Segregation in cities according to household size (work in progress)

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Introduction

Increase in single-person households:

• 15 % in Norway 1950
• 38 % in Norway 2001
• In Oslo 2001: More than 50 % single person households

What are the consequences?

- for households living in a city
- for the structure of cities
Issues of interest:

• Will the market for housing tend to segregate the two household types?
• How will the utility level of single-person households be relative to multi-person households?
• Implications for land use - extension of the city
• Will policies that stimulate multiperson households to live in the city centre be warranted?
The baseline model

- Monocentric city
- Individuals have identical preferences
- Household preferences depend on size (n)

$$u = u(q, n)$$

- Household income (y) exogenous (conditional on household size and labour force participation)
- Costs of commuting $tx$
- Price per sqm. floor space depends on location

Budget constraint for household located at distance $x$ from city centre:

$$y = c + p(q) + tx$$
The baseline household model

\[
\max_{\mathbf{q}} u(q; \mathbf{x}, \mathbf{y}; n) - p q - tx, q; n
\]

\[
\frac{u^n_q(q; \mathbf{x}, \mathbf{y}; n)}{u^n_c(q; \mathbf{x}, \mathbf{y}; n)} = p q
\]

(First order condition)

(All households of type \( n \) enjoy the same utility)

\[
\frac{\partial p}{\partial x} = \frac{-t}{q}
\]

(Rent of land declining function of distance from city centre)
Rent gradients for households of size 1 and 2

\[ \frac{\partial p^1}{\partial x} = \left( \frac{-t^2}{q^2} \right) \left( \frac{\varphi}{-\omega_1 - \omega_2} \right) \]

Rent gradient
single person household

Rent gradient
two person household

Transport cost ratio

Land consumption ratio

Proposition 1. If \( \gamma > 1 \), single-person households have at \( \tilde{x} \) a steeper rent gradient than two-person households. When this condition is fulfilled, single person households will occupy the dwellings closer to the city centre than \( \tilde{x} \), while two-person households will live further from the city centre than \( \tilde{x} \).
Assumption 1: Single-crossing preferences

\[ MRS^2 > MRS^1 \]
Result 1:

If:

- Income in the two person household equal to income in one person household
- Costs of transportation the same in the two households (for the same distance)
- Single-crossing preferences (Assumption 1)

then will the single-person household have the steepest rent gradient, and live close to the city centre.

Describes well the situation in the middle of the last century
Three problems with Result 1:

- Not so relevant today, with high female labour force participation
- Seems more relevant to compare households of different size when holding the labour force participation rate constant
- Aggregate income in a city with a given population will depend on how individuals group themselves into households

We want to neutralize the last effect by assuming:
• Assumption 2: The labour force participation rate is 1 in all households

We also assume:

• Assumption 3: Costs of transportation

\[ t \leq \varphi t^2 \quad \varphi \in [0.5, 1] \]
Optimum for both household types

Numeraire good

Optimum for single-person household

Optimum for two-person household

Land

11
Spatial segregation of households according to size

Rent

Single-person households

Two-person households

Agriculture

Distance from city centre

$\tilde{x}$
Non-working households

• **Retired** persons. Reasonable to assume
  \[ \varphi \in [0.5, 1] \] also for these.

• **Students**. Reasonable to assume
  \[ \varphi \in [0.5, 1] \] also for these.
Munich
Conclusions

A simple theoretical model with:
- **economies of scale** in household consumption
- **unequal household incomes** according to household size
- **unequal costs of transportation**

can explain why:
- single-person households will live centrally
- two-person households will live less central

The theoretical model obtains empirical support