Preferences, Income and Investment: A socio-economic Model of Residential Segregation and Neighborhood Change

Malte Grönemann

University of Mannheim

Aim and Motivation

I present a new theoretical model of residential segregation that aims to unify theoretical accounts of segregation, residential mobility, housing inequality, neighborhood stability, and neighborhood change.

Existing theories **misrepresent segregation dynamics** or cannot explain typical patterns:

1. Housing type and quality are among the most important preferences of households and are unequally distributed in space. However, many segregation theories do not consider supply at all.
2. The models considering supply treat it as fixed even though housing quality can change.
3. Many theories cannot explain why segregation persists after amenities change. Differences in amenities are not necessary for segregation.
4. The literature on segregation, gentrification, and residential mobility remain unconnected even though they describe processes in the same social system.

I propose an **agent-based model** that includes supply to explain the joint patterns of the spatial distribution of people and infrastructure and their dynamics.

Stylized Facts

My review of the literature yields the following stylized facts the theoretical model should be able to explain:

- There is **always segregation** along social, economic, and demographic lines beyond what we expect by random chance.
- The **extremes** of the income distribution are the **most segregated** groups.
- Housing type and quality are also unevenly placed.
- **Poorer residents** typically have **lower housing** quality and fewer neighborhood amenities.
- Poor residents have low housing security and **high rates of residential mobility**.
- **Neighborhoods are stable** over long periods, especially the neighborhoods at the extremes. Only a few neighborhoods change their relative position at a time, if at all.
- In gentrification, social change precedes economic change and infrastructure changes.
- Gentrification can quickly change a neighborhood, whereas decline is usually slower as built infrastructure creates inertia.

Demand: Households

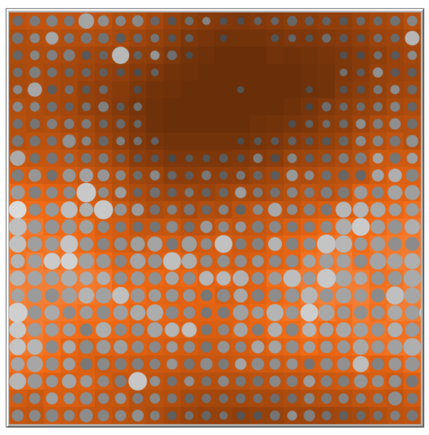
Households are mobile agents characterized by two fixed attributes: their **income** disposable on housing w_i and their social **status** s_i. Both are sampled from a $Beta(2,\ 5)$ distribution and can be set to correlate. I make two assumptions considering households' preferences:

1. **Households prefer a higher housing quality $q(x,t)$.**
2. **Households prefer a higher average social status $\bar{s}(x,t)$ of their neighbors.**

Based on these preferences, whose importance can be varied, **households move to an empty housing unit x that maximizes their utility**, conditional on the rent of that housing unit $p(x)$ is equal to or less than their income w_i.

$$U(x,t) = \bar{s}(x,t)^a q(x,t)^{1-a}$$

Figure 1. Example of the GUI



Supply: Landlords

Landlords do not provide new housing but must **invest in the upkeep** of existing housing units. It decays if they do not invest in housing quality $q(x,t)$. However, investments in housing have uncertain returns on investments depending on neighborhood characteristics and the market. I assume that landlords are **sideways-looking**:

1. **Landlords invest in their housing quality if average neighborhood rent $\bar{p}(x,t)$ increases.**

$$q(x,t) = \begin{cases} \bar{p}(x,t), & \bar{p}(x,t) \geq \bar{p}(x,t-1) \\ 0.9q(x,t-1), & \bar{p}(x,t) < \bar{p}(x,t-1) \end{cases}$$

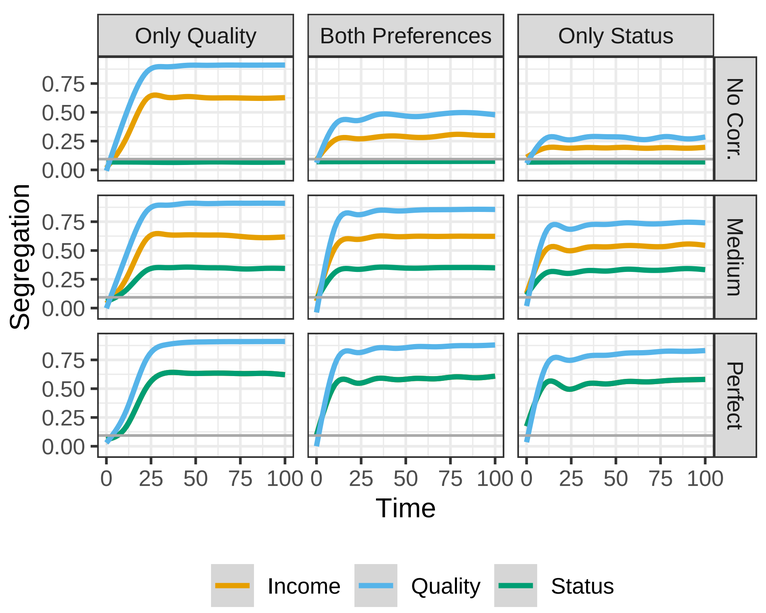
Rent

The price or rent $p(x,t)$ results from supply and demand in competitive markets. The units with the highest utility will be the most expensive, while the least expensive have the lowest level of utility. Rent is the **75th percentile of the incomes of all renters living in a housing unit with a lower utility**. Renters living in housing units with lower utility want to move there because they can increase their utility by moving to this housing unit.

Results I: Neighborhoods

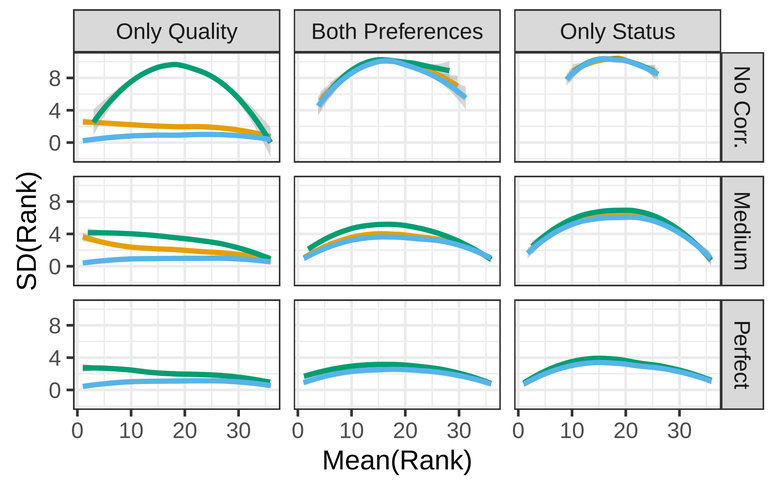
In the simulations, I vary the preferences of households and how strongly income and status are correlated.

Figure 2. Segregation over Time



No matter which preferences households have, residential segregation emerges. Both the investment rule and social preferences can create spatial segregation. When households only value housing quality, status segregation emerges when it is correlated with income. Only when households have only social preferences and status and income are uncorrelated is segregation low.

Figure 3. Neighborhood Stability (t > 50)

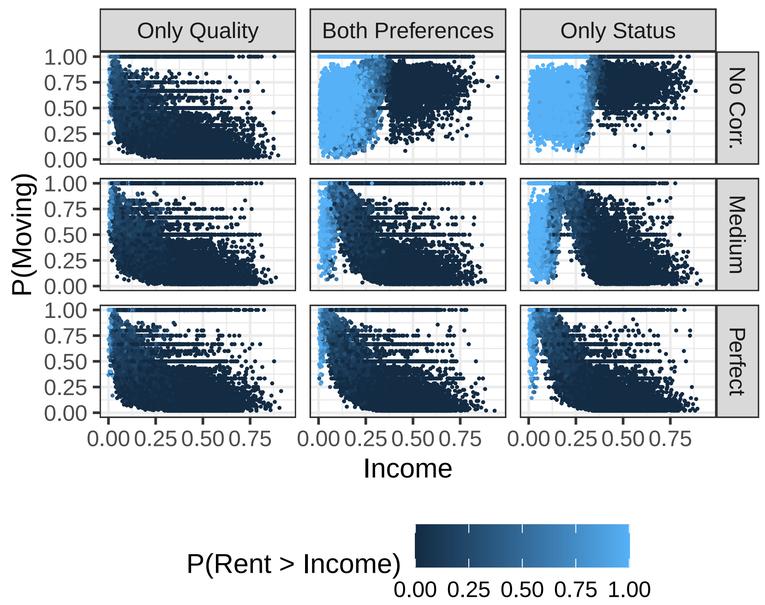


The anomaly in the top right corner is caused by the lack of stable neighborhoods. Everyone wants to live next to high-status households, but because they are not necessarily high-income, they get displaced. A chase game results, where households frequently move, both to increase their utility or due to displacement (see Fig. 4).

Otherwise, neighborhoods retain their rank in the city hierarchy over time, especially the neighborhoods at the extremes.

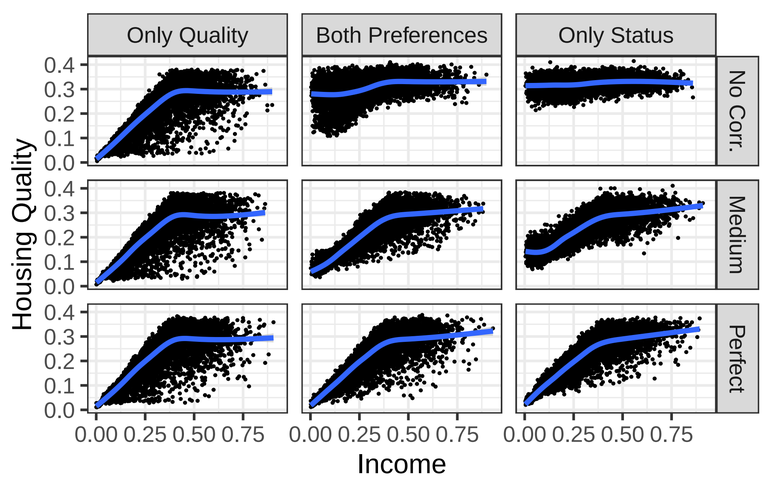
Results II: Inequality

Figure 4. Residential Mobility (t > 50)



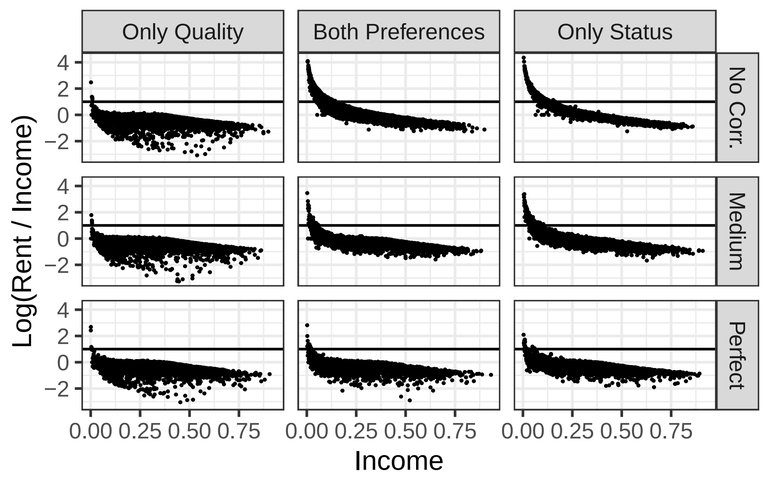
Neighborhoods remain stable even though there is substantial residential mobility. Lower-income households have higher residential mobility, often because they cannot afford their unit. However, the poorest have little lower residential mobility as they already occupy the cheapest available housing.

Figure 5. Housing Quality by HH Income (t > 50)



When there is segregation, inequalities in housing quality emerge, with high-income households having higher-quality units, even when they have only social preferences.

Figure 6. Proportion of Income spent on Rent (t > 50)



Spending on rent increases with income but the proportion of income spent decreases. Low-income households frequently spend more than their disposable income.

Discussion

Preliminary results indicate that **the model can reproduce stylized facts**. Under empirically plausible parameter combinations, cities are segregated by social characteristics, and housing is unequally distributed as well. Neighborhoods are stable over time even with considerable residential mobility. The richest occupy the highest-quality housing units, have low mobility, and spend a lower fraction of their income on housing. Households with low incomes are frequently in precarious housing situations, even without assuming predatory behavior by landlords.

malte.groenemann@uni-mannheim.de