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Choice of season cards in public transport: an SP experiment*

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Abstract

This paper studies a Stated Preference (SP) experiment on the choice of type of Season card, conducted among existing Dutch railways season cardholders. It uses MNL, nested logit and mixed logit to analyse their choices. It is found that MNL underestimates the price sensitivities of the respondents and overestimates their willingness to pay (WTP) for reductions in the usage restrictions of the card. The price elasticities for the season card without restrictions are rather inelastic, whereas responses for the card with restrictions are very elastic. The current cardholders have a strong preference for continuing to own the unrestricted card. The mixed logit estimation shows that there are large differences in the individual marginal utilities of the price of the season card, and the person specific benefits of owning a season card.

Keywords: SP experiment, rail season card, travel cost compensation, mixed logit

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1 Introduction

This paper studies the choice of rail season card of Dutch travellers. Season cardholders pay a certain amount per month or year and travel further free of extra charge. In the experiment, respondents choose between (1) an unrestricted season card, which is the same as their current one only more expensive, (2) a cheaper card with travel frequency and rush hour travel restrictions and (3) stop owning a season card.

MNL, nested logit and Mixed logit estimations are used to study the responses in the SP experiment. The two card alternatives both entail owning a card. It is found that the utility of owning a season card differs substantially over the respondents. In the MNL estimations, the alternative specific constants (ASC's) capture average utility. Variations from the average are unmeasured and stay in the errors. The errors of the two card alternatives are thus related and this violates the IID assumption of MNL. Nested logit and mixed logit can control for this.

An interesting aspect of the used survey is that it has information on the proportion of the card's price paid by the respondent. This makes it possible to control for the effect of compensation by third parties. This is important as a large share of the Dutch travellers get their costs (partly) compensated by a third party (Steer Davis Gleave, 2006). The empirical study of price sensitivities of travellers largely does not control for travel cost compensation. While travel cost compensation is often named as a reason for why demand elasticities are so price inelastic.

From the estimations, elasticities to changes in the attributes and willingness-to-pay for changes in the restrictions are calculated. Large and interesting differences between the results from MNL, nested logit and mixed logit are found.

The next section discusses the used methods. Then the SP experiment and the dataset are described. The fifth section analyses the MNL estimations. The sixth part discuses the nested logit estimation. The last section discuses the mixed logit estimation.

2 Estimation methodology

This study uses random utility maximization models. The utility function (U_{iq}) for alternative i of respondent q is formulated in (2.1). It has two parts, a deterministic part (V_{iq}) and an additive random part (ε_i), which is unknown to the observer. With multinomial logit (MNL) each individual is assumed to have the same parameter for each variable in V_{iq}. MNL bases its calculations on the assumption that the errors are independently and identically distributed (IID) (Koppelman & Sethi, 2000).

The deterministic utility function is represented by (2.2). The deterministic utility of alternative i is, for individual q, determined by a vector of k attributes ($\mathbf{x}_{iq}$) and their parameters (vector $\boldsymbol{\beta}_i$). Note that $\boldsymbol{\beta}'_i\mathbf{x}_{iq}$ also contains the alternative specific constant (ASC_i). Individual characteristics ($\mathbf{z}_q$) and their vector of parameters ($\boldsymbol{\delta}_i$) can be added to V_{iq}. People do not directly receive utility from these variables; they are added to control for observable differences in individuals. The vector $\mathbf{v}_i$ represents the effect of the characteristics on the weight attached to the attributes.

$$U_{iq} = V_{iq} + \varepsilon_{iq} \tag{2.1}$$

$$V_{iq} = (\boldsymbol{\beta}_i + \mathbf{v}'_i \mathbf{z}_{iq})' \mathbf{x}_q + \boldsymbol{\delta}'_i \mathbf{z}_{iq} \tag{2.2}$$

$$E_{x_{ikq}}^{P_{iq}} = \frac{\partial P_{iq}}{\partial x_{ikq}} \frac{x_{ikq}}{P_{iq}} = \beta_{ikq}(1 - P_{iq}) x_{ikq} \tag{2.3}$$

The direct point elasticity for the MNL model is given by (2.3). It can be interpreted as the elasticity of the probability that decision maker q chooses alternative i, in regard to a change in the kth variable.

Nested logit is a popular alternative for MNL. It to some extent relaxes the assumption of no correlation between the errors and identical distribution of all errors. Nested logit allows for correlation between the utilities of alternatives in predefined “nests”. This correlation comes from unobserved factors that influence the utility of the alternatives in the nest in the same manner. The assumption that the errors of the alternatives are unrelated and identically distributed is often violated. The relaxation of the IDD assumption is, however, still rather limited (Hensher, Rose & Greene, 2005).

For the season card choice of this study it seems likely that the two options which entail owning a season card have some similarities and are hence in the “season card” nest. The restricted card is by design the unrestricted card with a lower price and some validity restrictions added. This implies a nest tree with two levels. The scale parameters of the alternative level (μ_i) are normalised to one. Therefore, the deterministic utility functions ($V_{iq}=\mu_i*[(\boldsymbol{\beta}_i+\mathbf{v}'_i\mathbf{z}_q)'\mathbf{x}_{iq}+\boldsymbol{\delta}'_i\mathbf{z}_q]$) of nested logit are the same as with MNL. Under the said normalisation, the deterministic utility of nest l is $V_{lq}=\lambda_l*IV_{lq}$. The IV_{lq} is the “Inclusive Value” variable and is equal to the natural logarithm of the sum of the exponentials of the deterministic utilities of all alternatives in the nest.

The λ_l is the scale parameter for the branch level and is in this case also the IV parameter. The correlation of the deterministic utilities of two nested alternatives is corr(V_j-V_i)=1-$(\lambda_l)^2$. The closer the IV parameter is to one, the lower the correlation. If the parameter is not significantly lower than one, the model can be estimated by MNL (Louviere, Hensher & Swait, 2000). The choice probability point elasticity for nested logit, when μ_i is normalized and there are two levels, is following Koppelman and Wen (1998) given by

$$E^{P_{iq}}_{X_{ikq}} = \lambda_l * \beta_{ikq} P_q(i|l)(1 - P_q(l)) X_{ikq} + \beta_{ikq}(1 - P_q(i|l)) x_{ikq}. \quad (2.4)$$

The $P_{iq}(i|l)$ is the conditional choice probability of alternative *i,* conditional on its nest (branch) *l* being chosen. The $P_{lq}(l)$ is the choice probability of branch *l*. The total (unconditional) choice probability ($P_{iq}(i)$) is the product of the conditional choice probability of *i* and the choice probability of its nest (Hensher, Rose & Greene, 2005).

The MNL and nested logit methods are the most widely used. However, they suffer from the restrictive assumption and that every person must have the same parameters. Mixed logit allows for covariance between the error terms and non-constant variance of the errors and it is possible to estimate individual specific parameters (Bhat, 2000). However, mixed logit is much more complex and the formula for the choice probability has an open form integral in it. Hence, this probability generally cannot be calculated directly and is approximated by simulation (Hensher & Greene, 2003). The utility function is given by (2.5), where $\mathbf{x}_{iq}$ is a vector of attributes and $\boldsymbol{\beta}_{iq}$ a vector of individual parameters. The individual betas are determined by (2.6). The fixed average parameter $\boldsymbol{\beta}_i$ is the same as in MNL and the vector $\boldsymbol{\eta}_{iq}$ is the random component of the parameter. The distribution form of the random part has to be predefined.

$$U_{iq} = \boldsymbol{\beta}'_{iq} \mathbf{x}_{iq} + \varepsilon_{iq} \quad (2.5)$$

$$\boldsymbol{\beta}_{iq} = \boldsymbol{\beta}_i + \boldsymbol{\upsilon}'_{iq} \mathbf{z}_{iq} + \boldsymbol{\eta}_{iq} \quad (2.6)$$

With mixed logit it is also possible to take into account observable differences in the parameters. For this, a vector of background variables $\mathbf{z}_{iq}$ is multiplied by vector $\boldsymbol{\upsilon}_{iq}$, which determines the effect of the background variables on the parameter. As the ASC is part of $\boldsymbol{\beta}'_{iq} \mathbf{x}_{iq}$, it is possible to differentiate the ASC's. The remaining error term ε_{iq} is IID extreme value type one distributed

We use two types of distribution of the random component in this paper. The first is the triangular distribution and the second the lognormal. The latter distribution has the nice property that the estimated coefficient has the same sign for each respondent. This is useful for variables for which it is illogical to have negative or positive effects on utility. It is not directly possible to estimate negative coefficients with this distribution, however, this is easily be solved by multiplying the variable by minus one.

Values for $\boldsymbol{\eta}_{iq}$ are drawn and then using the values of the variables, the made choices and the predefined distributions of the $\boldsymbol{\eta}_{iq}$, the probabilities are calculated. The simulated outcome is different for each draw. The process is repeated for many draws and the average simulated choice probability is used as an approximation.

A remaining question is which number of draws results in a reasonably accurate and constant simulated outcome. The simulation for mixed logit traditionally uses pseudo-random draws. This method has the disadvantage that it requires rather many draws to get accurate results (Hensher, Rose & Greene, 2005). Bhat (2000) proposes the use of Halton intelligent draws. Halton sequences are generated from number theory and are more uniformly spread than the random draws. This causes the results to be stable with fewer draws. Therefore, this study uses Halton draws only.

The calculation of elasticities for mixed logit uses the same formula (2.3) as the MNL model. The difference is that the β_{ikq} with MNL is group specific, whereas with mixed logit this parameter is individual specific.

3 Utility functions for the season cardholders

This section describes the deterministic utility function (V_{iq}) for each alternative (i=1,2,3) for respondent q. In the first two alternatives, the respondent continues to own a season card. Accordingly, the functions of these two contain the benefit of owning a card. The price sensitivity, as measured by the parameter of the price variable, is assumed the same in both alternatives. To control for differences in the proportion of the season card price that respondents pay themselves, the price variable is interacted with the *proportion paid* by the respondent and the *proportion paid by others* variables. The parameter for price paid by a third party is zero if the respondent does not care about what the party spends. However, if for instance an employee is concerned about the effects that contributions have on the employer the coefficient could also be negative. The respondent could also fear that increases in the amount paid by the third party might induce the third party to make its compensation policy less generous or dread a negative relation between the travel compensation and the wage. The β_{p2q} is the coefficient of *price*proportion paid* and β_{p3q} the coefficient of the other interacted price variable. It is expected that β_{p3q} is negative, though less so than β_{p2q}. If the utility of having a card is subtracted from each alternative, this results in these utility functions

$$V(1=\text{unrestricted card})_q = \beta_{p2q}*\text{price}_{1q}*\text{proportion paid}_q+\beta_{p3q}*\text{price}_{2q}(1-\text{proportion paid}_q), \quad (3.1a)$$

$$V(2=\text{restricted card})_q = \beta_{p2q}*\text{price}_{2q}*\text{proportion paid}_q+\beta_{p3q}*\text{price}_{2q}(1-\text{proportion paid}_q) + \sum_{1}^{5} \gamma_{nq} * \text{restriction}_{nq} + ASC\_2_q, \quad (3.1b)$$

$$V(3=\text{no card})_q = -\beta 1_q * \text{owning a card}_q = ASC\_3_q. \quad (3.1c)$$

In (3.1a-c) the ASC of the *no card* option is defined as minus the utility of owning a card and measures the utility of owning a card. Five restriction variables are added to the restricted card's utility function. There are two variables measuring the beginning and end of the restrictions in the morning, two measuring the travel restriction in the afternoon and one dummy variable for if the restricted card has a maximum of five days per week of free of extra charge of travelling. The last restriction is a travel frequency restriction, whereas the earlier four are travel moment restrictions. These four variables are measured in minutes from some reference point. These reference point are measured in two ways. One is centred around 8:00 for the morning and 17:00 for the afternoon. Hence, for the AM peak there is a variable measuring how many minutes before 8:00 the restriction starts and a second for how long after the restriction ends. If these two variables are zero there is no travel restriction. This measurement gives the restriction as it was shown in the choice cards to the respondents.

The second type is centred around the times the respondent reported to start her round trip. Suppose that the respondent gets on the train at 8:00 AM for the outbound journey and at 18:30 for the return journey. Further, assume that the restricted card is invalid between 7:00-8:30 and 16:00-18:00. Then, if the respondent wants to travel with the restricted card, she should displace her outbound travel moment to 60 minutes earlier or to 30 minutes later. Accordingly, the displacement times earlier and later are 60 and 30 minutes. The start of the return journey does not need alteration and hence the values for displacement times for the return trip are zero.

The restrictions should negatively influence utility and thus the γ_n are hypothesized to be negative. There might also be some constant disutility of the restricted option, which is measured by the ASC_2 of the restricted card. The parameters of the two *proportion paid* interacted price variables can combined to form the total price coefficient by

$$\beta_{total\ q} = \beta_{p2q} * \text{proportion paid}_q + \beta_{p3q}(1\text{-proportion paid}_q)\,. \qquad (3.2)$$

If the estimation further uses homogenous parameters, the β_{p2q} and β_{p3q} are the same for each individual q. It is possible to control further for different responses to changes in the attributes. It seems likely that the coefficients for the price variables differ over the respondents for unobserved reasons. It is plausible that people with inflexible travel moments receive more disutility from the travel moment restrictions.

The utility of having a card differs over the respondents and it is likely that part of this remains unobserved. Examples of unobserved differences are accessibility of the origin train station, accessibility of the final destination from the destination rail station and relative preference for travelling by rail. The disutility of the restricted card could also differ over respondents. Hence, control variables are also added to the second option.

4 Discussion of the Season card stated preference experiment

This section discusses the season card choice exercise. This paper uses the dataset from an Stated preference (SP) season card experiment performed on 626 current day Dutch Railways (NS) season cardholders in the *NS tariff structure review stated preference survey* dataset from Steer Davis Gleave (2007). The experiment does not cover people who might become cardholders in the future. The results of this paper are not representative for the entire population of (potential) travellers. The stated preference experiment for season card choice had 32 different choice cards, of which each respondent was randomly shown 8 cards. Background questions were asked on for instance age, purpose and travel time of their most frequent trip and what proportion of the price of their season card they pay themselves.

They were also asked what the total price of their current card was. This value was used as a benchmark in the creation of the choice cards. Table 2.1 gives a description of the SP experiment and figure A.1 in the appendix gives an example choice card. There are four levels for the price attribute. The price difference was shared between an increase, relative to the current price, for the unrestricted card and a lowering for the unrestricted card. This split was randomly generated(Steer Davis Gleave, 2006).

Table 2.1. Description of the season card choice experiment

Dataset	Alternatives	Attributes	Number of respondents	Current card ownership of the respondents	Count per type card
Season card choice	1 Unrestricted season card	Price season card	626	1 Monthly network card	212
		Travel moment restrictions		2 Yearly network card	285
	2 Restricted season card	Maximum 5 days of travel per week		3 Monthly route card	24
				4 Yearly route card	105
	3 Neither				

Note: source Steer Davis Gleave (2006; 2007)

Travel on the restricted season card was invalid during the peak hours. A holder of this card hence has to travel outside the restricted periods or buy a normal train ticket. The start and end points of the AM and PM restricted periods varied independently around the references times of 8:00 and 17:00. Each of the four travel moment restriction variables had four levels, 0 minutes, 30 minutes, 60 minutes, and 90 minutes. In half of the choice cards, the restricted card had the limitation of maximum 5 days travelling per week with the card. For the analysis of this experiment, the prices of the yearly season card are divided by twelve(Steer Davis Gleave, 2006). The average the value for this rewritten price variable is 170 euros a month.

The respondents were asked, for the outward and return trip, if they could arrive earlier and later and if so by how much. The possible answers are not earlier, max 30 minutes, max one hour and more than an hour. Figure 2.1 shows how often the three alternatives were chosen. It is clearly visible that the unrestricted card is by far the most popular.

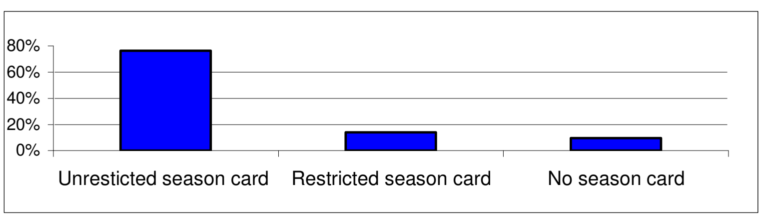

Figure 2.1. Choice frequency of the alternatives in the SP experiment

5 Estimation of the MNL models

Of the 626 respondents who completed the season card experiment, 568 respondents are actually used in this study. The other 58 respondent are filtered out because they reported that their most frequent trip made by the season card was for other purposes than commuting, going to school or a business trip. The focus in this study is on these three groups of "scheduled" travellers. As each respondent was shown 8 choice cards, there are 4544 observations. The models are estimated with NLOGIT (v3.017).

The four travel moment restriction variables, used in the main estimations, are in the displacement time format. These displacement time variables though cannot be directly used to measure schedule delay. Even with the restricted card, respondents can travel in the restricted period by single tickets or car. The advantage of the displacement time variables is that they make the effect of the restrictions more person specific, so that the value is more likely to reflect the concerns of the individual.

In an estimation not shown here, the final MNL model was re-estimated using the absolute travel moment restrictions instead of the displacement time variables. The replacement had very little effect on the other variables. The only noticeable effect was on the ASC_2.

Table 5.1. Estimation of the season card choice with one cost variable

		Season Card (1)		Card with limitations (2)		no card (3)	
		Coeff	t-statistic	Coeff	t-statistic	Coeff	t-statistic
Attributes							
Price (generic)		-0.0026***	-6.14	-0.0026***	-6.14		
Displacement time outbound trip **earlier**				-0.0085***	-3.70		
Displacement time outbound trip **later**				-0.0187***	-9.31		
Displacement time return trip **earlier**				-0.0119***	-6.35		
Displacement time return trip **later**				-0.0097***	-4.60		
Max 5 days travel				-0.2573***	-2.75		
Control variables							
Inflexible travel moment				-0.1311***	-3.91		
Journey time in minutes dummies	15 min or less	-0.3425**	-1.96			0.3292	1.41
	16 to 30 min	-0.4675***	-3.09			-0.5363**	-2.51
	31 to 45 min	-0.2000	-1.23			-0.3342	-1.51
	More than 90	-0.2028	-1.26			-0.3684*	-1.69
Car in household		-0.1853*	-1.76			-0.2074	-1.43
Frequency trip		-0.0199	-0.24			-0.1061	-0.92
ASC				-1.1109***	-5.26	-2.5707***	-10.78
Respondents 568	Choice cards per respondent 8				log-likelihood	-2840.65	

Note:: ***, ** and *, respectively indicate significance of the coefficient at the 1%, 5% and 10% level.

Table 5.1 shows the basic MNL estimation. This model does not control for the share of the price respondents pay themselves. The three alternatives each have their own columns where the coefficients that influence their utility are placed. All six coefficients of the attributes are of the expected sign and significant at the one percent level, for the price and travel moment restrictions they even are significant at the one per mille level.

Among the displacement time attributes, it is noteworthy that for the outbound trip being forced to travel later gives more disutility than travelling earlier. In contrast, for the return trip being forced to travel earlier gives more disutility than later. People rather leave earlier in the morning and later in the afternoon. This reflects the fact that the respondents are scheduled travellers. Both ASC's are significantly negative. The control variables make the ASC's group specific. The inflexible travel moment variable is a count variable for how often from four questions the respondent answered that she could not change her travel moments of the most frequent trip. The higher the value of this variable, the more inflexible she is and the less attractive the restricted card. This variable has a very significant negative effect on the utility of the restricted card.

All other control variables are added to the utility function of the unrestricted card and not to the one of the restricted card. These variables are meant to differentiate the ASC_2. However, limitations to the number of command characters per utility function in NLOGIT, made it impossible to add them directly. The group specific ASC for the restricted card is found by subtracting the coefficients in the season card column times the person specific values of the control variables from the ASC_2. The group specific ASC_3 is calculated in a similar fashion. This methodology is rather laborious. However, this seems the only manner to add these control variables.

Dummies reflecting the travel time of the most frequent trip are added to all estimations. The reader should note that these are not attributes, they are background variable. The journey times were reported in minutes. The variable is divided in five dummies; 15 minutes or less, 16 to 30 minutes, 31 to 45 minutes, 46 to 90 minutes and more than 90. The respondents with 31 to 45 minutes are the reference group. An advantage of using dummies is that it enables the study of non-linear effects. However, only the dummy for 16-30 minutes has a significant effect, its effect is though very significant.

The car dummy is one if the household of the respondent owns one or more cars. It has a slightly significant effect in the season card utility function. This variable is added to control for the effect of car availability. This indicates that persons with a car are more willing to accept the restrictions. Finally, the categorical variable on the weekly frequency of the most often made trip is added. This variable controls for the fact that persons who travel more, receive different utilities from the alternatives. The surprising result is that the variable has no effect, this is probably caused by the fact that this categorical variable varies little over the used respondents.

In Table A.1 in the appendix following the specification of (3.1a-c), two price variables with generic coefficients are used. The log-likelihood is much higher than in Table 5.1. Respondents react much stronger if they themselves have to pay more. There also is a negative effect to *Price * proportion paid by others*. This shows that the respondents do care about what others pay. Control dummies on occupation and purpose of the most frequent trip have no effect in the estimations. Interacting the attributes with the occupation, trip length and purpose of trips variables does not alter the results.

The estimation of Table A.2 tests whether there is a different valuation of the season card over the age groups. It appears that the 30 to 39 and 50 to 59 year olds value the season card significantly less than the 40 to 49 year olds. The 20 to 29 years old appear to value the season card also less, though this effect is only significant at the 10% level. For the 18 and younger and 60 and older no effect is found.

Until now, the effect of the variables was the same for every person. It seems plausible that the effects of the price and travel restrictions variables differ with the gender of the respondent. The results of the final MNL specification are shown in table 5.2. It interacts the gender dummy (which is one for women) with *price*proportion paid* and adds gender dummies to the utility functions. This model tests whether women value the price of a card differently or receive different utilities from the options than men.

There is a marked difference in the price sensitivities of those who pay little themselves and those who pay a large share. Interacting the *price*proportion paid by others* and the restriction attributes with background variables does not lead to statistical improvements. It was expected that respondents with more restricted travel moments value travel moment restrictions more. This was tested by interacting the displacement time variables with their respective answers on how much the travel moment can be changed. An example should make this arrangement clearer. The displacement outbound trip later variable was interacted with the answer to the question how much the respondent could start her most frequent outbound trip later. The interacted displacement time variables have, surprisingly, no effect in the estimation.

Similarly, car ownership, age, purpose of the trip and occupation do not differentiate the weights attached to the attributes. Interacting the gender dummy with the other attributes also does not improve matters. Women apparently attach the same value to the *price paid by others* and the travel restriction variables. This makes it plaisible that the effects of the restrictions and *price paid by others* are the same for all respondents.

Table 5.2. Estimation of the final MNL model

		Season Card (1) Coeff	Season Card (1) t-statistic	Card with limitations (2) Coeff	Card with limitations (2) t-statistic	no card (3) Coeff	no card (3) t-statistic
Attributes							
price*proportion paid (generic)		-0.0064***	-8.44	-0.0064***	-8.44		
price*proportion paid by other (generic)		-0.0023***	-4.85	-0.0023***	-4.85		
price*proportion paid*gender (generic)		0.0043***	4.01	0.0043***	4.01		
Displacement time outbound trip **earlier**				-0.0085***	-3.72		
Displacement time outbound trip **later**				-0.0187***	-9.29		
Displacement time return trip **earlier**				-0.0118***	-6.33		
Displacement time return trip **later**				-0.0098***	-4.63		
Max 5 days travel				-0.2578***	-2.75		
Control variables							
Inflexible travel moment				-0.1342***	-3.99		
Journey time in minutes dummies	15 min or less	-0.3540**	-2.19			0.3912*	1.66
	16 to 30 min	-0.4706***	-3.10			-0.4796**	-2.23
	31 to 45 min	-0.1937	-1.19			-0.2558	-1.44
	More than 90	-0.1806	-1.12			-0.4096**	-1.85
Car in household		-0.1916*	-1.82			-0.1443	-0.98
Frequency trip		-0.0273	-0.33			-0.1009	-0.85
Gender dummy		0.0658	0.67			-0.0260	-0.17
Age dummies	18 or less					0.0008	0.00
	19 to 29					0.3115*	1.90
	30 to 39					0.3834**	2.53
	50 to 59					0.3372**	2.21
	60 and older					-0.8267	-1.36
ASC				-1.105***	-5.68	-2.964***	-10.71
Respondents 568		Choice cards per respondent 8				log-likelihood -2815.64	

Note:: ***, ** and *, respectively indicate significance of the coefficient at the 1%, 5% and 10% level.

Interpreting the price variables remains difficult. When the price is raised, it is uncertain how much of this raise is paid by the individual and how much by the third party. The proportion paid could remain constant, the respondent could have to pay the entire increase herself. It is possible that following the increase of the respondent will convince the third party to increase the share that it pays. Conversely, the third party could make the compensation policy less generous. In the discussion of the estimations, it is assumed that the proportion paid is constant.

Now are discussed the choice probability elasticities and the Willingness-to-Pay (WTP) for the final MNL model. In the estimation of table 5.2 the coefficient for β_{p3q} is the same for each person. The β_{p2q} is for men given by the coefficient of *price*proportion paid*. For women the β_{p2q} is given by the value for the men plus the coefficient of *price*proportion paid*gender.* The resulting group specific coefficient is used in the calculation of elasticities and WTP's. There are two types of WTP's used here. This first divides the coefficient of the attribute by the coefficient of *price*proportion paid.* The second divides it by the calculated total price coefficient, as calculated by (3.2). These calculations hence use the fixed proportion paid assumption.

The total price coefficient in the final MNL estimation is -0.00288. This average is used to calculate the WTP's in the right column of table 5.3. The left two columns with WTP's are calculated by dividing the respective coefficients of the attributes by the gender specific coefficient of *price*proportion paid* for each choice card and than calculating the average. The left two columns measure the valuations for men and women in terms of own expenditure. The right column gives what total monthly price gives large equal utility as a one unit change in the restriction. It therefore also takes the contributions of the third part into account.

Table 5.3. WTP's for the final MNL model of Table 5.2

Variable	**WTP**		
	coef/[coef price*proportion paid]		**coef/total price coef**
	men	women	
Displacement time outbound trip **earlier**	1.438	4.173	2.958
Displacement time outbound trip **later**	3.155	9.157	6.490
Displacement time return trip **earlier**	2.001	5.809	4.117
Displacement time return trip **later**	1.65	4.788	3.394
Max 5 days travel	43.53	126.35	89.56

Table 5.4. Elasticities for the final MNL model of Table 5.2

Unrestricted season card		**Restricted season card**	
Variable	**Elasticity**	**Variable**	**Elasticity**
Price*proportion paid for males	-0.05	Price*proportion paid for males	-0.157
Price*proportion paid for females	-0.025	Price*proportion paid for females	-0.06
Price*proportion paid for all	-0.04	Price*proportion paid for all	-0.116
Price*(1-proportion paid)	-0.08	Price*(1-proportion paid)	-0.235
Total for price	-0.143	Total for price	-0.333
		Displacement time outbound trip **earlier**	-0.068
		Displacement time outbound trip **later**	-0.172
		Displacement time return trip **earlier**	-0.136
		Displacement time return trip **later**	-0.094

Women are willing to spend substantially more than men for decreases in the card restrictions. Men are willing to spend €3.16 per month and women €9.16 for a one minute decrease in the displacement time later for the outbound trip. They are willing to suffer a €6.49 per month increase in the total price for this. A one-minute decrease in the displacement time earlier for the return trip gives men the same utility as spending

€2.00 extra or a total price increase of €4.12. The values for the displacement later for the return trip are for women €4.79 and €3.39. It is apparent that it is most troublesome to start the journey later in the morning, whereas laving earlier is less of a problem.

The maximum travel frequency is valued as much as spending €43.53 by men and €126.35 by women. This is equal to a displacement time earlier and later for the outbound trip of 30 and 14 minutes.

Table 5.4 shows the elasticities for the final MNL model for all the attributes, except the discrete travel frequency limitation. The point elasticities are calculated with (2.3). The elasticities are aggregated from the individual elasticities by calculating the choice probability weighted average. For *price*proportion paid,* two independent averages for males and females are shown, as well as an independent average for the two combined.

The price elasticities are rather low (in absolute sence). Especially, the price elasticities for the unrestricted card are very small. The values are in fact so small that it is suspicious. It is surprising that the elasticity of price interacted with the share paid by the respondent is closer to zero than the elasticity of the other interacted price variable. This result is caused by the single fact that 57% of the respondents pay nothing themselves for the card. For them this elasticity is zero and this lowers the average.

Women react more inelastic to price changes. The elasticities for the restricted card are higher than for the unrestricted card. This is because the choice probability for the second alternative are much lower. The responses to changes in the restrictions are very inelastic. The effect for the displacement later for the outbound trip is the largest.

The elasticity for total price is calculated with (2.3). The inputs for this formula are the total price coefficient as calculated by (3.2), the total monthly price and the choice probability of the alternative. This last version is not hampered by the problem of the other two price elasticities that large shares of the respondents have zero elasticity, because the proportion paid is equal to zero or one. This version seems the most valid price elasticity. For total price, the elasticity for the unrestricted card is again the lowest.

The demands for the season card alternatives seems very inelastic. The MNL estimations show that there is a substantial difference in the price sensitivity depending on what percentage a respondent pays of the card price. Interacting the attributes with travel moment flexibility, car ownership, age or trip purpose of the trips does not alter the results.

6 Nested logit

The nested logit estimation controls the correlated utilities of the two card alternatives. The utility of owning a card differs over people for unobserved reasons. These unobserved elements cause the errors of the card alternatives to be related. The two season card alternatives are in the season card branch (nest) and the third stop owning a season card sits alone in its *degenerate* stop owning a card branch. Adding control variables was more difficult in the nested logit estimation than with MNL. When the inflexible travel time variable or the journey length dummies are added, the estimation does not converge. Journey time in minutes and its squared form are added to the estimation, allowing at least some control for non-linear effects. An advantage is that it is now possible to add the control variables to the second alternative.

Table 6.1. Nested logit model

	Season Card (1)		Card with limitations (2)		no card (3)	
	Coeff	t-statistic	Coeff	t-statistic	Coeff	t-statistic
Attributes						
Price * proportion paid (generic)	-0.0273***	-9.73	-0.0273***	-9.73		
Price * proportion paid by others (generic)	-0.0089***	-6.59	-0.0089***	-6.59		
Price * proportion paid*gender dummy (generic)	0.0137***	3.78	0.0137***	3.78		
Displacement time outbound trip **earlier**			-0.0089***	-3.82		
Displacement time outbound trip **later**			-0.0183***	-9.01		
Displacement time return trip **earlier**			-0.0112***	-5.84		
Displacement time return trip **later**			-0.0092***	-4.31		
Max 5 days travel			-0.2840***	-2.94		
Control variables						
Journey time in minutes			-0.0306***	-5.27	-0.0236***	-3.84
(Journey time in minutes)^2			0.0002***	4.82	0.0002***	3.45
Car in household			0.3086***	2.84	0.0066	0.06
Frequency trip			-0.1114	-1.29	-0.0856	-0.92
Gender dummy			0.0741	0.68	-0.1180	-1.02
ASC			-0.6697***	-2.94	-1.9280***	-8.97

IV parameters

Branch	coeff	t-statistic
Continue owning a season card	0.1710***	5.98
Not owning a card anymore	1.0000	Fixed normalised parameter

Respondents 568 Choice cards per respondent 8 log-likelihood -2799.17

Note:: ***, **,and * respectively indicate significance of the coefficient at the 1%, 5% and 10% level

The scale parameters on the alternative level and for the degenerate *no season card* branch are normalized to one. The correlation between the utility of two alternatives is given by corr(V_j-V_i)=1-(λ_l)^2 and thus for the two card alternatives the correlation coefficient is 1-(.17)^2 = .97. This is a very high correlation coefficient. Furthermore, the IV parameter is significantly lower than one. This signals that the IDD assumption is

violated. The log-likelihood of the nested logit is also much higher than in the final MNL model. The nested structure clearly is an improvement to the MNL estimation.
All the coefficient of the attributes are of the predicted negative sign and significant at the one percent level. The control variables have a substantial effect in the estimation. The utilities of owning a restricted card and stop owning a card decrease with trip length. However, the longer the current trip the less the decreasing effect of an extra minute. This is shown by the small though significant positive coefficient of the squared version. The longer the travel time of the most frequent trip, the more likely it is that the respondent prefers the unrestricted card. The car dummy has a positive effect on the utility of the restricted card, though it has no effect on the third alternative.
Persons who pay more for the card themselves are substantially more sensitive to price changes. The total price coefficient is calculated by (3.2) and is on average -.0173. This is more than five times the value from the final MNL model. The coefficient of the *proportion paid*price* variable in table 6.1 is differentiated between men and women.

Table 6.2 depicts the WTP's for the nested logit estimation. The same pattern as with MNL of valuations of the displacement time attributes is visible. Respondent are willing to pay most for reductions in the displacement time later for the outbound trip. Women again have substantially higher WTP's. The WTP's are much lower with nested logit than with MNL, because the price coefficients are much more negative with nested logit. Thus, if the correlation between the utilities of two card alternatives is ignored, this results in an overestimation of the WTP's.

Table 6.2. WTP's for the nested logit model of Table 6.1

Variable	**WTP**		
	Coef./[coef. of price*proportion paid]		**coef/total price coef**
	men	women	
Displacement time outbound trip **earlier**	0.324	0.647	0.755
Displacement time outbound trip **later**	0.669	1.337	1.561
Displacement time return trip **earlier**	0.409	0.817	0.954
Displacement time return trip **later**	0.335	0.669	0.780
Max 5 days travel	10.38	20.75	24.21

The coefficients for the restrictions are almost exactly the same with nested logit as with MNL. Respondents are willing to suffer 32 and 15 minutes of extra displacement time later and earlier for the outbound trip for a lifting of the travel frequency restriction. Men are willing to spend €10.38 a month for this and women €20.75.

Table 6.3. Elasticities for the nested logit model of Table 6.1

Unrestricted season card		Restricted season card	
Variable	**Elasticity**	**Variable**	**Elasticity**
Price*proportion paid for males	-0.222	Price*proportion paid for males	-0.896
Price*proportion paid for females	-0.079	Price*proportion paid for females	-0.380
Price*proportion paid for all	-0.161	Price*proportion paid for all	-0.697
Price*(1-proportion paid)	-0.194	Price*(1-proportion paid)	-0.832
Total for price	-0.356	Total for price	-1.530
		Displacement time outbound trip **earlier**	-0.068
		Displacement time outbound trip **later**	-0.166
		Displacement time return trip **earlier**	-0.123
		Displacement time return trip **later**	-0.085

The individual alternative choice probabilities elasticities are calculated with (2.4). The elasticities are, with nested logit, considerably higher than with MNL. Women show elastic responses to price increases in the restricted card. The response to price increases of the unrestricted card is again much more inelastic than for the restricted version. It is interesting to note that the elasticities of the displacement time variable are very similar with nested logit and MNL. This indicates that the largest problem the correlation caused was on the price variables. The elasticities are larger because the coefficients with nested logit are much more negative than with MNL. It is an interesting question what caused the underestimation of the elasticities by MNL

The nested logit section showed that there is a very significant correlation of the utilities of the two season card options. The usage of MNL estimations on this SP choice experiment results in biased results. The WTP's calculated from the nested logit output are substantially smaller and the price elasticities are higher.

7 Mixed logit estimations

Nested logit only relaxes the restrictive assumptions of the MNL in a limited manner. This section analyses the estimation of the mixed logit models. By making the ASC of the no card anymore option random, it is possible to control for unobserved differences in the net valuation of owning a season card. The ASC_3 is defined as the negative of this utility. The effect of changes in the interacted price variables has the same homogeneous effect in the previous estimations. It seems likely that these coefficients differ over the respondents for unobserved reasons. If this is not controlled for, these effects remain in the errors of the season card alternatives, which are therefore correlated. With mixed logit it is possible to make the coefficients individual. We use 2000 Halton draws and unconditional parameter in the mixed logit estimation. The individual marginal utilities are following Hensher, Rose and Greene (2005) given for lognormal and triangle distributions by

- lognormal; $\beta_{kq} = \pm \exp(\beta_k + \beta_{k\_sd} * N_{kq} + \mathbf{v}'_k \mathbf{z}_q)$, (7.1)
- triangle; $\beta_{kq} = \beta_k + \beta_{k\_sd} * T_{kq} + \mathbf{v}'_k \mathbf{z}_q$. (7.2)

Here N is a normal distributed randomly generated variable with a zero mean and a standard deviation of one. The T is random generated variable with a triangle distribution, with a zero mean and $-1 \leq T \leq 1$. The $\mathbf{z}_q$ contains the interaction variables and $\mathbf{v}_k$ their effects on the marginal utility of *k*. If the random parameter of an attribute with a lognormal distribution must be negative, the outcome of (7.2) is multiplied by minus one and before the estimation the attribute is multiplied by minus one.

The presentation of the mixed logit estimation needs some explanation. The "Random parameters" section in Table 6.1 depicts the fixed effect of the variables. The following section shows the parameters for the standard deviation of the random component (β_{k_sd}). The "Observed heterogeneity" gives the coefficients ($\mathbf{v}_k$) for the interaction variables. The interaction effect coefficient is the same for each respondent.

The estimation of table 7.1 tests whether the coefficient of *price*proportion* and the ASC_3 differ for observed and unobserved reasons. If the random parts have an effect this shows that there are unobserved differences. The random part of the price variable has a lognormal distribution. Before the estimation, the price variable is multiplied by minus one. The random part of ASC_3 has a triangle distribution. To make the differences observed, the price variable is interacted with the gender and car dummies. The significance levels of the coefficients of the interactions proclaim that the price sensitivity differs by gender and not over car ownership. Consequently, the calculations of the WTP's and elasticities for mixed logit ignore the effect of car ownership.

The ASC_3 and *price*proportion paid* variable have very significant coefficients of the standard deviation of the random component. This shows that both have parameters that differ over the respondents. The ASC_3 is on average very negative. The coefficients of the other attributes are of the expected negative sign and highly significant. The journey length variable and its squared form have very significant effects on the utilities of the restricted card and stop owning a card alternatives. The longer the travel time the lower the utilities of the second and third alternatives. The squared forms have small positive coefficients. The two control variables have different effects on the two alternatives. The car dummy has a positive effect on the utility of the limited card and no effect on the third alternative. The frequency of rail travel and gender variables have no effect.

Table 7.1. Random effects price paid by respondent and owning a season card

	Season Card (1)		Card with limitations (2)		no card (3)	
	Coeff	t-statistic	Coeff	t-statistic	Coeff	t-statistic
Random parameters						
Price*proportion paid	-3.687***	-16.7	-3.687***	-16.7		
ASC_3					-18.49***	-4.50
Derived standard deviations random parameters						
Price*proportion paid (l)	1.259 ***	6.04	1.259 ***	6.04		
ASC_3 (t)					39.97***	6.60
Observed heterogeneity						
Gender*Price*proportion paid	-.4775**	-2.49	-.4775**	-2.49		
Car dummy*Price*proportion paid	-.2879	-1.59	-.2879	-1.59		
Attributes						
Price*proportion paid by others	-0.0133***	8.19	-0.0133***	-6.52		
Displacement time outbound trip earlier			-0.0090***	-3.82		
Displacement time outbound trip later			-0.0201***	-8.90		
Displacement time return trip earlier			-0.0116***	-5.84		
Displacement time return trip later			-0.0106***	-4.52		
Max 5 days travel			-0.2990***	-2.86		
Control variables						
Journey length in minutes			-0.0361***	-5.34	-0.1873***	-3.55
(Journey length in minutes)^2			0.0003***	4.99	0.0013***	3.09
Car in household			0.4293***	3.24	0.0260	0.03
Frequency trip			-.1473	-1.49	-0.7978	-.79
Gender dummy			0.0401	.340	-0.8041	-.93
ASC			-0.6686***	-2.99		
Respondents 568	Choice cards per respondent 8		Number of Halton draws 2000		log-likelihood -2785.10	

Note:: ***, ** and *, respectively indicate significance of the coefficient at the 1%, 5% and 10% level.

The coefficient for the random parameters and especially the lognormal distributed versions cannot be interpreted directly. Therefore, table 7.2 gives the descriptive statistic for the marginal utilities, as calculated by formula (7.1) for the price variable and by (7.2) for ASC_3. In Tables A.3 and A.4 in the appendix the marginal utilities are differentiated over gender and proportion paid by the respondent of the total price.

Table 7.2. Descriptive statistics of the individual marginal utilities from Table 7.1

Coefficient	Mean	Standard Deviation	Minimum	Maximum
Total price effect	-0.0177	0.035	-0.851	-0.0004
Price*proportion paid	-0.0389	0.086	-2.170	-0.0001
Price*proportion paid **with the insignificant effect** of the interaction car ownership dummy	-0.0476	0.107	-2.893	-0.0001
ACC_3	-18.55	15.10	-54.12	17.99
ACC_3 plus control variables	-23.19	15.16	-60.45	15.94

None of the restriction attributes are found to have random components. This is similar to the finds of the MNL estimations, where the coefficients of the restrictions did not differ for observed reasons. It was tried to give *the price*(1-proportion paid)* variable a random parameter as well. However, these attempts were unsuccessful at achieving a stable result and thus this variable has only a fixed parameter.

The total price effect is calculated using formula (3.2), where β_{p2q} is given by (7.1). In this, the fixed part coefficient is -3.69, the coefficient for the standard deviation (β_{k_sd}) is 1.26 and the coefficients ($\mathbf{v}_k$) for the gender and car interactions are -.478 and -.288. The fixed parameter (β_{p3}) for the other price variable is -0.013. Men are more sensitive to price changes than women. If the effects of the control variables are added to the ASC, the differences disappear. The average marginal effect of the total price is -.0177, which is slightly larger than with nested logit.

The coefficient of the random part of the ASC_3 is in absolute terms more than twice the size of the fixed part. This ASC is meant to measure the negative of utility of owning a card. This suggest that this utility varies substantially for unobserved reasons. As table A.4 also shows, the price sensitivity differs substantially with the share respondents' pay of the total price. The gender interaction variable also explains a large share of variations in the price coefficient. The coefficient of the random part is in this case (only) 34% of the size of the fixed coefficient. The random part has a very significant and still sizable effect.

Table 7.3. WTP's for mixed logit estimation of Table 7.1

Variable	**WTP**					
	Coef./[coef. of price*proportion paid]			**Coef./total price coef.**		
	average	men	women	average	men	women
Displacement time outbound trip **earlier**	0.797	0.981	1.576	1.227	0.756	0.855
Displacement time outbound trip **later**	1.783	2.197	3.529	2.746	1.692	1.913
Displacement time return trip **earlier**	1.030	1.269	2.039	1.586	0.978	1.105
Displacement time return trip **later**	0.945	1.165	1.871	1.456	0.897	1.014
Max 5 days travel	26.57	32.74	52.58	40.91	25.22	28.50

Table 7.3 depicts the WTP's using the price*proportion paid coefficient and the total price effect. The WTP's calculated from this mixed logit estimation are smaller than those from MNL and larger than those from nested logit. The WTP's for the restrictions have the same pattern as in the nested and MNL outcomes. To take away the 5 day per week maximum of travel days the respondents are on average willing to spend almost

41 euros. This has the same value for the average respondent as an increase in the displacement time earlier and later for the outbound trip of 33 and 15 minutes. The relative in minute levels values are remarkably similar to those found by MNL.

The calculation of the individual elasticities uses equation (2.3). In table 7.5, the choice probability weighted averages of the point elasticities for the unrestricted card are differentiated over car ownership and gender. Table 7.6 does this for the price variables of the restricted card and table 7.7 shows the elasticities for the restriction attributes.

The elasticity estimates for the restriction are highly inelastic and very similar to those found earlier. For the restricted card alternative, the responses are highly elastic to the price attribute. Conversely, the price elasticity for the unrestricted card is inelastic. Demand for the unrestricted card is rather fixed and the restricted card must offer large price savings for it to be competitive.

Table 7.5. Elasticities for the season card alternative for Table 7.1

Coefficient	**Weighted averages of the elasticities**						
	average	**A car in the household**			**no car in the household**		
		both genders	men	women	both genders	men	women
Total price effect	-0.855	-0.778	-0.958	-0.526	-1.036	-1.251	-0.764
Price*proportion paid	-0.487	-0.409	-0.563	-0.193	-0.670	-0.848	-0.445
Price*proportion paid by others	-0.368	-0.369	-0.395	-0.333	-0.366	-0.404	-0.319

Table 7.6. Price elasticities for the restricted season card alternative for Table 7.1

Coefficient	**Weighted averages of the elasticities**						
	average	**A car in the household**			**no car in the household**		
		both genders	men	women	both genders	men	women
Total price effect	-2.711	-2.379	-2.764	-1.772	-3.594	-3.665	-3.479
Price*proportion paid	-1.587	-1.256	-1.608	-0.703	-2.464	-2.564	-2.301
Price*proportion paid by others	-1.125	-1.123	-1.156	-1.069	-1.130	-1.101	-1.177

Table 7.7. Elasticities of changes in the travel restrictions for Table 7.1

Variable	**Weighted average of the elasticity**
Displacement time outbound trip **earlier**	-0.071
Displacement time outbound trip **later**	-0.188
Displacement time return trip **earlier**	-0.131
Displacement time return trip **later**	-0.100

The price elasticities for the unrestricted card are higher than those found with nested logit. The price elasticity of the restricted card was also more elastic with these mixed logit estimations. Men again react more inelastically to price changes than women

Mixed logit enables the estimation of heterogeneous responses. The price variable has individual effects and the ASC_3 has a random part to control for unobserved individual utilities of owning a card. The price elasticities from mixed logit are much larger than from MNL. This seems a valid find, as the elasticities from MNL are disturbingly small.

8 Conclusions

This paper studies a Stated Preference (SP) experiment conducted among existing Dutch railways season cardholders. It uses multinomial logit (MNL), nested logit and mixed logit to analyse the responses of 568 cardholders to 8 choice cards. The respondents chose between (1) an unrestricted card (2) a cheaper card with restrictions and (3) stop owning a season card.

The analysis has shown that the assumptions behind the MNL method are violated by the structure of this experiment. The two card alternatives are perceived as very similar and their utilities are highly correlated, while the option not to buy a card anymore is rather different. The price influences the utility of a card in a heterogeneous manner: different persons have rather different price sensitivities. The mixed logit specification appears to provide the most satisfactory results.

The option to continue to own an unrestricted season card the most popular. There are large differences in the price elasticities of the restricted and unrestricted card. The price elasticities of the restricted season card are very elastic, while the price elasticities of the unrestricted card are generally inelastic. The responses to the travel restriction attributes are very inelastic. The coefficients and elasticities for the price variables obtained with MNL are much closer to zero than those obtained with nested and mixed logit. An interesting question for further research is what has caused the very low estimation of the price sensitivities and WTP's in the MNL estimations.

The proportion respondents' pay of the price of the season card has a large influence on their price sensitivity and their choices. Respondents who pay nothing or a small share themselves have much lower price elasticities. This is important as a very large share of the travellers get their travel cost entirely of partly compensated. Furthermore, travel cost compensation as often named as a reason for low aggregate elasticities in transport.

The reader should note that this was an experiment on the purchase of travel means and that there is no attribute measuring such a thing as travel time. The found preferences are though only valid for the current cardholders, as the study ignores persons who might become holders in the future. The survey also ignores the effects of the decisions of the possible future cardholders on the choices of the current cardholders.

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Appendix

Figure A.1. Translated example of a season card SP choice card

If the Dutch railways would offer your the following alternatives:

Season card A	Season card B
On weekdays invallid between 7:30-9:00 and 16:30-17:00	Valid all day
Card can be used at maximum 5 days a week	
Price of the season card is € 188	Price of the season card is € 230

Which would your choose?

○ Season card A ○ Neither ○ Season card B

Note: original choice card were in Dutch, the translations are by the authors. The figure is based on Steer Davis Gleave (2006, pp 7, fig 3.1)

Table A.1. Estimation with control for who pays the season card

		Season Card (1)		Card with limitations (2)		no card (3)	
		Coeff	t-statistic	Coeff	t-statistic	Coeff	t-statistic
Attributes							
Price * proportion paid (generic)		-0.0042***	-6.82	-0.0042***	-6.82		
Price * proportion paid by others (generic)		-0.0018***	-3.62	-0.0018***	-3.62		
Displacement time outbound trip **earlier**				-0.0085***	-3.71		
Displacement time outbound trip **later**				-0.0187***	-9.31		
Displacement time return trip				-0.0119***	-6.35		
Displacement time return trip **later**				-0.0097***	-4.60		
Max 5 days travel				-0.2572***	-2.75		
Control variables							
Inflexible travel moment				-0.1323***	-3.94		
Journey time in minutes							
dummies	15 min or less	-0.3339*	-1.91			0.3055	1.30
	16 to 30 min	-0.4610***	-3.04			-0.5352***	-2.49
	31 to 45 min	-0.1998	-1.22			-0.3039	-1.37
	More than 90	-0.2067	-1.29			-0.3394	-1.55
Car in household		-0.1876*	-1.78			-0.1895	-1.30
Frequency trip		-0.0162	-0.20			-0.1280	-1.11
ASC				-1.0903***	-5.16	-2.5014***	-10.27
Respondents 568		Choice cards per respondent 8		log-likelihood -2833.22			

Note:: ***, **, and *, respectively indicate significance of the coefficient at the 1%, 5% and 10% level.

Table A.2. Final MNL model without gender effects

		Season Card (1)		Card with limitations (2)		no card (3)	
		Coeff	t-statistic	Coeff	t-statistic	Coeff	t-statistic
Attributes							
price*proportion paid (generic)		-0.0043***	-7.13	-0.0043***	7.13		
price*proportion paid by other (generic)		-0.0017***	-3.60	-0.0017***	3.60		
Displacement time outbound trip **earlier**				-0.0085***	-3,71		
Displacement time outbound trip **later**				-0.0187***	-9,29		
Displacement time return trip **earlier**				-0.0118***	-6,33		
Displacement time return trip **later**				-0.0098***	-4,63		
Max 5 days travel				-0.2573***	-2,75		
Control variables							
Inflexible travel moment				-0.1356***	-4,03		
Journey time in minutes dummies	15 min or less	-0.3456**	-1.97			0.3335	1.41
	16 to 30 min	-0.4660*	-3.07			-0.5164**	-2.40
	31 to 45 min	-0.1966	-1.20			-0.2842	-1.27
	More than 90	-0.1920	-1.19			-0.3719*	-1.68
Car in household		-0.1884*	-1.79			-0.1670	-1.14
Frequency trip		-0.0253	-0.31			-0.1003	-0.85
Gender dummy						-0.2089	-1.45
Age dummies	18 or less					-0.0667	-0.19
	19 to 29					0.2986*	1.84
	30 to 39					0.3710**	2.46
	50 to 59					0.3487**	2.30
	60 and older					-0.7702	-1.27
ASC				-0.3719	-1.68	-2.6885**	-9.98
Respondents 568		Choice cards per respondent 8				log-likelihood -2827.1	

Note:: ***, ** and *, respectively indicate significance of the coefficient at the 1%, 5% and 10% level.

Table A.3. Differentiated averages of the individual marginal utilities from Table 7.3

Coefficient	**Averages coefficients**						
	average	**A car in the household**			**no car in the household**		
		both genders	men	women	both genders	men	women
Total price effect	-0.0177	-0.0173	-0.0198	-0.0135	-0.0188	-0.0218	-0.0147
Price*proportion paid	-0.0389	-0.0375	-0.0464	-0.0246	-0.0420	-0.0504	-0.0306
ACC_3	-18.55	-18.68	-18.59	-18.82	-18.23	-17.80	-18.80
ACC_3 plus control variables	-23.19	-23.41	-23.43	-23.38	-22.30	-22.30	-22.30

Table A.4. Differentiated marginal utilities over proportion paid by the respondent

	Price*proportion paid	Price*proportion paid by others	Total price effect
proportion paid=1	-0.0437	-0.0113	-0.0437
proportion paid=0	-0.0386	-0.0113	-0.0113