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Reference-dependent housing choice behaviour: why are elderly reluctant to move?

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Abstract

This paper provides novel insights into whether reference-dependence affects the preference for moving of elderly households. We propose an extended framework to measure reference dependence that allows the identification of symmetric as well as asymmetric valuation of losses and gains by an individual. The framework is applied in a discrete choice model based on a stated preference experiment with 440 elderly Dutch home owners. We find clearly that the current living situation (reference) affects the housing choice behaviour; the effect differs however by housing attribute. Among other things, we find a general aversion to changing location. The framework we present is generic and can be readily applied in other stated choice experiments. The reference-based model increases the goodness-of-fit substantially in the case considered and the results have clear implications for ageing-in-place policies which are currently being developed in many countries.

Keywords: elderly housing; housing preferences; reference-based choice; discrete choice modelling; stated choice experiment.

JEL classification: D12, R21, R31

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1. Introduction

Elderly citizens are often reluctant to move to another dwelling, even when their own home becomes less suitable for their changing needs (e.g. Angelini and Laferrère, 2012, De Jong et al., 2018). This may reduce the effectiveness of ageing-in-place policies that aim at stimulating seniors to live independently as long as possible. However, not much is known yet about possible motives behind the relatively low residential mobility of the elderly. We contribute to this discussion by examining how much loss aversion – and more generally reference-dependence - affect the housing choices of seniors. We propose a novel methodology to measure reference-dependence and apply it in a discrete choice model based on a stated choice experiment with 440 Dutch 65+ home owners.

The concept of reference-dependent choice behaviour was introduced in the prospect theory by Kahneman and Tversky (1979). The theory predicts that people evaluate outcomes of their choices relative to a specific reference point (often the status quo), classify these outcomes as gains and losses, and prefer avoiding losses to acquiring equivalent gains. The theory gives an explanation for what is known as the status-quo bias in decision making, that is, a tendency of people to prefer maintaining the current state (Kahneman et al., 1991). Significant loss aversion effects were found in studies in various domains such as e.g. transportation choices (Hess et al., 2008; Rose and Hess, 2010; Kim et al., 2020) and energy-saving behaviour (Bartczak et al., 2017). While in housing choices the reference point is well-defined by the current home where people live, and can be expected to be salient for people, the topic of reference dependence has received only little attention in housing preference studies. The only study we know of is Habib and Miller (2009) who finds significant loss aversion effects for service attributes in residential location choices. We aim to add insights specifically on reference-dependence of housing choices of elderly households.

We propose an extended framework to measure reference dependence that allows the identification of symmetric as well as asymmetric valuation of losses and gains. For this purpose, we extend existing conceptualizations and analysis frameworks. Our workhorse is a discrete choice model, a well-established tool to measure the preferences of households in housing decisions. The model assumes that the preference for a particular choice alternative is based on an evaluation of known attributes of the choice alternative and predicts the choice between available alternatives as a function of these preferences and attributes. The formulation of the model in a random-utility-maximizing framework allows the estimation of attribute preference values based on data of choice outcomes (McFadden, 1984).

Reference-dependence choice behaviour has received some attention in discrete choice modelling. In existing approaches, reference-dependence is conceptualized as an asymmetry in evaluation of losses and gains, while zero utility is assumed for reference levels, and choice alternatives are formalised as relative (percentage) deviations from this reference.[1] Masiero and Rose (2013) argue, however, that the idea of asymmetric evaluation does not necessarily imply zero utility for the reference point. They propose a model where the utilities for reference levels (absolute utility values) are estimated in addition to valuations of losses and gains. They argue furthermore that to allow this, choice alternatives in a choice experiment must be presented in terms of absolute attribute values instead of changes relative to reference levels as is done in reference pivoted stated choice experiments (Hess et al., 2008; Rose and Hess, 2010). In fact,

[1] So individuals are first asked to indicate the levels they are currently experiencing for the attributes considered in the choice experiment. In choice tasks, the attribute levels of hypothetical choice alternatives are then represented explicitly as deviations (positive or negative) from current levels.

this means a return to the original presentation method, followed in non-reference-based studies. Reference effects will then emerge in how individuals evaluate choice alternatives depending on the reference levels they use.

Just as in the approach of Masiero and Rose, we estimate utilities for absolute attribute levels as well as utilities for losses and gains relative to the reference point and use a choice experiment where choice alternatives are presented in terms of absolute values. Compared to Masiero and Rose, however, we consider a wider range of models of reference dependence and aim to identify on a per-attribute basis the best fitting model. We define and test symmetric as well as asymmetric models of reference dependent evaluation per attribute. The framework we present is generic and can be readily applied in stated choice experiments.

We use a dataset that is focused on housing preferences of elderly. The data were collected in 2017 in The Netherlands and involved a sample of 441 persons in the age between 65 and 75 years old. The choice experiment asked the participants to choose between the reference status quo and hypothetical housing alternatives that were varied in terms of location and dwelling attributes.

Our paper is connected to a number of literature streams. The first one concerns studies on housing preferences of households. These studies have focused on a range of topics such as tenure choice (Özyildirim et al., 2005), neighbourhood characteristics (Morrow-Jones et al., 2004), elderly housing (e.g., Jong et al. 2018, Ossokina et al., 2019), student housing (Verhetsel et al. 2017), household interaction (Molin et al., 2002), combined transport and housing choice (e.g., Tillema et al., 2020, Teulings et al., 2018), ethnic segregation (Ibraimovic and Hess, 2018) and developing regions (Del Mistro and Hensher, 2009). We add to this literature by studying the role of a reference dependence and loss aversion in housing choices of elderly.

The second relevant body of literature contains studies on loss-aversion in the housing market. These have mostly focused on monetary loss-aversion: sellers are not willing to sell a house below their reservation value, what leads to a fall in trading volumes during economic downturns (Genesove and Mayer, 2001, Engelhardt, 2003, Einio et al., 2008, Bokhari and Geltner, 2011). Our contribution is to analyse loss-aversion and reference-dependence for a wide variety of housing and location attributes and to study whether the nature of the effects differs between these attributes.

Our study is also connected to the current policy-related debates in different countries. While the proportion of 65+ citizens in the population is increasing sharply,[2] governments make arrangements to stimulate the elderly to live independently at home for as long as possible (Mosca et al., 2017). Better insight in living preferences of the elderly and in how emotions of loss and gain impact the willingness-to-move can help policy-makers and housing providers to better adapt the housing supply to the needs of the target group.

The remainder of this paper is structured as follows. Section 2 outlines the proposed conceptual and analysis framework. Section 3 describes the data. Section 4 reports the estimation results and their practical implications. Section 5 concludes by summarizing the major conclusions and discussing avenues for future research.

[2] In Europe, for instance, one in four people is expected to be older than 65 in 2040 (Eurostat, 2017). In China and in USA, one in four people will be older than 60 in 2030 (UN, 2015).

2. A framework for analyzing reference-dependent choice

Concepts and definitions

Take a household which considers moving to another residence. It evaluates a particular alternative house on offer, based on the attributes of this house – size, type, location, etc. - that enter the utility of the household. Expected-utility-based theory assumes that the absolute values of the attributes enter the utility. Reference dependence allows the valuation to depend as well on the changes in the value of the attributes in comparison to the current - reference - situation. A negative change is classified as a loss, a positive change is classified as a gain. Losses have a negative effect on utility, and gains have a positive effect on the utility.

Two types of situations can be distinguished with respect to reference dependence: 1) symmetric reference dependence – losses and gains of the same absolute magnitude have the same absolute effect on utility; and 2) asymmetric reference dependence – losses and gains of the same absolute magnitude have different absolute effects on utility. Loss aversion is the specific case of (2) where a marginal change in the level of attribute has a larger utility effect below the reference point. The reference-dependent part of the utility is often being linked to emotion-generated effects, while the absolute part of the utility is being linked to taste preferences. In the modeling framework proposed in the next section below preference parameters can be estimated separately from loss and gain effects whereby the latter effects may be symmetric as well as asymmetric.

Models

Consider now how reference dependence in either one of these forms can be incorporated in the discrete choice model. In the standard discrete choice model, the utility of an alternative *i* for an individual *n* is written as (assuming unlabeled alternatives and a reference alternative of not moving):

$$U_{in} = \alpha + \sum\nolimits_j V_j(X_{ij}) + \varepsilon_{in} \tag{1}$$

where X_{ij} is the value of attribute *j* in alternative *i*, α is a constant representing a utility of moving relative to the reference of not moving, V_j are utilities related to attributes *j* of alternative *i* and ε_{in} is an error term. In mixed logit formulations the structural utility components α_i and V_j also may have an *n* subscript due to individual-related random components related to taste parameters. For ease of presentation and without loss of generality, we will assume here non-random taste parameters and omit the *n* subscript. To allow reference-dependent valuations, the above utility function needs to be extended to:

$$U_{in} = \alpha + \sum\nolimits_j V_j\left(X_{ij}, X_{jn}^0\right) + \varepsilon_{in} \tag{2}$$

where X_{jn}^0 represents the value of attribute *j* in the reference situation. In the remainder of this section, we propose a parametrization of the function $V_j\left(X_{ij}, X_{jn}^0\right)$ that allows us to test the possible forms of reference-dependence in housing choices. We develop functional forms for continuous attributes (e.g., size of the dwelling in square meters) and discrete attributes (e.g., type of location), respectively.

First, for continuous attributes we propose the following function:

$$V_j(X_{ij}, X_{jn}^0) = \beta_j \cdot X_{ij} + \begin{cases} \delta_{j1} \cdot (X_{jn}^0 - X_{ij}) & if \;\; X_{jn}^0 > X_{ij} \\ \delta_{j2} \cdot (X_{ij} - X_{jn}^0) & if \;\; X_{jn}^0 < X_{ij} \end{cases} \tag{3}$$

where β_j is the marginal utility of attribute *j* based on taste preference, and δ_{j1} and δ_{j2} represent the marginal utilities of a decrease or increase, respectively, on attribute j. Under reference dependence δ_{j1} and δ_{j2} are unequal to zero. In case utility is increasing in the value of an attribute (i.e., $\beta_j > 0$), we expect that $\delta_{j1} < 0$ and $\delta_{j2} > 0$, representing a felt loss if the level decreases and a felt gain if the level increases. If $-\delta_{j1} > \delta_{j2}$, loss aversion is in place i.e. a loss weighs more heavily than a gain of equal size. Alternatively, a negative sign for both δ_{j1} and δ_{j2} would indicate a preference for no change on the attribute (inertia).

Second, for discrete attributes we propose the following model:

$$V_j(X_{ijk}, X_{jnh}^0) = \beta_{jk} \cdot X_{ijk} + \; \delta_{jkh} \cdot X_{ijk} \cdot X_{jnh}^0 \tag{4}$$

where: $X_{jnh}^0 = 1$, if individual *n* currently experiences level h on attribute j and $X_{jnh}^0 = 0$, otherwise; $X_{ijk} = 1$, if alternative *i* has level *k* on attribute *j* and $X_{ijk} = 0$, otherwise; β_{jk} is the utility assigned to level k based on taste preference and δ_{jkh} is an (emotional) loss or gain component in case $k \neq h$ ($\delta_{jkh} = 0, if \; k = h$). If reference dependence holds, then δ_{jkh} is unequal to zero for at least one combination *kh*. If, in terms of taste, level *k* is preferred over *h*, we expect $\delta_{jkh} < 0$ and, if *h* is preferred over *k*, we expect $\delta_{jkh} > 0$. As in the continuous case, the losses and gains are additive components and, hence, represent an extra utility related to an affective element of the experience of a change (positively or negatively).

The above models (3) and (4) offer a framework to estimate taste preferences as well as loss and gain effects. In addition, we propose an alternative model with fewer degrees of freedom where loss and gain effects increase or decrease the utility constant, α, which represents a (possibly negative) base preference for moving as compared to staying put. For continuous attributes this reduced model is defined as (replacing Equation (3)):

$$V_j(X_{ij}, X_{jn}^0) = \beta_j \cdot X_{ij} + \delta_j \cdot X_{jn}^0 \tag{5}$$

In this model, the reference level, X_{jn}^0, has an increasing or decreasing effect on the perceived utility depending on the sign of δ_j. This model includes just a single parameter to capture any loss or gain effects. Consequently, it assumes that there is no asymmetry in evaluation of losses and gains. For discrete attributes the reduced model is defined as (replacing Equation (4)):

$$V_j(X_{ijk}, X_{jnh}^0) = \beta_{jk} \cdot X_{ijk} + \; \delta_{jh} \cdot X_{jnh}^0 \tag{6}$$

In this model, δ_{jh} represents the effect of reference level h of attribute *j* on the utility of moving as compared to staying put. Since the loss and gain terms in the continuous model (last term Equation (5)) and the discrete model (last term Equation (6)) are independent of the attribute level considered (*k*), they in effect increase or decrease the utility constant, α. Thus, an individual who currently has a more favourable level on an attribute will experience a bigger loss and hence have a lower base preference for moving. Therefore, in the following we will refer to the latter model given by Equations (5) and (6) as the constant-shift model. Note that the constant-shift model assumes fewer parameters - in the continuous case δ_{j1} and δ_{j2} are replaced by δ_j and in the discrete model δ_{jkh} are replaced by δ_{jh}.

The general model (Equations (3) and (4)) and the constant-shift model (Equations (5) and (6)) offer a framework to analyse reference-dependent evaluation behaviour. An increase of fit of the general model compared to the standard model (Equation (1)) would be evidence for the presence of reference-dependent evaluation. Comparison between the general model and constant-shift model provides information about whether evaluation of losses and gains is symmetric around the reference point. The constant-shift model does not account for asymmetric evaluation. Hence, an increase in fit relative to the constant-shift model in the latter comparison would be evidence for asymmetric evaluation.

3. Application - analysis of elderly housing preferences

Discrete choice experiment data

The data originate from a stated choice experiment conducted in 2017 on a sample of 441 Dutch home-owners in the age category of 65-75 (see Ossokina et al., 2019). In the choice tasks, respondents were presented choice-sets consisting of two hypothetical housing alternatives. Focusing on a particular housing concept suited for elderly, the presented choice alternatives were senior-friendly apartments. For each alternative, the respondents were asked to indicate the expected living satisfaction in comparison with their current housing situation, choosing from five options: much lower than now, lower than now, same as now, higher than now, much higher than now. This set up allows us to estimate a constant utility for the alternatives relative to the reference. The survey included three choice experiments that were focused on preferences regarding dwelling, building and location characteristics, respectively. For each experiment attribute profiles were generated based on an orthogonal experimental design and choice sets were compiled by randomly selecting two profiles from the design. Each respondent received 12 choice tasks divided into 4 choice tasks for each experiment. For the present analysis we use the data related to the location choice experiment, to evaluate reference-dependence regarding the evaluation of dwelling location characteristics. Table 1 shows the attributes of the apartment location alternatives that were varied in the choice task. Each attribute has three levels. The price levels were pivoted around the market value of the current housing of the person to make sure that offered alternatives did not fall outside a price range that is realistic for the respondent.

An additional part of the questionnaire included questions about the existing residential situation of the respondent that provide information about reference levels. Table 1 also shows the data available from that part. The answer categories of questions about the existing residence do not always correspond exactly to the levels varied in the choice experiment. Note, however, that the framework we use does not require an exact correspondence between experimental and existing levels either so that this data limitation does not imply a restriction for the analysis.

The choice experiment was administered through an on-line questionnaire. The sample was based on a national panel of the Dutch population. Given the target group focused on, only persons aged between 65 and 75 years and currently living in a privately owned dwelling (as opposed to rented) could participate.

Table 1. Attributes and attribute levels

Attribute		Level 1	Level 2	Level 3
Green	DCE	More than 15 minutes cycling	15 minutes cycling	10 minutes walking
	Exist	More than 15 minutes cycling	More than 10 minutes walking, but less than 15 minutes cycling	Less than 10 minutes walking
Shops	DCE	More than 15 minutes cycling	15 minutes cycling	10 minutes walking
	Exist	More than 15 minutes cycling	More than 10 minutes walking, but less than 15 minutes cycling	Less than 10 minutes walking
Public transport	DCE	No Bus/tram in front of the door; No train station on a 10 min car trip	Bus/tram in front of the door; No train station on a 10 min car trip	Bus/tram in front of the door; train station on a 10 min car trip
	Exist	Station in more than 15 minutes cycling	Station in more than 10 minutes walking, but less than 15 minutes cycling	Station in less than 10 minutes walking
Location	DCE	Within a larger city	Smaller city, more than 15 minutes driving from a larger city	Suburbs of a larger city
	Exist	Within a larger city	Smaller city, more than 15 minutes driving from a larger city	Suburbs of a larger city
Price	DCE	10% more expensive	Equal to the current price	10% less expensive
Neighbourhood	DCE	Mixed tenure types, mixed household types	Mostly owner-occupied, mostly seniors	Mostly owner-occupied, mixed household types

Set-up of the analysis

The data allow us to study reference-dependent valuation for the following attributes: Location, Green, Shops and Public transport (see Table 1 for a definition of the attributes). These are all discrete attributes. For discrete attributes, the number of parameters depends on the number of levels of the corresponding reference variables. In the general model, the number of delta parameters equals (H – 1) x K (H is the number of reference levels and K the number of levels in the alternatives for the attribute), as one delta parameter for each level k is set to zero for normalisation. Consistently, the delta parameter related to the combination of equal levels of the reference and attribute variables is set to zero. Given this setting, the beta parameters represent the evaluation of individuals that currently experience the same level (and therefore should experience no loss or gain). Since each attribute has three levels in the reference situation as well as choice experiment, the number of delta parameters per attribute equals (2 x 3 =) 6.

The analysis is built up in two steps. The aim of the first step is to identify the best fitting model for each attribute, where the models are 1) no reference-dependence (the standard model), 2) general reference dependence (the general model) and 3) special reference dependence (the constant-shift model). The best fitting model for an attribute j is identified by comparing the model fit of the general model with two reduced models, namely the model where delta parameters, δ_{jkh}, are set to zero (the standard model) and the model where the delta parameters are replaced by δ_{jh}-parameters which are fewer in number (the constant shift model). A significant decrease in fit in the first comparison indicates that reference-dependence is relevant and a significant decrease in fit in the second comparison that this reference-dependence cannot be explained in terms of a constant shift. If the decrease in fit in the latter comparison is not significant and the decrease in fit is significant in the comparison between the constant-shift and the standard model then there is evidence for the constant-shift model. Note that when the general model does not outperform the standard model, it is still meaningful to test the performance of the constant-shift model. Since the latter has fewer degrees of freedom, the test may possibly show a positive outcome even when the fit increase of the general model is insignificant.

The results of the first-step analyses are used to specify a final model where the utility function of each attribute is specified according to the best fitting model for that attribute. The estimation of the final model offers insight in the role reference levels play in evaluations. The improvement in fit accomplished by the final model compared to the standard model indicates the overall size of the influence of this behaviour on the formation of housing preferences. Given the purpose of the analysis, the basic MNL model is used as framework for the models.

Results of attributes tests

Tables 2 and 3 show the results of the first-step analysis. The analysis is performed for each attribute separately. A model estimation is conducted for the model without and with the delta parameters included. The likelihood ratio test is used to test the significance of the decrease in fit taking into account the difference in number of parameters between the models compared. The statistic of this test is defined as $D = 2 \cdot (LL - LL_0)$ which is Chi-square distributed with degrees of freedom $df = K - K_0$ (LL and LL_0 are the loglikelihood values and K and K_0 are the number of parameters of the proposed model and null model). Assuming an alpha level of 5%, the results show the following.

Table 2. Decrease in fit of general model when delta parameters are omitted one attribute at a time

Attribute	LL	Decrease in fit (omit completely)			Decrease in fit (reduce to constant shift)		
		Chisq	df	p-value	Chisq	df	p-value
General model (base)	-1181.2						
Location	-1202.1	41.771	6	< 0.0001	39.534	4	< 0.0001
Green	-1185.4	8.260	6	0.220	1.254	4	0.869
Shops	-1187.4	12.265	6	0.056	8.295	4	0.081
Public transport	-1189.6	16.684	6	0.011	7.391	4	0.117

Table 3. Decrease in fit of the constant shift model when delta parameters are omitted one attribute at a time

Attribute	LL	Decrease in fit		
		Chisq	df	p-value
Constant shift model (base)	-1209.6			
Location	-1210.7	2.251	2	0.325
Green	-1213.0	6.971	2	0.031
Shops	-1211.3	3.421	2	0.181
Public transport	-1214.0	8.869	2	0.012

First, the decrease in fit when delta parameters are set to zero (comparing the general to the standard model) is statistically significant for Location and Public transport and not statistically significant for the other attributes. This indicates that reference-dependence plays a role for these two attributes only. The drop in fit is particularly large for Location, indicating that the influence of the reference is particularly strong there. Next, the decrease in fit when the general model is reduced to a constant-shift model is significant for Location only. This indicates that for Location the general model cannot be reduced to a constant-shift model without a loss in fit or, in other words, that for this attribute the reference dependence cannot be described in terms of a constant-shift model.

Table 3 shows the decrease in model fit of the constant-shift model when delta parameters for that model are set to zero one attribute at the time using the same procedure as before. Assuming again an alpha level of 5%, the tests show that the decrease in fit is significant for Green and Public transport. This provides evidence that in case of these two attributes reference-dependence plays a role that can be described in terms of the constant-shift model.

Combining the results of Tables 2 and 3 allows us to determine the best-fitting model. Location shows significant reference-dependence that cannot be reduced to a constant-shift model. Hence, the general model is the best fitting model for this attribute. On the other hand, Green and Public transport show reference-dependence that can be described by the constant-shift model as the reduction in fit when the general model is replaced by the constant-shift model is not significant and the decrease in fit when the constant shift model is replaced by the standard model *is* significant. For the remaining attribute, Shops, there is no evidence for reference dependence.

Results of final model estimation

Table 4 represents the estimation results of the final model and the basic model for comparison. Recall that the final model is an extension of the basic model that, in addition to the main effects (beta parameters), includes extra terms to take reference-dependence into account (delta parameters). The extension involves the expansion of models for Green and Public transport with constant-shift δ_h-parameters and the expansion of the model for Location with more general δ_{kh}-parameters. In total, the extension includes 10 (= 23 – 13) additional parameters and leads to an increase of the adjusted rho-square from ρ = 0.174 to ρ = 0.189, which is a significant increase in model fit.

Table 4. Estimation results

Attribute		DCE-level	Existing level	Baseline		Final extended	
				Value	t-val.	Value	t-val.
Constant	α			-0.659***	-3.62	-0.364	-1.38
Location	$\beta 1$	City	-	-0.300**	-2.43	-0.165	-0.77
	$\beta 2$	Town	-	0		0	
	$\beta 3$	Suburb	-	0.019	0.16	-.431**	-2.03
	$\delta 11$	City	City			0	
	$\delta 12$	City	Town			-0.725***	-3.08
	$\delta 13$	City	Suburb			-0.732***	-3.09
	$\delta 21$	Town	City			-1.054***	-4.38
	$\delta 22$	Town	Town			0	
	$\delta 23$	Town	Suburb			-0.235	-1.14
	$\delta 31$	Suburb	City			-0.008	-0.04
	$\delta 32$	Suburb	Town			0.312	1.47
	$\delta 33$	Suburb	Suburb			0	
Green	$\beta 1$	Far	-	-0.285**	-2.31	-0.303**	-2.41
	$\beta 2$	Medium	-	0		0	
	$\beta 3$	Close	-	0.209*	1.79	0.187	1.59
	$\delta 1$	-	Far			1.108**	2.42
	$\delta 2$	-	Medium			0	
	$\delta 3$	-	Close			-0.011	-0.07
Shops	$\beta 1$	Far	-	-0.485***	-3.68	-0.473***	-3.54
	$\beta 2$	Medium	-	0		0	
	$\beta 3$	Close	-	0.431***	3.74	0.443***	3.79
Public transport	$\beta 1$	Far	-	-0.838***	-6.12	-.897***	-6.45
	$\beta 2$	Medium	-	0		0	
	$\beta 3$	Close	-	0.520***	4.68	0.506***	4.48
	$\delta 1$	-	Far			0.287**	2.17
	$\delta 2$	-	Medium			0	
	$\delta 3$	-	Close			-0.319*	-1.71
Neighborhood	$\beta 1$	Mixed tenure & household types	-	-0.351***	-2.80	-0.374***	-2.96
	$\beta 2$	Mostly seniors & home owners	-	0		0	
	$\beta 3$	Mostly home owners, mixed household types	-	-0.091	-0.76	-0.143	-1.17
Price	$\beta 1$	+10 %	-	-0.241*	-1.93	-0.236*	-1.87
	$\beta 2$	Equal	-	0		0	
	$\beta 3$	- 10 %	-	0.074	0.62	0.036	0.3
Loglikelihood				-1225.4		-1191.6	
# parameters				13		23	
Rho-squared				0.183		0.205	
Rho-squared adjusted				0.174		0.189	

*** significant at 1 %, ** significant at 5 %, * significant at 10 %

Turning to the detailed estimation results: all attributes have significant main effects with signs as expected. Consistently, the middle level of each attribute was fixed to zero to provide a base level against which the effects of the low and high level were estimated. The estimates indicate that elderly prefer to live in a suburb or town over a city, a lower price of the apartment and a location that is near to green, shops and public transport.

For the present analysis the estimates of the delta parameters are of particular interest. On this level, the results show several effects. First, regarding the distance to green the reference level has a significant impact on utilities. The estimates indicate that those who currently live far from green (more than 15 min. cycling) assign 1.108 utility units more to options for moving than those who currently live closer to green. Thus, because of their current (low) level of green they experience they find the housing alternatives presented more attractive than others do. Second, also Public transport displays a constant-shift effect of the reference situation. Elderly who currently live far from public transport assign 0.506 utility units more and elderly who currently live close to public transport assign 0.319 utility units less to alternatives for moving compared to the base group who lives at medium distance from public transport. Thus, for both Green and Public transport a currently experienced level may induce a threshold for moving.

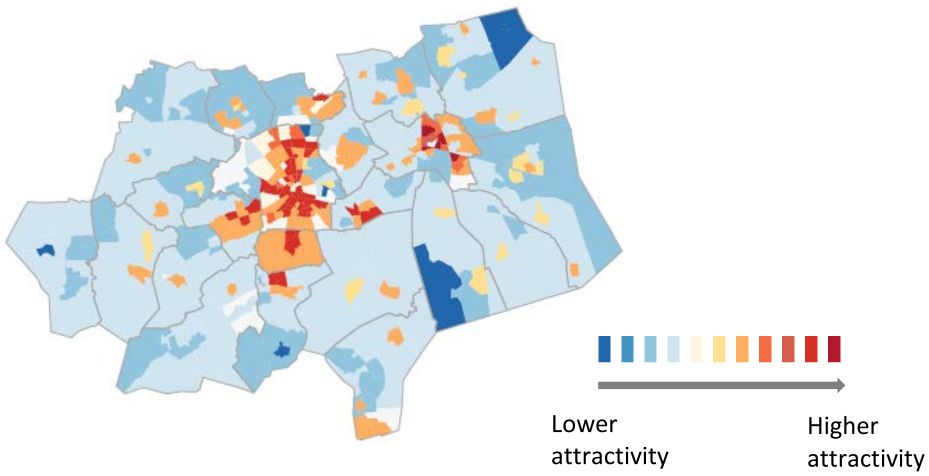
Location displays more complex loss and gain patterns that can only be described by the general model. In the base model, the estimated main effects of Location indicates that (large) city is the least preferred location type: on average the elderly prefer to live in a smaller city (referred to as Town) or in the suburbs of a larger city. The main effects change, however, when losses and gains are taken into account in the extended model. Then, the negative preference for city disappears and a negative (taste) preference for Suburb emerges as the only taste effect. Looking at losses and gains, we see that a change in location generates a loss in utility for moves from Town or Suburb to City as well as from City to Town. Moves between Suburb and Town and from City to Suburb are evaluated as being neutral. Clearly, location is not a type of attribute where alternatives can be positioned on a scale of increasing or decreasing utility and where the position of the current level determines whether a loss or gain is experienced. Rather, elderly prefer the location where they currently live when the move involves a change from Town to City or the other way round. Also, when they currently live in a suburb they are reluctant to move to a city location.

Summarizing, the results show that reference dependence plays a significant role in the choice behaviour of elderly and differs between attributes. Of the attributes tested, proximity of shops does not show statistically significant reference dependence; preferences regarding this attribute exist but they do not generate a threshold or drive to move when a loss or gain would be involved. On the other hand, preferences for proximity of green, location type and accessibility of public transport *are* affected by the current levels the individual experiences. In case of green and public transport there is no evidence of asymmetry as felt losses and gains appear to have equal weight. Reference-dependence is expressed in terms of a higher propensity to move of people who, in the reference situation, live far from green or have poor accessibility to public transport, and a lower propensity to move of people who, in the reference situation, have good accessibility to public transport.

Policy implications

The discussed insights into location preferences can be used to improve existing living environments making them more senior-friendly, or to determine a suitable location for seniors-oriented homes. Figure 1 gives an example. Here the neighbourhoods of the metropolitan region of the Dutch fifth largest city Eindhoven are ordered in terms of their attractivity for the elderly. The attractivity has been computed as the predicted utility from equation (2) using the estimated coefficients from Table 4. Warm colors (brown, red) indicate neighborhoods that are rich in attractive location features (proximity to public transport, greenery, proximity to shops), and cold colors (blue) for the neighborhoods that are relatively poor in attractive features. Centrally located neighborhoods in Eindhoven and a smaller town Helmond to the east of it, for example, score relatively high due to the availability of shops and good public transport. A municipality or developers can use such a map as an analysis tool for various purposes. On the one hand, in this way it becomes clear which locations are particularly suitable for developing senior dwellings. On the other hand, a lower score for a neighborhood where many seniors live can signal that there is a need for additional facilities there. As our reference-based model suggests, especially improving the availability of public transport and green in locations where these amenities are scarce will lead to a considerable increase in the living comfort for the elderly.

Figure 1 Neighbourhoods of Eindhoven region (Netherlands), predicted attractivity for elderly



4. Conclusions and discussion

In this study, we considered the influence of reference levels on elderly housing preferences. We proposed a framework that allows the simultaneous estimation of absolute utilities for particular levels of attributes and utilities related to feelings of losses and gains when attribute levels differ from the reference level. In this framework, symmetric as well as non-symmetric evaluations of losses and gains can be identified. To account for a range of possible behaviours, we proposed different parametrizations of attribute utility that allows us to identify the best fitting model on a per-attribute basis. In an application to elderly housing choice we find significant reference effects on housing preferences. The data used were collected through a stated choice experiment recently conducted in The Netherlands.

The results indicate that the influence of reference level is particularly strong for location type (with levels: large city, town and suburb). We find that virtually any change of location type generates strong loss effects even to an extent that the reference point almost fully explains the preferences. This may reflect a status-quo bias (reluctance to change) or a self-sorting effect (people live currently at the place they prefer). For the attributes distance to green and distance to public transport we also find reference effects. These effects have the form of shifting the level of a base preference for moving that is independent of attributes of the offered alternative. For distance to shopping facilities we find clear preferences for particular attribute levels but no reference effects. Thus, for this attribute losses or gains do not play a significant role in the evaluations of housing alternatives.

The findings have implications for housing policy and design. For attributes where reference levels play a role, adaptation of offered housing alternatives to target groups defined in terms of levels they currently experience is important. The strong status-quo effects that we find for location type imply that a change of location type may generate a strong threshold for elderly to move. Thus, housing options targeted to elderly and linked to a certain location type will not be attractive to those elderly that currently live in a different type of location unless there are strong gains on other aspects that could compensate for this. At the same time, housing providers should be aware of an increased threshold to accept alternatives for elderly where this would entail a diminishment in terms of green and public transport facilities as this generates negative loss effects. Differentiating target groups in terms of the current accessibility of shopping facilities does not seem to be relevant.

These implications for policy making demonstrate the practical relevance of taking reference effects into account. The extended modelling framework is able to account for heterogeneity in choice behaviour that can be related to household's current housing conditions, which appears to be substantial. It is relatively easy to collect the data on reference levels in the context of stated choice experiments, so that this extra information can be obtained against low costs. Several problems and opportunities remain for future research. First, the data set used in this study allowed us to analyse reference effects for a limited number of attributes, for a particular user group (elderly) and for a particular region (The Netherlands) only. It might be interesting to replicate the study on other datasets to test the robustness of the findings and to broaden the scope on these dimensions (attributes, user group and region). Second, it might be useful to extend the analysis and also consider cross-attribute reference effects. In the present analysis, we considered the effect of reference level on preference for particular levels on the same attribute. A reference level on one attribute may however also influence preferences related to other attributes. Such an extended analysis may offer a broader view on the transitions that people are willing or reluctant to make in their housing decisions.

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