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ABSTRACT
The importance of physical resources in influencing life chances makes the study of resource allocation processes and rules especially pertinent and this leads naturally to the question: who gets what and why?

This article focuses on the significance of housing construction for residential mobility and addresses the vital question: who will gain from new construction? It examines whether it is possible to build directly for well-resourced households and hope that it indirectly also supports lower income households. It also examines the possibility that changes in the way in which the housing market operates with market-driven construction, geared at a post-modern housing lifestyle, have changed the situation for less well resourced households, compared to traditional housing construction.

The study is based on a unique longitudinal database that covers the total population in Sweden over the period 2000–2002. The data are analysed using a Markov chain model that provides a way of analysing the relationship between vacancies in the housing market and household mobility. Tentative answers to questions on the length of the vacancy chains that are created when different types of dwellings become vacant in Stockholm city and what type of households are involved and not involved, are given. These answers have important implications for urban planning.

KEY WORDS: Vacancy chains, Markov models, housing, Sweden

Introduction
The Stockholm region is the largest metropolitan area in Sweden with 1.8 million inhabitants, or 20 per cent of the total population. It is also the fastest growing region being a hub of economic growth and a magnet for migrants (especially young people) from other parts of the country.

Inevitably, this gain of inhabitants has far-reaching effects on the social and economic sustainability of the region, not least in the housing market. Prices of owner occupied dwellings increase and few vacancies occur in the rented sector. A growing
The increasing lack of available dwellings in this growth region is affecting the formation of new households, the functioning of the labour market and the long-term conditions for a growth in the economy. The problem can be addressed either by an increased production of dwellings or a more efficient use of the existing housing stock. If the problem is tackled through new construction, one burning question is the mix of dwelling types and their characteristics. Should we in the first instance build dwellings for those households that have a politically recognized need for a new dwelling, or should we be content with the possibility that today’s more exclusive construction indirectly will generate a supply of available dwellings in the housing market for economically weaker households? Of vital importance for the answer to this question, and moreover for the efficient use of the housing stock, is households’ mobility patterns in the housing market.

The aim of this paper is to analyse the impact of vacancies created by new construction on intra-urban residential mobility and to provide an answer to the question: who gets what and why?

The article starts with a short examination of the reasons why people move, followed by an overview of the vacancy chain process, as well as the use of Markov chain models, their functions and limitations. It ends with a case study about residential mobility in Stockholm city. By simulating the vacancy chains arising from new construction in Stockholm it is possible to assess how new resources are distributed in the housing market and so who gains from new construction.

Of special interest is the length of chains initiated in different sectors of the housing market. The crucial questions are: can we expect longer chains from vacancies initiated in large and expensive dwellings and can we expect households to benefit more from these vacancies? And is the housing market characterized by mutual bilateralism in interaction among states (uniform pattern)? In that case there are few reasons to build for less well-resourced households, but with a manifest demand for housing. They can gain from a market-determined construction of dwellings for well-resourced households.

**Why do People Move?**

Mobility is an aspect of a household’s career in the housing market, caused by reasons such as changes in household composition and income. These moves can be regarded as a product of the accessibility to different types of housing and households’ demand for housing. The size and composition of the housing stock, the location of dwellings in relation to workplaces and services, together with the transport network, constitute the framework within which households compete with each other in the search for housing on the basis of preferences and spending power.
Some factors that affect the propensity to move are quite stable throughout the lifetime, while others are related to particular stages of the lifecycle, including the completion of education, entry to the labour market or retirement. Marriage and divorce also frequently prompt households, or members of households, to move (Morrison, 1973; Dieleman, 2001; Dieleman and Mulder, 2002).

The latest research within the area of regional and residential mobility has dealt with the elaborate process that lies behind the decision to move when several household members are involved in the decision, and with relationships between residential and workplace location (Nordvik, 2001). High transaction costs may lead to a household postponing adjustments to its housing consumption in response to changes in prices, preferences or household composition. Limitations in the housing market give rise to a low correlation between housing preferences and actual housing choices (Gär ling & Friman, 2002).

The relationship between housing construction and residential mobility is both an empirically and theoretically fascinating question. Research about residential mobility – theoretical as well as an empirical – assumes that social and economic mobility is going hand in hand with geographical mobility. The high correlation among social, economic and geographical mobility can be explained by the dwelling’s complexity as a good and its intimate connection to the socio-economic, political and physical neighbourhood. A dwelling utilizes not only a person’s basic need of a shelter, security, independence and welfare, it is also an indicator of the social position and differences in disposable income between households. When someone rents or buys a dwelling, they purchase not only the physical unit but also a certain neighbourhood and with specific accessibility to services. A change in household incomes is often manifested in a residential move. At the same time there are households with low incomes more mobile than households with higher incomes. One explanation for this pattern is that the latter group is much more likely to be living in owner-occupied single-family houses, a type of housing with relatively low mobility.

Economic growth tends to increase residential mobility, as has been demonstrated in a number of US studies, although the precise mechanism by which this occurs is uncertain. Myers et al. (1997) concluded that economic growth results in greater mobility because rising private incomes facilitate the entry into the housing market for new households and also enable existing households to improve their housing conditions by moving. Other explanations for mobility include alienation and a culture that encourages mobility. A specific issue is the role that new construction plays as a means of generating mobility in the local housing market. Sands (1990) makes the same observation in a study of Detroit, where the economic situation was found to have an important impact on household mobility. The effects, however, vary across different kinds of households. Single-person households, with their naturally high mobility, are affected less by changes in property throughout the economic cycle than are married or cohabitating couples.
Residential mobility is also related to other characteristics in the urban fabric, such as the age of housing stock, the age composition among households in the local market (i.e. the share of mobile young individuals) and the extent of regional mobility. Regions with strong economic growth have an in-migration of young individuals and at the same time high levels of new construction. Elderly, well-established households are less inclined to move and are thus less inclined to create vacancies in the local housing market.

New conditions in the Swedish housing market

The conditions for choosing and exchanging dwellings have changed in Sweden over the past ten years. Housing expenditures have increased considerably and are now ranked as the highest in Europe in terms of expenditures as share of disposable income. The waiting time for a (rent controlled) flat has increased, while young adults tend to stay much longer in their parental homes. Homelessness has also increased at the same time (National Board of Health and Welfare, 2006). Housing consumption has also evolved into a matter of lifestyle choices – possibly as a result of increasing income inequality between households.

Not only have the economic conditions changed on the housing market, so has the housing supply. The large-scale housing construction programmes in Sweden are over and will not resume in the foreseeable future. Over the last few years, only 10–15,000 dwellings have been built annually, as compared to over 100,000 at the beginning of the 1970s. In fact, we have to go back as far as the turn of the past century to find a situation with a comparably low housing construction. Many of the dwellings produced are for particular groups, such as students, older people or people with disabilities. The rest are often targeting well-off households with very specific demands for environmental and technical design. They are mostly co-operative dwellings that require a substantial down-payment. Very few rented dwellings are built and the Swedish legal framework does not permit flats to be owner-occupied (Turner, 2001).

With an increasing shortage of dwellings in the growth areas, the present situation with a low construction volume and the construction of the ‘wrong’ type of dwellings, criticism is abundant. It is argued that this type of construction in different ways is crowding out construction that is targeted on poorer households. These are households without a primary contract (as opposed to a sub-lease); young individuals who are prepared and eager to leave their parental home and a large number of predominately young individuals from other parts of the country who want to move to the growth regions to study, work or simply to follow a particular life-style.

The defenders of today’s exclusive and market-determined construction argue that such construction facilitates mobility throughout the housing market. They argue that an exclusive production can accommodate the needs of well-off households and, at the same time, free-up second-hand dwellings, which can be used by poorer households.
Even if new construction always is bound to be a small part of the total housing stock, it is nevertheless important to create mobility within the stock. New construction is in many cases necessary to create the mobility that enables many households to take a step upward on the housing ladder. Residential mobility and a turnover of dwellings can also be created in other ways, for example through regional mobility or death leading to the dissolution of a household. Research has shown, however, that new construction is more efficient in creating mobility within the stock than regional mobility and deaths (see, for example, Bysveen & Knutsen, 1987; Magnusson, 2000).

**Embedded First-order Markov Chains with Absorbing States**

Allocation of housing is a social process and empirical studies have revealed that *vacancy chains* appear to organize a variety of social processes (Chase, 1991, p. 133; Spilerman, 1972). In a vacancy chain process, a vacant unit enters the system. The vacancy is taken by an individual who leaves his or her previous dwelling empty, which is taken by the next individual who in turn leaves his dwelling empty, and so on. In this vacancy chain process, the vacancy works both directly – the first move – and indirectly – the subsequent moves – to provide opportunities for individuals. Resource allocation is normally a zero-sum game in which only one can gain and all others lose, at least where the Pareto efficient criterion (whereby no one can be made better-off without someone else being made worse-off) is met (Spilerman, 1972).

Markov chain models provide one particular way of analysing the relationship between vacancies in the housing market and household mobility. One of these models will be used in the following case study of Stockholm.

Markov chain models can be described as socio-demographic accounting models that simulate the flow of housing opportunities. The models are not primarily concerned with the motives and attributes of people who move, but seek to identify the macro-structural processes in housing markets which create and constrain the availability of opportunity for choice.

A vacancy chain defines the sequence of moves a vacancy takes from an initial state to a final absorbing state. Vacancy chains in a human system take considerable time, mostly because people are geographically scattered.

In an embedded first-order Markov chain model, only the current position matters for the next step taken by the vacancy. Embedded implies that clock-time is not an issue in the model, i.e. time spent in a state is ignored. Of interest, instead, are the possibilities for a vacancy to make a transition from one state to all other states. Absorbing means that all chains will meet an end. The vacancies, not the households, are in focus in a vacancy chain, since the vacancy has to exist before a household can start to move.

Vacancies move, with a definite probability, between states or positions that are defined by different attributes. The model assumes stable probabilities in all steps.
and also homogeneous states (explained below). That important assumption has been tested by Magnusson (1994) and found to satisfy reasonable demand for stationarity.

Vacancy chains, as a system for distribution as well as transition probability matrices in different vacancy chain systems, show common properties. Chase reaches an important conclusion that ‘vacancies usually move to other positions within the same state or they move downward one or sometime two states in status. Vacancies rarely move to higher ranking states and vacancies are most often absorbed from low-ranking states’ (1991, p. 140). From a household perspective this conclusion implies upward mobility, usually in small to moderate jumps. These conclusions are valid for mobility in the labour market as well as the housing market. The crucial issue here is the definition of upward and downward moves. The definition is not simple and is sometimes confused with housing careers. Upward and downward moves on the housing ladder involve changes in the standard or quality of housing occupied. In contrast the concept of housing career is neutral and tells only the housing history of an individual (Abramsson, 2003).

**Formalizing the vacancy chain process**

The Markov model simulates the intersectoral transfer and absorption of vacant housing opportunities as a function of vacancy creations. The following section is based on Emmi and Magnusson (1994) and Magnusson (1994).

Vacancies in the housing market arise when: a) new dwellings are built; b) households leave the market due to regional displacement; and c) households die or dissolve. The model is based on accounting equation 1. It states that the total number of vacancy transfers in each sector (n') equals those that are transferred to it from other sectors (N'T) plus those added at its margin by vacancy creating events (n'_c). In the following equations the sign ('') indicates a row.

\[ n' = 1'N'T + n'_c \]  

(1)

The accounting statement can be made into an analytical model by using intersectoral vacancy transfer probabilities. This requires three assumptions about the nature of vacancy transfers:

1. Housing sectors are defined in a way that vacancies in any given sector are governed by transition probabilities that are approximately the same for all vacancies in that sector.
2. Vacancy transition probabilities remain constant during any simulation or forecast period.
3. Vacancy transfers are dependent only upon the sector of their present occupancy and are independent of any prior history of transfers – quite simply that vacancies are without memory.
With the assumptions of (1) homogeneity, (2) stationarity and (3) markovicity, a matrix of vacancy transition probabilities \( P \) can be introduced (equation 2). It identifies the probabilities upon transfer of a vacancy in any given sector being transferred to all other sectors.

\[
n' = np + n'_c
\]  

(2)

Substituting transition probabilities into the accounting statement transforms that statement into an analytical model (equation 3). But this formulation fails to isolate the total volume of transfers to one side of the equation.

\[
(I - P)n' = n'_c
\]  

(3)

The unknown vector is found by using either of two equivalent methods – a power expansion series or matrix inversion (equation 4). Mathematically, the solution by matrix inversion is more elegant, but, for explanationatory purposes, the power expansion series better expresses the fundamental mechanics of the forward reaching vacancy chain:

\[
n' = n'_c(I + P + P^2 + P^3 + ...) = n'_c(I - P) - 1 = n'_cM
\]  

(4)

\( In'_c \Rightarrow \) number of moves from an initiating state direct to an absorbing state

\( Pn'_c \Rightarrow \) number of moves from \( i \) to \( j \) direct

\( P^2n'_c \Rightarrow \) number of moves from \( i \) to \( j \) via \( k \)

\( P^3n'_c \Rightarrow \) number of moves from \( i \) to \( j \) via \( k \) and \( l \)

Once available, a vacancy may be transferred repeatedly. However, upon each transfer, a vacancy is exposed to a positive and often large probability of being absorbed. As argued above the chances of its continuing to circulate after one or two transfers diminish rapidly. The sum of the accumulating but ever declining probabilities of successive transfers define a new matrix \( M \) called alternatively the Markov multiplier matrix and the fundamental matrix of a Markov chain. Its elements define the expected fractional number of times a vacancy initiated in any sector \( i \) ever visits any sector \( j \) before absorption. Its elements equal the sum of the probabilities of going from \( i \) to \( j \) in one or more steps. The row sums of \( M \) (\( m \)) define sector-specific vacancy chain lengths – the number of dwelling units involved in the vacancy chains initiated by vacancy creations in sector \( i \).

Newly created housing opportunities induce a chain of vacancy transfers captured by the Markov multiplier matrix. These, plus the absorption probabilities, define
the expected number of vacancies transferred to each absorbing state (equations 5 and 6).

\[ m = M * 1 \]  \hspace{1cm} (5)

\[ n'_a = n'_c M(p_a)_{dg} \]  \hspace{1cm} (6)

Vacancy transfers are the algebraic transposition of intra-urban household moves. A forecast of the vacancy transfers is an implicit forecast of intra-urban residential mobility. Here mobility is not represented as the outcome of independent and autonomous households exercising rational choice between housing alternatives. It is represented as a process whose realization depends explicitly upon the creation and subsequent diffusion of opportunities within a commodity hierarchy. Intra-urban residential mobility is portrayed as the outcome of an interdependent and simultaneously determined stochastic process that is deeply embedded within the sectoral dimensions of an urban housing market and in the intergroup relations these reflect.

In related papers, Emmi and Magnusson (1995a, 1995b) assess the five-year projection accuracies of a six-sector Markov chain model calibrated on each of three different municipalities. They find that projection error is limited to between 4 and 9 per cent of total variation. The models are between 91 and 96 percent accurate over a five-year projection period. Using eight- and ten-sector models, Magnusson (1994) finds the models to be between 92 and 95 per cent accurate over the same five-year projection period. This level of accuracy suggests that the intersectoral diffusion of vacant housing opportunities effectively capture the most important aspects of intra-urban residential mobility.

Patterns of interaction

The systems of interactions between states are complex. However, some general patterns are created in the housing market. As shown in Emmi and Magnusson (1994), the state interactions can be organized in three archetypal patterns (Table 1).

The block-diagonal pattern (A) describes a situation of severe market segmentation. Examples of low interaction between states can be found in many European cities with highly attractive inner city areas and less attractive suburban areas. Vacancy transfer between these blocks of states is infrequent. The triangular pattern (B) characterizes a hierarchical relationship of domination, subordination and unilateral state interaction. In these unbalanced relations, vacancies are transferred mainly in only one direction. In an extreme situation vacant housing opportunities can only be cleared from the housing market by transfer to an absorbing state, i.e. new households or demolition. The uniform pattern (C) describes a housing market with mutual bilateralism in interaction among states and housing promotes social objectives rather than economic

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Who Gets What and Why?

Table 1. The intensity of state interaction categorized as high, medium and low

<table>
<thead>
<tr>
<th>Origin</th>
<th>State 1</th>
<th>State 2</th>
<th>State 3</th>
<th>State 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>State 1</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>State 2</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>State 3</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>State 4</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

- a) Block-diagonal pattern
- b) Triangular pattern
- c) The uniform pattern

objectives (Emmi & Magnusson, 1994). In most urban areas interaction between states on the housing market is complex and combines the archetypal patterns described above.

Chase and DeWitt (1988) discuss interaction in a resource system from a socio-economic perspective. They emphasize that allocation of resources through vacancy chains have both indirect and direct consequences. They give some examples: chains move through resource systems in orderly ways to provide mobility of certain types of individuals but no other types of individuals. They continue: ‘chains started with high-status resources units tend to provide mobility for individuals with a broad range of previous units as the chain flow from the top to the bottom of a resource system, but chains started with low-status units provide opportunities only for individuals at the bottom of the system’ (Chase & DeWitt, 1988, p. 85). At the same time, chains tend to follow segments in the resources system and only to a limited extend cross the boarder of a segment, for example chains started in a suburb do not continue to the city centre and vice versa.

Vacancy Chains in the Housing Market – the Case of Stockholm

One way to describe and analyse the relation between the supply of vacant dwellings and the household mobility is to trace the chain of vacancies followed by primary vacant dwellings. The following case study concerns the interplay between structure of the housing market and household mobility in Stockholm city between 2000 and
2002. The purpose is to give tentative answers to questions such as the length of vacancy chains that arise when different types of dwellings become vacant and which households are involved in the vacancy chains, i.e. who gets what.

Data and method

The empirical base for the study consists of data collected by Statistics Sweden (SCB) and stored in a comprehensive and a unique, longitudinal database named Geoswede. The database includes data for selected variables for the period 1990–2004 for all 10 million plus individuals who at some point during the period resided in Sweden and were registered in the Swedish social security system. Important variables are related to the dwelling (type of building, type of owner, geographical location) and the households’ resources (disposable income, education, etc.). However, the latest data for dwellings are for the year 2002.

Between year 2000 and 2002, about 2,000 vacancies were created in the city of Stockholm due to new construction. Vacancies in the housing market were furthermore initiated through household death, dissolution and outmigration. However, these ways of initiating vacancies are not analysed in this case study. The number 2,000 is estimated from Geoswede by year of construction (2000, 2001 or 2002). The amount of new dwellings 2000–2002 is limited compared to the total stock of dwellings in Stockholm, the additional contribution over three years being just 0.5 per cent.

From the database Geoswede, vacancies being created between 2000 and 2002 and households who have moved during the same period have been identified. The households are assumed to have moved just once between 2000 and 2002.

A critical issue in Markov chain models is the definition of states. When states are to be defined, the assumption about stable transition probabilities has to be fulfilled, i.e. states has to be homogenous. But the definition of states must also be as factually logical as possible. In other words, it is necessary to find a balance between statistical significance and the possibilities of interpreting results in terms familiar in notions of the housing market. In principle, the best way to define homogeneous states is to include all relevant dwelling attributes. But all attributes cannot be included for practical reasons. It is necessary, therefore, to find some strategic variables. In the present study, states are defined using variables proven theoretically and empirically to be relevant in previous research and also accessible in the database – with the exception of dwelling size and recurrent dwelling costs which are not in the base. The definition of states therefore reflects mobility when states are defined by form of tenure, structure type and location. The following states are defined (the abbreviations appear in parenthesis):

- Single-family house, co-operative (Sc)
- Single-family house, owned (So)
- Multi-family house, private rented (Mr-priv)
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- Multi-family house, co-operative (Mc)
- Multi-family house, public rented (Mr-pub).

Additional states are defined as absorbing, i.e. states where the vacancies meet an end. The following absorbing states are defined (abbreviations appear in parenthesis):

- Newly formed families from Stockholm city (local new)
- Newly formed families from outside Stockholm city (new)
- In-migration to Stockholm city (inmove).

States where vacancies are initiated are labelled ORIGIN and states to where they are transferred are labelled DESTINATION.

Findings

In Table 2, the absolute numbers of vacancy transfers are presented. The column Total reports the total number of vacancies initiated in each state. More than two-thirds of all vacancies were initiated in the state with co-operative dwellings in multifamily houses (Mc). Another 13 per cent were initiated in the state with public rented dwellings in multi-family houses (Mr-pub). Less than 10 per cent were initiated in each of the other states.

One-third of the primary supply is immediately claimed by families moving to Stockholm city from other local housing markets (inmove), and by newly formed households (local new, new), i.e. the vacancy was initiated and absorbed in the next step. This implies that the primary supply of dwellings does not contribute to a turnover on the housing market and has no secondary effects. Table 3 shows the probability for a vacancy initiated in different states in the housing market to take a step to another state or to take a step to an absorbing state (family formation and in-migration).

Depending on in which state the vacancy is initiated, the probability for immediate absorption varies between .21–.41; the highest probability is found in states with

Table 2. Absolute number of vacancy transfers

<table>
<thead>
<tr>
<th>Origin</th>
<th>Sc</th>
<th>So</th>
<th>Mr-priv</th>
<th>Mc</th>
<th>Mr-pub</th>
<th>Local new</th>
<th>New</th>
<th>Inmove</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sc</td>
<td>15</td>
<td>14</td>
<td>20</td>
<td>28</td>
<td>26</td>
<td>12</td>
<td>12</td>
<td>32</td>
<td>159</td>
</tr>
<tr>
<td>So</td>
<td>3</td>
<td>33</td>
<td>12</td>
<td>23</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>18</td>
<td>99</td>
</tr>
<tr>
<td>Mr-priv</td>
<td>0</td>
<td>2</td>
<td>78</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>6</td>
<td>13</td>
<td>108</td>
</tr>
<tr>
<td>Mc</td>
<td>7</td>
<td>144</td>
<td>176</td>
<td>376</td>
<td>106</td>
<td>92</td>
<td>97</td>
<td>373</td>
<td>1371</td>
</tr>
<tr>
<td>Mr-pub</td>
<td>0</td>
<td>9</td>
<td>65</td>
<td>53</td>
<td>76</td>
<td>11</td>
<td>9</td>
<td>53</td>
<td>276</td>
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<tr>
<td>Total</td>
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<td>484</td>
<td>213</td>
<td>120</td>
<td>129</td>
<td>489</td>
<td></td>
</tr>
</tbody>
</table>

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Table 3. Vacancy transition probabilities (P: P^a)

<table>
<thead>
<tr>
<th>Destination</th>
<th>Sc</th>
<th>So</th>
<th>Mr-priv</th>
<th>Mc</th>
<th>Mr-pub</th>
<th>Local new</th>
<th>New</th>
<th>Inmove</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sc</td>
<td>.09</td>
<td>.09</td>
<td>.13</td>
<td>.18</td>
<td>.16</td>
<td>.08</td>
<td>.08</td>
<td>.20</td>
<td>1.00</td>
</tr>
<tr>
<td>So</td>
<td>.03</td>
<td>.33</td>
<td>.12</td>
<td>.23</td>
<td>.04</td>
<td>.01</td>
<td>.05</td>
<td>.18</td>
<td>1.00</td>
</tr>
<tr>
<td>Mr-priv</td>
<td>.00</td>
<td>.02</td>
<td>.72</td>
<td>.04</td>
<td>.01</td>
<td>.04</td>
<td>.06</td>
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<tr>
<td>Mc</td>
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<td>.08</td>
<td>.07</td>
<td>.07</td>
<td>.27</td>
<td>1.00</td>
</tr>
<tr>
<td>Mr-pub</td>
<td>.00</td>
<td>.03</td>
<td>.24</td>
<td>.19</td>
<td>.28</td>
<td>.04</td>
<td>.03</td>
<td>.19</td>
<td>1.00</td>
</tr>
</tbody>
</table>

The table presents the probabilities of moving from one housing market state to another. The highest probability of vacancy transfer is within the co-operative single-family houses (Sc) and multi-family houses (Mc), and the lowest in privately rented multi-family houses (Mr-priv). About 25 per cent of all vacancy chains end when families move to Stockholm from other local housing markets (inmove). Another 5 per cent end when a new family from Stockholm, lacking its own residence, enters the housing market (local new). This can be a result of divorce or of youngsters moving from the parental home to their first own home. An additional 5 per cent end when a new family from outside Stockholm housing market lack a residence move to Stockholm (inmove). Once absorbed, the chain of vacancy transfers is ended and the vacancy disappears from the system.

However, a vacancy initiated in Stockholm City between 2000 and 2002 has a considerably high probability for transfer between states. For example, a vacancy initiated in a privately rented multi-family house (Mr-priv) has a 0.72 probability for transfer within that state. A vacancy initiated in an owned single-family house (So) has a high probability of transfer to a single-family house or to a co-operatively owned multi-family house (Mc).

Once transferred, a vacancy may transfer over and over again. The vacancy chain is simulated by determining the probabilities of going from state i to state j in one, two, three or more steps and then taking the sum of this series of probabilities. The matrix presented in Table 4 defines the probabilities of going from state i to state j in one step (P). The square of Table 4 defines the probabilities of going from state i (P^2).

Table 4. Markov multiplier matrix (M = \sum P^a) and vacancy chain length (m = M*1)

<table>
<thead>
<tr>
<th>Destination</th>
<th>Sc</th>
<th>So</th>
<th>Mr-priv</th>
<th>Mc</th>
<th>Mr-pub</th>
<th>Total</th>
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<tbody>
<tr>
<td>Sc</td>
<td>1.1</td>
<td>.3</td>
<td>1.1</td>
<td>.5</td>
<td>.3</td>
<td>3.4</td>
</tr>
<tr>
<td>So</td>
<td>.1</td>
<td>1.7</td>
<td>.2</td>
<td>.7</td>
<td>.2</td>
<td>3.8</td>
</tr>
<tr>
<td>Mr-priv</td>
<td>.0</td>
<td>.2</td>
<td>3.9</td>
<td>.3</td>
<td>.1</td>
<td>4.4</td>
</tr>
<tr>
<td>Mc</td>
<td>.0</td>
<td>.3</td>
<td>1.0</td>
<td>1.6</td>
<td>.2</td>
<td>3.1</td>
</tr>
<tr>
<td>Mr-pub</td>
<td>.0</td>
<td>.2</td>
<td>1.6</td>
<td>.5</td>
<td>1.5</td>
<td>3.8</td>
</tr>
</tbody>
</table>
Who Gets What and Why?

... to state $j$ in two steps, and the cube defines the probabilities of going from state $i$ to state $j$ in three steps. The sum of this infinite series of matrixes raised to increasingly higher power is referring to as Markov multiplier matrix (M). Its elements define the expected fractional number of times a vacancy initiated in $i$ will visit $j$ prior to absorption. In Table 4 the Markov multiplier matrix for the about 20,000 vacancies initiated in Stockholm city 2000–2002 is exposed.

The analysis of vacancy chains is intended to show the overall pattern of housing turnover in a housing market. The average length of the chain, regardless of housing submarket, was about 3.7 links, i.e. for every vacant dwelling 3.7 families moved.

The average length of the vacancy chains appearing in different sectors of the housing market varied by between 3.1 and 4.4 links, i.e. for every vacant dwelling, between 3.1 and 4.4 families moved. Vacancies initiated in a private rented multi-family house ($Mr$-priv) gave the longest vacancy chains and in co-operatively owned multi-family house ($Mc$) the shortest. However, the length of chain also varies considerably by dwelling size. Lack of information about dwelling size is one source of uncertainty in the findings.

Length of vacancy chains does also vary by location. To assess the impact of vacancies initiated in different geographical locations, the Markov chain model must be disaggregated. Three areas are defined – the inner city, the suburb dominated by public housing and suburbs with a mixed housing stock. The assumption behind this division is that different housing sectors are involved when vacancies are initiated in inner city or suburban areas. The division also reflects the structural barriers families face when adjusting their housing consumption. A vacancy initiated in the inner city might never reach the suburb and vice versa. The idea here is to test the block diagonal pattern presented in Table 1A. The result from the disaggregated Markov chain model is presented below in Tables 5 and 6.

Table 5a, b, and c show the vacancy transition probabilities for vacancies initiated in the inner city respectively the suburbs. In the inner city, vacancies are initiated in only a few sectors on the housing market – mainly co-operative and rented, and just a few owners. The definition of states has been adjusted according to where vacancies are initiated, even if they are transfers to other states. The reason is technical – the matrix has to be $n \times n$. In the inner city, two states are defined – Coop/Owned (co-operative and owned respectively) and Rented (rented). In the suburbs, vacancies are initiated in all previously defined sectors of the housing market. Table 6a, b and c shows the vacancy chain length.

The average chain length in the inner city, despite origin and destination, is 2.9, in suburban areas with a mixed housing stock 3.5, and in suburban areas dominated by public housing 2.2. A vacancy initiated in a co-operative dwelling (mostly in multi-family houses) or in a rented dwelling (mostly public rented) in the inner city (Table 6a) gives three families a chance to move. The vacancy chain also has a tendency to continue within the same state before absorption. The average vacancy chain in a mixed suburb varies between 3.7 and 5.0 (Table 6b). Even if the vacancies initiated in
Table 5. Disaggregated vacancy transition probabilities (P:P*)

<table>
<thead>
<tr>
<th>Origin</th>
<th>Coop/Owned</th>
<th>Rented</th>
<th>Local new</th>
<th>New</th>
<th>Innove</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Inner city</td>
<td>.43</td>
<td>.21</td>
<td>.04</td>
<td>.06</td>
<td>.27</td>
<td>1.01</td>
</tr>
<tr>
<td></td>
<td>.19</td>
<td>.53</td>
<td>.05</td>
<td>.02</td>
<td>.20</td>
<td>1.00</td>
</tr>
<tr>
<td>b) Suburb mixed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Destination</td>
<td>Sc/So</td>
<td>Mr-priv</td>
<td>Mc</td>
<td>Pub</td>
<td>Local new</td>
<td>New</td>
</tr>
<tr>
<td>Sc/So</td>
<td>.31</td>
<td>.11</td>
<td>.20</td>
<td>.09</td>
<td>.04</td>
<td>.05</td>
</tr>
<tr>
<td>Mr-priv</td>
<td>.02</td>
<td>.75</td>
<td>.03</td>
<td>.01</td>
<td>.03</td>
<td>.05</td>
</tr>
<tr>
<td>Mc</td>
<td>.16</td>
<td>.13</td>
<td>.24</td>
<td>.12</td>
<td>.08</td>
<td>.07</td>
</tr>
<tr>
<td>Pub</td>
<td>.06</td>
<td>.24</td>
<td>.18</td>
<td>.35</td>
<td>.00</td>
<td>.12</td>
</tr>
<tr>
<td>c) Suburb mixed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Destination</td>
<td>Sc/So</td>
<td>Mr-priv</td>
<td>Mc</td>
<td>Mr-pub</td>
<td>Local new</td>
<td>New</td>
</tr>
<tr>
<td>Sc/So</td>
<td>.18</td>
<td>.14</td>
<td>.19</td>
<td>.14</td>
<td>.09</td>
<td>.08</td>
</tr>
<tr>
<td>Mr-priv</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>Mc</td>
<td>.16</td>
<td>.09</td>
<td>.16</td>
<td>.09</td>
<td>.10</td>
<td>.08</td>
</tr>
<tr>
<td>Mr-pub</td>
<td>.12</td>
<td>.06</td>
<td>.23</td>
<td>.35</td>
<td>.00</td>
<td>.04</td>
</tr>
</tbody>
</table>

A specific state to a great extent continue to transfer within the same state, vacancies initiated in suburbs create more opportunities in other states compared to vacancies created in the inner city. For example, a vacancy initiated in a public dwelling (Mr-pub) takes 2.1 steps within the state private rented (Mr-priv) and 0.6 steps within the state multi-family co-operative (Mc) and 1.8 steps within public rented (Mr-pub) before absorption. Turnover in the same state as the vacancy was created is much more common in the inner city. The vacancy chains are shortest in suburbs dominated by public housing. Most transfers are also within the same state. The consequences are low probabilities for a step on the housing ladder, at least when it comes to type of building and tenure.

But do the vacancies transfer between inner city and suburbs? Does new construction in the attractive inner city create opportunities for families in the less attractive suburbs? The answers are evident from Tables 7 and 8. A vacancy initiated in an inner city area has a high probability for transfer within inner city (0.40). The probability to be absorbed by families moving to Stockholm from other regions is also high (0.25). The probability for the vacancy to be absorbed by newly formed families is low (0.09). The probability for transfer to a suburban area is comparable to absorption by in-migrants. A vacancy initiated in a mixed suburb
Table 6. Disaggregated Markov multiplier matrix \( M = \sum P^t \) and vacancy chain length \( m = M^*1 \)

<table>
<thead>
<tr>
<th>Destination</th>
<th>Coop/Owned</th>
<th>Rented</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Inner city</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coop/owned</td>
<td>2.1</td>
<td>0.9</td>
<td>3.0</td>
</tr>
<tr>
<td>Rented</td>
<td>0.8</td>
<td>2.5</td>
<td>3.3</td>
</tr>
<tr>
<td>b) Suburb mixed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sc/So</td>
<td>1.7</td>
<td>1.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Mr-priv</td>
<td>0.2</td>
<td>4.4</td>
<td>0.3</td>
</tr>
<tr>
<td>Mc</td>
<td>0.4</td>
<td>1.4</td>
<td>1.6</td>
</tr>
<tr>
<td>Mr-pub</td>
<td>0.3</td>
<td>2.1</td>
<td>0.6</td>
</tr>
<tr>
<td>c) Suburb public</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sc/So</td>
<td>1.3</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Mr-priv</td>
<td>0.0</td>
<td>1.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Mc</td>
<td>0.3</td>
<td>0.2</td>
<td>1.3</td>
</tr>
<tr>
<td>Mr-pub</td>
<td>0.4</td>
<td>0.2</td>
<td>0.5</td>
</tr>
</tbody>
</table>

has a high probability for transfer within the suburbs (0.53) but a very low probability for transfer to inner city (.12). In other words, new dwellings in suburban areas create additional opportunities for families to move within the suburban areas, but hardly any opportunities for them to move to inner city areas.

A vacancy initiated in inner city takes 1.9 steps within inner city but also 0.9 steps to suburban mixed areas (Table 9). A similar pattern is found in suburban public areas. In suburban mixed areas most of the steps are taken within these areas.

Disposable income has a strong effect on who gets opportunities in the housing market, and especially where. Disposable family income 2002 is here weighted with the equivalized size of the family according to the Statistics Sweden equivalence scale.

Families moving to newly constructed dwellings in inner city areas have a 50 per cent probability for transfer to inner city (.12). In other words, new dwellings in suburban areas create additional opportunities for families to move within the suburban areas, but hardly any opportunities for them to move to inner city areas.

Table 7. Vacancy transition probabilities \( P: P^t \)

<table>
<thead>
<tr>
<th>Destination</th>
<th>Inner city</th>
<th>Suburb mixed</th>
<th>Suburb public</th>
<th>Local new</th>
<th>New</th>
<th>Inmove</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inner city</td>
<td>.40</td>
<td>.20</td>
<td>.06</td>
<td>.04</td>
<td>.05</td>
<td>.25</td>
<td>1.0</td>
</tr>
<tr>
<td>Suburb mixed</td>
<td>.12</td>
<td>.53</td>
<td>.07</td>
<td>.06</td>
<td>.06</td>
<td>.17</td>
<td>1.0</td>
</tr>
<tr>
<td>Suburb public</td>
<td>.07</td>
<td>.22</td>
<td>.32</td>
<td>.08</td>
<td>.07</td>
<td>.24</td>
<td>1.0</td>
</tr>
</tbody>
</table>
higher disposable income compared to families in suburban public areas and 25 per cent higher compared to families in suburban mixed areas. Income differs also between different types of new construction. Families buying co-operative dwellings in the inner city have, as expected, a higher disposable income compared to families buying the same type of housing in suburbs. As a consequence, relatively poor families, i.e. families in the first income quintile (disposable income ppp (purchasing power parity) below 11,800 Euros in 2002) are highly overrepresented in suburban areas, and relatively wealthy families, i.e. families in the fifth income quintile over-represented in inner city area (disposable income ppp above 27,800 Euros in 2002). The differences vary between types of suburb. The proportion of families in the first and in the fifth quintile is more balanced in mixed areas, whereas relatively poor families are over-represented in newly constructed dwellings in public areas.

About 20 per cent of all families moving to newly constructed dwellings between 2000 and 2002 are so-called ‘new Swedes’. Only a small fraction (10 per cent of all) is made up of ‘new Swedes’ moving to newly constructed dwellings in Stockholm’s inner city. All others are found in the suburban areas (mixed and public). However, once entering the attractive inner-city housing market, the residential pattern among families moving to newly constructed dwellings does not show any significant differences (chi square 2.4) between ‘new’ and indigenous Swedes. They are moving to co-operative dwellings and public rented dwellings in the same proportions. The pattern is about the same in suburban mixed areas (chi square 4.8). But in suburban public areas – the residential pattern among ‘new’ and indigenous Swedes shows a significant difference (chi square 124.6). The most conspicuous difference between ‘new’ and indigenous Swedes is a more than three times higher probability for indigenous Swedes to move to co-operative single-family houses, but a 1.5 times higher for ‘new’ Swedes to move to co-operative dwellings in multi family houses.

Conclusions

The allocation of housing is a social process and vacancy chains appear to organize a variety of social processes. The analysis of vacancy chains in Stockholm city

Table 8. Disaggregated Markov multiplier matrix (M = \( \sum P^k \)) and vacancy chain length (\( m = M^*1 \))

<table>
<thead>
<tr>
<th>Origin</th>
<th>Inner city</th>
<th>Suburb mixed</th>
<th>Suburb public</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inner city</td>
<td>1.9</td>
<td>0.9</td>
<td>0.3</td>
<td>3.1</td>
</tr>
<tr>
<td>Suburb mixed</td>
<td>0.5</td>
<td>2.5</td>
<td>0.3</td>
<td>3.3</td>
</tr>
<tr>
<td>Suburb public</td>
<td>0.4</td>
<td>0.9</td>
<td>1.6</td>
<td>2.9</td>
</tr>
</tbody>
</table>
Who Gets What and Why?

2000–2002 demonstrates a housing market with rather long vacancy chains and families benefiting from primary and secondary effects of new construction. But the results also indicate a segmented housing market. Vacancies do not transfer easily between different geographical areas and between housing submarkets.

The vacancies created in the city of Stockholm were primarily initiated in co-operative dwellings in multi-family houses. One-third of the primary supply did not have any secondary effects. Instead it was claimed by families moving to Stockholm city from other local housing markets in Sweden and by newly formed households. However, a vacancy initiated in Stockholm city between 2000 and 2002 had a considerably higher probability for transfer between states and directly affected turnover in the housing market.

The average length of the chain was about 3.7 links. For every new constructed dwelling in Stockholm city, 3.7 families moved. Previous research implies that structure, type and form of tenure have an effect on chain length. Vacancies initiated in owner occupation and in co-operative dwellings give longer vacancy chains compared to vacancies initiated in rented dwellings. But this is not the case in Stockholm city. Rented dwellings in Stockholm in both public and private housing estates produce long vacancy chains. In other words, they create opportunities for families with different resources to move. This result was not expected. Rented dwellings do not always have a position on the top of the housing ladder in Sweden. The explanation is geographical location. Even if housing preferences in Sweden favour owner-occupation and co-operative dwellings, rented dwellings in economically strong areas are in general very attractive (Turner, 2007). New construction in the rented sector creates opportunities for families in the housing market to move, but is not directly accessible for new families due to today’s exclusive and market-determined construction and the associated high rents.

But does new construction in attractive areas create opportunities for families in the less attractive areas? That is a central question in many post-welfare states where new construction mainly adds dwellings to the top segment of the market, and housing needs among economically weak households are supposed to be solved by secondary effects from that construction. The result from the Stockholm case study shows that a vacancy initiated in an inner-city area has a high probability of transfer within the inner city. But the probability for transfer to a suburban household living in public housing is very low. The pattern is the same for vacancies initiated in different types of suburban areas – vacancies do not cross borders between different submarkets, especially not to suburbs dominated by public housing. There are not many possibilities for families living in public housing in suburbs to take a step on the housing ladder to a mixed area or to the inner city.

This study supports a better known pattern – ‘new Swedes’ are twice as likely to move to public housing. Moving to co-operative houses might be a sign for a step up the housing ladder among ‘new Swedes’. Magnusson and Özüekren (2002) have examined how Turkish households adjust their housing consumption to their
needs by making a housing career. That study, considering Turkish households, was conducted in three medium-sized municipalities in the central part of Sweden. Their study reports a strong impact of higher income and increased household size among households moving to larger dwellings and, in some cases, a move from rented into owner occupied single-family houses.

Disposable income has a strong effect on who gets opportunities in the housing market, especially where the prices of co-operative dwellings follow the market and in inner-city areas, which are in principle more attractive then suburban areas. But surprisingly geography does not matter for families moving to newly constructed public housing. The public housing sector may be the one of few heritages from the traditional housing welfare policy. This characterization of public housing in Sweden feeds into a view that this is a tenure form open to everyone, and there is no stigma attached to living in an area belonging to a municipal housing company (the Swedish version of public housing). The results from this study give support to that view – public housing does not add to housing segregation (Magnusson & Turner, 2007).

The housing market is segmented into an inner city market and a suburban market, and vacancies do not transfer in a uniform pattern. There are few pathways from suburbs to the attractive inner city, or in another way, moving between suburbs and the inner city is fenced by invisible walls. And the results support the idea about the block-diagonal pattern shown in Table 1. To create opportunities for families to move from suburb to inner city vacancies have to be initiated in the inner city area. It is not possible to rely on vacancy chains to create these opportunities.

This tentative result is also supported by Harrison (1990), who analysed structural mobility in the labour market. His results confirm that difficulties for some groups to make a career in the labour market were not rooted in the absence of mobility opportunities, but in the lack of established pathways out of low-status occupational employment.

However, these probabilities are approximations. States based only on housing type, tenure and geographical location build in heterogeneity since other important aspects for vacancy transfer are neglected. Nonetheless, the probabilities give some important knowledge about how the housing market is segmented.

**Acknowledgements**

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**Note**

1. A purchasing power parity (ppp) equalizes the purchasing power of families due to number of adults and children.
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Turner, B (2001) Varför bygger det så lite där efterfrågan är som störst? (Why is there so little construction when the demand is so high?), *Ekonomisk debatt*, 2, pp. 117–127.
