Housing Affordability with Local Wage and Price Variation

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Housing policy and differences in the cost of living

Defining housing affordability

- Housing affordability is commonly operationalised as a fixed rent-to-income ratio
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Housing affordability

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Key criticisms from economists

1. Major welfare programs should not be tied to local price levels (subsidy to expensive locations with above average quality of life).
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Key criticisms from economists

1. Major welfare programs should not be tied to local price levels (subsidy to expensive locations with above average quality of life).
2. Affordability metrics should not conflate income inequality with housing market problems and amenity consumption.
Location, regional linkages and the spatial economy

- **Motivation**
- **Theoretical set-up**
- **Empirical Model**
- **Results**
- **Next Steps**

Local wage and price variation

- **Employment, earnings**
  - Urban labour market
  - Real income
  - Expenditure
  - Regional employment share
    - Migration, job creation, firm formation

- **Cost-of-living**
  - Real estate, housing market

- **Amenities**
  - Geography, environment, local public goods, infrastructure, culture

- **Housing affordability**
  - National rent-to-income ratio

- **Relative wages**
- **Relative rents**
Localized amenity compensation differentials

Measuring the quality of life

- Hedonic indices of quality of life
Measuring the quality of life

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  - Spatial variation in rents and wages reflect the cost of consuming localized amenities that influence the quality of life
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Measuring the quality of life

- **Hedonic indices of quality of life**
  - Spatial variation in rents and wages reflect the cost of consuming localized amenities that influence the quality of life
  - Rosen (1979) $\rightarrow$ Roback (JPE 1982, 1988) $\rightarrow$ Blomquist et al. (AER 1988)
  - Quality-of-life rankings, based on relative amenity expenditures
Localized amenity compensation differentials

Measuring the quality of life

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Measuring the quality of life

- Hedonic indices of quality of life
  - Spatial variation in rents and wages reflect the cost of consuming localized amenities that influence the quality of life

- Quality-of-life rankings, based on relative amenity expenditures

- Key challenges: data → fixed effects, geography, normalization, validity of rankings
Localized amenity compensation differentials

Research objectives

- Quality-of-life adjusted metric of metropolitan-level housing affordability (consistent with a general class of cost-of-living indices, reflecting environmental and other nonmarket factors that affect consumers’ well-being).
- Quantify relationship between housing assistance payments and quality of life premia across metropolitan areas.
Localized amenity compensation differentials

Preview of results

- Annual inter-metropolitan housing subsidy differentials comparable to quality of life premia across metropolitan areas, growing in importance for larger metropolitan areas
- National estimates suggest average annual housing subsidy $1,833 for 2-bedroom unit for a 4-person household
- Large regional variations in the size of per-household subsidies, ranging from $980 in the Midwest to $3,014 in the West
- Average U.S. household sacrifices between $4,000 and $6,000 in 2000 to consume the bundle of amenities conveyed by preferred location (Bieri, Kuminoff, and Pope, 2012)
The Rosen-Roback GE framework

- **Choice problem:**
  \[
  \max_{j,x,h} U(x, h; q_j) \quad \text{subject to} \quad w_j = x + r_j h, \\
  \text{where} \quad q_j = \theta_1 a_{1j} + \theta_2 a_{2j} + \ldots + \theta_k a_{kj}
  \]

- **Equilibrium condition:**
  \[
  V(w_j, r_j; q_j) = \bar{V} \quad \forall \quad j = 1, \ldots, J
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- **Key result:**
  \[
  h \frac{dr}{dq} - \frac{dw}{dq} = \frac{\partial V/\partial q}{\partial V/\partial w} \quad \text{full implicit price}
  \]
Measuring the price of quality of life

- Key result:
  \[ h \frac{dr}{dq} - \frac{dw}{dq} = \frac{\partial V/\partial q}{\partial V/\partial w} \]

- Expenditure function:
  \[ r_{ij} = f(X_r^{ij}, A_j; \beta_1), \quad \text{where} \quad A_j = [a_{1j}, \ldots, a_{kj}] \]

- Wage function:
  \[ w_{ij} = f(X_w^{ij}, A_j; \beta_2), \quad \text{where} \quad A_j = [a_{1j}, \ldots, a_{kj}] \]
## Measuring the price of quality of life

- **Key result:**
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- **Wage function:**
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  w_{ij} = f(X_{ij}^w, A_j; \beta_2), \quad \text{where} \quad A_j = [a_{1j}, \ldots, a_{kj}]
  \]

- **Nonmarket implicit price:**
  \[
  \text{QOLI}_j = \sum_{k=1}^{K} a_{jk} \left[ \frac{\partial r}{\partial a_k}(X_{ij}^r, A_j; \hat{\beta}_1) - \frac{\partial w}{\partial a_k}(X_{ij}^w, A_j; \hat{\beta}_2) \right]
  \]
Rosen-Roback general equilibrium model

Isodensity and isocost curves determine equilibrium wages $w^*$ and rents $r^*$
Site-specific characteristics

Location A has above-average amenities and below average productivity
Site-specific characteristics

Productivity effect dominates amenity effect in location B
Site-specific characteristics

Net effect on rents depends on relative shift of isoultility and isocost curves
Classification by dominant effect

Relative importance of wage and rent compensating differentials
Housing subsidies based on rent-to-income ratio

The size of the local housing assistance payment is the difference between the location specific equilibrium rent and the respective rent that corresponds to the affordability ratio as defined by public policy. E.g. for location $A$ $HAP_A = r_A - r'$. 
Sorting and locational equilibrium

Urban rent and compensating differentials

Motivation

Theoretical set-up

Empirical Model

Results

Next Steps
Two-stage estimator

- **First stage (OLS):**
  \[
  r_{ij} = X_{ij}^r \beta + \lambda_j^r + \varepsilon \\
  w_{ij} = X_{ij}^w \beta + \lambda_j^w + \nu
  \]

- **Second stage (FGLS):**
  \[
  [\hat{\lambda}_j^r, \hat{\lambda}_j^w] = \hat{\lambda}_j = \alpha + A_j \delta + \xi_j \\
  \hat{\delta} = (A'\hat{\Omega}^{-1}A)^{-1} A'\hat{\Omega}^{-1}\hat{\delta}_j, \text{ where } \hat{\Omega} = VCOV(\hat{\delta})
  \]
**Two-stage estimator**

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  \]

- An atypical omitted variable problem with the goal to recover the composite index \( \text{QOLI}_j \), not marginal prices of individual amenities \( \hat{\delta} \)

  \[ \text{QOLI}_j = \sum_{k=1}^{K} a_{jk} \left( \hat{\delta}_k^r - \hat{\delta}_k^w \right) \]
Amenity data

- **Geography:**
  - Precipitation, humidity, heating degree days, cooling degree days, wind speed, sunshine, coast, coastal watershed, tornados, property damage from hazard events, seismic hazard, earthquakes, land surface form topography, heavy fog, scenic drive mileage, land area in national parks, distance to nearest state park and to nearest national park, mountain peaks
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- **Environmental externalities:**
  - Visibility, TSP, NPDES dischargers, landfill waste, superfund sites, treatment/storage/disposal sites, large quantity generators of hazardous waste, nuclear power plants, PM2.5, PM10, ozone, sulfur dioxide, carbon monoxide, nitrogen dioxide, cancer risk, neurological risk, respiratory risk
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- **Local public goods:**
  - Violent crime, teacher-pupil ratio, # schools, # public buildings, direct general expenditures, # hospitals, expenditures for hospitals and health, expenditures on parks and recreation, expenditures per student, private to public school enrollment, child mortality, museums and historical sites, zoos, botanical gardens and nature parks, campgrounds and camps
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- **Infrastructure:**
  - Central city, # airports, # ports, interstate highway mileage, urban arterial mileage, # Amtrak stations, # urban railway stops, railway mileage, federal expenditures
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- **Infrastructure:**
  - Central city, # airports, # ports, interstate highway mileage, urban arterial mileage, # Amtrak stations, # urban railway stops, railway mileage, federal expenditures

- **Cultural/urban amenities:**
  - Restaurants & bars, theatres & musicals, movie theatres, bowling alleys, amusement parks, research I universities, golf courses and country clubs, military areas, distance to nearest urban center, distance to metro area, distance to metro area > 250k, distance to metro area > 500k, distance to metro area > 1.5m, housing stress indicator, persistent poverty indicator, retirement destination indicator
Notes: HUD subsidies are defined as the annual housing assistance payments (HAP) that bridge the gap between the gross rent on a unit (FMR plus a 35% utility allowance) and the maximum total tenant payments (TTP) for a given household (capped at 30% of area median income for very-low income households). Average subsidies are calculated using the FMRs for 1-bedroom (2-person family), 2-bedroom (4-person family), 3-bedroom (6-person family) and 4-bedroom (8-person family) units in combination with respective household-size specific income limits that are indicated in parentheses.
2-bedroom, 4-person family subsidy
Range of subsidies
### Annual HUD subsidy summary statistics

<table>
<thead>
<tr>
<th></th>
<th>U.S.</th>
<th>Northeast (1)</th>
<th>Midwest (2)</th>
<th>South (3)</th>
<th>West (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>$1,833.8</td>
<td>$2,766.4</td>
<td>$979.8</td>
<td>$1,457.9</td>
<td>$3,013.7</td>
</tr>
<tr>
<td>St. dev.</td>
<td>$1,232.5</td>
<td>$1,335.7</td>
<td>$368.8</td>
<td>$755.5</td>
<td>$1,352.4</td>
</tr>
<tr>
<td>Min</td>
<td>$30.4</td>
<td>$937.8</td>
<td>$56.8</td>
<td>$30.4</td>
<td>$766.0</td>
</tr>
<tr>
<td></td>
<td>Erie, PA</td>
<td>Terrehaute, IN</td>
<td>Morristown, TN</td>
<td>Pocatello, ID</td>
<td></td>
</tr>
<tr>
<td>Max</td>
<td>$7,285.2</td>
<td>$6,590.1</td>
<td>$2,393.9</td>
<td>$3,684</td>
<td>$7,285.2</td>
</tr>
<tr>
<td></td>
<td>Barnstable Town, MA</td>
<td>Rapid City, SD</td>
<td>Punta Gorda, FL</td>
<td>Santa Cruz, CA</td>
<td></td>
</tr>
<tr>
<td>N. obs.</td>
<td>358</td>
<td>45</td>
<td>89</td>
<td>148</td>
<td>76</td>
</tr>
</tbody>
</table>

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HUD low-income housing subsidies and quality of life
HUD housing subsidies as a fraction of quality of life
HUD housing subsidies as a fraction of quality of life
## Annual housing subsidies within the urban hierarchy

<table>
<thead>
<tr>
<th>Metropolitan Statistical Area</th>
<th>Population (’000s)</th>
<th>Range of subsidy*</th>
<th>QOLI†</th>
<th>Share‡</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Very large metro areas (population &gt; 3 million)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detroit-Warren-Livonia, MI</td>
<td>4,453</td>
<td>$1,174.9</td>
<td>$5,138.3</td>
<td></td>
</tr>
<tr>
<td>San Francisco-Oakland-Fremont, CA</td>
<td>4,124</td>
<td>$7,115.7</td>
<td>$9,902.3</td>
<td></td>
</tr>
<tr>
<td><strong>Premium</strong></td>
<td></td>
<td>$5,940.7</td>
<td>$4,764.0</td>
<td>80.2%</td>
</tr>
<tr>
<td><strong>Large metro areas (population &gt; 1.5 million)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birmingham-Hoover, AL</td>
<td>1,052</td>
<td>$837.8</td>
<td>$3,197.9</td>
<td></td>
</tr>
<tr>
<td>San Jose-Sunnyvale-Santa Clara, CA</td>
<td>1,736</td>
<td>$6,661.9</td>
<td>$10,508.0</td>
<td></td>
</tr>
<tr>
<td><strong>Premium</strong></td>
<td></td>
<td>$5,824.1</td>
<td>$7,310.1</td>
<td>125.5%</td>
</tr>
<tr>
<td><strong>Mid-sized metro areas (population &gt; 0.5 million)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Youngstown-Warren-Boardman, OH-PA</td>
<td>602</td>
<td>$616.8</td>
<td>$3,561.6</td>
<td></td>
</tr>
<tr>
<td>Poughkeepsie-Newburgh-Middletown, NY</td>
<td>622</td>
<td>$4,627.89</td>
<td>$6,565.6</td>
<td></td>
</tr>
<tr>
<td><strong>Premium</strong></td>
<td></td>
<td>$4,011.1</td>
<td>$3,004.1</td>
<td>74.6%</td>
</tr>
<tr>
<td><strong>Small metro areas (population &lt; 0.5 million)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morristown, TN</td>
<td>123</td>
<td>$30.4</td>
<td>$2,670.2</td>
<td></td>
</tr>
<tr>
<td>Santa Cruz-Watsonville, CA</td>
<td>256</td>
<td>$7,285.2</td>
<td>$9,423.1</td>
<td></td>
</tr>
<tr>
<td><strong>Premium</strong></td>
<td></td>
<td>$7,254.8</td>
<td>$6,752.9</td>
<td>93.1%</td>
</tr>
</tbody>
</table>
Summary

- Local variation in wages and prices imply significant inter-metropolitan differences in the ratio of income to housing cost locational equilibrium.
- Operationalizing housing affordability in terms of a national policy raises concerns from an allocational perspective.
- Using unadjusted FMRs as a basis for allocating housing assistance is most problematic for larger metropolitan areas where amenity-driven compensating differentials play a particularly important role.
- Recognition that price-to-income ratios are affected by the location-specific attributes of housing markets provides transparent measure of housing affordability, directly applicable to a flexible menu of policy options.
Future work

- Amenity expenditures do not measure social welfare. Bounds?
- Track changes over time: 2000 to 2010
- Investigate “environmental” Tiebout sorting (Rhode and Strumpf AER2004)
Are green cities nice places to live?