ABSTRACT

Neoclassical models in housing economics pay little attention to the search-strategies of relocating households. This paper discusses the effects that space and information-gathering during the search may have on the existing models for residential mobility and the determination of house prices and market rents. As an illustration of these effects I will show what the change in the outcome of simulations is, when the well-known Schelling Tipping model for segregation is extended with spatially-based decision rules for relocation.

Keywords: residential mobility, house price, social rented market, social networks, segregation, simulation.

1. INTRODUCTION

Despite its known shortcomings the neoclassical approach in economics remains a comprehensive and powerful tool for understanding a wide range of economic and social phenomena. The most successful application of the neoclassical approach in the field of housing economics is in the so-called hedonic pricing method. According to the hedonic method each attribute of a dwelling and its surrounding area has an implicit price attached to it, reflecting the production costs of firms and willingness to pay by households for each attribute, where the attached to it, reflecting the production costs of firms and willingness to pay by households for each attribute, where the sum of these so-called ‘shadow prices’ defines the house price. Since each firm and household faces the same equilibrium price, individual firm and household characteristics no longer matter and the house price is defined solely in terms of the attributes of the dwelling and the location [1]. There are a few limitations to the application of the hedonic method on the housing market:

• There is a high degree of variability in house types, size, year of construction, state of maintenance and aesthetic quality on the market.

• Dwellings are durable goods; construction of new dwellings takes time and it’s costly to adapt the existing housing stock to a change in preferences.

• Dwellings are immovable objects; housing shortages in one area can co-exist with excess supply in adjacent areas.

• Search and transaction costs (including moving costs) are substantial.

It’s hard to maintain that a general equilibrium between supply and demand can exist that determines house prices in an area, when dwellings are such imperfectly competitive goods. Nevertheless the hedonic method has been extremely successful in explaining house price and rent differentials based on the attributes of the dwelling, but much less so in explaining value differentials based on the attributes of the location. A similar discrepancy between the valuation of the dwelling and the location arises in neoclassical models that explain housing supply and demand and some of the choices that lie behind it, the household’s decision to stay in, exit from or relocate to an area.

To better understand residential mobility and the determination of house prices and rents other modes of thinking about the housing market might help. Two divergences from the neoclassical approach in economics are considered in this paper:

1. The determination of house prices and rents on the macro-level is separated (yet not excluded) from the exit and relocation choice made on the micro-level: each household takes prices and rents as given, so that their informational content takes precedence over their exchange value.

2. The importance of the spatial foundations of the housing market: space is an essential property of the housing market that shapes the decision to relocate by households and ultimately the determination of house prices and rents.

After briefly explaining the spatial foundations of the housing market, drawing upon network-based simulation models for building trust among internet traders, some research is discussed that validates the spatially-based approach. A discussion on the consequences of spatial considerations for the determination of house prices and market rents follows suit. After this the focus shifts toward the issue of geographical segregation, as an illustration of the main ideas put forward in this paper.

2. THE VALUATION OF LOCATION QUALITY

Among the transitions that take place on the housing market, the best understood one is the decision to exit the old home. A household becomes dissatisfied with the attributes of the dwelling or the home surroundings and when the gap between the household’s needs and the availability, quality and (implicit) price of the attributes becomes too large, the search for a new home commences. The likelihood of moving increases with lower residential satisfaction or one of its elements: dwelling and neighborhood satisfaction. The latter term can be thought of as the household’s private evaluation of the home surroundings. Its value can be obtained through residential surveys, while its objective value is usually modeled as the spatial effects of attributes that influence the living quality at the location.

Abstracting from the dwelling, the decision to relocate results from the best possible match between the household’s needs and financial leeway and the (expected) increase in neighborhood satisfaction. The general use of changes in satisfaction levels, the underlying attributes and housing costs as explanatory factors in neoclassical models implies that the effects of the new location quality in the relocation choice work at a similarly low spatial scale and contain the same exact information as those of the old location quality in the exit choice. Most decision models for moving contradict this view [2, 3]: knowledge on the new location is never as exact as that obtained through daily living experience. The decision models further state that the search for a new dwelling starts by pre-selecting suitable areas, after which additional information on the new location is collected, often by inspection, whenever vacancies appear in pre-selected areas. The neoclassical models work well at analyzing the effects of the highly visible and non-spatial attributes of the dwelling on house prices, rents or relocation, but lack the spatial structure to evaluate the contribution of attributes of the location, let alone that of hidden attributes such as social circumstances in the area.
To understand the way in which house-seekers obtain information on hidden attributes of the location, I draw upon the Regret- and Repage-models for analyzing reputation- and image-building among autonomous agents in Artificial Intelligence [4, 5, 6]. By substituting the location of the dwellings for the nodes in social networks, these computational models yield a framework for modeling the spatial foundations of the housing market, where the transmission of information takes place along the social/spatial ties of households. The information on the location quality consists of four types of social evaluations:

- **Private evaluation**: the direct assessment of the home location quality carried out by the resident household.
- **Witness evaluation**: the assessment of the home location quality done by local witnesses. Firsthand witnesses can be identified as friends, families or co-workers of the household.
- **Neighbor evaluation**: the assessment of the location quality in adjacent locations deduced by the household and witnesses from neighbors’ private evaluations of their home location.
- **Reputation**: the anonymous, commonly known and non-binding outsider view on the location.

The private evaluation of the home location quality is instrumental in the exit choice of the firsthand witness, the resident household (see figure 1a). At the opposite end of the scale is the reputation, the common voice on living conditions in the area as expressed in the public opinion and the media. Reputations aren’t based on the assessment of attributes, but express the ‘brand’, ‘status’ or ‘name’ of the place. They mention common traits (poor, middle-class, ethnic, CBD etc.) used for comparing and ranking neighborhoods, without going into depth how these traits have come about. Reputations can be used for pre-selecting areas to reduce the cost of information-gathering, or as the sole social evaluation of the location quality when movers don’t have access to other assessment techniques. The non-binding nature of reputations means that a household may know its value, but need not let it influence its decision-making if the household disagrees with the content of the reputation.

The private evaluations of other households provide an input to the indirect assessment of the location quality, which improves upon the information contained in reputations. The quality of locations in the vicinity of the home location can be acquired through first-order neighbors (see figure 1b). Social ties with befriended witnesses allow for the dissemination of information on their respective home locations. The relocating household can also receive information on hidden attributes in areas adjacent to these locations, through the transmission of information by (chains of) neighbors to the witnesses (see figure 1c). The indirect assessments suffer from communication depreciation, since the reliability, expertise and preferences of first- and higher-order witnesses have to be taken into account [7]. Collective experiences, shared preferences and communication among local residents lead to a convergence in opinion and this produces the shared image as the common value for the location quality at these locations and the surrounding area [4].

**Figure 1 Information gathering in two-dimensional space [7]**

1a) **Private evaluation (unconnected)**

1b) **Neighbor evaluation**

1c) **Witness and neighbor evaluation**

Private evaluations are more exact than the shared image due to communication depreciation, whereas the shared image is preferred to the reputation since the latter is not based on actual attributes. Even when a household is well-informed, the reputation still serves as a pre-selection device during the early stages of the search. The hierarchy in the informational content carries over to the spatial scale of the assessments: the immediate surroundings of the location are assessed in the private evaluation, reputations relate to entire neighborhoods and the spatial scale of the shared image falls somewhere in between. The reason why the spatial scale of the reputation

**Figure 2 Location and residential mobility (adapted from Marans and Rodgers [8])**

![Diagram of spatial scale and response](image-url)
exceeds that of the indirect assessments lies in its very definition. Reputation is an information good that minimizes the costs of information gathering and hence requires economies of scale [9]. The private evaluation of the immediate surroundings, the shared image and the neighborhood reputation enter the household’s assessment of the vacant location and affect its exit and relocation choice as shown in figure 2.

3. THE DEMAND FOR SOCIAL RENTED DWELLINGS

To test the validity of the spatially-based approach in residential mobility choice, data on the exit rate (number of moves per dwelling) and the relocation choice as shown in figure 2. The circular relationship between the likelihood of exit depended upon household characteristics, the attributes of the dwelling, the regulated rent and neighborhood satisfaction. The latter measure was derived from the scores of respondents living in the same six-digit postal code area as the social renters, using kriged values when datasets did not overlap. A locally weighted average, centered at the dwelling and with a radius of 250 meters (0.155 miles), reflecting the low spatial scale of the home surroundings, was used to get rid of any remaining bias. To give an idea of the effect of the private evaluation on the exit rate: at a location where neighborhood satisfaction was one point higher on a one-to-tent scale, the exit rate dropped by 0.024 points or 12% [10].

When the two models are compared the higher spatial scale of neighborhood satisfaction in the relocation choice as opposed to that in the exit choice stands out. This is as expected, since the former reflects the shared image that is built upon several private evaluations of adjacent home surroundings, which in turn are approximated by the local average in the exit model. Although a centered average for neighborhood satisfaction was tested for the relocation model (as were various spatial scales for this and the reputation-based measure), the non-centered average with fixed boundaries proved superior. This suggests that the shared image pertains to homogeneous sections within the administrative neighborhood, rather than on a distance-profile. The spatial scale of the reputation-based measure (an administrative neighborhood contains from one up to nine boxes) makes sense, since administrative boundaries tend to be the scale at which information on the neighborhood is presented in the public opinion, official statistics, real estate listings and media coverage, exactly the type of costless content on which the external view is built.

The empirical validation of some of the predictions from the spatially-based reputation and expectations new light on the literature of sales space in housing economics, not only in the sense that cognition (as witnessed by the explanatory power of subjective survey scores) starts to plays a role in relocation, but also in the fact that the external view is built. To clarify this non-binding nature: unlike a house-buyer a social renter need not base its relocation choice upon the price, because he or she doesn’t incur financial losses when the shadow price understates the private evaluation of the location quality.

A potentially more serious issue is that owner-occupiers and private renters might use prices and rents as signals for the name of the area. This has no bearing on their relocation choice, since individual behavior has a limited impact on the average house price or rents in the area. On the macro-level however a higher housing demand increases the average house price and rent, but also the income, educational achievement and ethnic status of the population. These social circumstances could feed back into the location choice [12]. The circular relationship between the dependent variable and some of the explanatory variables is recognized in some housing market models [13], but only in the sense that hidden attributes (e.g. the reputation of the area) and house prices are determined simultaneously. To counter this endogeneity, alternative estimation techniques than those in current use are needed. It remains a question whether results from the rented market in the Netherlands carry over to the owner-occupied market in other countries. Quantitative evidence from the Budapest housing market shows that well-informed intra-urban movers buy into good spots in ill-reputed areas at a ‘discount’, whereas ill-informed long-distance movers are drawn by the ‘status’ or ‘prestige’ of the area [14].

4. RACIAL AND INCOME SEGREGATION

An outcome of residential mobility that is often viewed as socially undesirable is geographical segregation based on ethnicity, class or income. This issue has been studied intensively within the realm of computer simulations, pioneered by Schelling [15]. In his and various follow-up models agents of two (and sometimes three) groups are randomly distributed on a two-dimensional grid, with a number of empty boxes as alternative locations. For each occupied box ‘happiness’ is measured by counting the number of same-group nearest neighbors. ‘Switching’ occurs when happiness falls below a certain threshold and if the agent is able to find an empty box where it will be happy. When it does, the next unhappy agent switches boxes until no relocation is either needed or beneficial.
What Schelling wanted to show, is that even with modest preferences for same-group neighbors, segregation emerges almost as an inevitable outcome. As an illustration of the way in which the social evaluations of the location quality enter residential mobility, I will append Schelling’s Tipping model with spatially-based decision rules for relocation.

The simulation follows the algorithm presented in Pollicott and Weiss [16]. A 20 by 20 grid is constructed, where 180 boxes are occupied by sites labeled 1 (or white), 180 boxes by sites labeled -1 (or black) and 40 empty (or grey) boxes labeled 0. Happiness is counted on a Von Neumann neighborhood with four neighbors (south, west, north and east), three neighbors on the edges and two neighbors in the corners of the grid. With moderate preferences for same-group neighbors the happiness rule means that half of them must be of the same color, whereas this proportion changes to one-third for weak preferences. In the standard Tipping model unhappy agents switch to empty boxes where the same happiness rule applies as in the vacated one. According to the spatially-based model the relocation rule is different from the happiness rule, since the conditions for the exit and relocation choice are not the same. As variations of the standard Tipping model I consider an image- and a reputation-based decision rule in the search for an alternative:

1. The relocation rule is calculated on a third-order contiguity Von Neumann neighborhood (with 24 in stead of 4 neighbors). Proper adjustments in the rule are made for boxes with less than 24 neighbors. The larger spatial scale of the relocation rule reflects the use of less exact information on happiness at the new location in image-based search.

2. Agents of the white group are confronted with designated areas (7 by 7 boxes) where the relocation rule is less strict or stricter. These areas describe neighborhoods that have a ‘white’ or ‘black’ reputation, creating an autonomous preference or dislike among white agents for relocation to these areas. The non-binding nature of reputations means that only the white group is affected by the change in the relocation rule.

Figure 3 shows the results for the Tipping model with and without the image-based relocation rule. With moderate same-group preferences the relocation rule leads to slightly more segregation, whereas desegregation increases marginally when same-group preferences are weak. This outcome is similar to that reported by Laurie and Jaggi [17], but the mechanism is different from that described by these authors. They expand the ‘vision’ of agents: the number of neighbors used to calculate ‘happiness’ at the old and new location. An increase in ‘vision’ leads to greater tolerance for first-order neighbors of a different color when agents have weak preferences or live in predominantly same-group areas, causing them to switch less. With moderate preferences unhappy agents switch more often, shunning border regions and creating more segregation. With image-based relocation the incidence of switching doesn’t change compared to the standard model, yet the likelihood of an agent of the same color filling a vacated box is greater when preferences are weak. With moderate preferences, agents returning to vacated boxes are mainly of the opposite color, leading to segregation. Image-based relocation does not alter the main gist of Schelling’s Tipping model: a tendency to segregate even with modest preferences for same-group neighbors.

Figure 3 Schelling’s Tipping model with image-based search

Initial configuration

Standard model; moderate same-group preferences

Model with image-based relocation; moderate same-group preferences

Standard model; weak same-group preferences

Model with image-based relocation; weak same-group preferences

Matters become more interesting with the reputation-based relocation rule for two reasons (see figure 4). In equilibrium the 7 by 7 areas designated as black (shaded region in the southeast quadrant) and white (in the northwest quadrant) have become predominantly black or white. The main vehicle here is white relocation that shows a directional bias: white agents are more likely to leave the black area and to relocate in the white area, mimicking ‘white flight’. This asymmetry creates room for black agents to relocate to the black area and less room for them to relocate to the white area. Another feature of reputation-based search is that no white islands (areas surrounded by opposite group neighbors) remain in the black area, whereas the opposite does occur. With a Von Neumann neighborhood the first type of configuration is unstable due to the autonomous dislike among white agents for relocation in black areas. Reputation then increases the number of same-group relocations to and from areas designated with either favorable or unfavorable reputations, even with weak preferences for same-group members, making the content of the reputation something of a ‘self-fulfilling prophecy’.
This paper has considered some theoretical and empirical shortcomings of the neo-classical approach in housing economics. Spatial considerations during the search stage affect the relocation choice and through it the determination of house prices or market rents, and should be built into the housing market models. The dynamics of spatially-based relocation were illustrated by appending Schelling’s Tipping model for segregation with different relocation rules. Although simulations can’t substitute for real-life observations and the technique was used here to illustrate an idea, taken together with the evidence on the role of reputations in the relocation choice of social tenants the outcome of the simulation with a reputation-based relocation rule sheds new light on policy choice of social tenants and the outcome of the simulation with a reputation-based relocation rule sheds new light on the outcome of the simulation with a reputation-based relocation rule sheds new light on the evidence still points at the fact that voluntary relocation of low-income households to high status areas seems a much more promising way to combat geographical segregation than trying to attract high-income households to ill-reputed areas.

5. DISCUSSION

The success of programs that increase housing supply as a means to attract high-income households to poorer areas is dependent upon a simultaneous increase in reputation of the area. If the name of the formerly ill-reputed neighborhoods doesn’t improve, households who live elsewhere are less willing to relocate there. A stagnant reputation may also prevent rises in house prices, although the researchers admitted that higher occupancy levels and better maintenance might have contributed to this [18]. Accepting that the encountered price-effect was unrelated to the influx of some poorer households, the evidence still points at the fact that voluntary relocation of low-income households to high status areas seems a much more promising way to combat geographical segregation than trying to attract high-income households to ill-reputed areas.

LITERATURE


