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The spatial transferability of a decompositional multi-attribute preference model

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Abstract. An empirical test is made of the spatial transferability of a decompositional multiattribute preference model, in the context of spatial shopping behaviour. The model which is estimated for the city of Maastricht is used to predict shopping patterns in a part of the city of Eindhoven. The results indicate that the goodness of fit of the model reduces only slightly. This supports the assumption that decompositional preference models may be used to uncover utility or preference functions which are independent of spatial structure.

Introduction

The issue of spatial transferability of spatial choice models has been of increasing interest to model builders. During the last decade, an ever increasing number of studies have been concerned with testing whether the parameters of a model, calibrated in a particular study area, can be used successfully to predict observed choice-behaviour in another area. In prior studies the transferability assumption has been tested in the context of spatial interaction, revealed preference, and discrete choice models, but to the best of the authors' knowledge no such studies exist in connection with decompositional preference models. This is surprising, especially because these preference models have been developed specifically for uncovering preference or utility functions which are independent of spatial structure. Preference structures are derived from individual responses to hypothetical choice-alternatives, and, as these alternatives may be located everywhere, it may be argued that, in theory at least, the derived preference structures are applicable to different spatial structures unless preference formation is highly influenced by local experience (see Timmermans, 1984a, for details).

The primary aim in the present study, therefore, is to fill this gap. In particular, there is an empirical assessment of the spatial transferability of a decompositional multiattribute preference model applied to the problem of consumer choice of shopping centre. However, in order to place this study in the wider context of the problem of spatial transferability, a summary of previous research will first be given. This is followed by a description of the data, of the model used in the present study, and of the results of the analyses. The paper is concluded by a discussion of the implications of these findings.

The spatial transferability problem

The issue of spatial transferability, although couched in different terms, dates back to Rushton (1969) who introduced the distinction between models of spatial behaviour and models of behaviour in space. He suggested use of the second term for the description of actual or observed spatial behaviour, whereas the term spatial behaviour, on the other hand, refers to the rules by which individuals evaluate spatial choice-alternatives and by which choices are made. He argued that behaviour in space is highly influenced by the spatial structure of the area under investigation, that is, the locational arrangement of the choice alternatives, and, hence, that

models based on observed behaviour are invalid as postulates in theory. Timmermans and Veldhuisen (1981) later extended this point of view and argued that models based on observed behaviour may not only be invalid as postulates in theory, but also as planning tools which are used to predict the likely consequences of policy measures on spatial choice-behaviour as, by definition, planning is typically concerned with changing the spatial structure of the study area.

Rushton's discussion was critical to spatial interaction models, at the time of his writing the major type of model in the field. It coincided with a series of studies on the relationship between spatial structure and the parameters of spatial interaction models (Baxter, 1983; Cliff et al, 1974; 1975; 1976; Curry, 1972; Curry et al, 1975; Ewing, 1974; Fotheringham, 1983; Fotheringham and Webber, 1980; Gould, 1975; Griffith and Jones, 1980; Johnston, 1973; 1975; 1976; Olsson, 1970; 1975; Sheppard, 1979a; 1979b; Sheppard et al, 1976). Most of these studies were rather theoretical. However, in more empirically oriented studies these criticisms were generally supported. For example, Pankhurst and Roe (1978) calibrated a spatial interaction model in Derby, and used the estimated values of parameters to predict consumer choice-behaviour in Watford. They found that the predictive ability of the model was reduced substantially.

Since the mid-1970s discrete choice models have become the most frequently applied models of spatial choice-behaviour. It was believed that the sophisticated assumptions underlying these models would suffice for the prediction of choices in other locations. On the other hand, as discrete choice models are also based on observed behaviour, the arguments expressed in connection with spatial interaction models are probably equally applicable to discrete choice models, although it appears that, so far, Louviere (1979) is one of the few scholars who has raised doubts against the spatial transferability of discrete choice models. Anyway, there have been a number of empirical studies in which the transferability question has been addressed (Atherton and Ben-Akiva, 1976; Galbraith and Hensher, 1982; MacCarthy, 1982; Talvitie and Kirshner, 1978). The results of these studies have been rather contradictory and, in addition, are not particularly relevant for the present discussion as all these studies have been concerned with aspatial choice-behaviour.

There are only a few modelling approaches which concentrate on rules of spatial choice-behaviour. All the approaches have in common the assumptions that choice alternatives can be defined in terms of attributes and that preference or choice is arrived at by a cognitive integration of the part-worth utilities associated with these attributes, into some overall preference or utility measure. The approaches differ, however, in terms of the way in which these rules are identified. Rushton's revealed preference model was based on a comparison of the chosen and rejected choice-alternatives. Hence, the composition of the choice set was explicitly incorporated in the derivation of the preference function. He argued that preference functions derived in this way were invariant. This transferability hypothesis has been tested in a few studies. Rushton (1971) himself showed that preference structures can be accurately recovered from a great variety of choice patterns by use of simulated data on choice. Timmermans (1981) found evidence of invariant preference functions in two Dutch regions—the derived choice-rules could predict choice behaviour when transferred from one region to the other. Hence, it seems that the preference-scaling model is to be preferred in terms of transferability, unless some clear cultural boundaries are crossed (see Lentnek et al, 1975). It should be noted, however, that this model has been questioned in that it is doubtful that it uncovers preferences rather than consistency of spatial behaviour (for example, MacLennan and Williams, 1979; 1980; see also Timmermans and Rushton, 1979).

One problem associated with the preference-scaling model is that it still relies on actual behaviour and available choice-alternatives. In contrast, decompositional preference models are based on hypothetical choice-alternatives and experimental designs. Consequently, the second approach allows the researcher to construct different choice-sets and control the statistical properties of the data. In theory, therefore, the transferability of decompositional preference models is expected to be better than that associated with preference-scaling models. In the next section we report on a test of this hypothesis.

Study areas and methodology

The decompositional preference model

As stated before, the main aim in the present study is to assess the spatial transferability of a decompositional multiattribute preference model. First, for those readers who are less familiar with this type of model, a short summary of its essentials will be given.

Consider a multiattribute choice-alternative (for example a shopping centre) which can be described as the ordered m -tuple, x , where

$$x = (x_1, x_2, \dots, x_j, \dots, x_m). \quad (1)$$

Here x_j is the level of alternative x on the j 'th attribute. Further, assume that an individual's choice-behaviour is the result of his or her subjective evaluations of the attributes of the choice alternatives, combined into an overall evaluation of each alternative x . Subjects may then be asked to rank the choice alternatives with respect to their overall evaluation. To understand the decisionmaking process involved, it is necessary to identify the composition rule which has been applied in such a task to arrive at the overall evaluation, and to infer part-worth utilities of the attribute levels. This measurement problem is known as the 'conjoint measurement problem' and the rule which specifies the composition of the subjective evaluations of the attribute levels is called 'the conjoint measurement model' (Krantz, 1964; Luce and Tukey, 1964). It constitutes one approach to decompositional preference modelling.

In conjoint measurement, one is thus concerned with simultaneously measuring the joint effect of two or more variables on the ordering of the dependent variable. It typically involves the following steps. First, a measurement model which describes the combination of individual effects is specified. Next, the hypothetical choice-alternatives are generated. This step involves the identification of the attributes which are considered important in influencing the choice behaviour of interest, the definition of these attributes in terms of attribute levels, and then the combination of these into hypothetical choice-alternatives in accordance with some experimental design. The choice of design is largely dictated by the chosen measurement model, especially because the complex measurement models cannot be estimated on the basis of simple experimental designs. Subsequently, subjects are requested to express their overall evaluation or preference for the resulting set of choice alternatives. These preference measures are then decomposed into the so-called part-worth utilities associated with the various attribute levels, given the a priori specified measurement model. The validity of the decomposition may be assessed by a calculation of some goodness-of-fit measure. The most appropriate conjoint measurement model for a given decisionmaking task may be identified by a comparison of goodness-of-fit measures for alternative models of measurement.

Once these preference structures have been derived, the next step involves specification of a decision rule which predicts an individual's choice behaviour given the position of the choice alternatives on his or her subjective preference scale.

Actual choice-behaviour may then be simulated by the definition of real-world choice alternatives in terms of the attributes levels incorporated in the experiment, by the calculation of an individual's preference score for each alternative on the basis of the derived preference function and then by the application of the chosen decision rule to the calculated preferences.

In the present study the following model was chosen:

$$U_{li} = \sum_k \sum_m \beta_{lkm} Z_{kmi} + \varepsilon_i, \quad (2)$$

where

U_{li} is the overall preference of individual, l , for the i th alternative,

β_{lkm} is individual l 's part-worth contribution of the m th level of the k th attribute,

Z_{kmi} is the presence ($Z_{kmi} = 1$) or absence ($Z_{kmi} = 0$) of attribute level m of the k th attribute for the i th alternative,

ε_i is a stochastic error term.

This linear additive model can be considered as a formal representation of a compensatory decisionmaking process, in that low scores on some attribute may, at least partially, be compensated by high scores on one or more of the remaining attributes. The summation term of the equation permits this compensation. The model is known to be very robust. It should be noted that the chosen model is rather simple; more elaborate procedures would involve incorporating choice-set effects and various context effects. Although one would expect such effects to exist, and the predictive results of the complex context-sensitive models appear to be very good [for example, see Louviere and Timmermans (1987) for a review], the results obtained with the simpler linear additive model also appear quite promising and, in fact, no study has actually systematically compared the performance of these different models.

The construction of a decompositional preference model also involves the choice of a decision rule which specifies the functional relationship between the derived preference function and overt behaviour. In general, different types of decision rules may be considered. The first rule states that an individual will invariably choose that alternative included in the choice set which received the highest preference score. The second rule is more complex and was derived from the following assumptions. First, assume that the preference, U_i , for choice alternative i is a stochastic variable, given by

$$U_i = \bar{U}_i + \varepsilon_i, \quad (3)$$

where

$\bar{U}_i$ is the average preference for alternative i ,

ε_i is the stochastic error.

If the difference in the overall preferences associated with choice alternatives i and j is then denoted by u_{ij} , it follows that the probability that alternative i will be chosen is given by

$$\begin{aligned} p_i &= \text{prob}(U_i > U_j), \\ &= \text{prob}(\bar{U}_i + \varepsilon_i > \bar{U}_j + \varepsilon_j), \quad i \neq j, \quad \forall j, \\ &= \text{prob}(u_{ij} > 0). \end{aligned} \quad (4)$$

If it is assumed that the errors are described by a multivariate normal density-function and that all variances are equal, the probability of choosing alternative i then becomes

$$p_i = \left[1 + \sum_j \exp \left(\frac{-\pi u_{ij}}{3^{1/2} s_{ij}} \right) \right]^{-1}, \quad (5)$$

where s_{ij} is the standard deviation of the difference in overall preference. It has been found previously (Timmermans and van der Heijden, 1984) that this probabilistic decision-rule leads to satisfactory results.

Another important issue in the construction of the model concerns the definition of the choice set. In almost all previous studies it has been either explicitly or implicitly assumed that all alternatives present in the study area belong to all individuals' choice-sets. Consumers are thus assumed to have identical choice-sets. Although this assumption may be valid in some contexts, it is well known from the literature that consumers are only familiar with a limited number of shopping centres. Studies on the spatial information and usage fields of consumers (for example, Potter, 1979) have indicated that they are rarely familiar with more than six or seven shopping centres, and that they typically do not have identical choice-sets. Sectoral and distance bias are generally strong. These findings imply that a valid model should incorporate individual choice-sets. In theory, it is possible to identify explicitly each individual's choice set by looking at his or her spatial information or perhaps the usage field, but the disadvantage of such an approach is that it may be difficult to predict spatial information and usage fields at the individual level. At the very least, in the only study conducted so far which contained a prediction of the choice-set generating processes (van der Heijden and Timmermans, 1984) an aggregate approach was adopted. It was decided, therefore, to use a similar approach in the present study. Thus, the definition of the choice sets was based on the following equation which predicts the probability that an individual will be familiar with a particular shopping centre.

$$p_{ij} = \frac{\exp(-0.090 + 1.292X_{j1} - 0.885X_{j2} - 2.222X_{j3})}{1 + \exp(-0.090 + 1.292X_{j1} - 0.885X_{j2} - 2.222X_{j3})} \quad (6)$$

where

p_{ij} is the probability that an individual at location i will be familiar with the j th shopping centre,

X_{j1} is the size of the j th shopping centre,

X_{j2} is the distance between location i and shopping centre j ,

X_{j3} is a variable denoting the presence ($X_{j3} = 1$) or absence ($X_{j3} = 0$) of an intervening opportunity between location i , and shopping centre j .

Thus, the simulation works as follows. First, the shopping centres are described in terms of the attributes included in the preference experiment. Next, for each respondent separately, a choice set is identified on the basis of the spatial information field that is predicted for residential zones. The respondent's preference score for each shopping centre is then calculated by the application of the part-worth preference function to the description of the shopping centres in terms of attribute levels. Given these preference scores, actual behaviour is simulated by the implementation of the probabilistic decision-rule.

The study areas

The two study areas used in the analyses were the Maastricht region and the northern district of the city of Eindhoven. Both data sets have been used in previous publications (for example, see Timmermans, 1984b; Timmermans et al, 1984). Maastricht is situated in the south of the Netherlands. Apart from the city centre, the city has twenty-four shopping centres. It is a historical city; only a few of its shopping centres are planned. In contrast, the northern district of the city of Eindhoven is completely planned and was developed after the Second World War. Twelve mainly planned shopping centres can be identified in this district.

The analyses also included the city centre, so that, in total, thirteen shopping centres were used in the Eindhoven case.

The data

The data for the Maastricht region were obtained from a randomly selected sample of 678 respondents. The person in the household who was responsible for shopping, usually the wife, was invited to complete the questionnaire. The data were collected through personal interviews by experienced interviewers who were hired locally and trained by a national opinion-research company. Because some of the measurements were rather complex, care was taken that the interviewers fully understood all measurement procedures. In addition, the phrasing of the questions, as well as their elucidations, were extensively tested in pilot studies. As a means of motivating them, respondents were told that their answers would be used to formulate proposals for future retail plans.

A variety of data was collected, but for the present analysis only some of these are relevant. First, actual shopping behaviour was measured by the presentation of a list of eighteen goods (goods not bought daily). For each type of good, respondents were asked to name up to three shopping centres where they buy the particular good, the frequency of purchase, and the amount they usually spend. These responses were aggregated across respondents to yield measures of actual choice-probabilities and market shares. Second, data on consumer preferences for a set of hypothetical shopping-centres were obtained. This, of course, constitutes the conjoint experiment. The shopping centres were defined in terms of five attributes: range of choice, parking facilities, price, atmosphere, and travel time. These attributes were selected on the basis of the results of previous projects in which it was consistently suggested, by use of different techniques of measurement such as repertory grids, factor listings, and importance scales, that these attributes are among the most important attributes influencing consumer choice of shopping centres. Each attribute was varied over three levels: choice range varied over limited, medium, and wide range of choice; parking facilities varied over bad, average, and good; price varied over low, average, and high; atmosphere varied over bad, average, and good; and travel time varied over 5, 25, and 45 minutes. A trade-off design was used to measure consumer preferences. Thus, respondents were shown a series of trade-off matrices in which two attributes were combined. As there are five attributes, ten $[(5 \times 4)/2]$ trade-off matrices were constructed. Because each attribute was defined in terms of three attribute levels, each matrix contains nine cells, each of which represents a combination of attribute levels of the two attributes involved. Respondents were asked to rank all nine combinations of attribute levels from most preferred to least preferred for each trade-off matrix separately. To avoid pattern responses, the order of the attribute levels was varied across pairs of attributes. Each respondent was asked to ascertain that the preference orderings were correct. Otherwise, they were allowed to change the ordering. They were told that their responses should reflect their preferences when shopping for nondaily goods. Thus, this procedure resulted in ten strict-rank orderings of hypothetical shopping-centres, which varied over only two attributes for each respondent. The trade-off design was used to reduce the experimental task. It should be noted that by the adoption of a trade-off design, one implicitly assumes that respondents are capable of expressing their preferences for a combination of two attributes independently of the levels of the other attributes. If one wishes to devise an actual test for possible interaction effects, a suitable fractional factorial design should be used.

The data obtained for the district of Eindhoven were very similar. Again, several data were collected but, for the present analysis, only the data on actual behaviour are important. The randomly selected sample consisted of 194 respondents, who were asked to state their frequency of shopping for nondaily goods in each of the thirteen shopping centres. These frequencies were converted into actual choice-probabilities and market shares.

Analysis and results

The following procedure was adopted to assess the spatial transferability of the decompositional preference model.

- (1) The linear additive model was estimated for each respondent separately, on the basis of the data pertaining to the city region of Maastricht.
- (2) The validity of this model was assessed.
- (3) The shopping centres in the district of Eindhoven were defined in terms of the attribute levels used in the experiment as implemented in Maastricht.
- (4) The parameters, estimated on the basis of the Maastricht data, were used to predict consumer choice of shopping centres in the district of Eindhoven, and these predictions were compared with actual spatial behaviour of consumers in the district of Eindhoven.

Thus, the first step in the analysis involved the estimation of the preference function. The part-worth utilities can be estimated by a variety of techniques (Timmermans, 1984a). In the present case, standard linear regression analysis was used to obtain the parameter values of the preference model. Strictly speaking, this is an invalid procedure as the dependent variable is only measured at an ordinal scale. It has been shown in several simulation studies, however, that the results from ordinary least-squares tests are virtually indistinguishable from the results obtained by theoretically preferable techniques such as linear programming or nonmetric scaling. The disadvantage of these techniques is that they are very costly in terms of computing time. Therefore, linear regression analysis was used.

The full data matrix for the estimation of one respondent's preference model consists of 720 observations on ten independent variables. For the estimation of the part-worth utilities, only $(M_k - 1)$ linearly independent variables are needed for each attribute k , where M_k denotes the number of attribute levels of attribute k . Thus, in the present case each attribute can be represented by two indicator variables, which yield a total of ten $(= 5 \times 2)$ independent variables in the regression analysis. Effect coding was used to value the independent variables. This means that, for each attribute, a number of coded vectors, equal to the number of attribute levels minus 1 $(3 - 1 = 2)$, were constructed. For these coded vectors values of 1 were assigned to choice alternatives which were characterised by an arbitrarily chosen attribute level; values of 0 were assigned to alternatives which were characterised by all remaining attribute levels but one; and values of -1 were assigned to all choice alternatives which were characterised by the excluded attribute level. The value of the independent variable was set to 0 when that attribute did not appear in the trade-off matrix, corresponding to the observation in the data matrix. Because each trade-off matrix contains nine cells, each trade-off matrix generates thirty-six $[= (9 \times 8/2)]$ implicit paired comparisons. The value of the dependent variable was set to 1 for the preferred combination of attribute levels, and 0 otherwise. Hence, each paired comparison yields two observations which implies that, in total, 720 $(= 10 \times 36 \times 2)$ observations were generated. An indication of the goodness of fit of the linear additive 'main-effects only' preference model was obtained by a calculation of Kendall's tau, a measure which expresses

the strength of the ordinal relationship between the predicted and the manifest rank-orderings in the trade-off matrices.

The estimation results are given in table 1, and it is shown that these are satisfactory. 89.3% of the respondents exhibit a tau value of 0.8 or higher; only six have a value of lower than 0.6. The mean tau value is 0.88; its standard deviation is only 0.07.

Further support for the validity of the preference model was obtained by testing whether the estimated scales of preference for the various attributes were monotone in a priori anticipated directions. In particular, it was assumed that preference should increase with increasing levels of range of choice, parking facilities, and atmosphere, whereas it should decrease with increasing levels of price and travel time. The results are provided in table 2, in which the validity of the model is clearly demonstrated. The results indicate that at least 94.1% of the respondents have a utility function which is in the anticipated direction. The highest percentage, 97.8%, is obtained for the attribute for range of choice. The lowest results were obtained for the distance attribute, although here the percentage of respondents with part-worth utilities in anticipated directions is still 94.1%.

A third test on the validity of the preference model consisted of a cross-tabulation of the monotonicity test across the values of tau. In table 3 the resulting cross-tabulations are given. It is shown that those respondents whose part-worth utilities are in the anticipated directions also exhibit a high tau-value. Few respondents with high tau-values have part-worth utility functions which are not in anticipated directions.

After the estimation of each individual's preference model, the next step of the analysis involved linking these preferences to observed spatial patterns of consumer choice. This step can be considered as a test of the external validity of the preference model. It tests whether the derived preference functions are systematically related to overt choice-behaviour. This is done by the implementation of some

Table 1. Frequency distribution of tau.

Tau	Frequency	Percentage	Cumulative percentage
0.0-0.1	0	0.0	0.0
0.1-0.2	0	0.0	0.0
0.2-0.3	0	0.0	0.0
0.3-0.4	0	0.0	0.0
0.4-0.5	1	0.1	0.1
0.5-0.6	5	0.7	0.9
0.6-0.7	10	1.5	2.4
0.7-0.8	57	8.4	10.8
0.8-0.9	218	32.2	42.9
0.9-1.0	387	57.1	100.0

Table 2. Monotonicity test.

Variable	Monotonicity	
	absolute	percentage
Range of choice	663	97.8
Distance	638	94.1
Price	656	96.8
Parking facilities	654	96.5
Atmosphere	658	97.1

decision rule. In this study, a probabilistic rule is used which states that the probability of choosing an alternative is given by the multivariate logistic equation, outlined in the previous section of the paper. The implementation of these decision rules necessitates that each of the shopping alternatives should be defined in terms of the attribute levels included in the preference experiment. This can be accomplished along several different lines, but in the present case the following straightforward procedure was used. In the case of continuous attributes the actual attribute scores were used; in the case of ordinal attribute levels the shopping alternatives were assigned to a particular attribute level by examining their objective characteristics and by arbitrarily setting boundaries. Part-worth utilities were then obtained by simple linear interpolation or extrapolation in the case of continuous attributes, and by linear assignment in the case of ordinal attributes.

The predictive ability of the probabilistic decision-rules was assessed by a comparison of predicted market shares, obtained by aggregating predicted individual choices across respondents, and by a comparison of actual market-shares. To avoid interpretation bias, different goodness-of-fit measures were calculated.

The results of this part of the analysis are given in table 4. It is clearly demonstrated that the predictive ability of the probabilistic decision-rule is satisfactory. The linear additive 'main-effects only' preference function, when combined with a probabilistic decision-rule, accounts for 99.3% of the variance in the shopping-centre choice probabilities, as indicated by the coefficient of determination. The results in table 4 also suggest a reasonably linear relationship between predicted and actual choice-behaviour—Robinson's agreement measure, which measures departures from the $x = y$ regression line is equal to 0.996. The mean absolute error is only 0.199.

The third step in the analyses involved the definition of the shopping centres located in the district of Eindhoven in terms of the attribute levels used in the experiment. The same procedure as used in the Maastricht case was adopted.

Table 3. Cross tabulation of tau against monotonicity.

Tau	Monotonicity			
	absent		present	
	absolute	percentage	absolute	percentage
0.0–0.1	0	0.0	0	0.0
0.1–0.2	0	0.0	0	0.0
0.2–0.3	0	0.0	0	0.0
0.3–0.4	0	0.0	0	0.0
0.4–0.5	1	0.1	0	0.0
0.5–0.6	5	0.7	0	0.0
0.6–0.7	9	1.3	1	0.1
0.7–0.8	24	3.5	33	4.9
0.8–0.9	34	5.0	184	27.1
0.9–1.0	10	1.5	377	55.6

Table 4. Goodness of fit of the model.

Measure	Value
Coefficient of determination	0.993
Robinson's agreement measure	0.996
Theil's inequity measure	0.009

That is, in the case of continuous attributes the actual attribute scores were used; in the case of ordinal attribute levels the shopping alternatives were assigned to a particular attribute level by an examination of their objective characteristics and by the arbitrary setting of boundaries. Part-worth utilities were then obtained by simple linear interpolation or extrapolation in the case of continuous attributes and by linear assignment in the case of ordinal attributes. More specifically, the choice range of each shopping centre was assumed to be represented by the total number of shops. The parking facilities were measured by a determination of the percentage of free parking lots for each shopping centre on a number of occasions, and calculation of the mean percentage for each centre. Price levels and distance were also empirically measured, but the atmosphere of a shopping centre was measured subjectively. That is to say, the respondents were asked to evaluate those shopping centres they are familiar with on a six-point rating scale ranging from very bad to extremely good. For each shopping centre a mean evaluation score was calculated, and the centres were allocated to the attribute levels on the basis of these mean scores.

After the shopping centres had been defined in terms of the experimental attribute levels, the preference parameters, as estimated on the basis of the data pertaining to Maastricht, were used to predict the spatial behaviour of consumer choice in the district of Eindhoven. Choice sets were defined along two different lines. In a first analysis it was assumed that a choice set was equal to a usage field, implying that a choice set was assumed to consist of all shopping centres that are patronised. In a second analysis, choice sets were predicted from equation (6). The results of both analyses are given in table 5, which demonstrates the close correspondence between the observed and the predicted patterns of choice in the district of Eindhoven. The best results are obtained when the usage fields are used, but it is also shown in the table that the predictions are still quite good when the choice sets are also predicted. In order to quantify the degree of correspondence between the observed and the predicted patterns of choice, a series of goodness-of-fit measures were calculated. Of course, these measures produce the same results (table 6). The model explains 99.4% of the destination totals; the relationships between the predicted and the observed patterns of choice is quite linear, as indicated by Robinson's agreement measure, and Theil's inequity coefficient is only 0.02.

Table 5. Observed and predicted choice patterns in Eindhoven.

Shopping centre	Observed choice (%)	Predicted choice (%)	
		usage fields	information fields
1. Woenselse Heide	2.73	1.76	1.62
2. Tempel	2.42	2.36	2.50
3. Vaartbroek	5.10	5.02	6.31
4. Jagershoeft	2.08	1.65	0.89
5. Prinsejagt	1.28	1.14	1.57
6. Eckart	2.09	2.09	2.08
7. W.C.Woensel	47.01	47.13	47.77
8. H.Staetslaan	3.32	3.60	2.57
9. P.v.Asplein	2.58	2.68	2.71
10. Oude Gracht	2.40	2.72	1.80
11. Coenderslaan	1.03	0.34	0.50
12. Kruisstraat	12.61	12.60	12.67
13. City	15.34	16.90	17.01
Total	100.00	100.00	100.00

It is also demonstrated in that overall, the goodness of fit of the model is almost equally good in the Eindhoven case as it is in the Maastricht case. Hence, these findings support the view that a decompositional multiattribute preference model is independent of spatial structure.

Table 6. Goodness-of-fit measures.

Measure	Value	
	usage fields	information fields
Coefficient of correlation	0.997	0.996
Robinson's agreement	0.994	0.991
Theil's inequity measure	0.020	0.020

Conclusion and discussion

The main thrust in this paper has been to test the spatial transferability of a decompositional multiattribute preference model in the context of spatial shopping-behaviour of consumers. As this type of model is based on hypothetical choice-alternatives, which can be located everywhere in space, and on experimental measurement designs, the transferability of this model is expected to be relatively good.

The findings of the present study generally support this hypothesis. The goodness of fit of the model was hardly reduced when the model was transferred from the one study area to the other. This implies the existence of a high degree of consistency within preferences of shopping alternatives between consumers residing in the two study areas. It also implies that their preferences can be uncovered accurately by the use of decompositional preference models.

To some degree, this finding is at variance with the results of recent research which suggest that individual decisionmaking and choice behaviour is influenced by the composition of the choice set. Individuals tend to place more importance on those attributes that have a higher variance (for example, Eagle, 1988; Meyer and Eagle, 1982). Similar research has been conducted in connection with spatial interaction models (Fotheringham, 1985) and discrete choice models (Borgers and Timmermans, 1987; 1988). Thus, it seems that, although this so-called weight-shifting, context-dependent behaviour may be important, its influence on overall goodness of fit cannot be detected, at least not in the present case. One possible explanation may be that, although the two study areas differ substantially in terms of size, type, and age of shopping centres, they are still too similar, in terms of composition of the choice sets and of the variance of the selected attributes, to produce different types of spatial behaviour. It is important, therefore, to replicate this type of research in other study areas as well as in other contexts, which involve different types of spatial choice-behaviour.

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