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Departure from the Housing Market: Effects on Housing Supply in the Netherlands

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Abstract

The ageing of the population in Western societies leads to an increasing primary supply of housing in the existing stock. Ever more older households leave the independent housing market. For the Netherlands this process is expected to create a larger primary supply of housing than new construction does by the year 1995. Deaths of single persons living independently are the main cause of primary supply in the stock. In this article the composition of this supply is estimated for the Netherlands and compared with new construction. The vacancy chains triggered by the primary supply are evaluated. The characteristics of households who occupy the vacancies are compared.

Introduction

The ageing of the population of western societies has generated a wide interest in all aspects of older people, and in their patterns of housing consumption and residential mobility (Clark and White, 1989; Golant, 1984; 1989). There are now quite detailed studies of migration flows of older people in and between urban areas, and various studies have tried to incorporate the movements of older people in general theoretical frameworks of residential mobility (Preston, 1984; Struyk, 1987; Hooimeyer et al., 1988; Golant, 1989).

From the fact that mobility and housing choice vary over the life cycle it follows that, as the demographic structure of the population as a whole changes, there will be aggregate effects of demographic change on the functioning of housing markets. There have been a number of studies that try to assess these aggregate effects, such as lower mobility rates and different filtering processes (Grebler and Burns, 1988; Rima and van Wissen, 1987; Hooimeyer et al., 1986). But the number of studies in this field is small. On top of that, most of these studies are demand-orientated. As far as we are aware, no research has yet been reported aimed at estimating the supply of dwellings vacated as

a result of household dissolutions. Also, in the related field of vacancy chain analysis, the supply due to household dissolution has been largely ignored, even though it might be the major source of primary supply, triggering off vacancy chains in many local housing markets. Vacancy chain analysis has concentrated on the multiplier effects of new construction (Bourne, 1981; Scholten and Hooimeyer, 1984). Recently however some attention has been paid to the primary supply due to the out-migration of households (Bysveen and Knutsen, 1987; Akiri, 1989).

From a policy point of view, this lack of attention to the supply generated by vacancy chains that are triggered off within the existing stock is surprising. In a recent paper, the Dutch Ministry of Housing declared the mismatch between housing costs and income level in the rental sector to be the major problem in the Dutch housing system. Stimulating moves into the owner-occupied sector, by those renters who can afford it, is seen as the remedy for this problem. In the earliest version rather stringent measures were announced to stimulate first-time buying, including temporary contracts for cheap rental accommodation which end once household income passes a certain level.

This policy has two major drawbacks. First,

there is no guarantee that moves into newly constructed owner-occupied housing will generate vacancy chains which lead to the supply of cheap rental accommodation. On the contrary, existing research (Scholten, 1988) shows that expensive rental dwellings and owner-occupied housing dominate the secondary supply generated by this type of new construction. In particular expensive rental dwellings in high-rise structures are vacated. Second, introducing new levels of control over housing market processes is in conflict with the more general policy of a retreating government. Housing policy in the Netherlands, as in most other European countries, has become more market-orientated. Forcing people out of their dwellings is not viable, unless it is absolutely necessary. Limiting access into inexpensive housing of higher-income households on the other hand is in line with the existing practice. Giving priority in housing allocation to people leaving an inexpensive rental dwelling behind is also not uncommon. Both practices, however, are largely restricted to allocation in the rental sector.

In order to assess the magnitude of the number of vacancies that can be allocated to lower-income households, it is necessary to have an estimate of the number of opportunities that arise within the existing stock. Building inexpensive rental housing is no option at the present price levels and under the present subsidy system. Although one might argue that these estimates can be derived from the present level of turnover in the existing stock, it is our contention that it is worthwhile having a closer look at the mechanisms that create these opportunities. We will show that the number of these opportunities will rise due to demographic causes.

In this article we will discuss the effects of the death of (elderly) one-person households on the supply of dwellings in the Dutch housing market. We will:

- analyse the composition of the primary supply generated from death, as compared to primary supply from new construction;
- analyse the vacancy chains that are initiated by primary supply through death;
- investigate which households benefit mainly from the supply generated by the death of single persons that live independently.

Not reported in this article, but also part of the larger research project, are analyses of the

supply created by moves to institutional forms of residence.

Departure from the Dutch housing market

In the 1960s, when the Netherlands experienced a huge housing shortage, moving to homes for the aged was stimulated, even among relatively young senior citizens. This tendency was counteracted in the 1970s. Older people clearly indicated that they wanted to live independently as long as they could. Also the costs of institutional forms of residence turned out to be high. Rather than cutting levels of care (which was delayed until the 1980s, when existing homes were faced with budget cuts) the access into institutions was limited, introducing other facilities such as meals on wheels. To beat the housing shortage special programmes were set up, building small, inexpensive rental accommodation for young households.

This change in policy left its mark on housing distribution in the Netherlands. Serail (1988) summarises the living arrangements of Dutch households over 55 years of age. The large majority of these households (95 per cent) live independently until the age of 75. Above this age, 30 per cent of all persons become dependent on relatives or special institutional arrangements for their housing. The step from independent housing to dependent living arrangements occurs at a stage when many household have become one-person households. Health considerations are often stated as the main reason of leaving the independent housing. In fact, access to institutions is now limited to such an extent that large waiting lists have become common. Moving into a home for the aged is not a choice anymore for the older people involved. As a result many people remain in their independent dwelling until they die or until their health condition has deteriorated to such an extent that they have to be taken into hospital.

Before households leave independent housing many make adjustment moves to more suitable housing: 68,000 per year in the period 1982-85 (4 per cent of all households over 55 years old). On average, households move once between the age of 55 and 80. As could be expected from the literature, many

older Dutch households decrease their housing consumption; for example of the households that move, 60 per cent relocate to smaller dwellings. 'Senior' housing plays an important role in these moves: 20 per cent of the moving households aged 65–74 and 50 per cent of those over 75 move into such housing. Senior housing used to be constructed under a special national programme. It consisted of rental dwellings in which the living room should not be larger than 29 m². Being 65 or over was the only requirement for entry. In 1984 this programme was abolished. The funds were allocated to the municipalities within the framework of a more general policy of decentralisation. As a result senior housing has become more diversified. In most municipalities housing which is suited to the (future) needs of older people (with bathroom facilities and a bedroom at the same level as the living room) is constructed, but this housing might be allocated to small younger households as well. An increased share is constructed in the private rental and owner-occupied sector. It is often hard to distinguish this type from mainstream housing. Recent surveys, therefore, ask the inhabitant their opinion as to whether their dwelling is suited for older people (3 per cent of the total stock in 1986). Although the construction of these new forms of senior housing has become more popular in recent years, this housing is still in short supply. Only one out of three older households wanting to move actually does so over a two-year period. Among younger households this ratio is 50 per cent (de Haas, 1987).

Departure from the market of independent housing does not only occur when people move to homes for the aged and to institutions. In our definition, four reasons for departure from the housing market can be distinguished:

- a household moves to special dependent housing for elderly (not senior dwellings, which is independent housing) or an institution;
- a household moves from independent housing to lodging or cohabitation;
- a person living independently dies; or
- a household leaves the Netherlands (which we will ignore here).

The total number of households that depart from the housing market for these reasons, and the primary housing supply which this generates, can only be estimated roughly,

because the Dutch housing surveys sample existing households that live independently only. Hooimeyer and Linde (1988) estimate the primary supply of dwellings as a result of departure from the housing market at 70,000 in 1985 and expect this number to rise to over 100,000 by the year 2000. The estimate for 1985 can be roughly divided according to the three causes mentioned: 27,000 as a result of the death of one-person households, 28,000 as a result of cohabitation (including young couples) and 15,000 as a result of transitions to institutions. New construction is now at a level of 110,000 units per annum in the Netherlands, but will probably drop to 75,000 units by the year 1995. The primary supply in the existing stock, and new construction together, roughly equal the number of new households (185,000 per annum out of a total number of 6 million households) which originate by family formation (people leaving the parental home, separated people leaving their partners) and net (in)migration.

For this contribution we generated a more reliable estimate, using recent data. These analyses show that in 1985 25,400 dwellings in the stock have become vacant because of the death of a person living independently as a one-person household (more than 98 per cent are from deaths of persons 55 years or older). This is slightly lower than the estimate by Hooimeyer and Linde (1988). However, their expectation that this number will be doubled by the year 2000, and will then be the major cause of primary supply in the existing housing stock, still seems valid.

Data and research design

The data we use in this analysis come primarily from the *National Housing Needs Survey 1985/1986* (WBO 85/86). The survey is a 0.6 per cent sample of all households in the Netherlands in 1985, carried out under the auspices of the Central Bureau of Statistics (CBS, 1986a). The data contain information on the changes in the housing situation of individual households in the period 1981–85 and on household characteristics at the time of the interview, which was held at the end of this period.

From this file we sub-sampled different groups of dwellings and households for the various parts of our analysis. In the first place we selected all dwellings occupied in 1985 by

a one-person household aged 55 or over. We distinguished 18 types of dwellings on the basis of tenure, type of structure (single- and multi-family), size and price of the dwelling. These four characteristics are the main elements in choice and allocation of housing in the Netherlands (Priemus, 1979; van der Schaar, 1987). We added the extra category of 'senior' housing, discussed above (see Table 1 for the 18 categories). To estimate the primary supply in the stock generated by death, we multiplied the age- and sex-specific death rates for the Netherlands (CBS, 1986b), with the age- and sex-specific distribution of one-person households over the 18 dwelling types. We also used an inventory of all new housing constructed in 1985 and classified this housing into the same 18 categories. The composition of the primary supply in the Dutch housing stock generated by death and by new construction can be compared in this way.

Primary supply of housing either through death or new construction generates vacancy chains in the existing housing stock, because many households that move into such dwellings already occupied a house that then becomes vacant. A vacancy chain may be defined as a sequence of moves of households and vacancies of dwellings initiated by dwellings available as primary supply of housing. So primary supply of housing has a multiplier effect of vacant dwellings in the existing stock. The extent and composition of this secondary supply can be evaluated with a vacancy chain model.

The methodology of the vacancy chain model is well established and documented extensively in the literature (White, 1971; Emmi, 1984; Scholten and Hooimeyer, 1984; Emmi and Magnusson, 1988). Therefore some brief comments suffice here. The vacancy chain model can be described as a Markov chain model. The basis of the model is a matrix of recruitment probabilities. The rows of this matrix contain the probabilities that dwellings of type J are vacated as a result of the supply of a dwelling of type I, and the probability that this supply is occupied by a new entrant into the housing market. This row of probabilities is called the recruitment pattern.

As the dwelling types that show up in the rows are identical to those in the columns, this recruitment matrix can be used to reconstruct vacancy chains. This can be pictured as follows. The vector of primary supply is mul-

tiplied by the recruitment matrix. This results in the vector of secondary supply that is vacated by moves to this primary supply (the first link of the vacancy chain). This vector of secondary supply is again multiplied by the recruitment matrix rendering the secondary supply in the second link, and so forth. As a number of dwellings are occupied by new entrants, the secondary supply in each link decreases, and soon reduces to zero. In the model the total secondary supply is estimated directly by deriving a matrix of multipliers from the recruitment matrix (see Appendix).

An obvious advantage of this approach is that data on individual links, irrespective of their position in the chain, suffice to estimate recruitment probabilities.

These data can easily be derived from the national survey (CBS, 1986a). All moves of households in the period 1982-85 are recorded, specifying the attributes of the dwelling occupied and the previous dwelling. As it is also known from the data-set whether the occupied dwelling had been occupied before, new construction and its recruitment pattern can be singled out directly.

In the survey the characteristics of households which moved into new or existing dwellings are also given. By comparing those who moved into new or existing housing it is possible to evaluate, to some extent, which types of households benefit mainly from primary supply through newly constructed dwellings and from primary supply arising from death.

Results

1. Primary supply

The composition of the primary supply of dwellings from the death of a one-person household (an estimated 25,400 units in 1985) is compared with the total Dutch housing stock and with new construction in Table 1. As compared to the total stock the composition of the primary supply resulting from death is strikingly specific. Most of the vacancies are rental dwellings, often cheap and small housing. Relatively few large, expensive and owner-occupied dwellings become available, because few older households live in these segments of the stock. This is partly due to the fact that few of the older households ever owned a house as compared to younger generations. But it is also a result of the housing adjustment process of older house-

Table 1 Primary supply due to death, new construction and the total Dutch housing stock in 1985

Dwelling Type	Supply due to Death			New Construction			Total Stock	
	Absolute *10	%	Chain Length	Absolute *10	%	Chain Length	Absolute *100	%
Special dwelling for elderly	542	21.3	2.14	345	3.5	1.97	1,516	3.0
Rent, multi-family <=3-r, <=fl 450, elevator	258	10.1	1.48	443	4.5	1.57	1,747	3.5
Rent, multi-family <=3-r, <=fl 450	262	10.3	1.32	998	10.2	1.31	4,239	8.5
Rent, multi-family <=3-r, > fl 450, elevator	137	5.4	1.60	527	5.4	1.77	1,128	2.3
Rent, multi-family <=3-r, > fl 450	25	1.0	1.41	273	2.8	1.51	573	1.1
Rent, multi-family > 3-r, <=fl 450	121	4.7	1.56	157	1.6	1.88	3,754	7.5
Rent, multi-family > 3-r, > fl 450	54	2.1	1.61	395	4.0	1.68	1,921	3.9
Rent, single-family <=3-r, <=fl 450	170	6.7	1.48	204	2.1	1.62	1,503	3.0
Rent, single-family <=3-r, > fl 450	32	1.3	1.46	233	2.4	1.82	469	0.9
Rent, single-family = 4-r <=fl 450	193	7.6	1.91	178	1.8	1.66	4,850	9.8
Rent, single-family = 4-r > fl 450	28	1.1	1.79	1,494	15.2	1.85	2,729	5.5
Rent, single-family > 4-r <=fl 450	91	3.6	1.89	12	0.1	1.30	2,208	4.4
Rent, single-family > 4-r > fl 450	23	0.9	1.76	220	2.2	1.90	2,524	5.1
Owner-occupied, <= 4-r, <=fl 125,000	267	10.5	1.66	1,383	14.1	1.82	5,877	11.8
Owner-occupied, <= 4-r, > fl 125,000	130	5.1	1.94	2,425	24.7	1.82	4,274	8.6
Owner-occupied, > 4-r, <=fl 125,000	90	3.6	1.93	75	0.8	1.99	2,975	6.0
Owner-occupied, > 4-r, <=fl 175,000	54	2.1	1.90	242	2.5	2.01	3,949	7.9
Owner-occupied, > 4-r, > fl 175,000	65	2.5	1.93	208	2.1	1.98	3,498	7.0
Total	2,542	100.0	1.75	9,812	100.0	1.76	49,735	99.8

holds towards rental, smaller and cheaper housing, which we described above.

The differences in the composition of the primary supply originating from death and new construction are also large. Small and relatively cheap housing, which is often used by older households and vacated through death, is hardly present in the newly constructed housing. The emphasis in new construction in 1985 is on multi- and single-family housing, with a fairly high rent, and on fairly cheap owner occupation. By 1989 the construction of new dwellings in owner occupation has shifted to more expensive housing, as a result of the recovery of this market, after a stagnation in the period 1979–84 (Kersloot and Dieleman, 1988; *V-bulletin*, 1989). This comparison between primary supply due to death and new construction emphasises the fact that newly constructed housing, because of its relatively high price, is mainly accessible for modal and higher-income households, while primary supply in the existing stock seems to create more housing opportunities for lower-income households.

2. Vacancy chains

As stated before the primary supply has a multiplier effect on residential mobility, because vacancy chains are triggered off. The average chain length equals the number of moves that are generated by the supply of one dwelling. This multiplier effect can vary considerably between dwelling types. Most decisive in determining the multiplier effect of a dwelling type is its accessibility to newcomers on the housing market (in our analyses, the Netherlands has been split up into 51 urban regions, which have been treated as regional housing markets). Newcomers on the housing market are: new households, migrants from another housing market area, and households whose former dwelling was demolished. They do not leave a vacancy behind in the regional housing market and therefore terminate the vacancy chain.

The average chain length per dwelling type is listed in Table 1. The general pattern conforms to what is known from the literature (cf Scholten, 1988). Owner-occupied dwellings have a higher multiplier than rental accommodation. Small dwellings generate shorter chains than do large dwellings. Accessibility to small starting households in particular account for these differences. Looking at the pattern in more detail reveals that the highest

multiplier is to be found in the first dwelling type, the special dwellings for older people. Although this may come as no surprise (these dwellings are rarely allocated to newcomers in the market), it has not received a great deal of attention in vacancy chain studies.

Table 1 also shows that apartments with an elevator have a higher multiplier than apartments without. Obviously allocation is again biased towards older people. In general the multipliers from new construction are slightly higher than those from primary supply in the existing stock. However this does not necessarily mean that the total secondary supply generated by new construction is higher.

Perhaps more interesting than the total secondary supply is its composition. The chosen methodology allows for a very detailed estimate of the composition of the dwellings vacated. For every dwelling type the multiplier per type of dwelling that is recruited is given. However, choosing a detailed dwelling typology, as we did in this analysis, leads to very large tables, which are hard to present. We therefore limit ourselves in presenting only the multiplier effects of the dwelling types that were most common in the primary supply in the stock and through new construction. These are listed in Table 2 (the types shown account for over 50 per cent of the primary supply). The entries in the table represent the number of dwellings recruited in the sub-markets heading the columns as a result of the supply of 100 dwellings of the type indicated in the rows.

Most striking is the pattern of the special dwellings for older people. Supply of 100 of these dwellings leads to the vacation of another 113 dwellings, 11 of which are again suited to the needs of elderly households. The secondary supply is generated in all sub-markets, but nearly 70 per cent consists of cheap dwellings (less than f1450 in monthly rent, or under f125,000 in value). This points to the strategic value of this type of dwelling in triggering off vacancy chains which generate affordable housing to lower-income groups.

Newly constructed dwellings have a different multiplier effect, generating vacancies in expensive rental accommodation. This means that the selective provision of housing by means of new construction (notably to higher-income groups) is to some extent exacerbated by the secondary supply it generates, if we compare this to the secondary supply generated within the stock.

Table 2 *Secondary supply per 100 dwellings of primary supply*

	Senior	Multi Rent Cheap	Multi Rent Expensive	Single Rent Cheap	Single Rent Expensive	Owner Cheap	Owner Expensive	Total
Existing stock								
Special for elderly	11	36	11	21	10	17	7	113
Rent, multi, 3-r, <fl 450, elevator	0	26	4	7	4	4	1	46
Rent, multi, 3-r, <fl 450	1	19	5	3	2	2	0	32
Own, 4-r, <fl 125,000	0	22	8	6	14	9	5	64
New construction								
Own, 4-r, >fl 125,000	0	20	13	10	23	9	7	82
Rent, single, 4-r, >fl 450	1	34	20	10	12	6	4	87
Own, 4-r, <fl 125,000	0	23	14	7	22	8	5	79

Table 3 *Total supply arising as a result of death and new construction in 1985*

Dwelling Type	Supply due to Death		New Construction	
	Absolute *10	%	Absolute *10	%
Special dwelling for elderly	612	13.8	400	2.3
Rent, multi-family <=3-r, <=fl 450, elevator	361	8.1	850	4.9
Rent, multi-family <=3-r, <=fl 450	549	12.4	2,026	11.8
Rent, multi-family <=3-r, > fl 450, elevator	206	4.6	794	4.6
Rent, multi-family <=3-r, > fl 450	63	1.4	522	3.0
Rent, multi-family > 3-r, <=fl 450	402	9.0	1,229	7.2
Rent, multi-family > 3-r, > fl 450	178	4.0	1,205	7.0
Rent, single-family <=3-r, <=fl 450	233	5.2	438	2.5
Rent, single-family <=3-r, > fl 450	58	1.3	321	1.9
Rent, single-family = 4-r <=fl 450	355	8.0	570	3.3
Rent, single-family = 4-r > fl 450	142	3.2	2,236	13.0
Rent, single-family > 4-r <=fl 450	156	3.5	242	1.4
Rent, single-family > 4-r > fl 450	141	3.2	879	5.1
Owner-occupied, <= 4-r, <=fl 125,000	440	9.9	1,845	10.7
Owner-occupied, <= 4-r, > fl 125,000	186	4.2	2,584	15.0
Owner-occupied, > 4-r, <=fl 125,000	154	3.5	282	1.6
Owner-occupied, > 4-r, <=fl 175,000	111	2.5	459	2.7
Owner-occupied, > 4-r, > fl 175,000	99	2.2	339	2.0
Total	4,446	100.0	17,221	100.0

If we compare the total supply of dwellings generated by new construction with the total supply arising in the stock due to death, then two conclusions can be drawn (see Table 3). The total multiplier from new construction is not larger than the one from primary supply in the stock. On average 1.75 moves are generated by the primary supply of one dwelling in both instances. The second conclusion is that the total supply generated by death contains more rental dwellings and notably more cheap dwellings than the supply resulting from new construction.

3. Access to primary supply

The characteristics of dwellings that become vacant because of death differ substantially from newly constructed housing, as the analyses have shown. Therefore different types of households may be expected to profit from this new and older primary supply of housing. The survey data (CBS, 1986a) provide information on the new occupants of primary supply. Tables 4 and 5 show the household composition and Table 6 the income of those households that move into the vacant existing housing and into the newly constructed housing.

Houses that are vacant because of the death of a one-person household are frequently occupied again by older households (Table 4) and are especially suitable for and accessible to single persons (Table 5). Nearly half of these vacancies are now occupied by a one-person household. New construction attracts relatively few of these households and becomes mainly occupied by the households aged 25–44 and couples with or without children. This is the group of households that is generally very active in the housing market and increases its housing consumption (Deurloo et al, 1987). But primary supply from death is also important for this group of households (aged 25–44); more than 40 per cent of the vacancies are taken up by this group.

As might be expected the primary supply created by *death* – generally inexpensive, rental and small housing – is mainly taken up by below-average income households (63 per cent; Table 6). Only 50 per cent of *new* construction becomes occupied by these households. The relationship between income and price of dwelling seems closer for new occupants of primary supply from death than from new housing. For example new single-family rental dwellings with a relatively high

Table 4 Households by age who moved to primary supply due to death and new construction in 1985. Absolute (*100) and percentages

Age	Supply due to Death		New Construction	
	Absolute	%	Absolute	%
< 25	40	15.7	142	14.5
25–44	107	42.0	617	62.8
45–64	40	15.8	122	12.5
≥ 62	67	26.5	100	10.2
Total	254	100.0	981	100.0

Table 5 Households by composition who moved to primary supply due to death and new construction in 1985. Absolute (*100) and percentages

Household	Supply due to Death		New Construction	
	Absolute	%	Absolute	%
Singles	113	44.7	247	25.2
Couple without children	74	29.1	343	35.0
Couple with children	50	19.7	335	34.1
One-parent family	13	5.0	50	5.1
More-persons	4	1.5	6	0.6
Total	254	100.0	981	100.0

Table 6 Households by income who moved to primary supply due to death and new construction in 1985. Absolute (*100) and percentages

Income	Supply due to Death		New Construction	
	Absolute	%	Absolute	%
< f 30,000	162	63.7	478	48.7
> f 30,000	92	36.3	503	51.3
Total	254	100.0	981	100.0

rent are more often allocated to lower- rather than higher-income households. The allocation mechanism for new housing, which is fairly strongly government controlled in the Netherlands probably partly corrects for income constraints in access to housing. For dwellings in the existing stock this seems to be less true.

Conclusion and discussion

The ageing of the Dutch population is leading to an increase in primary supply of housing in the existing stock, because more old households depart from the market of independent housing. In the coming decade this process is expected to become more important for primary supply of housing than new construction. The death of old single persons that still live independently is a major element in the vacancies that occur in the existing housing stock. The characteristics of these vacancies are completely different from those of newly constructed dwellings. It is mainly rental and small and inexpensive housing which becomes available, while new construction is often more expensive and larger and is relatively more often owner-occupied housing. This pattern persists when vacancy chains, triggered off by primary supply through death and new construction, are compared. The primary and secondary supply through death serves an important function, especially for single persons and lower-income households looking for housing, while newly constructed housing is often more accessible to modal and higher-income households.

In the Netherlands the new construction of housing is still regulated by the national, provincial and local governments. Probably because primary supply arising in the existing stock through deaths is an autonomous process, housing policy and the plans for new construction of housing ignore this source of primary supply. For example the new document on Dutch housing policy in the 1990s (Ministerie van Volkshuisvesting, 1988) hardly pays attention to primary supply in the stock. The demand for new construction is derived directly from the increase in the number and characteristics of the households that can be expected in the Netherlands. Secondary supply from vacancies triggered off by new construction is emphasised. But primary and secondary supply of housing resulting from departure of households from the housing market is forgotten, even though this serves an ever-important function for many households – especially households with a relatively weak position in the housing market.

Departure from the housing market through death cannot be influenced by housing policy, but the policy will be affected by the process. The shortage of low-cost housing will diminish

as a result of the increasing supply due to death. It should be questioned whether the proposed policy of (forced) tenure changes to the owner-occupied sector will have the same effect and whether this is needed at all. Transitions to institutional forms of residence, however, are dependent on policy; the availability of special (dependent) housing for older people and of institutions for elderly persons who need this care is mainly determined by government funding for these facilities. It should be considered whether the government has not gone too far in cutting these budgets. Enlarging the capacity would not only reduce the waiting lists, but would also have beneficial effects on the provision of housing. In the next stage of the research we are now investigating primary supply created by elderly persons moving into dependent housing situations and the vacancy chains that are triggered off by this process.

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Appendix

The starting point for the Markov chain model is a cross-tabulation of all dwellings occupied (the rows) by the dwellings left behind (the columns). As not every household leaves a dwelling behind (eg new households, migrants, people who move from a dwelling that is demolished), the number of columns equals the number of rows, plus the categories of households that do not vacate a dwelling. By dividing each entry with its row total, recruitment probabilities are derived.

The matrix of recruitment probabilities (P) consists of two sub-matrices. The matrix Q, containing the probabilities that dwellings are recruited, which is a square matrix, and the matrix R, containing the probabilities that a dwelling is occupied by a new entrant to the market.

The secondary supply which arises in the first link of the chain can be estimated by multiplying the vector of primary supply (a) with the matrix Q (a.Q). The secondary supply in the second link can be estimated by multiplying the result of the first link (a.Q) with the matrix Q (a.Q²), and so forth. This can be reduced as follows:

$$\begin{aligned}
 & a + a.Q + a.Q^2 + a.Q^3 + \dots = \\
 & a.(I + Q + Q^2 + Q^3 + \dots) = \\
 & a.(I-Q)^{-1} = \\
 & a.M = b
 \end{aligned}$$

in which I is the identity matrix, M is the multiplier matrix and b is the vector of total supply resulting from the primary supply (a). To apply this method a number of assumptions with regard to the recruitment probabilities have to be made:

- the probabilities should be homogeneous, splitting up the dwelling types distinguished should result in recruitment patterns per sub-type, which do not differ significantly;
- the probabilities should be stationary in time;
- the probabilities should be constant, irrespective of the place in the chain.

We have tried to meet the first assumption by employing a dwelling typology which is as detailed as the data allowed. The second assumption is not very critical as we used the method to make an *ex post* estimate of the vacancy transfers. The third assumption could not be met, as we found some heterogeneity which appeared in the first link of the chains. Newly constructed dwellings have recruitment probabilities which differed significantly from the recruitment within the existing stock. We therefore used an expanded version of the model, first described by Brouwer (1982).

The basic extension of this method is to apply two matrices of recruitment probabilities (Q) to come up with an expanded multiplier matrix (M). The first recruitment matrix Q₁ contains the recruitment probabilities of new construction, the second Q₂ the probabilities of vacancy transfers within the existing stock. The multiplier matrix is expanded as follows:

$$M = \begin{bmatrix} I & M_1 \\ O & M_2 \end{bmatrix}$$

in which I is the identity matrix, O is a matrix filled with zeroes, M₁ is Q₁(I-Q₂)⁻¹ and M₂ is (I-Q₂)⁻¹.

To apply this matrix, the vector of primary supply (a) has to be disaggregated into primary supply due to new construction and primary supply within the stock (a₁ a₂). Multiplication of this vector with the expanded matrix M renders the total supply (b) which consists of the new construction (b₁) and the supply due to primary supply in the existing stock plus the total secondary supply (b₂).