Commuting, Migration, and Local Employment Elasticities

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Introduction

- Many changes in the economic environment are local
  - Climate, infrastructure, innovations, institutions, regulations
- The effect of these changes depends crucially on the ability of labor to move in response: **The elasticity of local employment**
- Two main sources for employment changes: Commuting and migration
  - Workers spend 8% of their work-day commuting
    - Seek balance between residential amenities, cost of living and wage
- We propose a quantitative spatial GE theory with goods trade that incorporates these two channels
  - study the response of local outcomes to local shocks
Introduction

- We discipline our quantitative model to match
  - Gravity in goods trade
  - Gravity in commuting flows
  - Distribution of employment, residents and wages across counties
- The quantitative importance of these two channels varies across counties depending on their local characteristics
  - Leads to significant heterogeneity in the employment elasticity
  - Locations are not independent spatial units as often assumed in cross-section regressions
  - Underscores general equilibrium effects
- Affects the estimated effects of most local policies and shocks and their external validity
  - Heterogeneity is well accounted for by commuting links
Key Mechanisms

- Productivity differences and home market effects
  - Forces for the concentration of economic activity
- Inelastic housing supply and heterogeneous preferences
  - Forces for the dispersion of economic activity
- Commuting allows workers to access high productivity locations without having to live there
  - Effectively reduces the congestion effect in high productivity areas
- Elasticity of employment with respect to local shocks (e.g. productivity, amenities, infrastructure) depends on
  - Ability to attract migrants
  - Ability to attract commuters from surrounding locations
## Commuting Across Counties and Commuting Zones

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<th>p75</th>
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<td>Outside CZ</td>
<td>Total (Res)</td>
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<td>0.33</td>
<td>0.58</td>
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<td>0.37</td>
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<td>0.73</td>
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</table>

Tabulations on 3,111 counties and 709 CZ after eliminating business trips (trips longer than 120km); min is 0 for all.

- **For the median county**
  - Around 1/4 of its residents work outside the county
  - Around 1/3 of them work outside the county’s commuting zone
Related Literature

- **Quantitative international trade literature on costly trade in goods**
  - Eaton and Kortum (2002) and extensions

- **Economic geography literature on goods trade and factor mobility**

- **Urban literature on costly trade in people (commuting)**

- **Local labor markets literature**
Preferences and Amenities

- Utility of an agent $\omega$ that lives in $n$ and works in $i$ is

$$U_{ni\omega} = \frac{b_{ni\omega}}{\kappa_{ni}} \left( \frac{C_{n\omega}}{\alpha} \right)^\alpha \left( \frac{H_{n\omega}}{1-\alpha} \right)^{1-\alpha}$$

where $C_{n\omega}$ is the CES consumption basket with elasticity of substitution $\sigma$, and $H_{n\omega}$ housing consumption

- Utility cost of commuting are given $\kappa_{ni}$

- Amenities, $b_{ni\omega}$, drawn i.i.d. from Fréchet distribution

$$G_{ni}(b) = e^{-B_{ni}b^{-\epsilon}}, \quad B_{ni} > 0, \epsilon > 1$$
Production

- Horizontally differentiated varieties produced under monopolistic competition
- Labor required to produce $x_i(j)$ units of output in $i$ is
  \[ l_i(j) = F + \frac{x_i(j)}{A_i} \]
- Prices at $n$ are given by
  \[ p_{ni}(j) = \left( \frac{\sigma}{\sigma - 1} \right) \frac{d_{ni}w_i}{A_i}, \]
  where $d_{ni} \geq 1$ denotes iceberg transport costs between $i$ and $n$
- Constant equilibrium output $x_i(j) = A_i F (\sigma - 1)$ implies
  \[ M_i = \frac{L_{Mi}}{\sigma F} \]
Land Market

- There is an inelastic supply of land at $H_n$
- Price of land $Q_n$ determined from land market clearing

\[ H_n Q_n = (1 - \alpha) v_n L_{Rn}, \]

where $v_n$ is expected income of residents at $n$ and $L_{Rn}$ is the total number of residents

- Resulting price of land correlates well with house prices in the data
- Land owned by landlords, who receive income from residents’ expenditure on land, and consume goods where they live
  - Total expenditure on goods is the sum of expenditures by residents and landlords

\[ P_n C_n = \alpha v_n L_{Rn} + (1 - \alpha) v_n L_{Rn} = v_n L_{Rn} \]
Denote by $L_{Mi}$ the number of workers at $i$

Then, as in many trade frameworks, expenditure shares are given by

$$\pi_{ni} = \frac{L_{Mi} \left( d_{ni} w_i / A_i \right)^{1-\sigma}}{\sum_{k \in N} L_{Mk} \left( d_{nk} w_k / A_k \right)^{1-\sigma}}$$

And so the price of the consumption basket at $n$ is given by

$$P_n = \frac{\sigma}{\sigma - 1} \left( \frac{L_{Mn}}{\sigma F \pi_{nn}} \right)^{\frac{1}{1-\sigma}} \frac{w_n}{A_n}$$
Work-Residence Decision

- The indirect utility of an agent $\omega$ that lives in $n$ and works in $i$ is

$$U_{ni\omega} = \frac{b_{ni\omega}w_i}{\kappa_n P_n^n Q_n^{1-\alpha}}$$

which is drawn from

$$G_{ni}(u) = e^{-\Psi_{ni} u^{-\epsilon}}, \text{ with } \Psi_{ni} = B_{ni} \left(\kappa_{ni} P_n^n Q_n^{1-\alpha}\right)^{-\epsilon} w_i^\epsilon$$

- So the unconditional probability that a worker chooses to live in region $n$ and work in location $i$ is

$$\lambda_{ni} = \frac{B_{ni} \left(\kappa_{ni} P_n^n Q_n^{1-\alpha}\right)^{-\epsilon} w_i^\epsilon}{\sum_{r \in N} \sum_{s \in N} \sum_{r \in N} \sum_{s \in N} B_{rs} \left(\kappa_{rs} P_r^n Q_r^{1-\alpha}\right)^{-\epsilon} w_s^\epsilon}$$

- Free mobility implies that $\bar{U} = E[U_{ni\omega}]$ for all $ni$
Commuting

- Conditional probability that worker commutes to location \( i \) conditional on living in location \( n \) is

  \[
  \lambda_{ni|n} = \frac{B_{ni} \left( \frac{w_i}{\kappa_{ni}} \right) \epsilon}{\sum_{s \in N} B_{ns} \left( \frac{w_s}{\kappa_{ns}} \right) \epsilon}
  \]

- So labor market clearing implies that

  \[
  L_{Mi} = \sum_{n \in N} \lambda_{ni|n} L_{Rn}
  \]

- Expected residential income is then

  \[
  \nu_n = \sum_{i \in N} \lambda_{ni|n} w_i
  \]
General Equilibrium

- The general equilibrium is a vector of prices \( \{w_n, v_n, Q_n, P_n\} \) and allocations \( \{\pi_{ni}, \lambda_{ni}\} \) such that
  - Earnings equals expenditures (trade balance), \( w_i L_{Mi} = \sum_{n \in N} \pi_{ni} v_n L_{Rn} \)
  - Land markets clear
  - Agents move freely and labor markets clear, \( \bar{L} = \sum_{i \in N} L_{Mi} = \sum_{n \in N} L_{Rn} \)

- We formulate an isomorphic model using Armington or EK with external economies of scale, migration and commuting

- **Proposition (Existence and Uniqueness)** If

\[
\frac{1 + \varepsilon}{1 + (1 - \alpha) \varepsilon} < \sigma
\]

there exists a unique general equilibrium of this economy.
Data

- Commodity Flow Survey (CFS)
  - Bilateral trade between 123 CFS regions
  - Bilateral distance shipped

- American Community Survey (ACS)
  - Commuting probabilities between counties

- Bureau of Economic Analysis
  - Employment by workplace county
  - Wages by workplace county

- GIS data
  - County maps

- Parameters
  - Share of expenditure on consumption goods, $\alpha = 0.6$ (Davis and Ortalo-Magne, 2011)
  - Elasticity of substitution, $\sigma = 4$ (Bernard et al., 2003)
County Bilateral Trade and Productivities

- Model is quantified for counties, but trade observed for CFS regions
- County trade balance implies

\[ w_i L_{Mi} = \sum_{n \in N} \pi_{ni} \nu_n L_{Rn} = \sum_{n \in N} \frac{L_{Mi} (d_{ni} w_i)^{1-\sigma} A_i^{\sigma-1}}{\sum_{k \in N} L_{Mk} (d_{nk} w_k)^{1-\sigma} A_k^{\sigma-1}} \nu_n L_{Rn}. \]

- We observe (or can compute) \{w_i, L_{Mi}, L_{Ri}, \nu_i\}
- Let \( d_{ni}^{1-\sigma} = (\text{distance}_{ni})^{-1.29} \), then we can solve uniquely for productivities, \( A_i \)
- Obtain predicted county bilateral trade flows, \( \pi_{ni} \)
- Aggregate to CFS level and compare with actual trade shares
Gravity in Goods Trade Across CFS Regions

- Slope: -1.29 (after removing origin and destination fixed-effects)
Data vs. Model CFS Expenditure Shares
Bilateral commuting probabilities are:

\[ \lambda_{ni} = \frac{B_{ni} \left( \kappa_{ni} P_n^\alpha Q_n^{1-\alpha} \right)^{-\epsilon} w_i^\epsilon}{\sum_{r \in N} \sum_{s \in N} B_{rs} \left( \kappa_{rs} P_r^\alpha Q_r^{1-\alpha} \right)^{-\epsilon} w_s^\epsilon}, \]

We observe (or have solved for) \( \{w_i, L_{Mi}, L_{Ri}, v_i, \pi_{ii}, A_i\} \) and so can calculate \( Q_n \) and \( P_n \).

Use \( \kappa_{ni} = \text{distance}^\phi_{ni} \) and \( \phi \epsilon = 4.43 \), we can solve for the unique matrix of amenities \( B_{ni} \).
Gravity in Commuting Flows

- Slope: -4.43 (after removing origin and destination fixed-effects)
Separating $\phi$ and $\epsilon$

- Can rewrite the bilateral commuting probability in logs as

$$
\log \lambda_{ni} = - \log \left( \sum_{r \in N} \sum_{s \in N} B_{rs} \left( \kappa_{rs} P_r^{\alpha} Q_r^{1-\alpha} \right)^{-\epsilon} w_s^\epsilon \right) - \epsilon \log P_n^{\alpha} Q_n^{1-\alpha}
$$

constant

residence f.e.

$$
- \epsilon \phi \log \text{dist}_{ni} + \epsilon \log w_i + \log B_{ni}
$$

- To estimate $\epsilon$
  
  - Impose $\epsilon \phi = 4.43$
  
  - Instrument $\log w_i$ with $\log A_i$
    
    F-stat from first stage: 822.1

- We find $\epsilon = 3.30$ and $\phi = 1.34$
Two Quantitative Exercises

1. Shock to productivity of individual counties
   - We find substantial heterogeneity of local employment elasticity
   - Due in large part to commuting

2. Reductions in commuting costs
   - Large effects on the spatial distribution of economic activity
Large empirical literature on local labor demand shocks

“Differences-in-differences” specification across locations \( i \) and time \( t \)

\[
\Delta \ln Y_{it} = a_0 + a_1 I_{it} + a_2 X_{it} + u_{it}
\]

\( Y_{it} \) is outcome of interest and \( I_{it} \) is demand shock (treatment), \( X_{it} \) are controls and \( u_{it} \) is a stochastic error

Potential econometric concerns

- Finding exogenous shocks to labor demand
- Measuring the shock to local labor demand (interpreting \( a_1 \))
- Heterogeneous treatment effects
- Spatial linkages between counties and general equilibrium effects

To what extent are heterogeneous treatment effects, spatial linkages and general equilibrium effects a concern?

What if anything can be done to address these concerns?
Elasticity of Local Employment to Productivity

5% productivity shocks

Elasticity of Employment to Productivity
Eliminating bottom and top 0.5%; gray area: 95% bootstrapped CI

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Local Employment Elasticities
October 2016
Elasticity of Local Employment to Productivity
5% productivity shocks

New Haven (CT) $d\ln L_M/dA$: 1.47

Eliminating bottom and top 0.5%; gray area: 95% boostrapped CI
Elasticity of Local Employment to Productivity

5% productivity shocks

S. Diego (CA)
\[ \frac{d\ln L}{dA} : 0.63 \]

New Haven (CT)
\[ \frac{d\ln L}{dA} : 1.47 \]

Density

0.2

0.4

0.6

0.8

1

0

0.5

1

1.5

2

2.5

Elasticity of Employment to Productivity

Eliminating bottom and top 0.5%; gray area: 95% boostrapped CI
Elasticity of Local Employment to Productivity

5% productivity shocks

S. Diego (CA)
\( \frac{d \ln L_M}{d A} : 0.63 \)

New Haven (CT)
\( \frac{d \ln L_M}{d A} : 1.47 \)

Arlington (VA)
\( \frac{d \ln L_M}{d A} : 2.35 \)

Eliminating bottom and top 0.5%; gray area: 95% bootstrapped CI
Local Employment vs. Resident Elasticity to Productivity

5% productivity shocks

Elasticity of Employment and Residents to Productivity

Eliminating bottom and top 0.5%; gray area: 95% bootstrapped CI

Employment

Residents
Local Employment vs. Resident Elasticity to Productivity

5% productivity shocks

Arlington (VA)

\[ \frac{d \ln L}{d A} : 2.35 \]

\[ \lambda_{nn|n} : .310 \]

Eliminating bottom and top 0.5%; gray area: 95% boostrapped CI
Local Employment vs. Resident Elasticity to Productivity

5% productivity shocks

Density

Elasticity of Employment and Residents to Productivity

Employment
Residents

Eliminating bottom and top 0.5%; gray area: 95% bootstrapped CI

S. Diego (CA)
\( \frac{d \ln L_M}{dA} \): 0.63
\( \lambda_{nn|n} \): .996

Arlington (VA)
\( \frac{d \ln L_M}{dA} \): 2.35
\( \lambda_{nn|n} \): .310

Monte, Redding, Rossi-Hansberg

Local Employment Elasticities

October 2016
Local Employment vs. Resident Elasticity to Productivity

5% productivity shocks

S. Diego (CA)
\[ \frac{d\ln L_M}{dA} : 0.63 \]
\[ \lambda_{nn|n} : 0.996 \]

Arlington (VA)
\[ \frac{d\ln L_M}{dA} : 2.35 \]
\[ \lambda_{nn|n} : 0.310 \]

New Haven (CT)
\[ \frac{d\ln L_M}{dA} : 1.47 \]
\[ \lambda_{nn|n} : 0.746 \]
Explaining The Elasticity of Employment

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<th>2</th>
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<td>1.100**</td>
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<td><strong>constant</strong></td>
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* $p < 0.05$; ** $p < 0.01$. 

[Standardized] [Spatially Correlated Shocks] [More]
Deviation in Diff-in-Diff Estimates

- We estimate
  \[
  \Delta \ln L_{Mi} = a_0 + a_1 I_i + a_2 X_i + a_3 (I_i \times X_i) + u_i
  \]

- Using different comparison sets of “control counties”
  - Closest county, random county, neighbors, non neighbors, all counties

- Using two sets of controls
  - *Reduced-form controls*: land, employment, residents, workplace wages, employment and wages in neighboring areas
  - *Model-suggested controls*: partial equilibrium elasticities for commuting, migration, and goods market linkages

- Compute the deviation as
  \[
  \beta_i = \left( \frac{a_1 + a_3 X_i}{dA_i} \right) - \frac{dL_{Mi}}{dA_i} \frac{A_i}{L_{Mi}}
  \]
Distribution of Deviations in Diff-in-Diff Estimates
Using “closest county” and “all observations” control groups

Eliminating bottom and top 0.5%; M.S.: model-suggested controls; R.F.: reduced-form controls
The Role of Commuting in an Experiment

- Announcements of Million Dollar Plants (MDP)
  - Winning county where new firm locates
  - Runner-up counties (losing counties)

- 82 MDP announcements from Greenstone and Moretti (2004)
  - Greenstone, Hornbeck and Moretti (2010) use subset of 47 MDP openings that could be located in (confidential) Census data

- Difference-in-Difference specification
  - Before and after plant opening (at different time intervals)
  - Between winning and losing counties
  - We run

\[
\Delta \ln Y_{nkt} = \alpha \mathbb{1}_{nk} + \beta \lambda_{nn|n} + \gamma \left( \lambda_{nn|n} \times \mathbb{1}_{nk} \right) + \mu_k + \epsilon_{nkt}
\]

- \( \Delta \ln Y_{nkt} \): change in log employment \( t \) years after announcement
- \( \mathbb{1}_{nk} \): dummy for winning county in case \( k \)
- \( \lambda_{nn|n} \): share of residents working in county \( n \) in 1990
- \( \mu_k \): case fixed-effect
### Commuting and the Effect of MDP

#### Heterogeneous Treatment Effects and Case Fixed Effects

<table>
<thead>
<tr>
<th>$\tau$ years after</th>
<th>Adj $R^2$</th>
<th>Treatment Coefficient</th>
<th>Std. Error</th>
<th>Openness Coefficient</th>
<th>Std Error</th>
<th>Interaction Coefficient</th>
<th>Std Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.40</td>
<td>0.117**</td>
<td>0.028</td>
<td>-0.027</td>
<td>0.026</td>
<td>-0.124***</td>
<td>0.036</td>
</tr>
<tr>
<td>2</td>
<td>0.50</td>
<td>0.133**</td>
<td>0.037</td>
<td>-0.084***</td>
<td>0.035</td>
<td>-0.133***</td>
<td>0.048</td>
</tr>
<tr>
<td>3</td>
<td>0.46</td>
<td>0.149**</td>
<td>0.048</td>
<td>-0.130***</td>
<td>0.045</td>
<td>-0.140***</td>
<td>0.062</td>
</tr>
<tr>
<td>4</td>
<td>0.41</td>
<td>0.159*</td>
<td>0.059</td>
<td>-0.167***</td>
<td>0.056</td>
<td>-0.151**</td>
<td>0.077</td>
</tr>
<tr>
<td>5</td>
<td>0.39</td>
<td>0.213*</td>
<td>0.071</td>
<td>-0.191***</td>
<td>0.067</td>
<td>-0.213**</td>
<td>0.092</td>
</tr>
</tbody>
</table>

- Announcement has significant smaller employment effects in counties that are more closed to commuting
  - A county with an own commuting share at the 90th percentile rather than at the 10% the effect is between 49% and 43% smaller
- In our benchmark model the same exercise yields 32%
  - If anything, our model seems to underplay the importance of commuting compared to the data
Changes in Commuting Costs

- We use observed commuting flows to back out implied values of $\tilde{B}_{ni} = B_{ni} \kappa_{ni}^{-e}$, using
  \[ B_{ni} = \left( \frac{L_{ni}}{L_{nn}} \frac{L_{in}}{L_{ii}} \right)^{1/2} \]

- Compute this measure for both 1990 and 2007
  - We find a reduction in commuting costs of 4% at the 25th percentile, 12% at the median, and 21% at the 75 percentile

- Associated welfare changes:

<table>
<thead>
<tr>
<th>Change in Commuting Costs</th>
<th>Decrease by p75</th>
<th>Decrease by p50</th>
<th>Decrease by p25</th>
<th>Increase by p50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welfare Change</td>
<td>-21%</td>
<td>-12%</td>
<td>-4%</td>
<td>13%</td>
</tr>
<tr>
<td></td>
<td>6.89%</td>
<td>3.26%</td>
<td>0.89%</td>
<td>-2.33%</td>
</tr>
</tbody>
</table>
Changes in Commuting Costs

- Employment response of reductions in commuting cost by median change between 1990 and 2007

Monte, Redding, Rossi-Hansberg (2016)
Conclusions

- Study changes in local employment in response to local shocks
  - To do so we introduced migration and commuting into a spatial GE model

- Found that local employment elasticities are very heterogenous
  - Puts into question the external validity of empirical estimates of any single local employment elasticity

- Heterogeneity in commuting patterns important in generating the heterogeneity in employment elasticities
  - The model suggests simple controls to recover such heterogeneity
  - Underscores the importance of GE effects

- Emphasize the role of commuting to determine
  - the spatial distribution of economic activity
  - the consequences of reduction in trade costs
Existence and Uniqueness

Systems of $2N$ equations for $2N$ unknown values of $\{w, L_R\}$.

$$w^\sigma_n A_n^{1-\sigma} = \bar{W} \frac{1-\sigma}{\alpha} \left( \frac{\sigma}{\sigma-1} \right)^{1-\sigma} \left[ \sum_{k \in N} \bar{w}_k^{\frac{\sigma-1}{\alpha}} L_{Rk}^{1-(\sigma-1)\left(\frac{1}{\alpha\epsilon} + \frac{1-\alpha}{\alpha}\right)} \bar{v}_k^{1-(\sigma-1)\left(\frac{1-\alpha}{\alpha}\right)} H_k^{(\sigma-1)\left(\frac{1-\alpha}{\alpha}\right)} d_{kn}^{1-\sigma} \right].$$

$$= \bar{W} \frac{1-\sigma}{\alpha} \left( \frac{\sigma}{\sigma-1} \right)^{1-\sigma} \left\{ \sum_{k \in N} \left[ \sum_{r \in N} \frac{B_{rn}(w_n/\kappa_{rn})^\epsilon}{\sum_{s \in N} B_{rs}(w_s/\kappa_{rs})^\epsilon} L_{Rr} \right] \left( \frac{d_{nk} w_k}{A_k} \right)^{1-\sigma} \right\}. $$

Can show that this system has a unique fixed point.
Land Prices in Model vs. House Prices in Data

- Correlation: 0.51

Dashed line: linear fit; slope: 2.04
Explaining The Elasticity of Employment

Standardized

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>log $L_Mn$</td>
<td>-0.012</td>
<td>0.036*</td>
<td>-0.217**</td>
<td>0.147**</td>
<td>0.132**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>log $w_n$</td>
<td>-0.126**</td>
<td>-0.100**</td>
<td>-0.162**</td>
<td>-0.166**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>log $H_n$</td>
<td>-0.621**</td>
<td>-0.372**</td>
<td>0.007</td>
<td>0.020**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>log $L_{M, n}$</td>
<td>0.429**</td>
<td>-0.097**</td>
<td>0.072**</td>
<td>0.091**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>log $w_{n}$</td>
<td>0.090**</td>
<td>0.072**</td>
<td>-0.945**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\lambda_{n</td>
<td>n}$</td>
<td>-0.428**</td>
<td>-0.444**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.00</td>
<td>0.00</td>
<td>0.40</td>
<td>0.51</td>
<td>0.89</td>
<td>0.93</td>
<td>0.93</td>
<td>0.95</td>
<td>0.95</td>
</tr>
<tr>
<td>$N$</td>
<td>3,111</td>
<td>3,111</td>
<td>3,111</td>
<td>3,081</td>
<td>3,111</td>
<td>3,111</td>
<td>3,081</td>
<td>3,081</td>
<td>3,081</td>
</tr>
</tbody>
</table>

Dependent variables and all regressors are standardized. * $p < 0.05$; ** $p < 0.01$. 
Local Employment Elasticities and Productivity Shocks

5% productivity shocks

- Goods and labor market clearing imply that

\[ w_i L_{Mi} = \sum_{n \in N} \pi_{ni} v_n L_{Rn} \quad \text{and} \quad L_{Mi} = \sum_{n \in N} \lambda_{ni | n} L_{Rn} \]

- Partial equilibrium elasticities:

\[
\frac{\partial L_{Mi}}{\partial A_i} \frac{A_i}{L_{Mi}} = \frac{\partial L_{Mi}}{\partial w_i} \frac{w_i}{L_{Mi}} \cdot \frac{\partial w_i}{\partial A_i} \frac{A_i}{w_i}
\]

- Not GE, since holding \( w_{-i}, P., v. \) constant

\[
\frac{\partial L_{Mi}}{\partial w_i} \frac{w_i}{L_{Mi}} = \epsilon \sum_{n \in N} \left(1 - \lambda_{ni | n}\right) \frac{\lambda_{ni | n} L_{Rn}}{L_{Mi}} + \left(\frac{\partial L_{Ri}}{\partial w_i} \frac{w_i}{L_{Ri}}\right) \frac{\lambda_{ii | i} L_{Ri}}{L_{Mi}}
\]

\[
\frac{\partial w_i}{\partial A_i} \frac{A_i}{w_i} = \frac{(\sigma - 1) \sum_{n \in N} (1 - \pi_{ni}) \alpha_n}{[1 + (\sigma - 1) \sum_{n \in N} (1 - \pi_{ni}) \alpha_n] + [1 - \sum_{n \in N} (1 - \pi_{ni}) \alpha_n]} \frac{\partial L_{Mi}}{\partial w_i} \frac{w_i}{L_{Mi}} - \alpha_i \frac{\partial L_{Ri}}{\partial w_i} \frac{w_i}{L_{Ri}}
\]

\[
\frac{\partial L_{Ri}}{\partial w_i} \frac{w_i}{L_{Ri}} = \frac{\epsilon \left(\frac{\lambda_{ii}}{\lambda_{Ri}} - \lambda_{Mi}\right)}{1 + \epsilon (1 - \alpha) (1 - \lambda_{Ri})}
\]
Literature on Local Labor Demand Shocks

- Large empirical literature on local labor demand shocks
  - Bound and Holzer (2000): measure labor demand shocks using total local hours and industry composition as in Bartik (1991)
  - Greenstone, Hornbeck and Moretti (2010): million-dollar plants
  - Michaels (2011): oil abundance in Southern USA
  - Yagan (2014): great recession
Local Employment vs. Resident Elasticity to Productivity

5% productivity shocks to Commuting Zones

Eliminating bottom and top 0.5%; gray area: 95% boostrapped CI

Monte, Redding, Rossi-Hansberg

Local Employment Elasticities

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Distribution of Deviations in Diff-in-Diff Estimates

Using “neighbors”, “non-neighbors” and “random county” control groups

Eliminating bottom and top 0.5%; M.S.: model-suggested controls; R.F.: reduced-form controls

Densities using Non-Neighbors and Random controls are visually indistinguishable
Change in Residence Empl. and Importance of Commuting

Shutting down commuting

![Chart showing the relationship between percentage change in residents and employment/residents ratio. The chart displays a scatter plot with points spread across the graph, indicating a correlation between the two variables.]
CZ Own-commuting vs initial workplace employment

![Graph showing the relationship between CZ Avg. Share of Workers who Live in the County (Log Scale) and Initial Workplace Employment in CZ (thousands, log scale). The x-axis represents Initial Workplace Employment in CZ (thousands, log scale), ranging from 1 to 10,000. The y-axis represents CZ Avg. Share of Workers who Live in the County (Log Scale), ranging from 0.5 to 1.]
Spatially Correlated Shocks
Shares of manufacturing employment across counties (2007)
Spatially Correlated Shocks: Manufacturing

Elasticity to 6.2% manufacturing shock

Eliminating bottom and top 0.5%; gray area: 95% boostrapped CI
Spatially Correlated Shocks: All Sectors
Elasticity to 6.2% manufacturing and 3.1% non-manufacturing shock

Elasticity of Employment and Residents to Productivity

Eliminating bottom and top 0.5%; gray area: 95% boostrapped CI

Monte, Redding, Rossi-Hansberg
Local Employment Elasticities
October 2016
Spatially Correlated Shocks: All Sectors
Spatially Correlated Shocks: Non-Manufacturing

Elasticity to 3.1% non-manufacturing shock

Eliminating bottom and top 0.5%; gray area: 95% bootstrapped CI.
### Explaining the Importance of Commuting

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\log L_{Mn})</td>
<td>(0.974^{**})</td>
<td>(1.001^{**})</td>
<td>(-0.000)</td>
<td>(0.020^{**})</td>
<td>(0.341^{**})</td>
<td>(0.331^{**})</td>
<td>(0.028^{**})</td>
<td>(0.025)</td>
</tr>
<tr>
<td></td>
<td>((0.003))</td>
<td>((0.004))</td>
<td>((0.003))</td>
<td>((0.004))</td>
<td>((0.018))</td>
<td>((0.018))</td>
<td>((0.003))</td>
<td>((0.025))</td>
</tr>
<tr>
<td>(\log w_n)</td>
<td>(0.460^{**})</td>
<td>(0.480^{**})</td>
<td>(0.341^{**})</td>
<td>(0.331^{**})</td>
<td>(0.171^{**})</td>
<td>(0.239^{**})</td>
<td>(0.025)</td>
<td>(0.025)</td>
</tr>
<tr>
<td></td>
<td>((0.018))</td>
<td>((0.018))</td>
<td>((0.003))</td>
<td>((0.003))</td>
<td>((0.023))</td>
<td>((0.023))</td>
<td>(0.025)</td>
<td>(0.025)</td>
</tr>
<tr>
<td>(\log L_{Mn})</td>
<td>(0.957^{**})</td>
<td>(0.922^{**})</td>
<td>(-0.001)</td>
<td>(0.028^{**})</td>
<td>(-0.011)</td>
<td>(-0.022^{**})</td>
<td>(0.006)</td>
<td>(0.006)</td>
</tr>
<tr>
<td></td>
<td>((0.003))</td>
<td>((0.004))</td>
<td>((0.003))</td>
<td>((0.003))</td>
<td>((0.006))</td>
<td>((0.006))</td>
<td>(0.025)</td>
<td>(0.025)</td>
</tr>
<tr>
<td>(\log \bar{v}_n)</td>
<td>(0.066^{**})</td>
<td>(0.019)</td>
<td>(0.171^{**})</td>
<td>(0.239^{**})</td>
<td>(0.247)</td>
<td>(0.070)</td>
<td>(0.240)</td>
<td>(0.218)</td>
</tr>
<tr>
<td></td>
<td>((0.025))</td>
<td>((0.026))</td>
<td>((0.023))</td>
<td>((0.023))</td>
<td>((0.240))</td>
<td>((0.240))</td>
<td>(0.218)</td>
<td>(0.218)</td>
</tr>
<tr>
<td>(\log H_n)</td>
<td>(0.015^{*})</td>
<td>(0.037^{**})</td>
<td>(-0.011)</td>
<td>(-0.022^{**})</td>
<td>(-0.654^{**})</td>
<td>(-0.435^{**})</td>
<td>(-0.122)</td>
<td>(-0.111)</td>
</tr>
<tr>
<td></td>
<td>((0.006))</td>
<td>((0.004))</td>
<td>((0.006))</td>
<td>((0.006))</td>
<td>((0.122))</td>
<td>((0.111))</td>
<td>(0.220)</td>
<td>(0.220)</td>
</tr>
<tr>
<td>(\log L_{R,-n})</td>
<td>(-0.20^{**})</td>
<td>(-0.330^{**})</td>
<td>(-0.347)</td>
<td>(-0.238)</td>
<td>(-0.444)</td>
<td>(-0.347)</td>
<td>(-0.242) (\text{not shown})</td>
<td>(-0.220)</td>
</tr>
<tr>
<td></td>
<td>((0.005))</td>
<td>((0.032))</td>
<td>((0.240))</td>
<td>((0.218))</td>
<td>((0.039))</td>
<td>((0.242))</td>
<td>(0.220) (\text{not shown})</td>
<td>(0.220)</td>
</tr>
<tr>
<td>(\log L_{M,-n})</td>
<td>(-0.165)</td>
<td>(-1.485^{**})</td>
<td>(-1.199^{**})</td>
<td>(-0.881^{**})</td>
<td>(-2.647^{**})</td>
<td>(-0.057)</td>
<td>(-0.262)</td>
<td>(-0.30)</td>
</tr>
<tr>
<td></td>
<td>((0.238))</td>
<td>((0.301))</td>
<td>((0.336))</td>
<td>((0.223))</td>
<td>((0.169))</td>
<td>((0.338))</td>
<td>((0.306))</td>
<td>((0.30))</td>
</tr>
<tr>
<td>(\log \bar{v}_{-n})</td>
<td>(0.044)</td>
<td>(-0.347)</td>
<td>(-0.444)</td>
<td>(-0.347)</td>
<td>(-0.347)</td>
<td>(-0.347)</td>
<td>(-0.242)</td>
<td>(-0.220)</td>
</tr>
<tr>
<td></td>
<td>((0.039))</td>
<td>((0.240))</td>
<td>((0.242))</td>
<td>((0.242))</td>
<td>((0.242))</td>
<td>((0.242))</td>
<td>(0.220) (\text{not shown})</td>
<td>(0.220)</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>(-4.667^{**})</td>
<td>(-0.165)</td>
<td>(-1.485^{**})</td>
<td>(-1.199^{**})</td>
<td>(-0.881^{**})</td>
<td>(-2.647^{**})</td>
<td>(-0.057)</td>
<td>(-0.262)</td>
</tr>
<tr>
<td></td>
<td>((0.174))</td>
<td>((0.238))</td>
<td>((0.301))</td>
<td>((0.336))</td>
<td>((0.223))</td>
<td>((0.169))</td>
<td>((0.338))</td>
<td>((0.306))</td>
</tr>
<tr>
<td><strong>R^2</strong></td>
<td>0.98</td>
<td>0.98</td>
<td>0.98</td>
<td>0.98</td>
<td>0.03</td>
<td>0.16</td>
<td>0.15</td>
<td>0.30</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>3,111</td>
<td>3,111</td>
<td>3,111</td>
<td>3,111</td>
<td>3,081</td>
<td>3,111</td>
<td>3,081</td>
<td>3,081</td>
</tr>
</tbody>
</table>

In this table, \(L_{M,-n} \equiv \sum_{r:d_{rn} \leq 120, r \neq n} L_{Mr}\) is the total employment in neighbors whose centroid is no more than 120km away; \(\bar{w}_{-n} \equiv \sum_{r:d_{rn} \leq 120, r \neq n} \frac{L_{Mr}}{L_{M,-n}} w_r\) is the weighted average of their workplace wage. Analogous definitions apply to \(L_{R,-n}\) and \(\bar{v}_{-n}\). * \(p < 0.05\); ** \(p < 0.01\).
Deviations vs. General Equilibrium Elasticities
Comparing reduced-form and model-suggested controls

-4 -3 -2 -1 0 1 2 3 4
Deviation of Estimated Treatment Effect

-4 -3 -2 -1 0 1 2 3 4
Actual Elasticity of Employment to Productivity

Lines of Non-Neighbors, Random and All Observations overlap
Gray area: 95% CI

Monte, Redding, Rossi-Hansberg
Local Employment Elasticities

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Change in CZ Residents

Shutting down commuting

importance of commuting

size

CZ Avg. Share of Residents who Work in the County (Log Scale)

Initial Residents in CZ (thousands, Log Scale)
CZ Own-commuting vs initial residence employment

CZ Avg. Share of Residents who Work in the County (Log Scale) vs Initial Residents in CZ (thousands, Log Scale)