Sorting based on amenities and income

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(Work in progress)

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Projects

- **Economic valuation of cultural heritage (NICIS)**
  - Maintenance costs vs. Benefits
  - Does cultural heritage attract specific households?
  - What is the willingness to pay for cultural heritage?
  - Location choice models (revealed preference)
    - Tiebout (1956): *Households sort or 'vote with their feet' to choose their most preferred community*

- **Highly educated location preferences (NWO-HELP)**
  - How to attract or retain high educated households?
  - Work location vs. Amenities
  - (Focus on extending the location choice models)
  - (Focus on gaining additional insights from the location choice models)

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Today

- Motivation
- The model: Equilibrium sorting model
- Some extensions
- Econometric issues
- Data and study area
- Estimation results
- Discussion

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Motivation

- **Urban amenities are becoming more important for the location choice of households**
  - Traditional focus on cities as center of employment (Alonso-Muth-Mills models)
  - But other (consumption) needs are growing in relative importance
    - School quality
    - Restaurants
    - Theatres
    - Cultural status
    - Demographic composition
  - Producer city → Consumer city

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Motivation

- **Literature**
  - *Brueckner, Thisse and Zenou (1999)*
    - Why is central Paris rich and downtown Detroit poor?
    - An amenity based theory
    - Amenities are luxuries that affect the location choices of households
  - This has likely consequences for economic growth
  - *Glaeser, Kolko, Saiz (2001); Carlino and Saiz (2008)*

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Mechanisms

- **Amenities attract high incomes**
  - Example: cultural heritage
    - Canals of Amsterdam
- **High incomes attract each other**
  - Households are attracted to similar households
  - Social interaction effect
  - ‘multiplier’ on the impact of neighbourhood characteristics
- **The presence of high incomes may attract endogenous amenities**
  - Like shops, musea, theatre performances,…

Location equilibrium models

- **Sorting models**
  - Households choose their residential location
  - Between a fixed choiceset (municipalities / neighbourhoods / specific houses)
  - These locations differ in quality…
    - Distance to city center
    - Cultural heritage
    - Natural amenities
    - Demographic composition
    - …

Location equilibrium models

- **Why are sorting models used?**
  - Sorting models are structural models that explain house prices
    - More advanced than simple hedonic methods
  - Sorting models are able to account for heterogenous households
    - Marginal willingness to pay for various types of households (education, income, age, household size, etc.)
  - Equilibrium property can be exploited to study (exogenous) shocks
    - Counterfactual simulations
    - Segregation, gentrification, demographic composition
  - Sorting models are able to account for unobserved location characteristics
  - There is room for extensions (more later)

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Location equilibrium models

- **Basically: the sorting model is a logit model for location choice**
  - Choice alternatives are neighbourhoods
  - Decision makers are heterogeneous
    - Heterogeneity is related to household characteristics
    - Like education and income

- **We take into account unobserved neighbourhood characteristics**
  - Using the methodology of Berry, Levinsohn and Pakes (1995)
  - Two-step estimation procedure
  - Alternative-specific constants are further analysed in second step

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The model (1)

Choice probabilities: $$Pr_{i,n} = \frac{\exp(w_{i,n})}{\sum_{m=1}^{M} exp(w_{i,m})}$$

- Prob that household *i* chooses neighbourhood *n*
  w_{in}: deterministic part of the utility of neighbourhood *n* for household *i*
  ε_{in} : stochastic part of the utility of neighbourhood *n* for household *i*

- Total utility: $u_{in} = w_{in} + \varepsilon_{in}$

- Households maximize utility based on preferences and budget constraint

The model (2)

Utility: $$u_{i,n} = \sum_{k=1}^{K} \alpha_{i,k} X_{k.n} + \xi_n + \varepsilon_{i,n}$$

- Note that the coefficients are *i*-specific
  There is heterogeneity in tastes

- The ξ denotes unobserved neighborhood attributes
  Observed by the household, but not by the researcher
  Not *i*-specific

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The model (3)

Further specification of coefficients:

$$\alpha_{i,k} = \beta_{0,k} + \sum_{l=1}^{L} \beta_{k,l} \left(Z_{i,l} - \bar{Z}_l \right)$$

- Linear function of household characteristics *Z*
- Household characteristics are de-meaned
- β_{0k} is the average value of the coefficient for characteristic *k*

The model (4)

Substitute into the utility function:

$$u_{i,n} = \underbrace{\sum_{k=1}^{K} \beta_{0,k} X_{k.n} + \xi_n}_{} + \sum_{k=1}^{K} \left(\sum_{l=1}^{L} \beta_{k,l} \left(Z_{i,l} - \bar{Z}_l \right) \right) X_{k.n} + \varepsilon_{i,n}$$

And rewrite:

$$u_{i,n} = \delta_n + \sum_{k=1}^{K} \left(\sum_{l=1}^{L} \beta_{k,l} \left(Z_{i,l} - \bar{Z}_l \right) \right) X_{k.n} + \varepsilon_{i,n}$$

$$\sum_{i=1}^{I} Pr_{i,n} = S_n$$

- δ's are alternative-specific constants (mean indirect utility)
  - δ's and $\beta_{k,l}$ are estimated in the first step
  - δ's are then further analyzed in the second step

The model (5)

After estimating the logit model we write again:

$$\delta_n = \sum_{k=1}^{K} \beta_{0,k} X_{k.n} + \xi_n$$

- And use techniques for linear models to estimate the coefficients
- The unobserved heterogeneity now appears as an error term

Extensions

- **Social interactions → Multiplier effects**
  - Include demographic composition of the neighbourhood
  - Share of high income households
  - Share of high income households attract other (endogenous) amenities?
- **Characteristics of surrounding neighbourhoods**
  - Spatial lags of exogenous neighbourhood characteristics
- **(Movement costs)**
- **(Extending supply side)**

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Econometric issues

- **Why not estimate a simple logit model?**
  - Unobserved characteristics are not taken into account
  - They may have an impact on observed neighborhood characteristics

  - Example: housing price
    - If ξ is high, a neighborhood is attractive
    - Housing price will be relatively high there
    - But we do not observe the reason and will run the risk of interpeting this as low price sensitivity

Econometric issues

- **How to deal with this issue?**
- **Recall that in the second step we have a linear equation:**

$$\delta_n = \sum_{k=1}^{K} \beta_{0,k} X_{k.n} + \xi_n$$

- **The price is one of the *X-s***
  - We have an endogeneity problem

- **We can use 2SLS instead of OLS to deal with the endogeneity**

Instruments?

- **We can create an instrument exploiting the equilibrium property:**
  - Use the model to predict the prices that would be observed if all the ξ-s are equal to zero
    - These prices are uncorrelated with the ξ-s
    - And (probably) highly correlated with the observed prices
    - And should not be included in the estimation equation

- **Since we do not yet know the true coefficients, an iterative procedure is used**

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Social interactions

- **We want to include the possibility of preferences for the demographic composition of the neighborhood**
  - Especially of the share of high income households
- **This gives rise to a second endogeneity issue**
- **Which can be solved similarly**
  - We can compute the counterfactual share of high income households that would be observed if there were no unobserved heterogeneity

Data

- **We study household location in the Amsterdam area**

- **Household data**
  - Microdata Statistics Netherlands (GBA + IHI + SEC)

- **Neighbourhood data**
  - Price of a standard house (based on a simple hedonic model with neighbourhood fixed effects – NVM)
  - Percentage of high income households (Top 25% – CBS)
  - Conservation areas in km2 (RCE)
  - Distance to the nearest 100,000 jobs (PBL)

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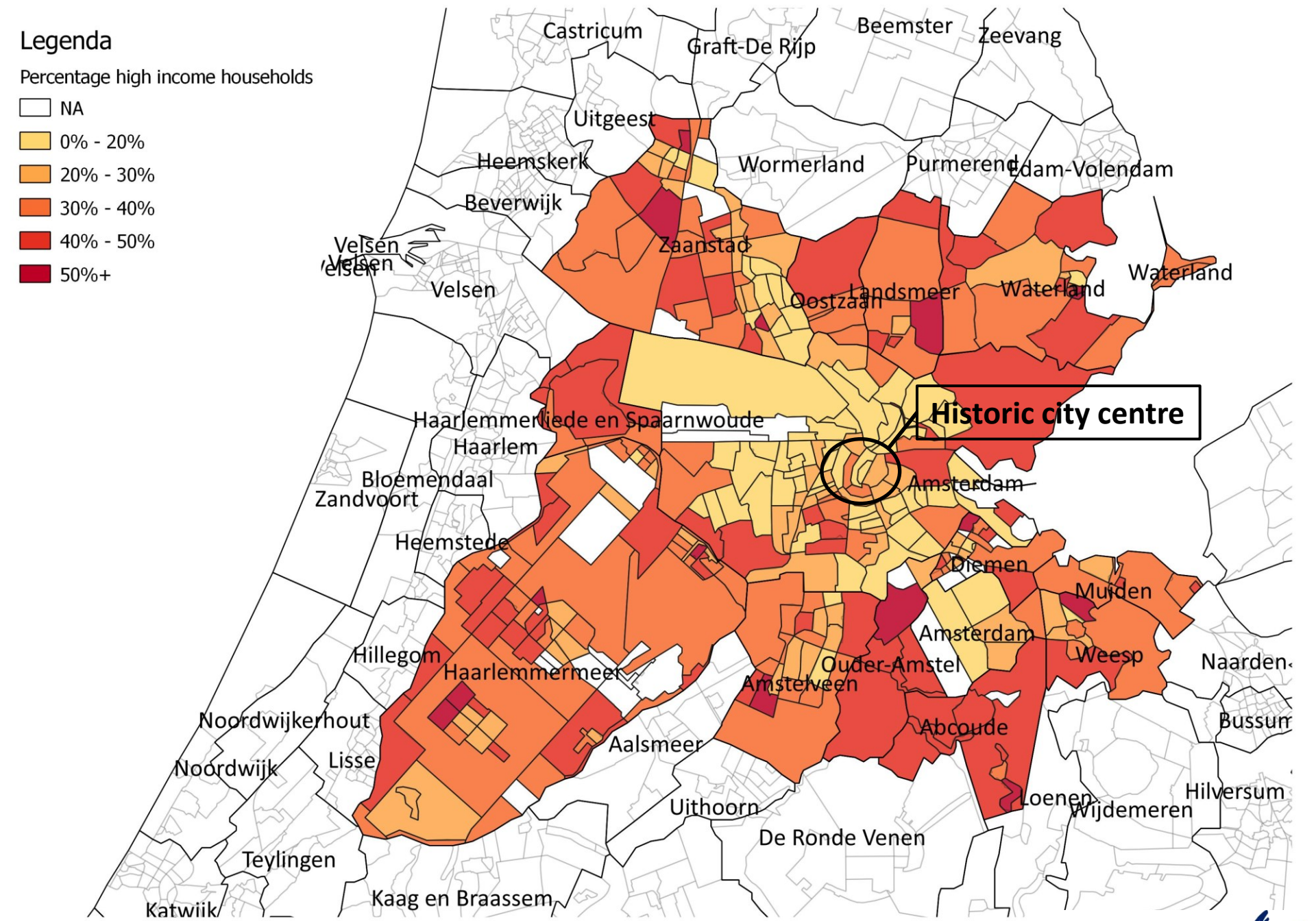

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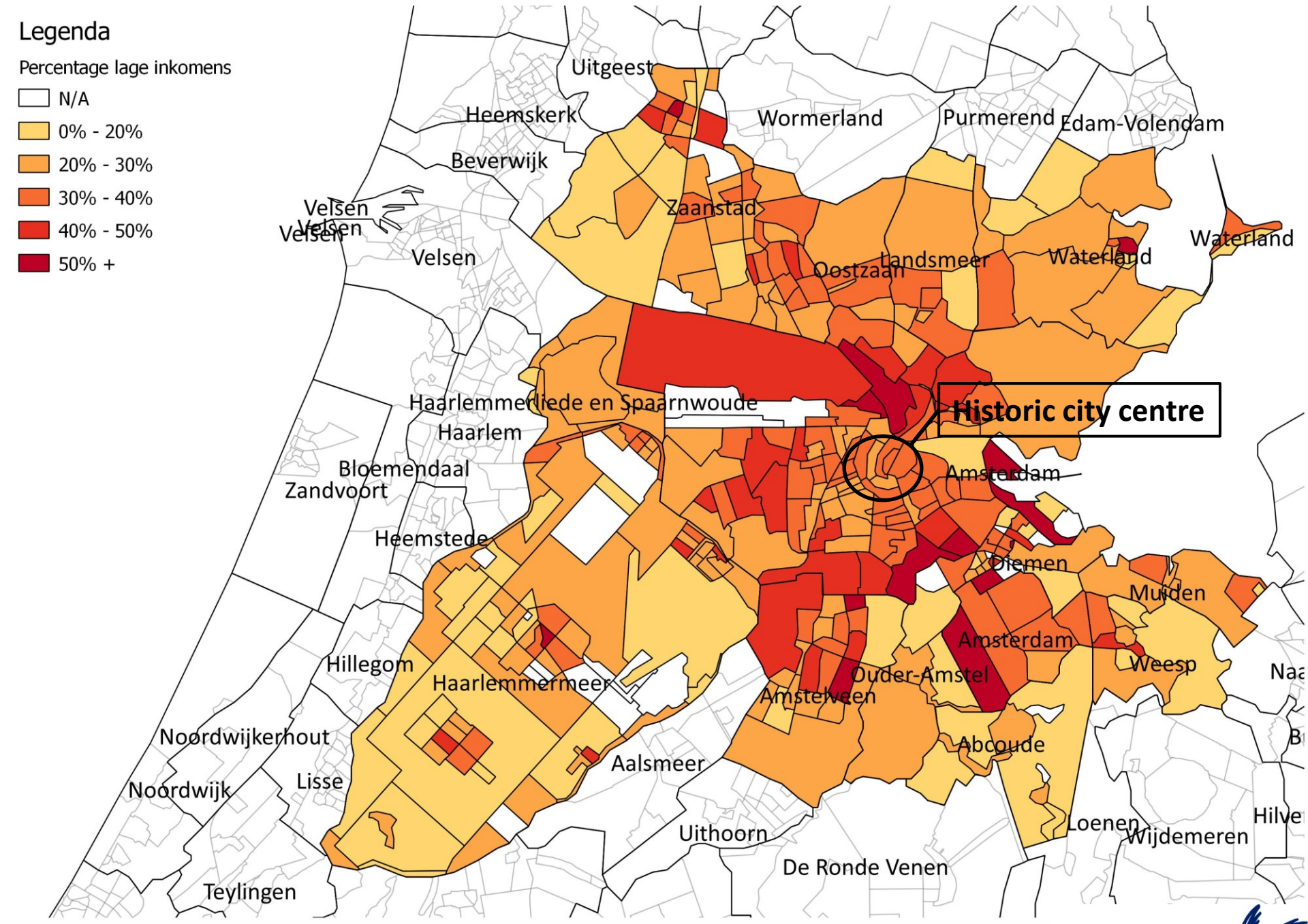

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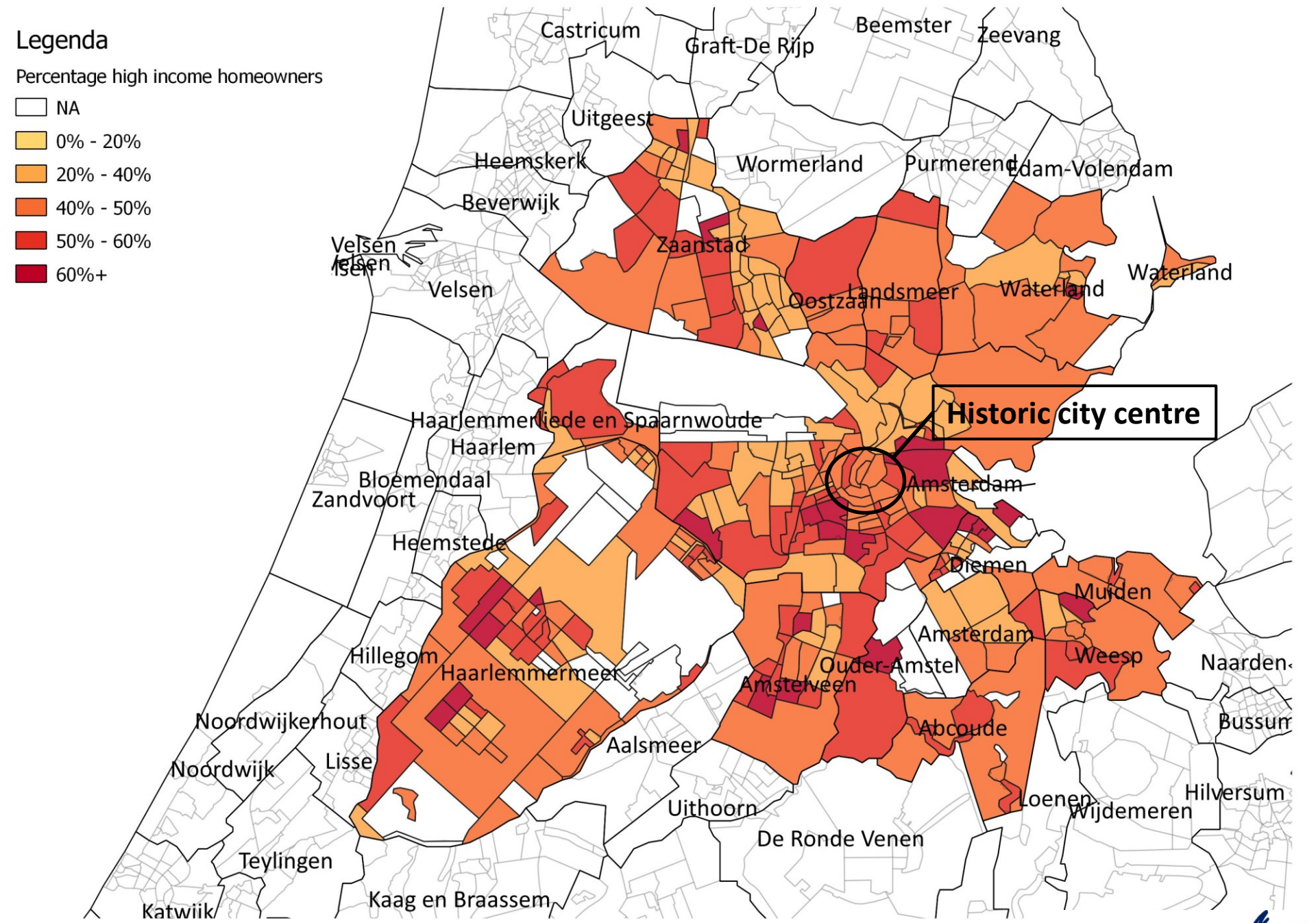

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Maps

- **Percentages of high income households are higher around Amsterdam**
  - Rental sector is around 60-70% in Amsterdam with a large amount of social housing

- **Percentages of high income homeowners are more equally distributed in the Amsterdam area**
  - In the sorting model we focus mostly on homeowners (real choices)
  - Interpreting the results for renters is difficult (not always a choice)

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Descriptives

Variables	Data source	Mean	SD	Min.	Max.
Household characteristics					
Gross primary household income	CBS (2008)	42,835	55,740	0	1,000,000
Household with children (-18)	CBS (2008)	0.240	0.427	0	1
Age of oldest household member	CBS (2008)	48.730	17.461	16	107
Social Economic Category					
Student	CBS (2008)	0.053	0.223	0	1
(Self-)Employed	CBS (2008)	0.559	0.496	0	1
Unemployed (Social assistance benefits)	CBS (2008)	0.176	0.381	0	1
Retired	CBS (2008)	0.212	0.409	0	1
Neighborhood characteristics					
Historic city center (km2)	RCE (2012)	0.027	0.134	0.000	1.029
Distance to the nearest 100,000 jobs (km)	PBL (2005)	8.287	3.355	0.637	18.407
Percentage rich households (%)	CBS (2008)	33.325	14.433	0.000	77.707
Price of standard house (in euros)	NVM (2009)	209,858	49,587	112,877	390,691

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First step results

- **Deviations from the alternative specific constant for homeowners**

Neighborhood characteristics	Household characteristics		
	Income	Employed	Retired
Standardized house price (in euros)	**0.01259**	**-1.3296**	**2.2091**
	(0.0006)***	(0.0779)***	(0.0368)***
Historical city center (km2)	**0.00313**	**-0.0967**	**0.0157**
	(0.0004)***	(0.0526)	(0.0445)
Historical city center in surrounding neighborhoods	**-0.00031**	**-0.0121**	**0.0524**
	(0.00005)***	(0.0054)***	(0.0021)***
High income households (%)	**0.00027**	**0.0233**	**-0.1736**
	(0.00001)***	(0.0059)***	(0.0029)***
Distance to the nearest 100,000 jobs (km)	**0.00001**	**0.0310**	**0.0323**
	(0.00004)	(0.001)***	(0.0005)***

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Second step results

Variables	(1) OLS (se)		(2) 2SLS (se)		(3) 2SLS (se)	
Standardized house price (in euros)	**-1.2582**		**-26.6315**		**-37.9354**	
	(0.5621)	**	(7.976)	***	(10.434)	***
Historical city center (km2)	**1.3146**		**5.7193**		**7.5236**	
	(0.3482)	***	(1.9397)	***	(3.327)	**
Historical city center in surrounding neighborhoods	**0.0521**		**1.2362**		**1.7907**	
	(0.0435)		(0.3828)	***	(0.517)	***
High income households (%)	**-0.0079**		**0.1634**		**0.2618**	
	(0.0087)		(0.0577)	***	(0.0812)	***
Distance to the nearest 100,000 jobs (km)	**-0.1323**		**-0.1383**		**-0.1692**	
	(0.0285)	***	(0.0922)		(0.1393)	
Constant	**15.5797**		**317.8204**		**451.915**	
	(6.661)	**	(95.043)	***	(124.15)	***
Price instrumented	No		Yes		Yes	
High income households instrumented	No		No		Yes	
F-statistic			11.427		6.598	

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Marginal willingness to pay

Marginal willingness to pay – in terms of house prices – for homeowners

	(1) Mean		(2) Income (+10,000)		(3) Employed		(4) Retired	
Historic city center (+km2)	**€ 40,274**		**€ 2,175**		**€ -1,300**	**(ns)**	**€ 1,838**	**(ns)**
Historic city center in surrounding n'hoods (+km2)	**€ 9,842**		**€ 91**		**€ -84**		**€ -193**	
High income households (+%)	**€ 1,414**		**€ 137**		**€ 55**		**€ 161**	
Distance to nearest 100,000 jobs (-km)	**€ 644**	**(ns)**	**€ 10**	**(ns)**	**€ -41**		**€ 174**	

- High income households prefer to live in neighbourhoods with a high concentration of high income households (Social interaction effect)
- High income households prefer to live in or around the historic city centre (+ its endogenous amenities)

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Simulation if we...

- **Eliminate the historical center of Amsterdam**
  - Exploit the equilibrium property of the sorting model

Neighborhoods	Standardized house price (in euros)	Predicted house price (in euros)	Difference	Percentage	Percentage rich households	Predicted percentage rich households
Amstel III en Bullewijk	119,581	191,581	+72,000	+60%	11.3%	12.6%
Bijlmer-Oost E, G en K	144,981	180,890	+35,909	+25%	19.1%	16.7%
Bijlmer-Centrum D, F en H	146,714	181,313	+34,599	+24%	17.4%	15.3%
Grachtengordel-Zuid	359,220	204,869	-154,351	-43%	31.6%	32.6%
Grachtengordel-West	359,694	204,790	-154,904	-43%	32.4%	33.2%
Museumkwartier	380,141	210,465	-169,676	-45%	37.0%	41.1%

  - How to explain the shift in share of rich households (work in progress)

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Social interactions

- **Strong impact of the share of high income households on the attractiveness of neighbourhoods**

- **What is behind this results?**
  - People want to meet high income households
    - e.g. want their children to go to school with children from high income households
  - High income households attract shops, restaurants, ... to neighborhoods
    - That are also appreciated by others → Multiplier effect

- **Simple regressions**
  - Does the concentration of high income households explain the number of shops, musea, theatre performances?

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Shops and high income households

Simple regressions of different type of shops

	(1)	(2)	(3)	(4)	(5)
	Grocery shops (#)	Fashion & Luxury shops (#)	Leisure & culture shops (#)	Musea (#)	Theatre performances (#)
	OLS (se)	OLS (se)	OLS (se)	OLS (se)	OLS (se)
Historic city center (dummy)	**17.0435** **	**59.7460****	**134.6857*****	**5.1371*****	**1.5641*****
	(7.0643)	(24.6781)	(36.8945)	(1.1375)	(0.4568)
Population (#)	**0.0035** ***	**0.0024****	**0.0034****	**0.0001**	**0.0001**
	(0.0004)	(0.0011)	(0.0014)	(0.0001)	(0.0001)
High income households (%)	**-0.0365**	**0.1241**	**-0.0026**	**-0.0054**	**-0.0022**
	(0.0352)	(0.1306)	(0.1224)	(0.0071)	(0.0040)
High income households in surrounding neighborhoods (%)	**-0.1808** **	**-0.5672****	**-1.2462*****	**-0.0199**	**-0.0150****
	(0.0727)	(0.2685)	(0.3374)	(0.0171)	(0.0080)
Constant	**7.6977** **	**15.5943***	**45.0938*****	**1.4116****	**0.7394**
	(3.2179)	(9.2797)	(13.7106)	(0.5963)	(0.3460)
Observations	290	290	290	231	231
R-squared	0.6155	0.2946	0.5570	0.5051	0.3949

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Conclusions

- **Stong impact of cultural heritage on attractiveness of neighbourhoods**
  - Especially, high income households are willing to pay more for living in or close to a historic city center
- **Social interactions**
  - Households prefer to live in neighbourhoods where high income households reside
  - Especially other high income households
- **Simulation**
  - Even without cultural heritage, high income households cluster in and around the city center
- **Endogenous amenities cannot explain this**

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Thank you for attending!
Questions?

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