The Housing Stock, Housing Prices, and User Costs: The Roles of Location, Structure and Unobserved Quality

Jonathan Halket [1] Lars Nesheim [2] Florian Oswald [3]

[1]Essex and CeMMAP

[2]UCL and CeMMAP, [3]Sciences Po

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Modelling Homeownership

- In many models, it is relatively easy to have renters:
  - Downpayment contraints keep young/poor out.
  - High transaction costs of buying/selling discourage short-duration households.
- It is harder to generate owners, particularly at the high rates observed.
  - Most approaches use ad-hoc assumptions which are hard to justify/verify.

Common Approach in Literature to generate Homeownership

Some ways to get homeowers from the literature:

- Exogenous supply restrictions: rentals are smallest available size / max size of rentals.
- Owning gives a *warm-glow* utility premium.
- Tenant-landlord contracting frictions lead to low quality and/or high cost rentals. Set higher depreciation on rentals.
- Tax advantages (Gervais '02).
- Insurance against rent volatility (Sinai & Souleles '05).
- And many others.

Here: Which houses are *selected* for Rental?

- How do houses get selected for either rental or owned sector by investors?
- What characteristics of a house are the main drivers of this selection?
- We cannot exclude that owning gives extra utility, but we ask a different question:

  *Under the assumption that people have preferences over location, characteristics, and money, can we understand homeownership **without** resorting to that extra utility?*

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- Our results suggest that accounting for unobserved property quality is important.
- It may be enough to explain why people "prefer" ownership, all else equal. (All else is not equal).

What this paper does:

- We develop a model investor choice between rented and owned property markets.
  - Seek to explain why some housing units become rental units while others become owner-occupied.
- We analyze prices, rents and probability of being owned as functions of dwelling characteristics and detailed geographic location.
- We provide a solution to the negative correlation in rent/price and homeownership.
- We use a very simple user-cost model to interpret our estimation results.

Model

Model Overview

- Imagine a general equilibrium model of housing choice.
  - Frictionless transfer from rental to owned sector.
- All agents are price takers.
  - Investors may be risk averse, or plan to sell house in future.
  - They compare present discounted expected value of house in each sector.
- Households match to houses, based on house characteristics.
  - Some characteristics are unobserved to econometrician.

Model

- Property has observable characteristics $z \in \mathbb{R}^n$ and unobservable characteristics $\varepsilon \in \mathbb{R}^2$.
- Observable characteristics include location, type of dwelling (detached, semi-detached, etc.), size (square meters), number of bedrooms, and age of structure.
- Unobserved characteristics captured by a vector ε "unobserved quality"
  1. Estimation results suggest that $\dim(\varepsilon) \geq 2$.
  2. Allow for different hedonic valuation of unobs. characteristics in each sector

Rental properties: Hedonic rent function

- If a dwelling unit is in rental sector, we observe its rent.
- Assume log annual rent is:

$$\begin{aligned}\ln R(z,\varepsilon) &= \alpha z + \underbrace{\lambda_1^r \varepsilon_1 + \lambda_2^r \varepsilon_2}_{\text{unobserved rental quality}} \\ &= \alpha z + \eta_r\end{aligned}$$

Owner-occupied properties: Hedonic price function

- If dwelling unit is in owned sector, we observe it's value (i.e. it's price estimated by the owner).
- Assume log value is:

$$\begin{aligned}\ln \pi^o(z,\varepsilon) &= \beta z + \underbrace{\lambda_1^o \varepsilon_1 + \lambda_2^o \varepsilon_2}_{\text{unobserved owned quality}} \\ &= \beta z + \eta_o\end{aligned}$$

Value in rental sector

- Value in rental sector is the expected present value of future revenues minus costs.
  - We never observe this: sales price of rental property.

- Assume that the log-value in the rental sector is:

$$\ln \pi^r(z, \varepsilon) = (\beta - \gamma)z + (\lambda_1^o - \lambda_1^s)\,\varepsilon_1 + (\lambda_2^o - \lambda_2^s)\,\varepsilon_2.$$

- $(\gamma, \lambda_1^s, \lambda_2^s)$ capture reduced-form loss in value of renting vs selling to owners.

Selection equation

- Investor sells housing unit to the sector where it has the highest value so that
$$P(z,\varepsilon) = \max_{\{own,rent\}} \{\pi^o(z,\varepsilon), \pi^r(z,\varepsilon)\}.$$
- Observe housing unit in the owner-occupied sector iff
$$\ln \pi^o(z,\varepsilon) \geq \ln \pi^r(z,\varepsilon)$$
- or, unit i is selected into owned market iff
$$\begin{aligned} \mathbf{1}\left[\text{owned}_i\right] &= 1 \\ \mathbf{1}\left[\gamma z_i \geq -\left(\lambda_1^s \varepsilon_{i1} + \lambda_2^s \varepsilon_{i2}\right)\right] &= 1 \\ \mathbf{1}\left[\gamma z_i \geq \eta_{is}\right] &= 1 \end{aligned}$$

Switching Regression

- Assuming that $\varepsilon \sim N(0, \Sigma)$ gives rise to a (Tobit-5) switching regression with error structure

$$\begin{bmatrix} \text{Rent:} \\ \text{Price:} \\ \text{Selected:} \end{bmatrix} = \begin{bmatrix} \eta_r \\ \eta_o \\ \eta_s \end{bmatrix} \sim \mathcal{N}\left(\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \omega_r^2 & \rho_{ro}\omega_r\omega_o & \rho_r\omega_r \\ \cdot & \omega_o^2 & \rho_o\omega_o \\ \cdot & \cdot & 1 \end{bmatrix} \right)$$

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- Main specification for z:
  - dwelling type and age,
  - polynomials in size (sq. meters) and distance from Trafalgar square,
  - *Location* is a flexible polynomial in 2-dimensional geographic coordinates detailing location of property.

Identification

- Selection model is identified by nonlinearities in inverse mills ratio.
- Exclusion restrictions are hard to find in this market:
  - need IV to affect selection
  - but not value/rent of the property
- Legal restrictions of which property can be rented out could work, but no such policies in place in London around 2011.

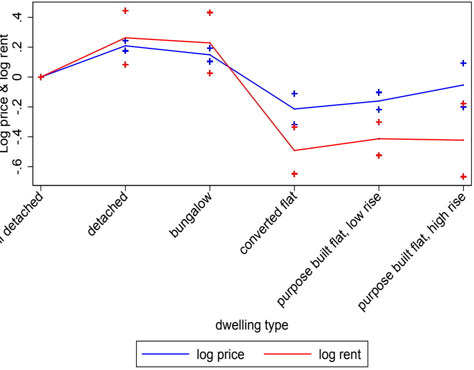
Data

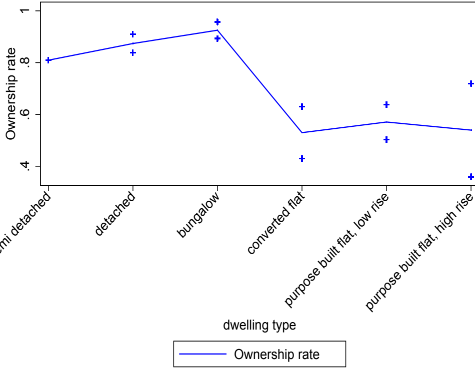
- Data from restricted access version of English Housing Survey (EHS 2011-2014).
- 2011 wave consists of 17,500 households observed in 2008/09.
- Focus discussion on 2011 wave but look at other waves to check robustness over time.
- Focus on a single economic market: all properties within 140km of Trafalgar square (“Greater London").

Results

Prices and selection vs. dwelling type

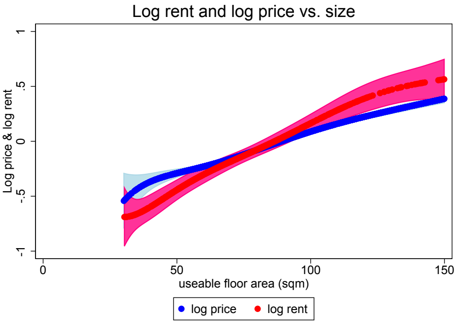
EHS 2011. *Baseline House:* semi-detached $75m^2$ house, 10km northeast of Trafalgar Square, built 1919-1944

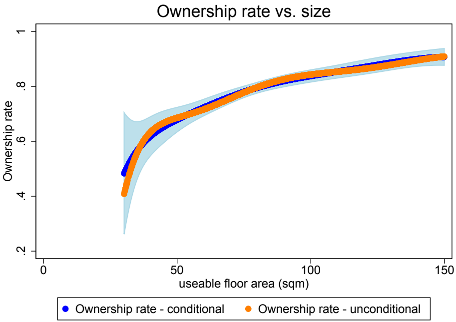




Prices and Selection vs dwelling size

EHS 2011





Analytical framework

- Use a Poterba (1992)-style user cost equation.
- User-costs in sector i determined by:
  - Effective discount rate $r^i(z, \varepsilon)$.
  - Maintenance and/or contracting costs $c^i(z, \varepsilon)$.
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  - Expected capital gains $g^i(z, \varepsilon)$.
- User-costs in the two sectors satisfy:

$$\pi^o(z, \varepsilon) = \frac{u(z, \varepsilon)}{r^o(z, \varepsilon) + c^o(z, \varepsilon) - g^o(z, \varepsilon)}$$

$$\pi^r(z, \varepsilon) = \frac{R(z, \varepsilon)}{r^r(z, \varepsilon) + c^r(z, \varepsilon) - g^r(z, \varepsilon)}$$

$u(z, \varepsilon)$: utility flow from ownership.

Discussion of Structure Restults

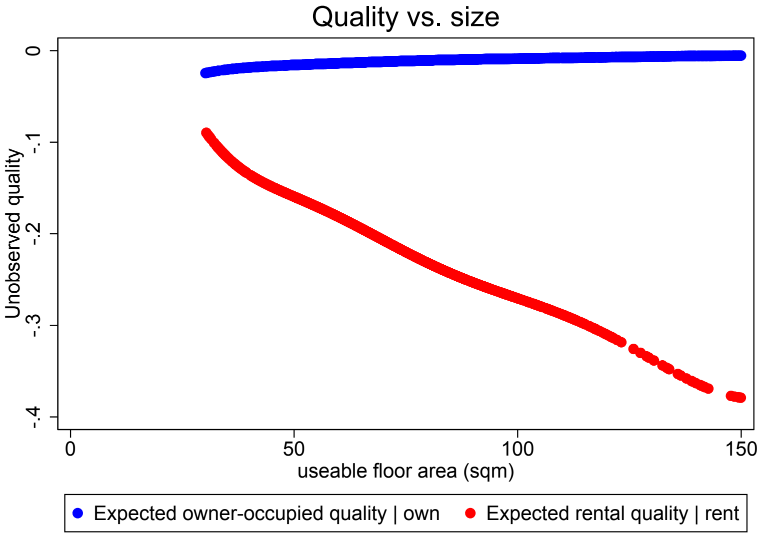
$$\pi^o(z,\varepsilon) = \frac{u(z,\varepsilon)}{r^o(z,\varepsilon)+c^o(z,\varepsilon)-g^o(z,\varepsilon)}$$

$$\pi^r(z,\varepsilon) = \frac{R(z,\varepsilon)}{r^r(z,\varepsilon)+c^r(z,\varepsilon)-g^r(z,\varepsilon)}$$

- More structure implies more ownership: $\frac{\partial \pi^o}{\partial z_s} > \frac{\partial \pi^r}{\partial z_s}$
- But Prices increase slower than Rents with size: $\frac{\partial \pi^o}{\partial z_s} < \frac{\partial R}{\partial z_s}$

Unobserved qualities vs. dwelling size

EHS 2011: Preference for owning?



Differential Costs?

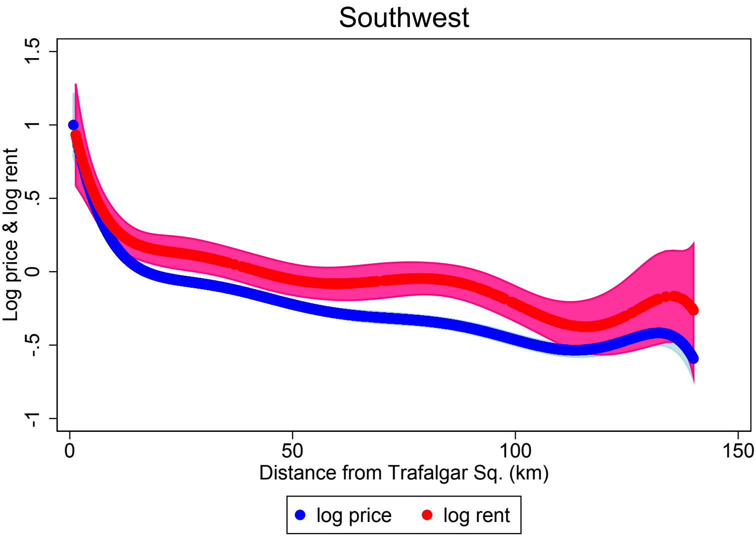
Can different maintainance/contracting costs explain selection on size?

- Would need costs in rental sector to increase faster with size than costs in the owner-occupied sector.
- Theoretical literature from 1980's discussing moral hazard in the rental market makes exactly this prediction.

- Unobservable characteristics may be the ones harder to contract upon.
- Larger rental houses have lower unobserved quality.

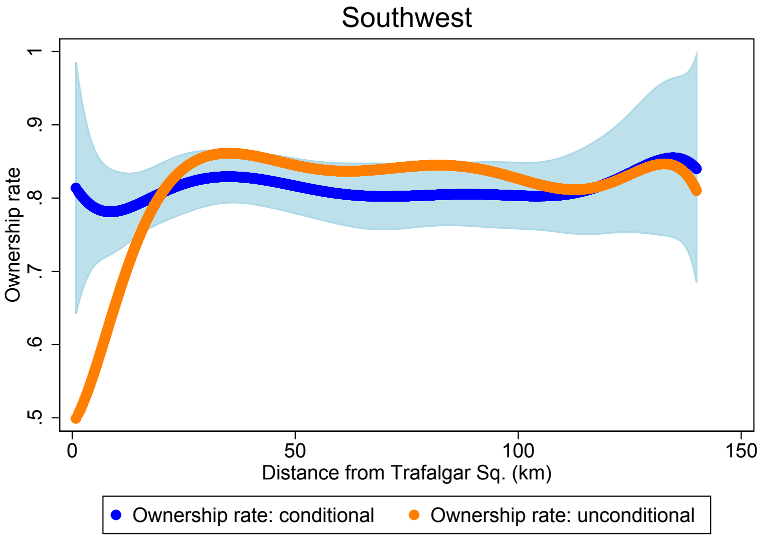
Rent and price vs. location

EHS 2011 *baseline house* ▸ More



Market share vs. location

EHS 2011 *baseline house* ▸ More



Unobserved quality by sector

- Recall the conjecture of $\dim(\varepsilon) \geq 2$:

$$\begin{aligned} \eta_r &= \lambda_1^r \varepsilon_1 + \lambda_2^r \varepsilon_2 \\ \eta_o &= \lambda_1^o \varepsilon_1 + \lambda_2^o \varepsilon_2 \end{aligned}$$

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- Properties with 1% higher “rental quality" (η_r) are 1% less likely to be in rental sector.
  - $corr(\eta_r, \eta_s) = \rho_r \approx -1$

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- Properties with 1% higher "rental quality" (η_r) are 1% less likely to be in rental sector.
  - $corr(\eta_r, \eta_s) = \rho_r \approx -1$
- Properties with higher "owner-occupied quality" (η_o) are equally likely to be in either sector.
  - $corr(\eta_o, \eta_s) = \rho_s \approx 0$

Unobserved quality by sector

One way to explain these results is as follows.

- Suppose there are two unobserved amenities:

1. ε_1 = A Jacuzzi
    - Increases flow utility from the property –> Increases rents
    - But also increases costs –> Reduces selection into the rental sector
    - Increased costs are capitalized into prices –> Prices in the owner-occupied sector remain constant.
2. ε_2 = A Beautiful View
    - No extra costs –> No affect on selection.
    - Increases flow utility –> increased rents and prices.

Implications

- We need at least two dimensions for unobserved quality ε to rationalized result.
- Evidence suggests that rental units have lower average unobserved "rental" quality.
- May explain why many models in housing literature require "warm glow" from ownership to explain the high rate of owner-occupancy.

Biased Estimates when Not accounting for Selection

- Selection on unobservables is statistically important. How important?
- It turns out to be qualitatively quite important.
- To illustrate this, we re-estimate our hedonic equations without first controlling for selection.
- A number of puzzles pop up if you looked through this mis-specified lens.

Homeownership and $\frac{\text{Rent}}{\text{Price}}$ *all else equal (?)*

- Consider the following hedonic regressions:

$$\begin{aligned} \ln R_i &= \alpha z_i + u_i \\ \ln P_i &= \beta z_i + u_i \end{aligned}$$

- Predict rent of owned properties, and price for rented ones, and get $\frac{\text{Rent}}{\text{Price}}$ for each.
- What's the correlation between market share of owned flats and this $\frac{\text{Rent}}{\text{Price}}$?

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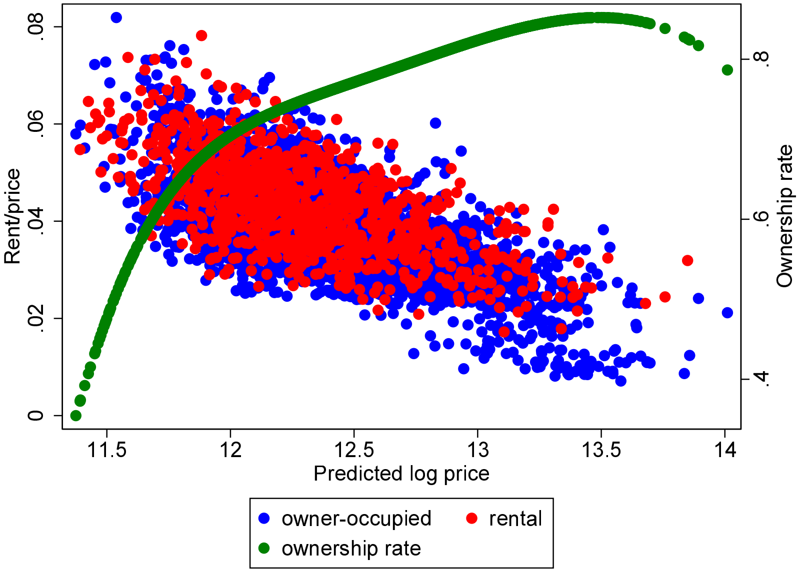
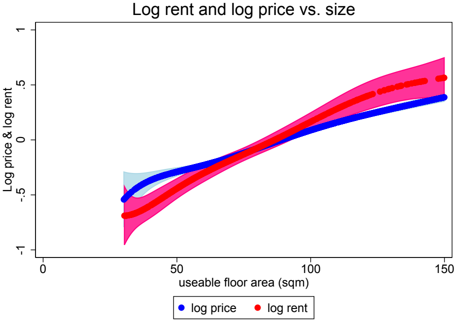
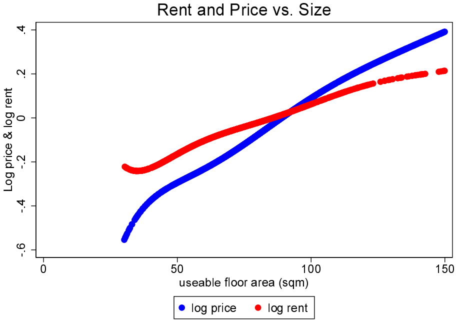
- As price increases, homeownership *increases* and $\frac{\text{Rent}}{\text{Price}}$ *decreases*.
- But why buy relatively expensive properties when (seemingly) equivalent rentals are much cheaper?

Homeownership and $\frac{\text{Rent}}{\text{Price}}$: all else *NOT* equal!



Bias in hedonic price functions: Slopes!

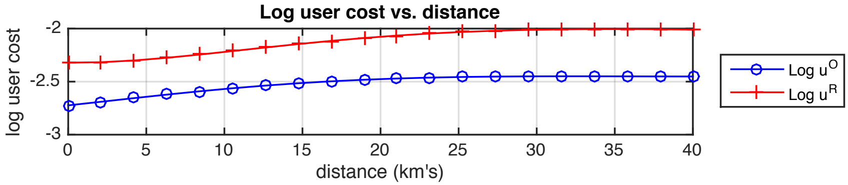


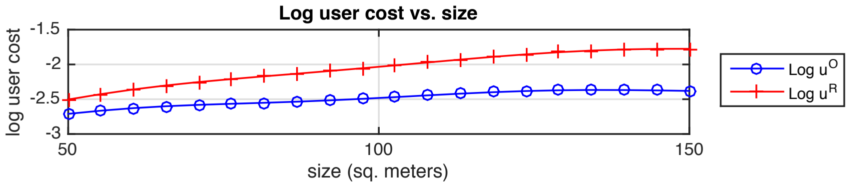


Estimating user costs

- We can use our estimates to back out how rental and own-occ user costs vary across properties.
  - We assume here that $R = u$, i.e. the service flow from the house is identical in both sectors.
- To do so we need to observe what the level of user costs are in the rental sector for at least one type of property.
- Fortunately, Bracke (2015) reports the r/p for a set of houses that are bought and then rented out.
- Then every parameter is exactly identified, except ω_{33}, which can be narrowed down to one of two values.

Empirical User Costs





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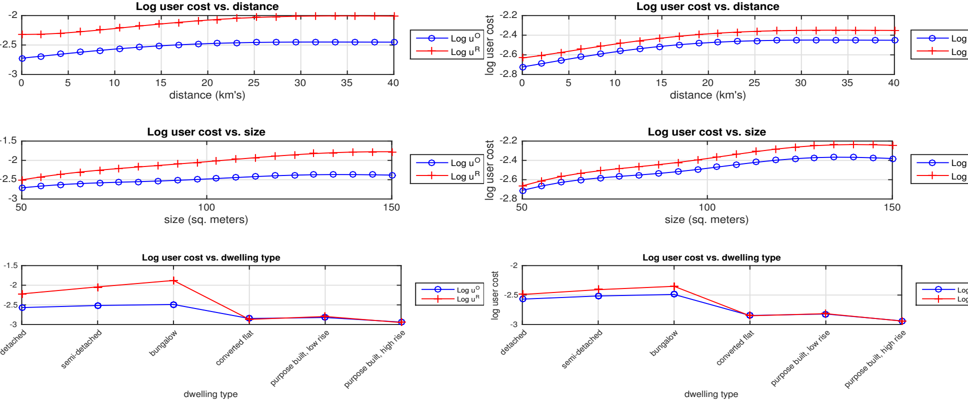


Contracting costs in rental sector: further assumptions

- Assume discount factors are equal across sectors:

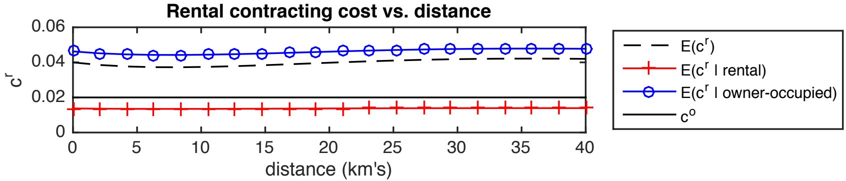
$$r^r(z, \varepsilon) = r^o(z, \varepsilon).$$

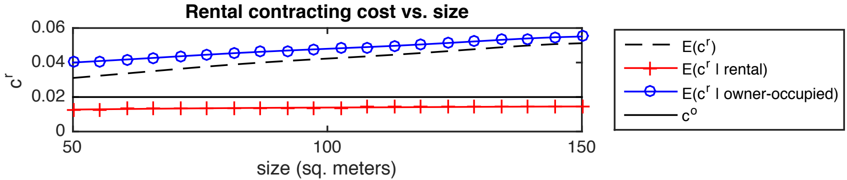
- Assume expected capital gains are equal across sectors:

$$g^r(z, \varepsilon) = g^o(z, \varepsilon).$$

- Then we can estimate magnitude of contracting frictions in rental sector.

Contracting costs in rental sector: how does c^r vary?





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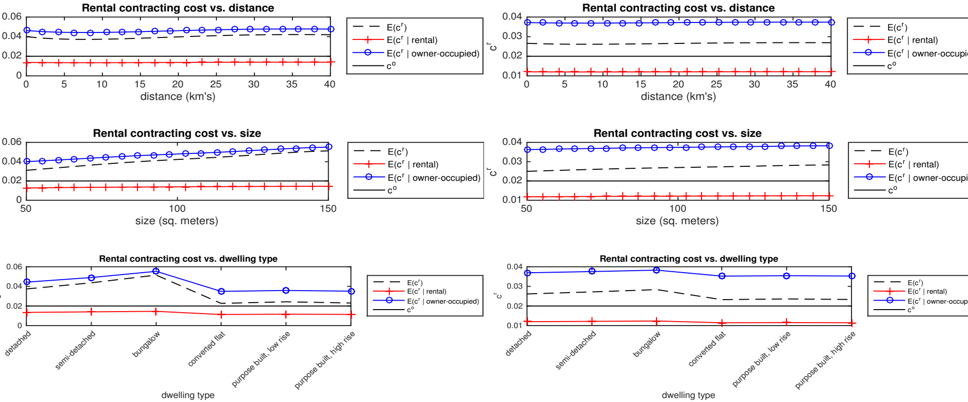

Final Point: What's next

- The decisions to buy/sell/save for a home are likely strongly connected to what type of house you want to live in.
- In particular, the tradeoff between location and physical characteristics.

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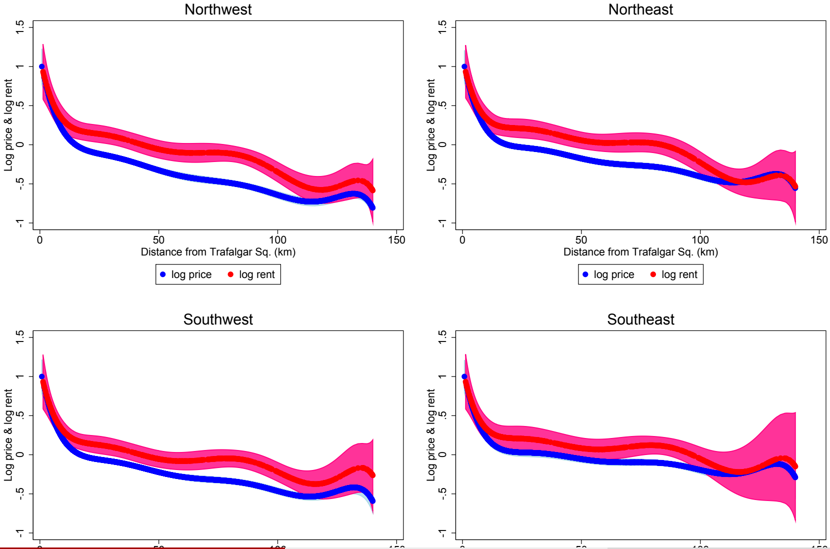
- The decisions to buy/sell/save for a home are likely strongly connected to what type of house you want to live in.
- In particular, the tradeoff between location and physical characteristics.
- Connects urban economics to macroeconomics through the financial decisions of households.

Rent and price (of the *baseline house*) vs. location

EHS 2011 ▸ back.



Market Share vs. location

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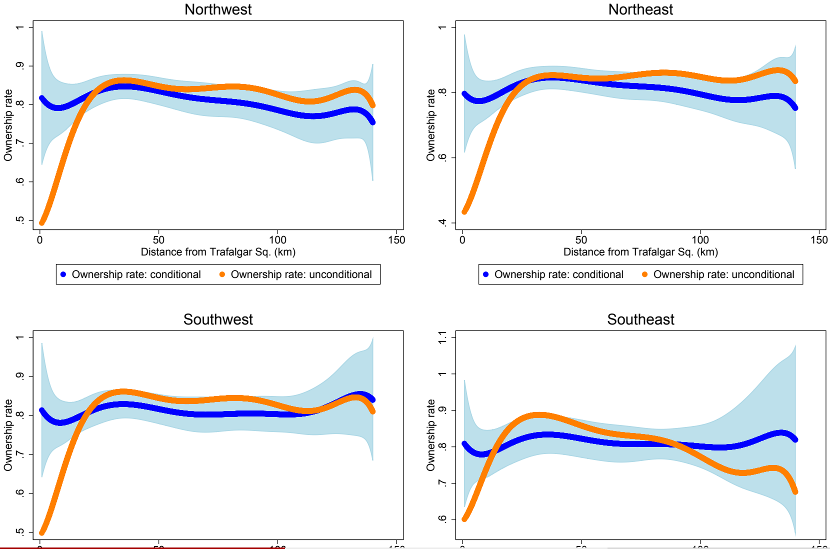

Maintainance Costs as a fraction of value

- Remember the user cost formulation

$$R(z) = (r + c(z) - g)\pi^r(z)$$

- Assume value is composed of land and structure value:

$$\pi^r(z) = VL(z) + VS(z)$$

- Also, total cost is

$$TC = c(z)\pi^r(z)$$

- Assume maintainance only for structural part: $c_0 VS(z)$
- Then

$$\begin{aligned} TC &= c_0 VS(z) \\ c(z)\pi^r(z) &= c_0 VS(z) \\ c(z) &= \frac{c_0 VS(z)}{VL(z) + VS(z)} \end{aligned}$$

back.