Urban Amenities

Urban Economics Association Summer School

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Special thanks to Jonathan Dingel, Jessie Handbury, and Hans Koster for their help and suggestions!

Introduction

What are urban amenities?

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- Person-specific: Social networks

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→ Mapping from demographics into location characteristics

Let's start diving into this amenity journey!

Amenities as a residual

Rosen-Roback model and Spatial Equilibrium

Rosen (1979) - Roback (1982): Workers/consumers are fully mobile, utility of location j described by

$$U_j = A_j + \alpha_w w_j - \alpha_r r_j$$

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Hence:

$$A_j = \bar{U} - \alpha_w w_j + \alpha_r r_j$$

$\implies$ Amenities A_j can be backed out as a residual

Implications of Spatial Equilibrium

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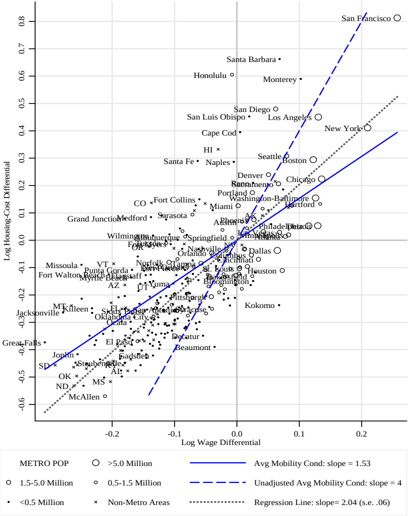
Motivates hedonic price regressions:

$$r_j = \frac{1}{\alpha_r}(A_j + \alpha_w w_h - \bar{U})$$

Albouy (2012) "Are Big Cities Bad Places to Live?"

Figure 1: Housing Costs versus Wage Levels across Metro Areas, 2000



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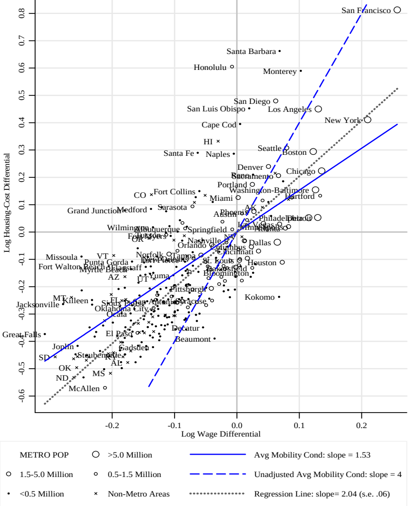

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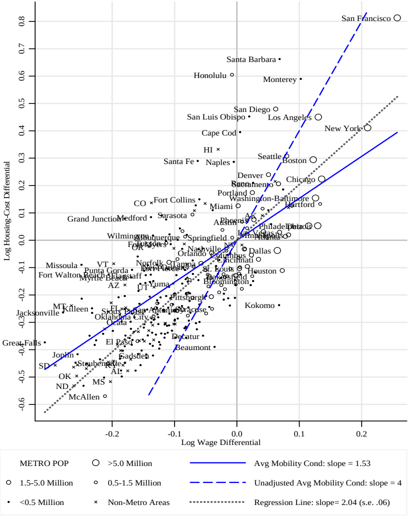

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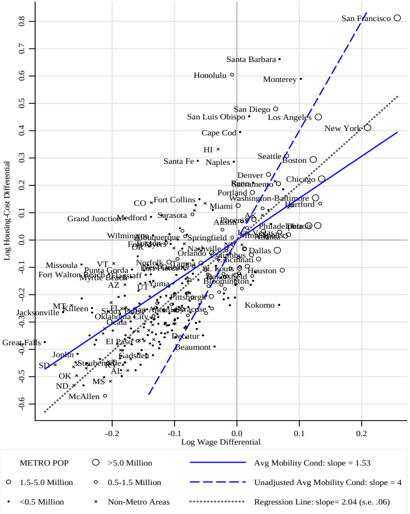

- Santa Barbara: weather, outdoors...
- New York: restaurants, museums, nightlife...
- Chicago: 8 months of winter?

Drawbacks of Spatial Equilibrium

Some implications at odds with reality:

- Labor supply perfectly elastic $\implies$ workers immediately and fully adjust to shocks
- If land is finite $\implies$ local shocks fully capitalized in rents
- Utility equalized across space $\implies$ no notion of welfare or spatial inequality

Introducing mobility frictions

Moretti (2011): introduce mobility frictions as idiosyncratic shocks

$$U_j^i = A_j + \alpha_w w_j - \alpha_r r_j + \epsilon_j^i,$$

with $\epsilon^i \sim G_\epsilon$

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$$\mathbb{P}_j^i = \mathbb{P}(A_j + \alpha_w w_j - \alpha_r r_j + \epsilon_j^i \geq \max_{j'} A_{j'} + \alpha_w w_{j'} - \alpha_r r_{j'} + \epsilon_{j'}^i)$$

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Links two approaches:

- **Spatial equilibrium:** Rosen (1979), Roback (1982), Glaeser (2008)...
- **Discrete choice model of products with heterogenous agents:** McFadden (1974), Berry, Levinsohn, and Pakes (1995)...

Endogenous location characteristics

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Some examples:

- Demographic composition
- Property taxes, local tax revenue collection
- School peers
- Public goods
- Consumption amenities

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Why are endogenous location characteristics worth studying?

- Understand how amenities are formed
- Generates feedback loops potentially amplifying shocks
- Important consequences on spatial inequality

Taking models to the data

Assume that

$$U_j^i = A_j - \alpha_r r_j + \xi_j + \epsilon_j^i,$$

where

$$A_j = f(D_j(p, A, \xi)).$$

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If $\epsilon_j^i \sim$ Type I EV, then:

$$\log \mathbb{P}_j - \log \mathbb{P}_0 = A_j - \alpha_r r_j + \xi_j,$$

where we have normalized $U_0 = 0$ with $j = 0$ represents living outside the country, city...

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We can estimate f and α_r using the previous equation!

The reflection problem

Two endogeneity issues due to simultaneity:

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Several solutions:

1. Assume that conditional on enough things there is no more ξ_j
2. Instrumental variables: housing supply shifters
3. Calibration

Examples of papers with endogenous amenities

Bayer, Ferreira and McMillan (2007): racial shares of neighborhoods

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Almagro and Dominguez-Iino (202?): local consumption amenities are the equilibrium outcome of a market for services

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Key paper connecting discrete choice IO literature and sorting equilibrium

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Utility function:

$$U_j^i = \alpha_x^i x_j - \alpha_r^i r_j + \alpha_d^i d_j + \epsilon_j^i,$$

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Observe:

$$\text{share black}_j = \frac{\sum_i \mathbb{1}\{race(i) = black\} \cdot \mathbb{1}\{j^*(i) = j\}}{H_j}$$

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Reflection problem solved:

- Price instruments are exogenous characteristics of other neighborhoods (BFM/BLP instruments)
- Include boundary fixed effects and assume demographics continuous at the border

Unpacking the black-box of amenities: Almagro and Domínguez-Iino (202?)

Motivation

Preference heterogeneity over amenities: different amenities cater to different groups

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Model the supply of amenities with differential entry responses

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Example: Bars and Young professionals vs. Private day care and Families

Research design

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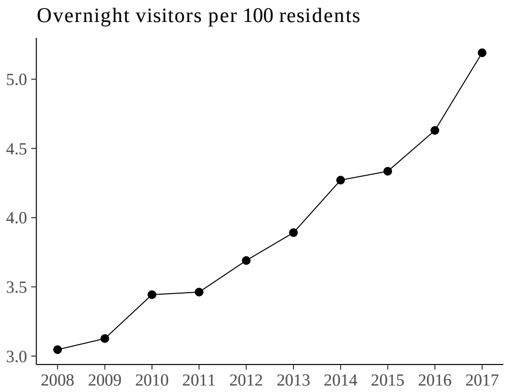
- Structural estimation using Dutch micro-data + establishments + tourism and short-term rentals
    - Tourism flows into Amsterdam as quasi-experimental variation in demographic composition
- Counterfactuals:
    - Welfare implications of the “tourism shock”
    - Role of endogenous consumption amenities in transmitting the shock
    - Evaluate taxes on tourism

Outline

Fact 1: Tourism in Amsterdam is dramatically increasing

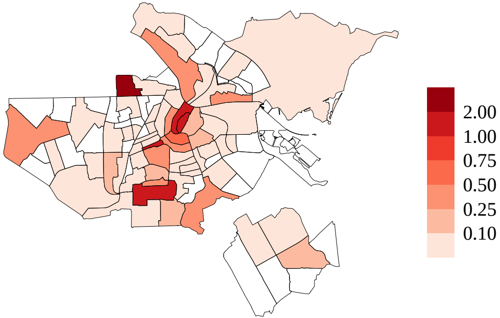
Figure 1: Nightly visitors per 100 residents



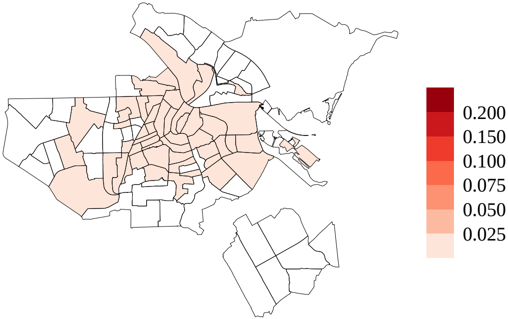
Why Amsterdam?

Fact 2: Tourists are expanding all over Amsterdam

Hotel beds per local resident (2011)



Commercial listing share of rental stock (2011)



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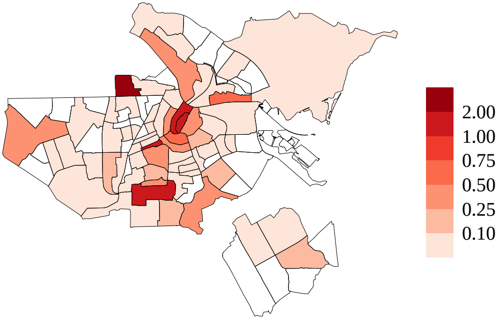

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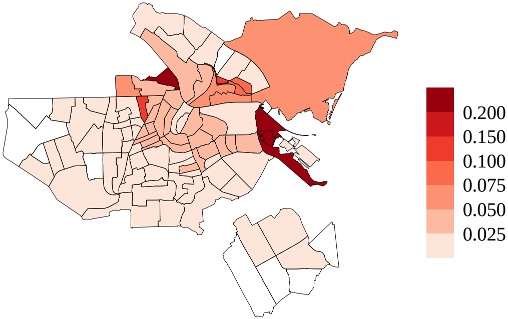

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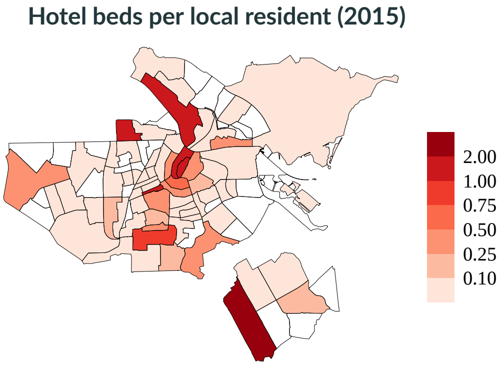

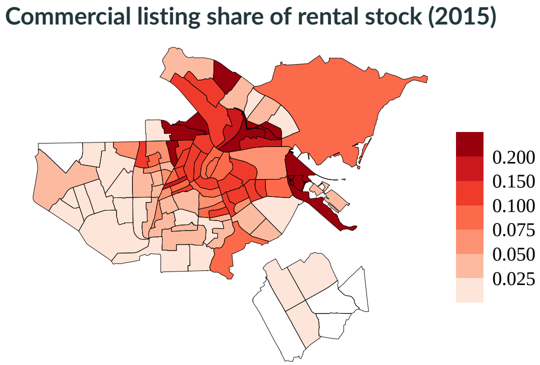

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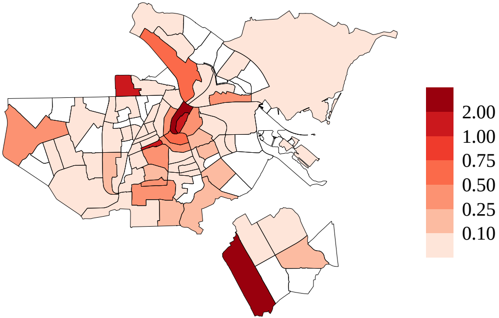
Hotel beds per local resident (2017)



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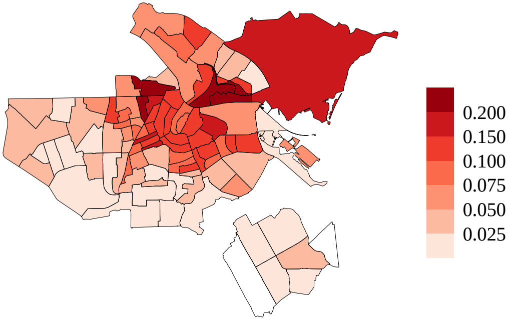
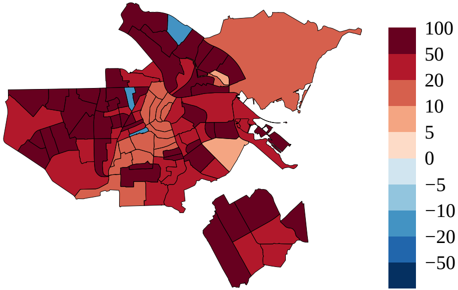


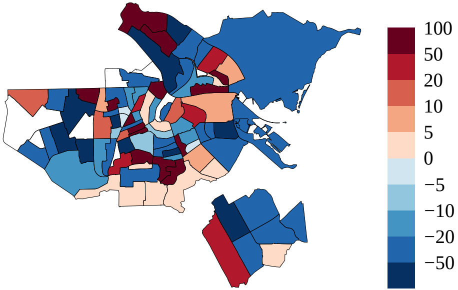
Fact 3: Amenities are tilting towards tourists

%Δ touristic amenities (2011−2017)



Note: Total growth for 2011-2017

%Δ nurseries (2011−2017)



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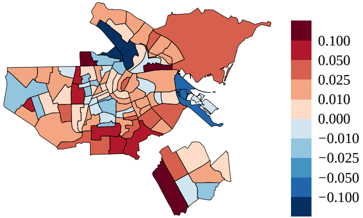
Fact 4: Differences in location choices across demographic groups

Differences by age:

Δ young population share



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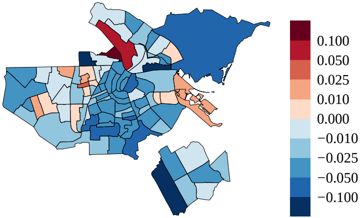
Δ middle−aged population share



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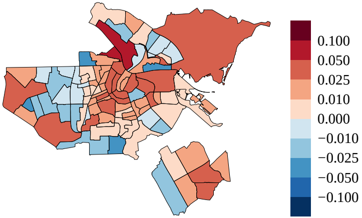

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Other demographics

Fact 5: Commercial Airbnb listings have a significant impact on rent

	Ln (rent/m2)					
	OLS	IV	OLS	IV	OLS	IV
Ln (commercial Airbnb listings)	**0.066*****	**0.090*****	**0.052*****	**0.114*****	**0.115*****	**0.190****
	(0.008)	(0.020)	(0.006)	(0.021)	(0.018)	(0.086)
Ln (housing stock)			-0.056**	-0.095***	-0.111***	-0.163***
			(0.027)	(0.028)	(0.028)	(0.060)
Ln (average income)			-0.492***	-0.490***	-0.353***	-0.313***
			(0.075)	(0.071)	(0.072)	(0.084)
Ln (high-skill population share)			0.330***	0.213***	-0.014	-0.143
			(0.053)	(0.061)	(0.100)	(0.186)
District-year FE					X	X
First stage F-stat		617.51		397.57		86.21
Observations	780	780	773	773	773	773
R2	0.154	0.133	0.422	0.330	0.579	0.546

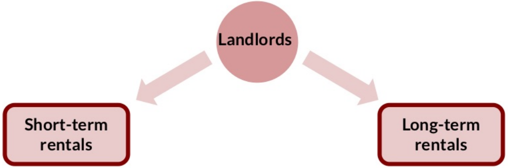
Notes: Standard errors clustered at the neighborhood level in parenthesis.

Instrument: Worldwide Airbnb Popularity$_t$ $\times$ Number of Historic Monuments$_j$

IV Rent Imputation

Outline

Model + data



Airbnb supply Microdata details

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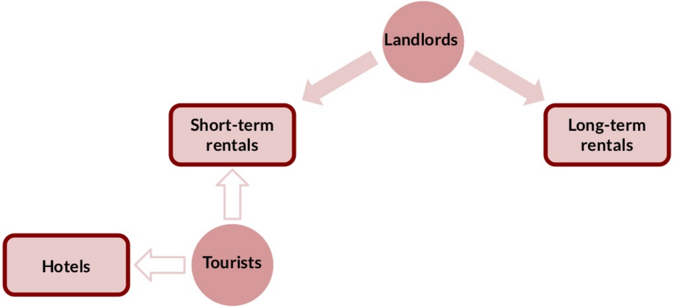

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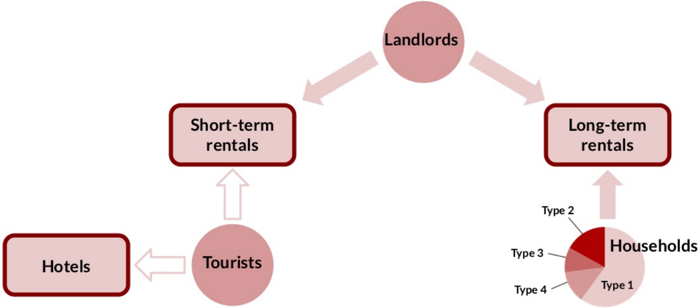

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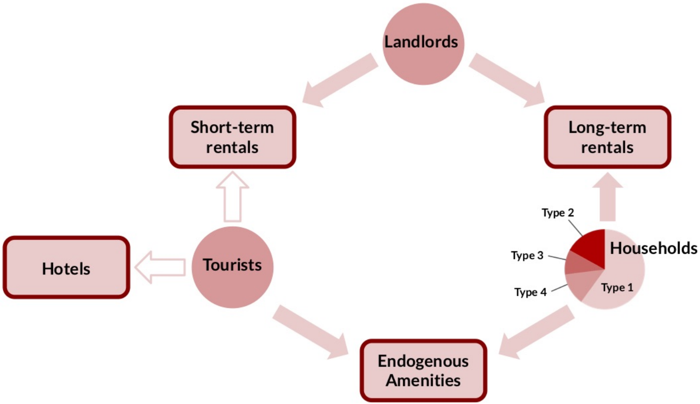
Model + data



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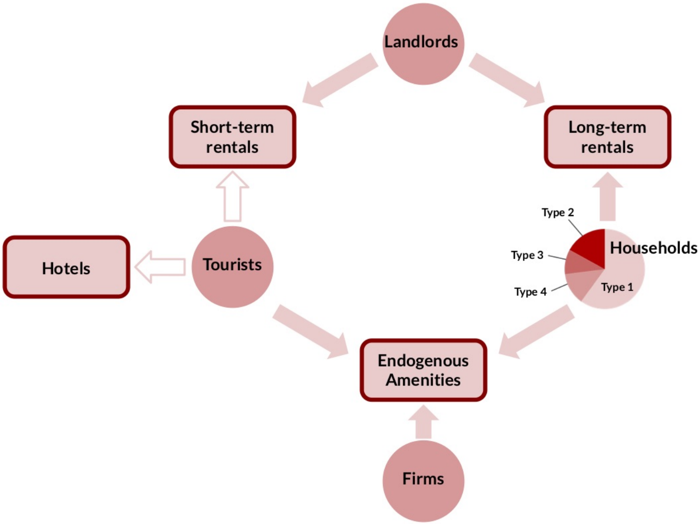

Airbnb supply
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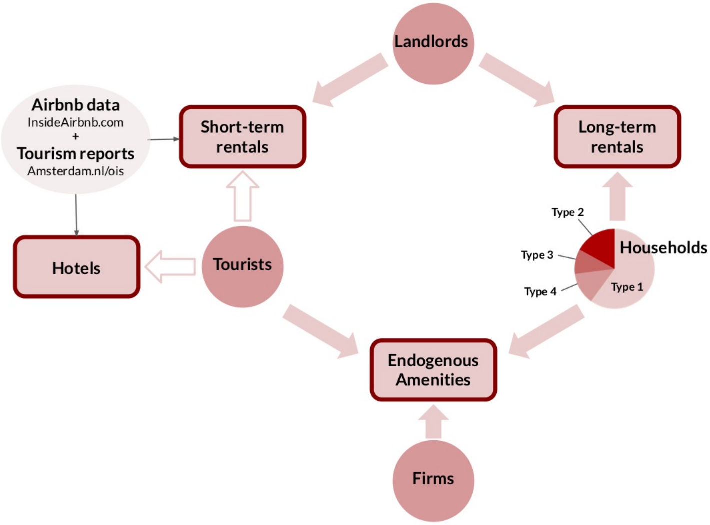
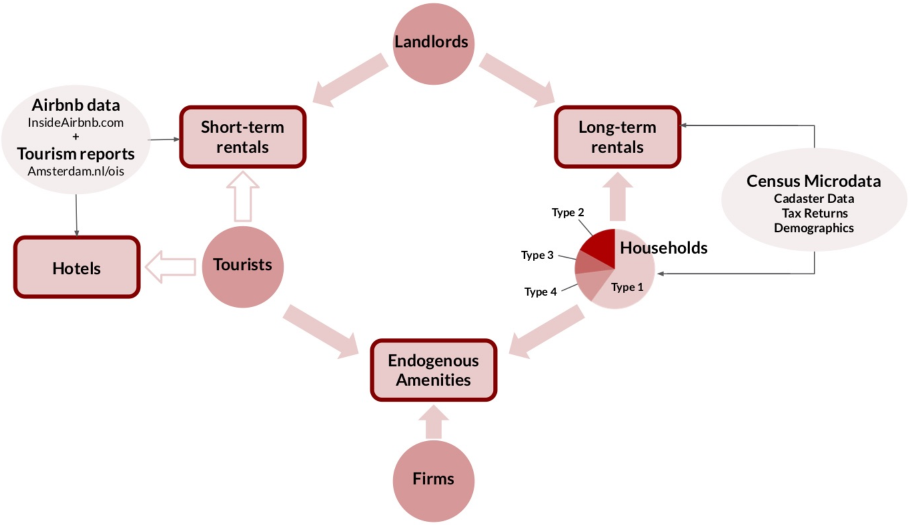


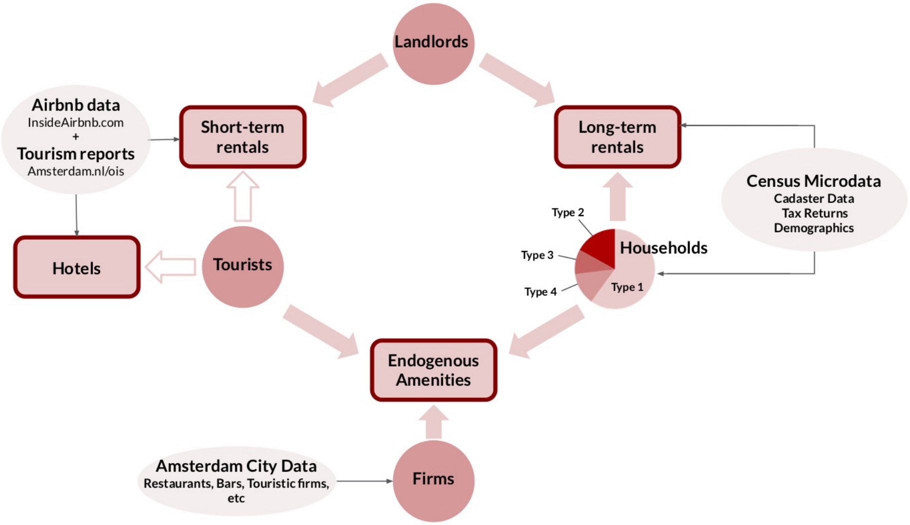
Airbnb supply | Microdata details

Model + data



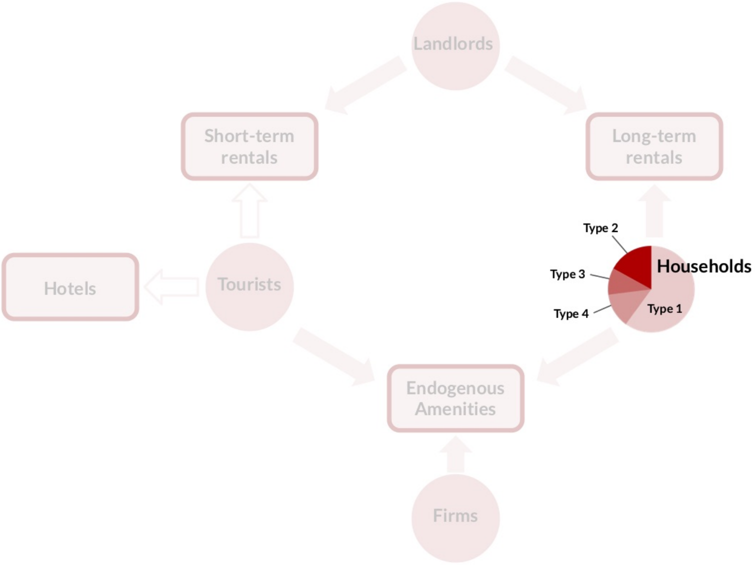
Airbnb supply | Microdata details

Model + data



Airbnb supply Microdata details

Defining heterogeneous households



Classifying households via k-means

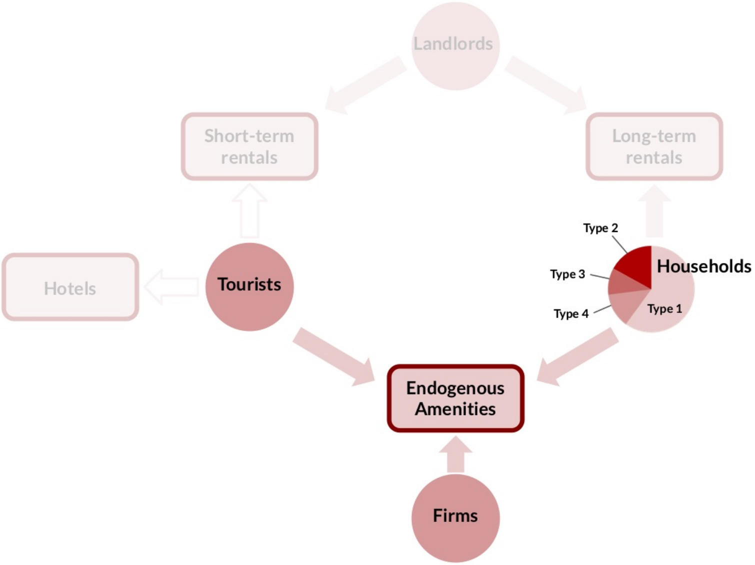
- We are interested in distributional effects
  $\implies$ define household 'types'
- Large number of demographics
  $\implies$ country of origin, skill, income, housing tenancy, household composition
  $\implies$ correlation: high income households tend to be high skill
- Classifying using arbitrary groups may lead to groups with few observations:
  $\implies$ high income with low education
  $\implies$ small groups lead to noisy estimates

Our approach: k-means exploits pre-existing correlations and avoids non-representative groups
$\implies$ minimize the number of groups while maximizing separation across groups

Clustering results from k-means algorithm

	Homeowners		Renters		Social Housing Tenants	
Group	Older Families	Singles	Younger Families	Students	Immigrant Families	Dutch Low Income
Age	44.59	37.84	40.56	28.42	55.12	38.52
Share Children	0.93	0.12	0.65	0.13	0.53	0.43
Share Low-Skilled	3.20%	2.42%	6.09%	5.40%	99.91%	0.02%
Share Medium-Skilled	3.01%	5.87%	2.28%	11.33%	0.09%	16.95%
Share High-Skilled	93.79%	91.71%	91.65%	83.27%	0.00%	83.02
Share Dutch Indies	6.92%	6.59%	4.12%	4.07%	13.22%	12.41%
Share Dutch	64.41%	58.74%	53.13%	61.44%	24.86%	49.36%
Share Non-Western	18.76%	21.43%	21.64%	19.48%	57.96%	30.37%
Share Western	9.91%	13.23%	21.12%	15.01%	3.96%	7.87%
Household Income (€)	62,031.39	30,611.41	47,441.08	16,821.48	21,243.24	27,714.85
Income Pctl.	77.04	45.49	64.64	23.23	33.41	42.17
Number of Households	106,388	78,561	105,712	124,112	83,117	174,203

Modelling endogenous amenities



Demand for amenities

Type k residents have income w^k and pay r for one unit of housing

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Consumption of amenities from residential location (Davis et al. (2019), Miyauchi et al. (2020))

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Consumption of amenities from residential location (Davis et al. (2019), Miyauchi et al. (2020))

Firms i supply differentiated products across different sectors s (bars, food stores, etc.),

A consumer of type k with income w^k maximizes utility choosing q_{si}:

$$\max_{\{q_{is}\}_{is}} \prod_s \left(\left(\sum_{i=1}^{N_s} q_{is}^{\frac{\sigma_s - 1}{\sigma_s}} \right)^{\frac{\sigma_s}{1-\sigma_s}} \right)^{\alpha_s^k} \quad \text{s.t.} \quad \sum_{i,s} p_{is} q_{is} = (1 - \alpha_h^k) w^k$$

- CES preferences across firms i: within a sector s there is equal substitution across firms
- Cobb-Douglas preferences across sectors s: different substitution across sectors

Supply of amenities

Within a sector s, a location j, and a time period t: Monopolistic competition with free entry

Firms have identical MC $\implies$ identical pricing decisions

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$$\alpha_{ks}(1-\alpha_h^k)w_t^k$$

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Given identical prices, consumers splits expenditure equally across N_{sjt} firms

$$\frac{\alpha_{ks}(1-\alpha_h^k)w_t^k}{N_{sjt}}$$

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$$\frac{\alpha_{ks}(1-\alpha_h^k)w_t^k}{N_{sjt}}$$

Denote M_{jt}^k number of type k residents. Selling profits of each firm are

$$\frac{1}{\sigma_s}\sum_k \frac{\alpha_{ks}(1-\alpha_h^k)w_t^k}{N_{sjt}} M_{jt}^k$$

Under free-entry condition profits are equal to operational cost F_{sjt}:

$$\frac{1}{\sigma_s N_{sjt}}\sum_k \alpha_{ks}(1-\alpha_h^k)w_t^k M_{jt}^k = F_{sjt}$$

Supply of amenities: Estimation

Assume unobservable cost has following functional form

$$F_{sjt} = \Lambda_j \Lambda_t N_{jt}^{\gamma}$$

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Take following equation directly to the data

$$\log N_{sjt} = \lambda_j + \lambda_t + \gamma \log N_{jt} + \log\left(\sum_k \alpha_{ks}(1 - \alpha_h^k) w_t^k M_{jt}^k\right) + \xi_{sjt},$$

where ξ_{sjt} is unexplained variation from entry cost.

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where ξ_{sjt} is unexplained variation from entry cost.

M_{jt}^k endogenous object. Address this concern by constructing demand shifters:

- Housing stock available across household types: owner-occupied, rental, social housing
- Number of hotel beds for tourists
- Interact each group's available housing stock with income group w_t^k

Amenity supply: constrained GMM results

$$\log N_{sjt} = \lambda_j + \lambda_t + \gamma \log N_{jt} + \log \Big(\sum_k \alpha_{ks} (1 - \alpha_h^k) w_t^k M_{jt}^k \Big) + \xi_{sjt}$$

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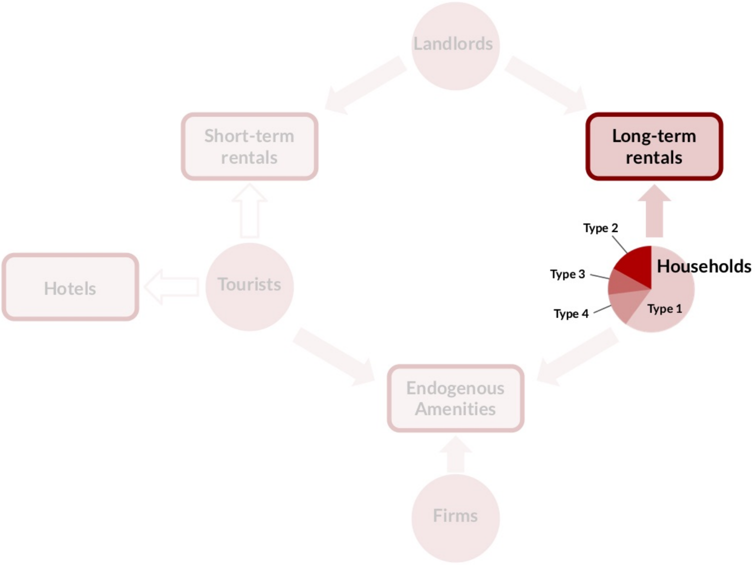
Group	Touristic Amenities	Restaurants	Café Bars	Food Stores	Non-Food Stores	Nurseries
Older families	59.944	0.0	0.0	0.0	2.271	415.243***
	[0.0,218.18]	[0.0,16.297]	[0.0,0.0]	[0.0,11.998]	[0.0,25.707]	[186.264,837.487]
Singles	364.062	59.441	0.0	52.182	0.0	0.0
	[0.0,833.441]	[0.0,148.899]	[0.0,0.0]	[0.0,167.529]	[0.0,43.415]	[0.0,0.0]
Younger families	0.0	0.0	3.543	29.255**	107.138***	387.489*
	[0.0,0.0]	[0.0,13.121]	[0.0,21.808]	[0.729,58.678]	[50.957,158.689]	[0.0,672.534]
Students	488.828*	199.533***	21.44	54.437	0.0	0.0
	[0.0,1072.092]	[76.883,288.674]	[0.0,40.371]	[0.0,129.194]	[0.0,0.0]	[0.0,729.872]
Immigrant Families	0.0	0.0	7.33***	38.676	43.796*	153.907
	[0.0,0.0]	[0.0,9.443]	[0.942,29.473]	[0.0,76.667]	[0.0,147.762]	[0.0,663.999]
Dutch Low-Income	0.0	0.0	0.0	0.0	0.0	0.0
	[0.0,137.308]	[0.0,22.976]	[0.0,0.0]	[0.0,36.584]	[0.0,0.0]	[0.0,0.0]
Tourists	435.917***	200.103***	113.284***	71.219***	368.742***	0.0
	[328.271,582.922]	[163.424,240.117]	[76.9,130.32]	[42.979,93.96]	[276.691,430.773]	[0.0,0.0]

Housing demand



Housing demand: Residential choice

At the beginning of period t, a household i of type k chooses

$$d_{it} = \begin{cases} j & \text{if moves into location } j \in \{0, 1, \dots, J\}, \\ s & \text{if stays in the same house in location } j_{it-1}, \end{cases}$$

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Whenever households move to a new house they incur moving costs

$$\text{MC}^k(d, x_{it}) = \begin{cases} \text{MC}_0^k + \text{MC}_1^k \text{dist}(j(d), j_{it-1}) & \text{if household moves} \\ 0 & \text{if household stays.} \end{cases}$$

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Household i's indirect utility flow from decision d is

$$u_t^k(d, x_{it}) = \delta_t^k + \delta_{j(d)}^k + \delta_\tau^k \tau_{it} - \delta_r^k \log r_{j(d)t} + \delta_a^k \log a_{j(d)t} - \mathrm{MC}^k(d, x_{it}) + \xi_{jt}$$

Dynamic discrete choice estimation

The dynamic programming problem is

$$V_t^k(x_{it}, \epsilon_{it}) = \max_d \; u_t^k(d, x_{it}) + \epsilon_{itd} \\ + \beta \mathbb{E}_t \Big[V_{t+1}^k(d, x_{it+1}, \epsilon_{it+1}) \big| d, x_{it}, \epsilon_{it} \Big]$$

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Several identification issues:

- Continuation values are unobservable and are a function of prices and amenities (r, a)
- Simultaneity bias for prices and amenities (r, a) due to unobservable demand shocks ξ

$$u_t^k(d, x_{it}) = \delta_t^k + \delta_{j(d)}^k + \delta_\tau^k \tau_{it} - \delta_r^k \log r_{j(d)t} + \delta_a^k \log a_{j(d)t} - \mathrm{MC}^k(d, x_{it}) + \xi_{jt}$$

Identification: Euler Equations in Conditional Choice Probability (ECCP)

For any two agents of same type k, moving to a new location $\tilde{d}$ is a renewal action:
$\implies$ Their future look the same and can cancel out continuation values

With a bit of algebra and some assumptions we get to the ECCP estimator

$$\ln\left(\frac{\mathbb{P}_t(d, x_t)}{\mathbb{P}_t(d', x_t)} \frac{\mathbb{P}_{t+1}(\tilde{d}, x_{t+1})^{\beta}}{\mathbb{P}_{t+1}(\tilde{d}, x'_{t+1})^{\beta}}\right) = u_t(d, x_t) - u_t(d', x_t) + \beta\big(u_{t+1}(\tilde{d}, x_{t+1}) - u_{t+1}(\tilde{d}, x'_{t+1})\big) + \eta_t(d, d', x_t)$$

Intuition:

- After renewal action $\tilde{d}$, same future flows after $t+2$
- Relative likelihood of d over d' only depends on differences in utility flows along those paths

$$\begin{tikzcd}
 & x_{t+1} \arrow[dr, "\tilde{d}"] & \\
x_t \arrow[ur, "d"] \arrow[dr, "d'"'] & & x_{t+2} \\
 & x'_{t+1} \arrow[ur, "\tilde{d}"'] &
\end{tikzcd}$$

Identification: Instrumental variables

Recall Euler Equation:

$$\ln\left(\frac{\mathbb{P}_t(d,x_t)}{\mathbb{P}_t(d',x_t)}\frac{\mathbb{P}_{t+1}(\tilde{d},x_{t+1})^\beta}{\mathbb{P}_{t+1}(\tilde{d},x'_{t+1})^\beta}\right) = u_t(d,x_t) - u_t(d',x_t) + \beta\Big(u_{t+1}(\tilde{d},x_{t+1}) - u_{t+1}(\tilde{d},x'_{t+1})\Big) + \eta_t(d,d',x_t)$$

and utility flows

$$u_t^k(d,x_{it}) = \delta_t^k + \delta_{j(d)}^k + \delta_\tau^k \tau_{it} - \delta_r^k \log r_{j(d)t} + \delta_a^k \log a_{j(d)t} - \mathrm{MC}^k(d,x_{it}) + \xi_{jt}$$

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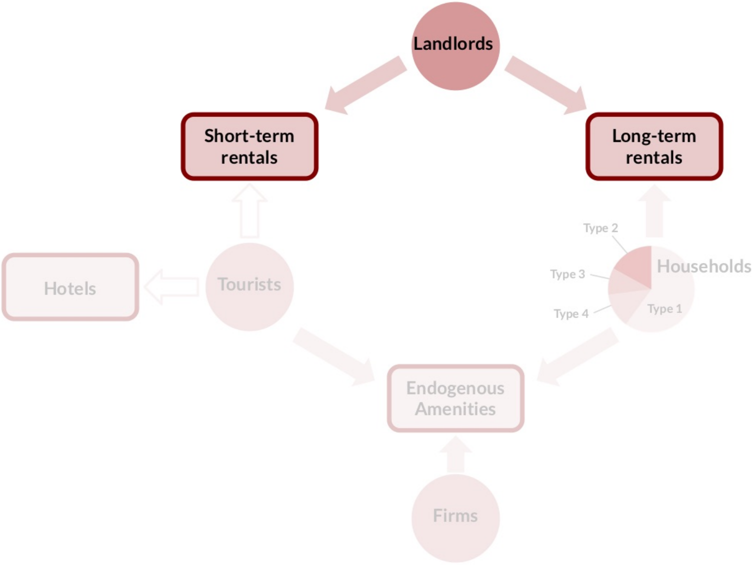
Identification of endogenous variables:

- Three supply shifters motivated by policy
- Demolition of housing stock
- Three BFM/BLP instruments

Preference estimates: IV results

	Older Families	Singles	Younger Families
Log Rent	-11.769***	-2.523**	-2.340**
	(1.201)	(0.987)	(1.045)
Log Tourism Offices	-1.193***	-0.449***	0.299**
	(0.169)	(0.143)	(0.144)
Log Restaurants	0.281	0.729***	-0.195
	(0.284)	(0.251)	(0.242)
Log Café Bars	-0.822***	-0.547***	-0.081
	(0.092)	(0.079)	(0.082)
Log Food Stores	-2.000***	-1.314***	-0.600**
	(0.324)	(0.280)	(0.289)
Log Nonfood Stores	0.700**	1.626***	1.429***
	(0.341)	(0.299)	(0.296)
Log Nurseries	1.763***	0.076	0.316**
	(0.172)	(0.141)	(0.148)
Location FE	✓	✓	✓
Time FE	✓	✓	✓
Neighborhood Controls	✓	✓	✓

Housing supply



Housing supply: Regression equation

Absentee landlords. Total supply of rental units in location j is $\mathcal{H}_j = \mathcal{H}_j^L + \mathcal{H}_j^S$.

If landlords have i.i.d. type I EV idiosyncratic shocks and solve:

$$\max_{h \in \{L,S\}} \left\{ \alpha r_{jt} + \epsilon_L, \quad \alpha p_{jt} - c_{jt} + \epsilon_S \right\}$$

Use logit inversion

$$\ln s_{jt}^L - \ln s_{jt}^S = \alpha(r_{jt} - p_{jt}) + \underbrace{\lambda_j + \lambda_t + \nu_{jt}}_{c_{jt}},$$

where ν_{jt} are unobservables in the cost c_{jt}.

Instrument for price gap $(r_{jt} - p_{jt})$ using demand shifter:

- Proxy of worldwide Airbnb popularity P_t **x** Touristic establishments pre-Airbnb entry T_j^{2008}

Airbnb prices

Housing supply: Estimation results

Long-term (LT) relative to short-term (ST) housing supply elasticities

	Dependent variable: ln (LT share) - ln (ST share)							
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
LT price - ST price	**0.144****	**0.354******	**0.140****	**0.360******	**0.096**	**0.341******	**0.020**	**0.241**
	(0.081)	(0.104)	(0.083)	(0.112)	(0.084)	(0.089)	(0.106)	(0.495)
Year FE			X	X			X	X
Wijk FE					X	X	X	X
First stage F-stat		69.22		23.94		14.72		15.82
Observations	271	271	271	271	271	271	271	271

Outline

Equilibrium definition

A *stationary equilibrium* is,

1. a vector of prices $\mathbf{r} = (r_1, \ldots, r_J)$ and a matrix of amenities $\mathbf{a} = [a_1, \ldots, a_J]$,
2. policy functions $h(r_j; c_j, p_j, \epsilon_l)$ for landlords, $d^k(j_i, \tau_i, \mathbf{r}, \mathbf{a}; \epsilon_i)$ for each type k household
3. a stationary distribution of types over locations and tenure, $\pi^k(\mathbf{r}, \mathbf{a})$

such that,

1. each landlord and each household supply and demand housing optimally, respectively
2. prices $\mathbf{r}$ clear the long-term housing market in each location j,

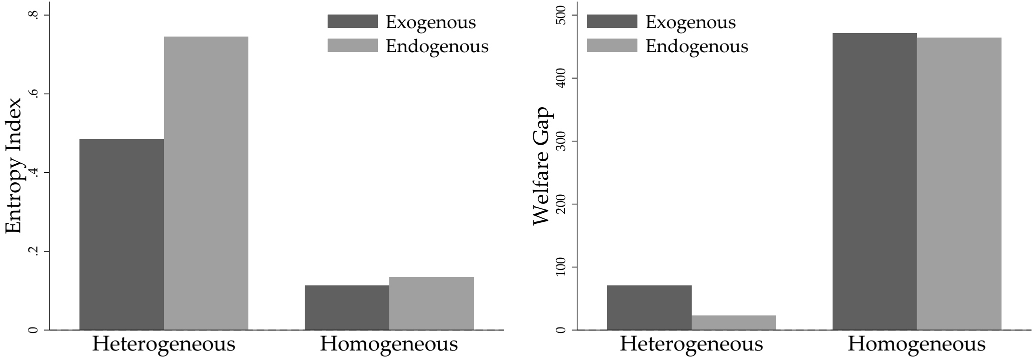
$$\mathcal{H}_j^L(r_j; c_j, p_j) = \mathcal{D}_j^L(\mathbf{r}, \mathbf{a})$$

3. the demand of amenities a_j is equal to the supply of amenities $\mathcal{A}_j$ in each location

$$a_j = \mathcal{A}_j = \mathcal{A}(M_j^1, ..., M_j^K, M_j^T).$$

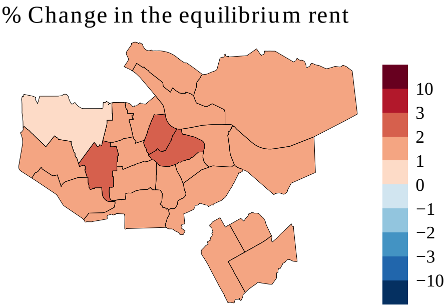
Endogenous amenities and preference heterogeneity

Figure 2: Residential sorting and welfare inequality

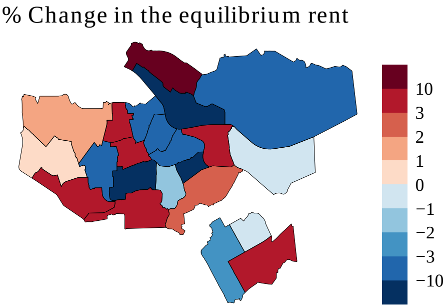


Short-term rental entry: Changes in rents

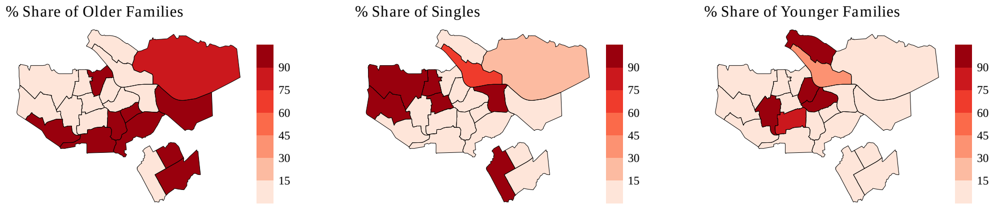
Exogenous amenities



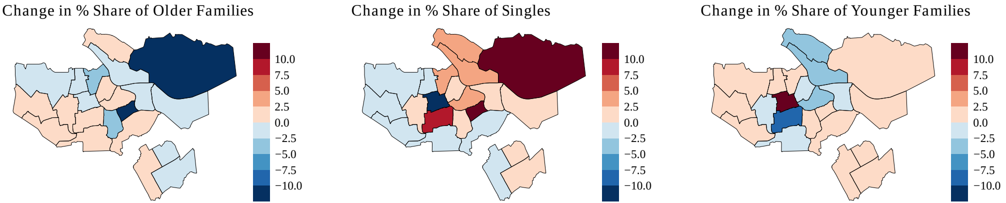
Endogenous amenities



Short-term rental entry: Changes in residents



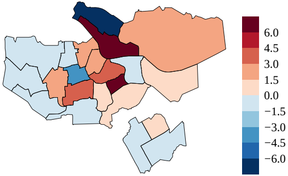
(a) Baseline population distribution with endogenous amenities



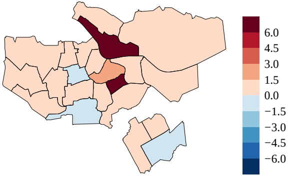
(b) Change in population distribution after short-term rental entry

Short-term rental entry: Changes in amenities

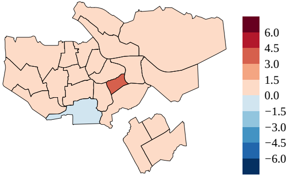
Change in % Share of Touristic Amenities



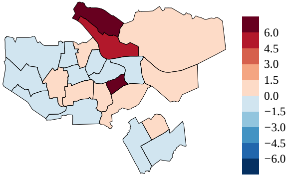
Change in % Share of Restaurants



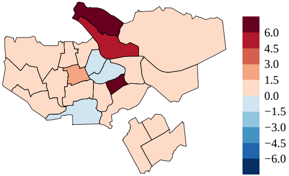
Change in % Share of Bars



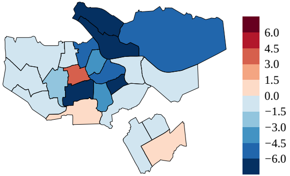
Change in % Share of Food Stores



Change in the % Share of Non−food Stores

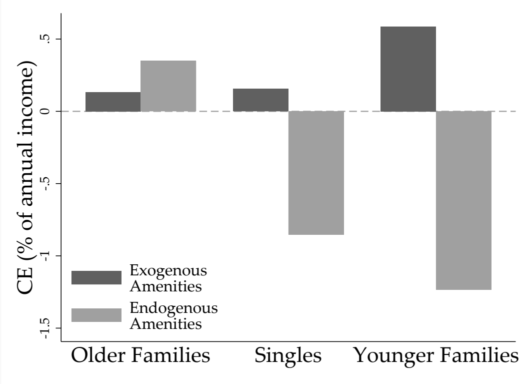


Change in % Share of Nurseries



Short-term rental entry: Welfare decomposition

Welfare effects on residents



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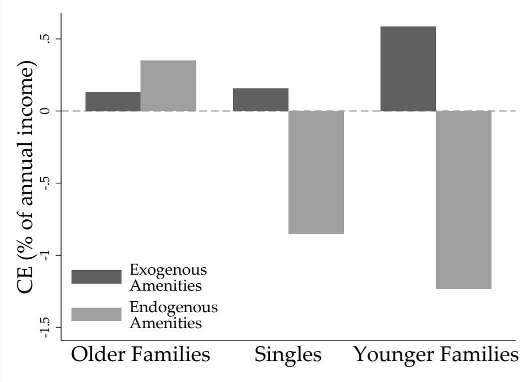
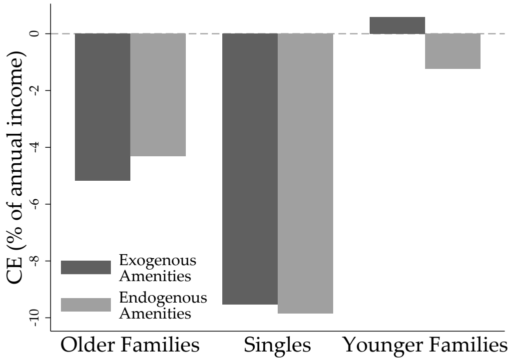


Homeownership-adjusted welfare effects



Final discussion

Data Sources

Location choices across space

- PSID: Kennan and Walker (2011)...
- CoreLogic: Bayer, Ferreira and McMillan (2007)...
- Census: Diamond (2016)...

Local prices and retail

- Nielsen: Handbury & Weinstein, Handbury (2021), Diamond & Moretti (2022), Hoelzlein (2020)...
- NETS: Couture & Handbury (2021) and Hoelzlein (2020)....
- Yelp/Google: Couture (2016), Davis, Dingel, Monras, & Morales (2019)

Commuting surveys:

- Alhfeldt, Redding, Sturm, & Wolf (2017)...

Newer Data Sources

Infutor:

- Diamond, McQuade, and Qian (2019)...

Credit card:

- Relihan (2022), Allen, Fuchs, Ganapati, Graziano, Madera, & Montoriol (2023), Diamond and Moretti (2023)...

Census microdata:

- Almagro and Domínguez-Iino (202?)...

Mobile phone location records:

- Miyauchi, Nakajima, and Redding (2022)...

Plenty of unanswered questions (totally subjective!)

Retail/consumption amenities:

- Vertical differentiation: quality
- Supply side: entry, competition
- Spillovers across types of retails: agglomeration forces, complementarities

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The role of the government and politics

- Public good provision
- Political economy of housing regulation

Thanks and have fun!