr>
<td>Towing</td>
<td>$81</td>
</tr>
</tbody>
</table>
Top-10 Cities in Auto Related Revenue FY 2016 ($ millions)

- Detroit
- Denver
- Boston
- Seattle
- Phoenix
- Philadelphia
- Washington, D.C.
- Los Angeles
- San Francisco
- Chicago

- Lic/Reg/Own
- Gas Taxes
- Traffic Enf.
- Parking/Fines
### Household: Auto vs. Property Tax Revenue

*Residential property digest only*

Source: DataUSA.io, Governing Magazine, and Author’s calculations

<table>
<thead>
<tr>
<th>City</th>
<th>Prop. val. median ($1000s)*</th>
<th>Prop. Taxes*</th>
<th>Share*</th>
<th>Auto rev/household</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Francisco</td>
<td>$1,002</td>
<td>$3,000+</td>
<td>87%</td>
<td>$1,245</td>
</tr>
<tr>
<td>Seattle</td>
<td>$606</td>
<td>$3,000+</td>
<td>76%</td>
<td>$514</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>$593</td>
<td>$3,000+</td>
<td>71%</td>
<td>$320</td>
</tr>
<tr>
<td>Washington, D.C.</td>
<td>$576</td>
<td>$3,000+</td>
<td>55%</td>
<td>$1,216</td>
</tr>
<tr>
<td>Boston</td>
<td>$495</td>
<td>$3,000+</td>
<td>54%</td>
<td>$550</td>
</tr>
<tr>
<td>Denver</td>
<td>$360</td>
<td>$3,000+</td>
<td>22%</td>
<td>$437</td>
</tr>
<tr>
<td>Atlanta</td>
<td>$262</td>
<td>$3,000+</td>
<td>48%</td>
<td>NA</td>
</tr>
<tr>
<td>Chicago</td>
<td>$243</td>
<td>$3,000+</td>
<td>62%</td>
<td>$639</td>
</tr>
<tr>
<td>Phoenix</td>
<td>$213</td>
<td>$3,000+</td>
<td>15%</td>
<td>$489</td>
</tr>
<tr>
<td>Philadelphia</td>
<td>$154</td>
<td>$3,000+</td>
<td>18%</td>
<td>$568</td>
</tr>
<tr>
<td>Detroit</td>
<td>$43</td>
<td>$3,000+</td>
<td>13%</td>
<td>$395</td>
</tr>
</tbody>
</table>

Peter Bluestone and Nicholas Warner
How Do Driverless Cars and Telecommuting Effect Property Tax? – the Monocentric City Model

Scenarios - Monocentric City Model with Driverless Cars and Telecommuting

- Current
- Weakened Relationship
- No Relationship

Peter Bluestone and Nicholas Warner
Why is the Property Tax Important?

• The property tax funds local governments and schools.
• Local governments may face political pressure to keep millage rates down even in the face of falling property values.
• Rate caps: Constrain local governments and school systems
Monocentric City Model: Commute Time Literature

Two fundamental strands of relevant literature:

1. Willingness to pay for shorter commutes frequently using the implementation of highway tolling [See: Lam and Small (2001) and Brownstone et al. (2003).]

2. Home price capitalization from transportation infrastructure investment, usually distance from transit stations or major corridors [See: Anas, Arnott and Small (1998), Bartholomew and Ewing (2011)]

3. Important aside: Actual commute times rather than proxies for commute time are relevant. Sherry (1999) finds that distance from the central business district can give results inconsistent with the model.
Shorter Commute Times: Tolling Results

• How much would you be willing to pay to cut your commute time by 5 minutes?
  – $1.00-$1.50
  – $1.51-$2.00
  – Less than $1.00

Studies find $1.50-$2.50.

Lam and Small (2001) and Brownstone et al. (2003).
Shorter Commute Times: Transit Stations

• How much more would you be willing to pay for a home to live one mile or less from a transit station?
  – $2,000-$6,000
  – $6,001-$12,000
  – Less than $2,000
Shorter Commute Times: Transit Stations

• Bay Area Rapid Transit (BART) stations: $74 per foot within the first quarter of a mile (change of $97,680 at 1/4 mile!)
  – $30 per foot for those houses greater than a quarter of a mile away. Sedway Group (1999)

• Study of five large U.S. cities, Boston, Atlanta, Chicago, Portland, and Washington, D.C. Baum-Snow and Kahn (2001)
  – Moving from three miles to one mile away from a transit station creates a housing premium of $4,972.
  – Rents rose by $19 per month for the same distance.

Metro Link St. Louis Garrett (2004)
$14 per foot closer (change of $18,480 at 1/4 mile!)
Center for State and Local Finance Study

• How would changes to commute time affect property values in the Atlanta metro area?
• Our contribution would be to estimate this change from observable data on commute times at the census tract/block group level combined with rich home sales data.
• Our empirical strategy attempts to control for endogenous determinants of changes in commute times.
Data Home Sales and Distance to Work

• Homes sales data: All counties in metro Atlanta from Data Quick with information on property characteristics, condition, age, bedrooms, square feet, and other relevant information.
• Zoned elementary schools’ Criterion-Referenced Competency Tests (CRCT) scores from the preceding year
• Longitudinal-Employer Household Dynamics Program Origin-Destination Employment Statistics (LODES) is used to estimate the straight-line distance to work.
• Census tract level mean minutes to work 2009 – 2013
• Permanent traffic measurement station data from Georgia Department of Transportation (GDOT)
Data

Continuous Count Stations (CCS or permanent)

There are approximately 300 CCS locations, including the permanent WIM stations, throughout Georgia that:

- Count and classify traffic 24/7/365
- Utilize two Inductive Loop Sensors and a Piezoelectric Sensor embedded in the pavement in each lane to detect and classify vehicles
- Use sensors that are connected to a controller cabinet mounted on a pole adjacent to the roadway

Source: GDOT
Data

Average straight-line distance that employees travel to work calculation visual yields 5.75 mile distance to work.

- Work Block Group A- 4 jobs: D= 6 Miles
- Work Block Group B – 5 Jobs: D= 3 Miles
- Home Block Group- 12 Jobs: D=9 Miles
- Work Block Group C- 2 jobs: D=12 Miles
- Work Block Group D- 1 Job
Summary Statistics: Key Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs.</th>
<th>Mean</th>
<th>Std. Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minutes to Work</td>
<td>208572</td>
<td>28.57</td>
<td>9.52</td>
</tr>
<tr>
<td>S.L. Distance to Work</td>
<td>208587</td>
<td>18.27</td>
<td>7.44</td>
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<tr>
<td>Percent Exceeds of CRCT</td>
<td>208587</td>
<td>0.29</td>
<td>0.17</td>
</tr>
<tr>
<td>Log Sales Price</td>
<td>208587</td>
<td>11.80</td>
<td>0.99</td>
</tr>
<tr>
<td>Square Feet</td>
<td>208587</td>
<td>2027.00</td>
<td>1109.31</td>
</tr>
</tbody>
</table>
Model 1: Naïve Hedonic Price Model

\[ \ln(P_{hmy}) = \beta_1 T_{bt} + \beta X_{hy} + \beta TS_{ts} + \delta MY + \varepsilon \]

- \( P_{hmy} \) is sales price of home(h) in month year (my)
- \( T_{bt} \) is a travel distance or commute time
- \( X_{hy} \) is a vector of home characteristics
- \( TS_{ts} \) is the preceding year’s elementary test score
- \( MY \) are month year fixed effects
Model 1: Naïve Hedonic Price Model

Econometric concerns with the naïve hedonic price model:
1. Unobserved neighborhood characteristics are not controlled for. Commute time is function of distance to CBD (time invariant) and congestion (endogenous to changes in demand for housing).

• Solutions
  – Block group fixed effects: Unobserved neighborhood characteristics
  – Two-stage least squares: Potential congestion endogeneity from higher demand for home leading to increases commutes and higher home values. IV is average annual truck traffic.
Model 1: Atlanta Major Corridor Map
Model 1: Change in Average Daily Truck Traffic
Model 1: Naïve Model Results  
*Preliminary Results Only*  
(Please do not reference.)

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Log of Sales Price</th>
<th>Log of Sales Price</th>
<th>Log of Sales Price</th>
<th>Log of Sales Price -IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miles to Work</td>
<td>-0.0142***</td>
<td></td>
<td>-0.0133***</td>
<td>0.0213</td>
</tr>
<tr>
<td></td>
<td>(0.00207)</td>
<td></td>
<td>(0.00197)</td>
<td>(0.0459)</td>
</tr>
<tr>
<td>Travel Time to Work</td>
<td></td>
<td>-0.00907***</td>
<td></td>
<td>-0.0083***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.00142)</td>
<td></td>
<td>(0.00132)</td>
</tr>
<tr>
<td>Block Group FE</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of Trucks IV</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.477</td>
<td>0.475</td>
<td>0.483</td>
<td>0.588</td>
</tr>
</tbody>
</table>
Model 2: Effect of New Transportation Infrastructure

• In October 2008, a $155 million project in Gwinnett County was completed that included HOV lanes, two new flyover bridges, and made other commute reducing investments.

• “A key segment of I-85 took 28 minutes to travel before the improvement and 17 minutes after and a typical commute to the city center was reduced by 15 minutes” - GDOT
Model 2: Effect of New Transportation Infrastructure
Model 2: Effect of New Transportation Infrastructure

• Before and after treatment effects:
  – Treatment group are sales along this corridor benefiting from the investment.
  – Control group are outside-of-the-perimeter matched sales.
Model 2: Effect of New Transportation Infrastructure Preliminary Results Only
(Please do not reference.)

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Before</th>
<th>After</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log of Sales Price</td>
<td>0.115***</td>
<td>0.147***</td>
<td>.0327***</td>
</tr>
<tr>
<td>Price</td>
<td>(0.00943)</td>
<td>(0.00833)</td>
<td>T-Stat</td>
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<tr>
<td>T.E. of 85 Corridor</td>
<td></td>
<td></td>
<td>2.6002</td>
</tr>
</tbody>
</table>
Model 3. Difference-in-Difference on outside-of-the-city traffic pressure

Permanent Traffic Station Map
Model 2: Nearest Neighbor Matching for Difference-in-Difference and Average Treatment Effects

• We construct a neighborhood matching protocol similar to Patrick and Mothorpe (2016)

• Restrict sales to those in treatment or control neighborhoods

• Implement difference-in-difference for inside a treatment neighborhood after 2008
Summary of Results to Date

• Home prices do reflect changes in commute times.
• If driverless cars or other technological advances weaken or break this relationship:
  – In places where the negative commute effect on home prices is high, property could appreciate faster than expected.
  – In places benefitting from the premium to live closer to work with the associated shorter commute times, digests could appreciate slower than expected or even decline, with potential implications for policy makers trying to fund local public services.
Thank you!

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Check out our research at cslf.gsu.edu or on social media.