

Urban Amenities

Urban Economics Association Summer School

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Introduction

Amenities as a residual

Endogenous location characteristics

Taking models of endogenous amenities to the data

Unpacking consumption amenities: Almagro and Domínguez-lino (2025)

Final discussion

What are urban amenities?

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Let's start diving into this amenity journey!

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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

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

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Implications:

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- Holding amenities fixed, wages and rents are positively correlated

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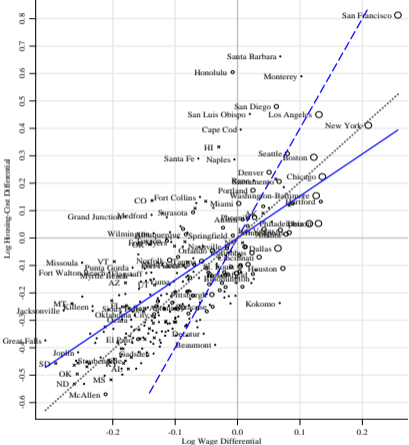
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Motivates hedonic price regressions:

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

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

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

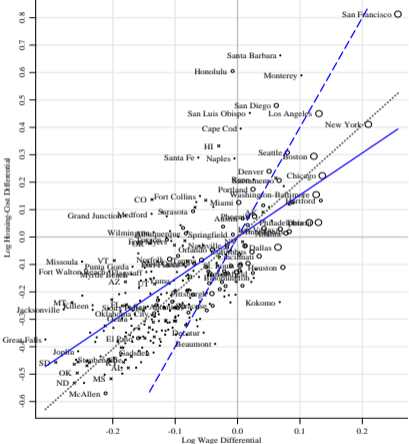


- Santa Barbara: weather, outdoors...

METRO POP	○ >5.0 Million	— Avg Mobility Cond: slope = 1.53
	◦ 1.5-5.0 Million	- - - Unadjusted Avg Mobility Cond: slope = 4
	• 0.5-1.5 Million Regression Line: slope = 2.04 (s.e. .06)
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- Santa Barbara: weather, outdoors...
- New York: restaurants, museums, nightlife...

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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

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

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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 heterogeneous agents: McFadden (1974), Berry, Levinsohn, and Pakes (1995)...

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- Consumption amenities (more on this later)...

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Why are endogenous location characteristics worth studying?

- Identification: Demographics correlate with **many** location characteristics Bayer et al. (2007)
- Counterfactual analysis: Feedback loops that shape spatial inequality Diamond (2016)
- Policy design: Understanding amenity formation guides neighborhood policy design

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Almagro and Dominguez-lino (2025): consumption and supply of (local) non-tradables

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Assume that

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

where A_j is amenities, p_j are housing prices, ξ_j unobservable demand shocks

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

$$\log \mathbb{P}_j - \log \mathbb{P}_0 = A_j - \alpha p_j + \xi_j,$$

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 using the previous equation!

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Two endogeneity issues due to simultaneity of equilibrium conditions:

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Several solutions:

1. Assume that conditional on enough things there is no more ξ_j
→ **Warning:** What's the interpretation of ξ_j ?
2. Instrumental variables: housing supply shifters (or control function approach)
3. Put further conditions on model (e.g. assume correlation structure of error ξ_j and covariates)

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Utility function:

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Observe:

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

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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

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Motivation

Preference heterogeneity over consumption amenities: different amenities cater to different groups

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Model the **supply of consumption amenities** with differential firm entry responses

- **Preferences externalities**
- Berry and Waldfogel (1999), Waldfogel (2008, 2010), Couture and Handbury (2019)

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

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 - **Absentee landlords** make supply decision about their rental units

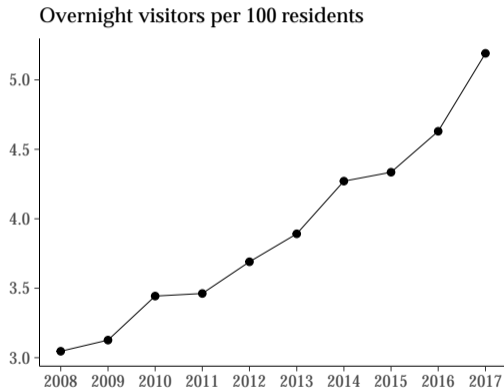
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 - Tourism flows into Amsterdam as quasi-experimental variation in demographic composition

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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

Data patterns in Amsterdam

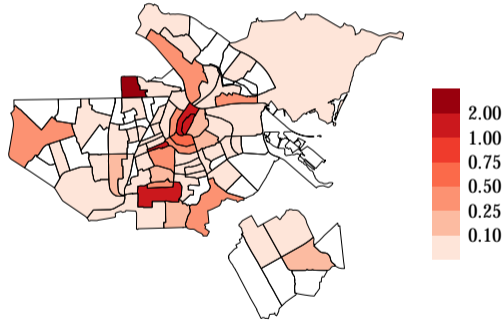
Fact 1: Tourism in Amsterdam is dramatically increasing

Figure 1: Nightly visitors per 100 residents

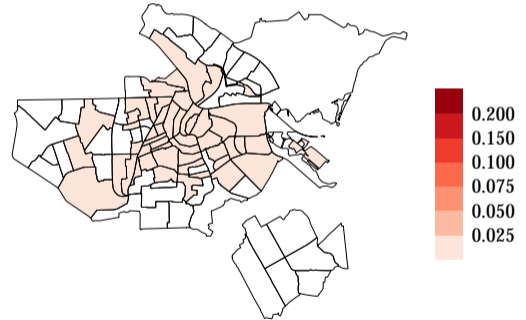


Fact 2: Tourists are expanding all over Amsterdam

Hotel beds per local resident (2011)

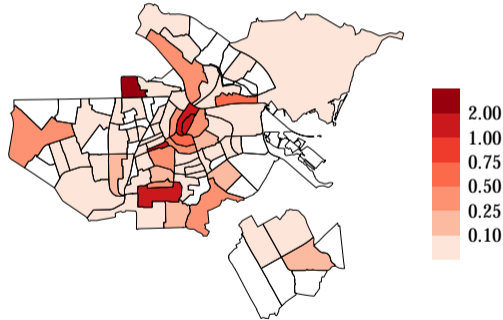


Commercial listing share of rental stock (2011)

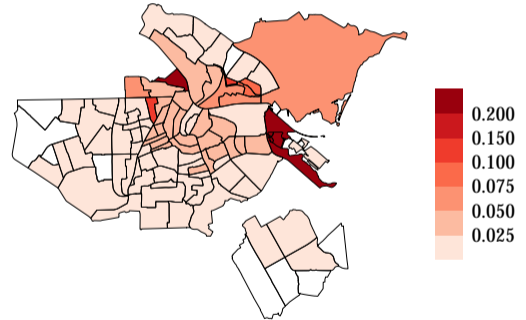


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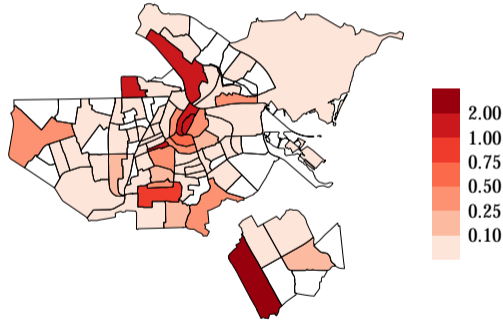


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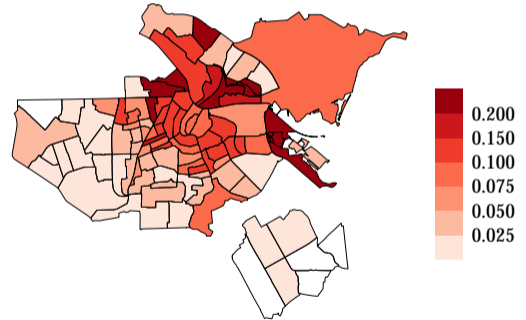


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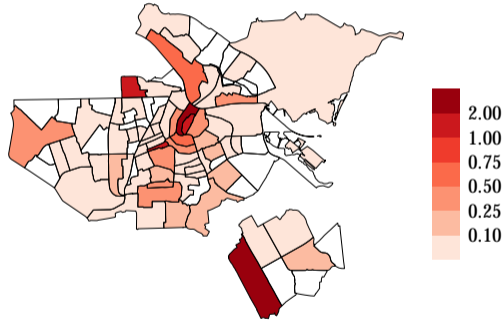


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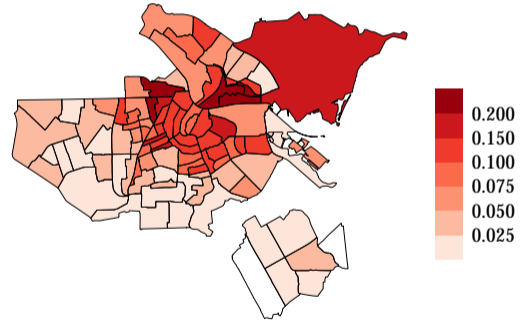


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Hotel beds per local resident (2017)

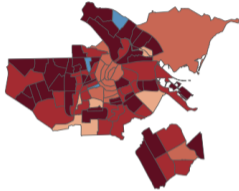


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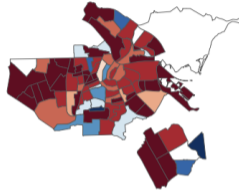


Fact 3: Amenities are tilting towards tourists

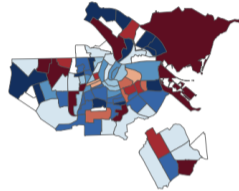
Touristic amenities



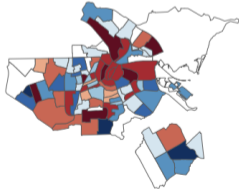
Restaurants



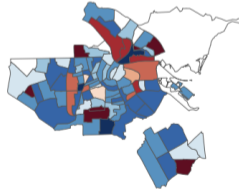
Bars



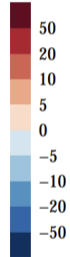
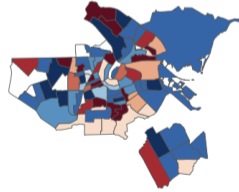
Food stores



Non-food stores



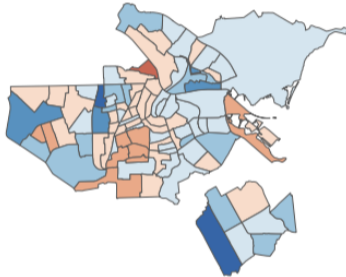
Nurseries



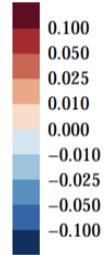
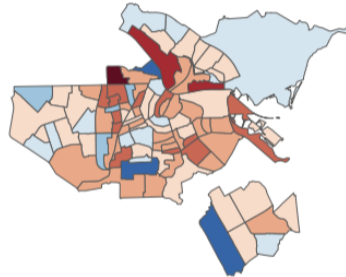
Note: Total growth (%) for 2011-2017

Fact 4: Differences in location choices across demographic groups

Δ population share married w/children



Δ population share single w/o children



Note: Total growth (pp) for 2011-2017

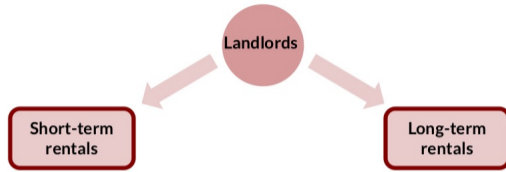
Fact 5: Commercial Airbnb listings have a significant impact on rent

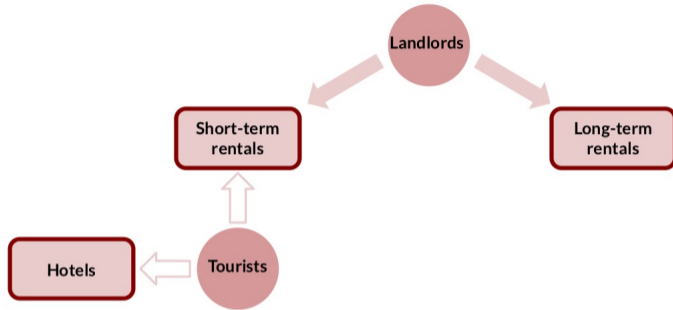
	Ln (rent/m2)					
	OLS	IV	OLS	IV	OLS	IV
Ln (commercial Airbnb listings)	0.065*** (0.008)	0.091*** (0.021)	0.051*** (0.006)	0.114*** (0.021)	0.109*** (0.018)	0.205* (0.093)
Control variables			X	X	X	X
District-year FE					X	X
First stage F-stat		586.89		384.21		69.66
Observations	770	770	763	763	763	763

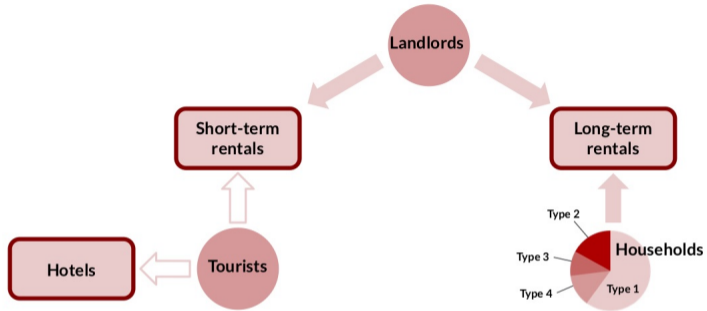
	Ln (house sale price)					
	OLS	IV	OLS	IV	OLS	IV
Ln (commercial Airbnb listings)	0.109*** (0.016)	0.290*** (0.030)	0.034*** (0.006)	0.149*** (0.016)	0.037* (0.022)	0.326** (0.102)
Control variables			X	X	X	X
District-year FE					X	X
First stage F-stat		572.02		370.87		65.9
Observations	738	738	737	737	737	737

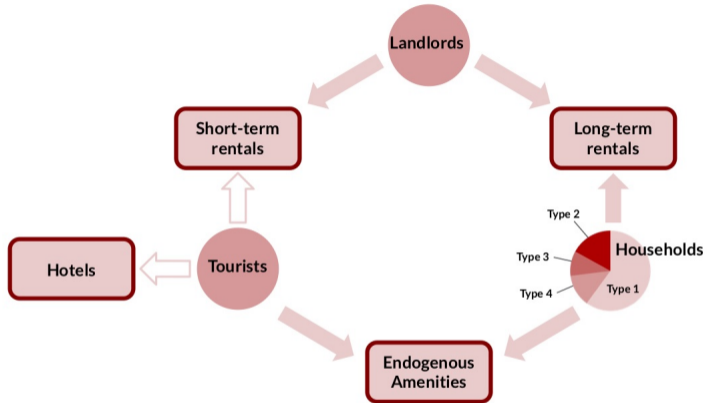
Instrument: $\text{Worldwide Airbnb Popularity}_t \times \text{Number of Historic Monuments}_j$

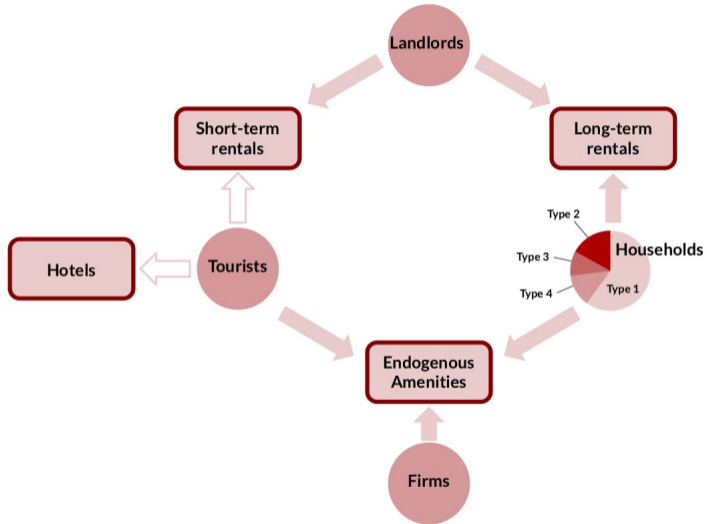
Structural model and estimation

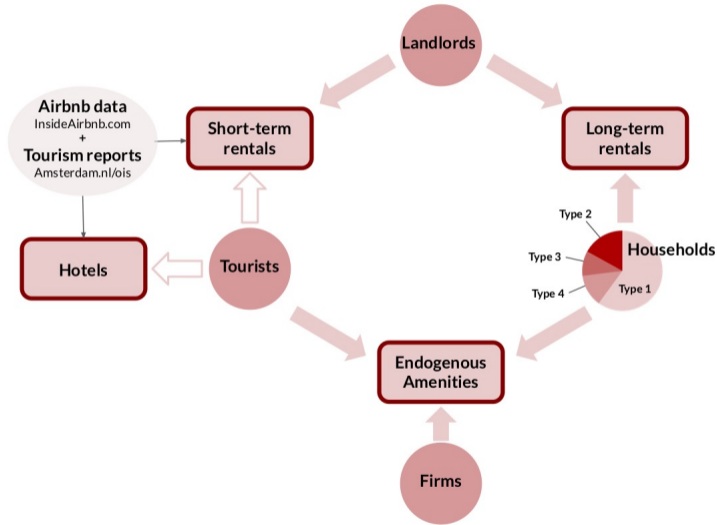


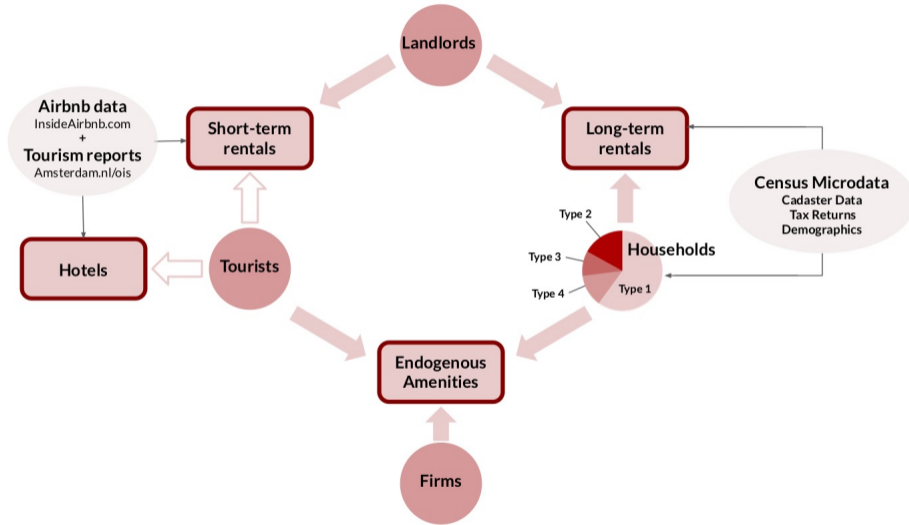


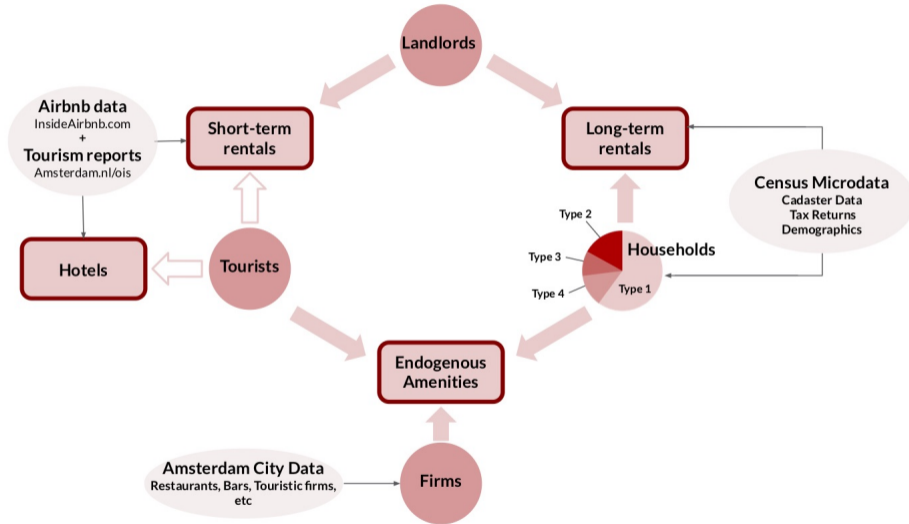




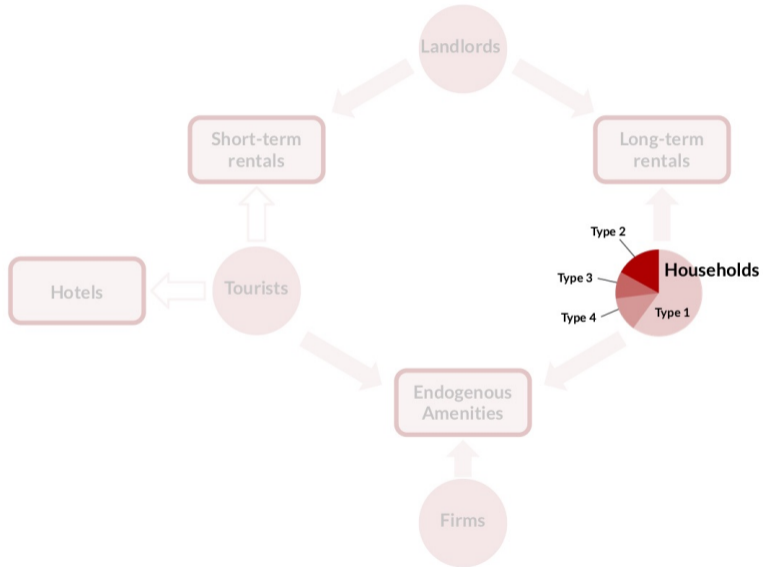








Defining heterogeneous households



Classifying households via k-means

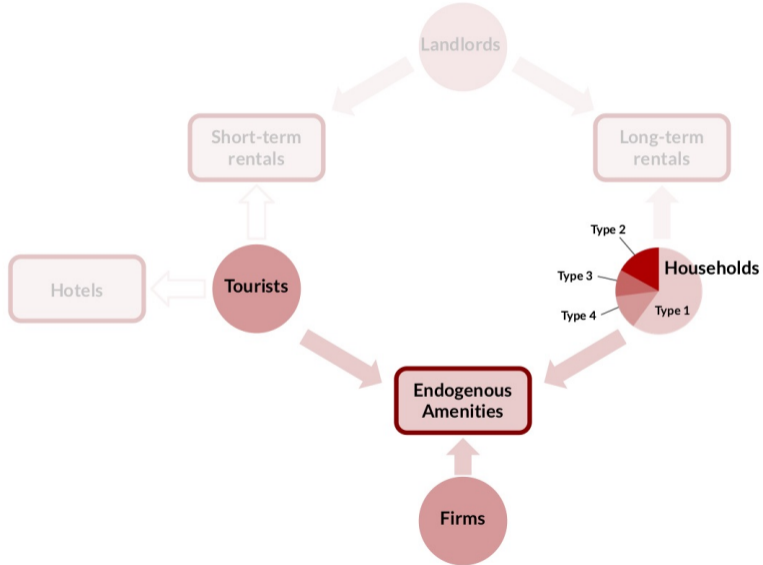
- We are interested in **distributional effects**
 - ⇒ define household 'types'
- **Large** number of demographics
 - ⇒ country of origin, skill, income, housing tenancy, household composition
 - ⇒ **correlation**: high income households tend to be high skill
- Classifying using arbitrary groups may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

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

Clustering results from k-means algorithm

Group	Homeowners		Renters		Social Housing Tenants	
	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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Type k residents have income w^k and pay r for one unit of housing

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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Given Cobb-Douglas preferences, expenditure on sector s :

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

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

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

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} :

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

Assume unobservable cost has following functional form

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

Supply of amenities: Estimation

Assume unobservable cost has following functional form

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

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

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

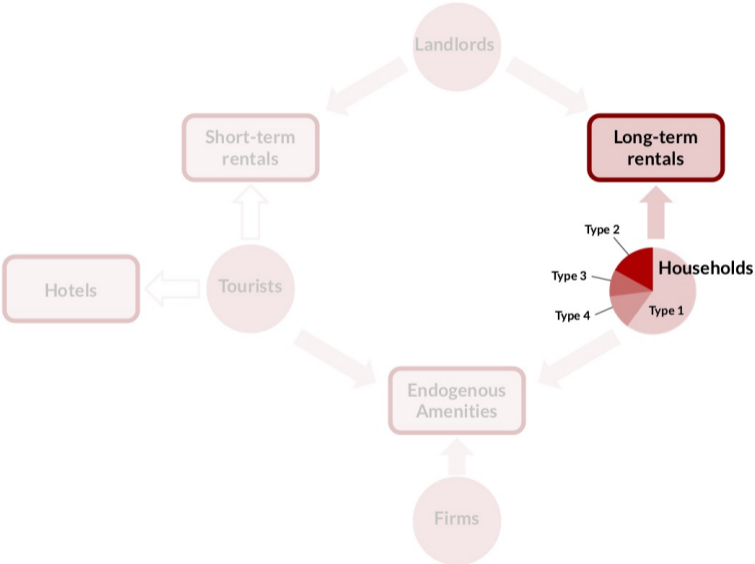
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	Touristic Amenities	Restaurants	Bars	Food Stores	Non-Food Stores	Nurseries
Older Families	186.3 [0.0,431.929]	7.374 [0.0,30.401]	0.0 [0.0,0.0]	4.469 [0.0,29.098]	11.359 [0.0,50.577]	980.803*** [368.357,1684.881]
Singles	403.022 [0.0,1816.258]	90.723 [0.0,317.227]	0.0 [0.0,0.0]	102.631 [0.0,327.09]	11.347 [0.0,176.969]	0.0 [0.0,0.0]
Younger Families	0.0 [0.0,0.0]	1.077 [0.0,16.47]	11.365 [0.0,38.983]	52.846** [0.0,123.07]	194.655*** [83.304,331.513]	637.116 [0.0,1326.254]
Students	984.639* [0.0,2014.696]	402.153*** [198.125,673.928]	22.562 [0.0,101.561]	123.078 [0.0,319.632]	2.355 [0.0,1.365]	221.204 [0.0,1759.481]
Immigrant Families	0.122 [0.0,0.0]	5.687 [0.0,49.542]	25.705** [1.126,63.178]	90.549 [0.0,210.37]	127.724** [3.251,331.895]	540.228 [0.0,1740.204]
Dutch Low Income	110.617 [0.0,371.65]	9.908 [0.0,56.277]	0.0 [0.0,0.0]	9.077 [0.0,78.283]	0.0 [0.0,0.0]	0.0 [0.0,0.0]
Tourists	749.072*** [522.649,974.412]	397.274*** [316.498,477.965]	211.571*** [156.406,269.374]	136.337*** [80.554,189.6]	724.223*** [579.264,892.963]	0.0 [0.0,0.0]

Note: ↑ 10% in tourists \implies ↑ 2.3% Touristic Amenities, ↑ 0.3% Restaurants, ↑ 2.3% Bars, ↑ 0.9% Food Stores, ↑ 2.9% Non-food Stores

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

$$MC^k(d, x_{it}) = \begin{cases} MC_0^k + MC_1^k \text{dist}(j(d), j_{it-1}) & \text{if household moves} \\ 0 & \text{if household stays.} \end{cases}$$

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Household i 's indirect utility flow from decision d is

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

The dynamic programming problem is

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

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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

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

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**:

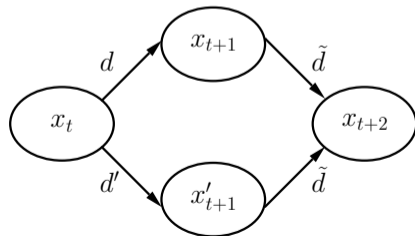
⇒ Their future look the same and can cancel out continuation values

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

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

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



Recall Euler Equation:

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

and utility flows

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

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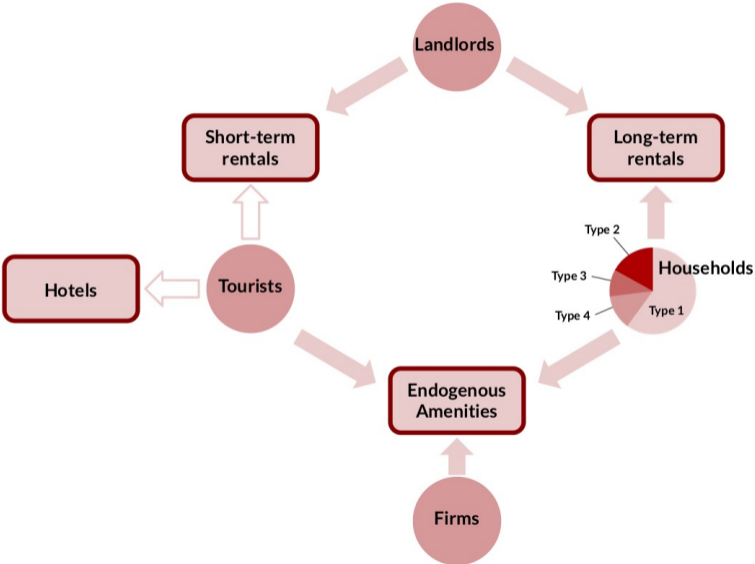
Identification of endogenous variables:

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

Preference estimates: IV results

	Older Families	Singles	Younger Families
High Location Capital	0.187*** (0.017)	0.210*** (0.013)	0.264*** (0.014)
Intra-City Moving Cost	-5.916*** (0.015)	-5.337*** (0.011)	-5.384*** (0.012)
Bilateral Moving Cost	-0.067*** (0.000)	-0.059*** (0.000)	-0.041*** (0.000)
In/Out of City Moving Cost	-4.407*** (0.012)	-4.012*** (0.009)	-4.043*** (0.010)
Log Rent	-10.886*** (1.205)	-2.310** (0.999)	-1.964* (1.027)
Log Touristic Amenities	-1.319*** (0.215)	-0.496*** (0.182)	0.317* (0.177)
Log Restaurants	0.288 (0.346)	0.735** (0.305)	-0.280 (0.286)
Log Bars	-0.757*** (0.099)	-0.528*** (0.085)	-0.104 (0.086)
Log Food Stores	-1.695*** (0.327)	-1.216*** (0.281)	-0.540* (0.282)
Log Nonfood Stores	0.427 (0.356)	1.533*** (0.311)	1.383*** (0.302)
Log Nurseries	1.631*** (0.173)	0.044 (0.143)	0.246* (0.147)

Housing supply + tourists



Counterfactuals

Equilibrium definition

A *stationary equilibrium* is,

1. a **vector of prices** $\mathbf{r} = (r_1, \dots, r_J)$ and a **matrix of amenities** $\mathbf{a} = [a_1, \dots, a_J]$,
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

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

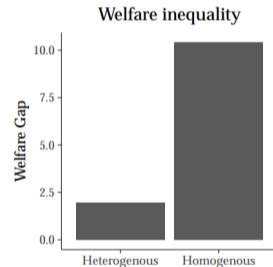
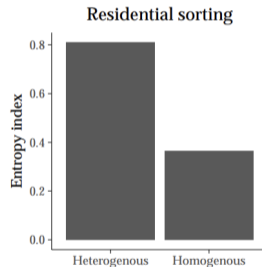
Evaluating heterogeneity in preferences

Preference heterogeneity shapes neighborhood differentiation, sorting and spatial inequality

Amenity	Gini index for each preference specification		
	Homogenous (HO)	Heterogenous (HE)	HE-HO
Touristic amenities	0.34	0.37	0.03
Restaurants	0.43	0.56	0.13
Bars	0.59	0.66	0.07
Food stores	0.32	0.57	0.25
Non-food stores	0.53	0.67	0.14
Nurseries	0.51	0.43	-0.08

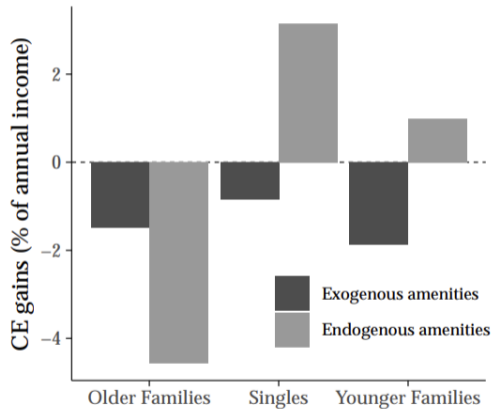
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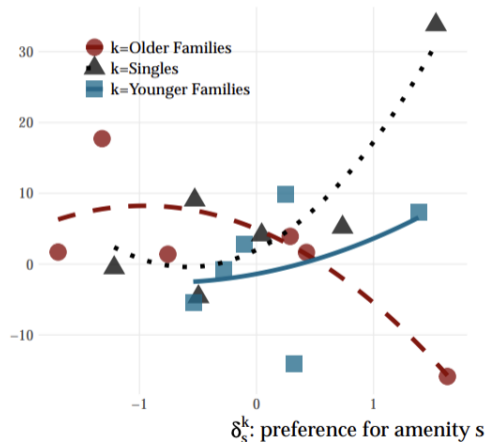


Simulating STR entry

Short-term rental entry: Welfare changes



Δ_s^k : change in exposure to amenity s



Should we tax tourists?

Taxing tourists

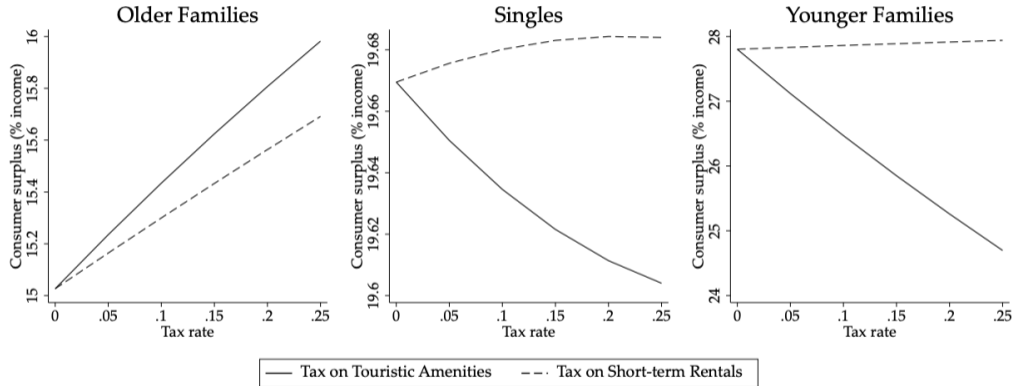


Figure 2: Caption

Introduction

Amenities as a residual

Endogenous location characteristics

Taking models of endogenous amenities to the data

Unpacking consumption amenities: Almagro and Domínguez-lino (2025)

Final discussion

Location choices across space

- CoreLogic: Bayer, Ferreira & McMillan (2007), Bayer, McMillan, Murphy & Timmins (2016), Diamond, McQuade & Qian (2019), Christensen & Timmins (2022)...
- Decennial Census/ACS: Moretti (2013), Diamond (2016), Monte, Redding & Rossi-Hansberg (2018), Couture, Gaubert, Handbury & Hurst (2024)...

Local prices and retail

- Nielsen: Handbury & Weinstein, Handbury (2021), Diamond & Moretti (2024), Hoelzlein (2025)...
- NETS: Holmes (2011), Couture & Handbury (2021) and Hoelzlein (2020)...
- Yelp/Google: Davis, Dingel, Monras, & Morales (2019)

Commuting surveys:

- Alhfeldt, Redding, Sturm & Wolf (2017), Severen (2023), Tsivanidis (2024), Allen & Arkolakis (2022) ...

More granular and newer data Sources

Infutor:

- Diamond, McQuade, and Qian (2019), Pennington (2021)...

Credit card:

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

Census microdata:

- Heblich, Redding & Sturm (2020), Tsivanidis (2024), Almagro & Domínguez-lino (2025)...

Mobile phone data (Veraset, SapheGraph, Dewey, Replica):

- Athey, Ferguson, Gentzkow & Schmidt (2021), Couture, Dingel, Green, Handbury & Williams (2022), Miyauchi, Nakajima, and Redding (2022), Akbar, Couture, Duranton & Storeygard (2023), Almagro, Barbieri, Castillo, Hickok, and Salz (2025)...

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The role of the government and politics

- Public good provision
- Political economy of housing regulation

Thanks and have fun!

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But let's also take a picture!
(Jessie's orders)