Housing Externalities

Authors: Rossi-Hansberg, Sarte, and Owens

SHAPE Seminar

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Outline

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Motivation

- Improvements to a particular house can cause positive externalities on nearby houses.
- Externalities decrease with distance, agglomeration occurs and thus the creation of cities.
- Agglomeration could justify government interaction to achieve the optimal agglomeration.
Hedonic Pricing Model

- Housing properties as collection/bundle of goods and services
- Determine implicit price in regression framework, log(\(pi\)) = \(xi + i\)
- Early work due to Zvi Griliches (1971) and Sherman Rosen (1974)
- ’Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition’, JPE
Partial Correlation

- ‘Location, location, location’
- Individual and neighborhood effects
- $\log(\pi) = + hi_1 + ni_2 + i$
- first-derivative as implicit price, $\log(\pi)/hki = 1k$
- empirical work: valuation of air pollution, neighborhood characteristics, spatial risk, etc.
- causality?
Specification Issues

- spatial (auto)correlation
- endogeneity
- sample selection
- causality
Correlation Approach vs Natural Experiments

- sample selection: propensity score matching
- causality: difference in difference
- compare treated or experimental ‘group’ over time to a control “group”
city investment program in subsidized housing
neighborhoods A (experimental) and control (B), pre- (T1) and post-investment (T2)
observe four ‘states’

<table>
<thead>
<tr>
<th>Time/Neighborhood</th>
<th>A (experimental)</th>
<th>B (control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁ (pre-experiment)</td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>T₂ (post-experiment)</td>
<td>c</td>
<td>d</td>
</tr>
</tbody>
</table>

Figure: Table 1
Difference-in-Difference Impacts

- regress \( \log(p) = 0 + 1T + 2A + 3(T A) + \)
- determine marginal effects

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Impacts</th>
<th>Marginal effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta_0 )</td>
<td>Baseline level</td>
<td>( a )</td>
</tr>
<tr>
<td>( \beta_1 )</td>
<td>Difference over time</td>
<td>( c - a )</td>
</tr>
<tr>
<td>( \beta_2 )</td>
<td>Difference between neighborhoods</td>
<td>( b - a )</td>
</tr>
<tr>
<td>( \beta_3 )</td>
<td>Difference in change over time between neighborhoods</td>
<td>( (d - b) - (c - a) )</td>
</tr>
</tbody>
</table>

**Figure:** Table 2
Authors set up a model to capture housing externalities and to make the model more tractable.

Lot sizes are all equal to 1, and all agents rent from absentee landlords at a rate of $q(l)$.

Utility from housing comes from directly improving a piece of land, or from the amount of housing services produced nearby.

The fact that housing services produced at a location affect the housing services enjoyed somewhere else defines a housing externality.
Set-Up

- A neighborhood is represented by $N = [-R, R]$, $R$ being the neighborhood’s edge.
- All agents are endowed with 1 unit of time, some time spent commuting, so if an agent starts from location $l \in N$ (where he lives) he works $e^{-\tau|l|}$ time units, $\tau > 0$.
- The production technology is linear, and it transforms one unit of time into $w$ units of a final good.
- Agent’s preferences are defined by the services (utility) obtained from housing at a given location, denoted $\hat{H}(l)$ for an agent living at $l$ and other types of consumption are denoted $c(l)$. 
Define $H(l)$ as investments in housing undertaken by an individual at $l$, then
$\tilde{H}(l) = \delta \int_{-R}^{R} e^{-\delta |l-s|} H(s) \, ds + H(l)$.

That is, an agent obtains services from improvements to their own location ($l$), as well as services done to houses nearby ($s$).
Agents living at $l$ spend their income, $we^{-\tau |l|}$ on rent they must pay, the housing investments, and consumption.

Authors assume a Cobb-Douglas utility function. And so an agent living at $l$ maximizes

$$\max_{c(l), H(l)} u(c(l), \tilde{H}(l)) = c(l)^\alpha \tilde{H}(l)^{1-\alpha}, 0 < \alpha < 1$$

Subject to the budget constraint and the equality for housing services $\tilde{H}$
After solving and substituting we obtain an expression for housing services obtained at \( l \) depending only on prices and housing services produced elsewhere:

\[
\tilde{H}(l) = (1 - \alpha) \left( we^{-\tau\|l\|} - q(l) + \delta \int_{-R}^{R} e^{-\delta\|l-s\|} H(s) \, ds \right)
\]
Neighborhood Equilibrium

- All agents are identical and choose where to live.
- Externalities are the lowest at the boundaries of the neighborhood, and so rent is higher. Individuals living further away must spend a greater share of their income on direct home improvements in order to obtain a constant level of housing services.
Richmond officials noted that programs carried out in the previous 25 years only had limited success.

They believed that investment concentrated in fewer areas might yield measurable results.

NiB uses federal funds.

Four broad neighborhoods: Church Hill, Highland Park-Barton, Jackson Ward-Carver, and Blackwell. All have concentrations of vacant structures, substantial poverty, and low home ownership rates.

The city of Bellmeade was to be added to these cities, but did not make the cut.
Applying Model to Neighborhoods-in-Bloom Program

- Authors consider an ‘impact’ area where a government funded program aims to increase housing investments by some fixed amount.
- For areas not directly impacted they add a term to capture externalities.
- For locations that are directly impacted they add a term that reflects capital improvement.
- It follows that investment in housing decreases everywhere in the neighborhood, especially in the impact area.
- Also, now agents can relax their budget constraint which leads to a bid up in the price of land causing higher land rents throughout the neighborhood.
Introduction

Figure: Following Rehabilitation Program

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Data

- Records of all properties that benefited from the NiB funding between 1999 and 2004
- Geo-coded listing of all properties sold between 1993 and 2004, including information on condition and age, construction descriptors, and various dimensional attributes.
- Remove any area that was directly impacted by NiB, to measure only the external effects.
Two questions:

Do changes in land value in the four selected neighborhoods decrease with distance in a way suggested by 2c?

Are changes in land value in control neighborhood both lower and more uniform across space due to the absence of an impact area?
Empirical Discussion

Figure 5: Distribution of changes in land value in the neighborhoods targeted by NiE

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Figure: caption

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Returns to land are more uniform and lower in Bellemeade

NiB neighborhoods resemble Bellemeade at points furthest area from impact area

Results are not driven by simultaneous increases in private investments related to gentrification

Assumptions

NiB funding per unit of residential land in impact area

Modified Subsidy Model of Blackwell neighborhood
Calibrated Model

Figure 10: Calibrated model and nonparametric estimates of land returns

Figure: caption