Transportation Research Part D 16 (2011) 402–408

Contents lists available at ScienceDirect

Transportation Research Part D

journal homepage: www.elsevier.com/locate/trd

The influence of positionality in car-purchasing behaviour on the downsizing of new cars

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ARTICLE INFO

Keywords:
Choice experiments
Fuel efficiency
Automobile purchases
Positional goods

ABSTRACT

This paper presents results from stated choice experiments looking at the influence of positionality in peoples' choices of passenger cars in the Netherlands. It provides evidence that cars are positional goods and that selected car attributes such as size, engine capacity and interior add to their positionality. This suggests downsizing of cars through corrective taxation aimed at CO_2 benefits would lead to lower welfare costs than micro-economic welfare theory suggests. The experiments also show that car buyers are very heterogeneous and have a strong predisposition to choose a type of car and its attributes similar to their current car.

1. Introduction

Economists and sociologists have argued that the utility of some, positional, goods not only have absolute value but relative value as well. This means that the utility individuals derive from these goods depends on how many others consume. As with any goods, the consumption of positional goods can result in negative externalities. This is particularly germane in the case of transport that is a major contributor to greenhouse gas emissions, in part the result of increased vehicle weight and engine power, traits which have gradually cancelled out the positive effect of technical improvements (Van den Brink and Van Wee, 2001). This paper quantifies the positionality of multiple car attributes using stated choice experiments.

2. Positionality of passenger cars

2.1. Welfare theory versus theory of positional goods

Utility theory is the generally accepted paradigm for the understanding of human behaviour in economics, as well as in transport sciences and many other disciplines. It assumes that the consumer behaviour of individuals is not interdependent; whether or not others are able to acquire a bundle with higher or lower utility does not affect the utility of separate individuals. Every net increase in utility thus increases overall utility and social welfare.

There has been a long history of criticism on this idea. Critics argue that the utility associated with some goods, and particularly high-status goods, have a larger element of positionality. Consuming such goods results in externalities due to 'snob effects' that means that the exclusivity and utility of such status-enhancing goods decreases when their overall consumption

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doi:10.1016/j.trd.2011.03.003

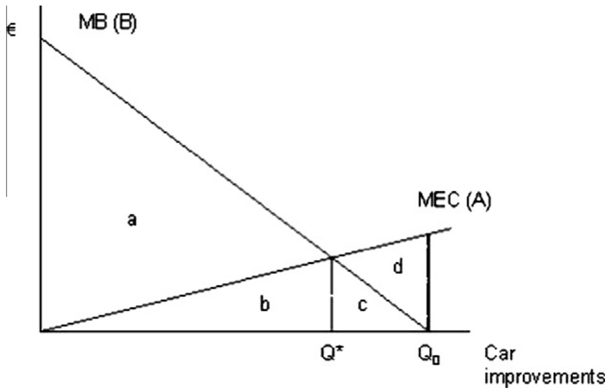

Fig. 1. Trade-off between marginal benefits of B and marginal external costs of A.

increases.[1] Since only 50% of people are in a financial position to own goods that have above average status, there is a continuous incentive for the other 50% to attempt 'to keep up with the Joneses' (Hirsch, 1976), or to compensate relative disadvantages by continuously buying more luxurious goods. This is also referred to as the 'positional treadmill' (Frank, 1985).

These consumption externalities provide a rationale for corrective taxing (Solnick and Hemenway, 1998; Verhoef and Van Wee, 2000). Internalising the external costs of the consumption of positional goods increases social welfare and limits resource expenditure. Fig. 1 illustrates the increase in social welfare for two individuals, A and B. Marginal benefit and marginal external cost curves as a function of hypothetical car improvements are shown for both individuals. Every additional car improvement for B will deteriorate the relative position of A, thereby increasing A's external costs. Without corrective taxing, B will maximise his utility by buying Q_0. B's utility or welfare amounts to $a + b + c$. At this level of consumption, A's loss in utility (which equals his external costs) amounts to $b + c + d$.

If B has to pay c in taxes he would lower his consumption to Q^*. A would still suffer external costs of b, but he would no longer lose c and d. The overall utility of A and B has increased. Apart from a gain in welfare, there is an environmental benefit if car Q_0 is smaller than Q^*, is more fuel-efficient and, thus, emits less CO_2.

2.2. Evidence on the positional value of cars

Empirical evidence of the positional value of cars is very limited. Psychological sciences distinguish between instrumental, symbolic and affective motives related to car use and car ownership (Steg et al., 2001). The three categories of motives are proposed in social psychology by Dittmar (1992) to explain the meaning of material possessions. Steg (2005) gives empirical evidence of Dittmar's conceptual model and shows that car ownership and use are not only related to instrumental motives but also to affective and symbolic motives. This implies that cars have an absolute and a relative, symbolic, value. Symbolic motives relate to the social comparison theory and to what economists describe as 'status'.

Alpizar et al. (2005) conducted a relative consumption experiment among 325 students from the University of Costa Rica, which included the purchase price of passenger cars. It was found that if a person buys a more expensive car, 45% of the gained utility could be attributed to the fact that his or her car has become more expensive than those of others. Carlsson et al. (2007) conducted a larger survey among 700 respondents in Sweden, to quantify the positionality of income, leisure and the purchase price and safety level of passenger cars. It was found that 50 to 75% of a car's purchase price is related to the element of positionality, whereas only 25% relates to its safety. Put differently, car buyers are willing to pay 50 to 75% of their car price in order to maintain their social position relative to other car owners. The fact that car safety has a lower degree of positionality than purchase price is as expected, since reducing the chance of injury or death does not become much less appealing if other people drive cars that *do* expose them to higher risks.

3. Design of the stated choice experiments

Stated choice experiments with framings were designed to determine the positionality of specific car attributes. The first choice experiment was designed to obtain the utility of car attributes in the reference situation. Other choice experiments were designed to examine the positionality of car attributes. Here, respondents were asked to choose their preferred car, from a situation of being relatively better or worse of, compared to others.

These choice experiments were part of an online questionnaire. Selection questions were included to filter out those individuals who were not planning to buy a new, not second-hand, privately owned car within two years. Consequently company cars, approximately 55% of all new car sales in the Netherlands, were excluded from the experiment. Revealed

[1] The other extreme case is the 'bandwagon effect', whereby utility rises the more that other individuals consume the good; fashion items being the commonly cited case.

Table 1
Attributes and attribute levels in the stated choice experiments.

Attributes	Attribute levels
Car class	Smaller (−1), same (0), larger (+1)
Engine size	+40%, +20%, 0%, −20%, −40%
Acceleration	+30%,+15%, 0%, −15%, −30%
Interior	Sober, average, luxurious
Fuel use	+30%, +15%, 0%, −15%, −30%
Car purchase costs	+40%, +20%, 0%, −20%, −40%
Fuel price at pump (euro/l)	Petrol: 0.87; 1.16; 1.45; 1.74; 2.03. Diesel: 0.70; 0.94; 1.17; 1.40; 1.64

preference questions focused on the cars that respondents owned, and which they used predominantly, at the time of questioning. These questions were aimed to reveal information on purchase price, kilometres driven, engine capacity and household income. Also, respondents' car sizes and classes were determined by showing them pictures of well-known car models to choose from. Respondents were asked to choose the car class that was most comparable with the car they currently owned. Six car classes were distinguished; submini, economy, compact, mid-size, large mid-size and top-end. The revealed preference data was used in the stated choice experiments. This allowed the construction of respondent-specific choices, that presented respondents with variations of cars that would not differ too much from their current situation, aiming to improve the reliability of responses.

3.1. Choice experiment with cars as non-positional goods

In the reference choice experiment, respondents were asked which car type they were most likely to buy within the coming two years. The attribute values indicated by the respondents in the revealed preference questions were used for calculating attribute levels in the choice tasks, as mentioned above. The attributes and attribute levels are shown in Table 1. Choice tasks consist of three choices and one no-choice option.

3.2. Choice experiments with cars as positional goods

For the positional choice tasks two manipulations were used for which the respondents were divided into two groups. The first group was asked to imagine a situation in which the average car sold in the Netherlands would be a size class smaller than the current average ('downsized') and a situation in which the average car sold in the Netherlands would be a size class larger than the current average ('supersized'). In both experiments, respondents were shown an image of the 'imaginary' Dutch average car. This was either the second smallest car size, economy, or the second largest car class, large mid-size. The attribute values in these manipulated choice experiments were not made relative to the respondents current cars, in the hope that differences in willingness to pay between owners of small and large cars could be distinguished more clearly.

The second group of respondents was presented with a choice experiment in which they were asked to imagine to be living in either the US, were the average car size is larger than in the Netherlands ('supersized'), or in Italy, where the average car size is smaller than in the Netherlands ('downsized'). This group was not shown an image of what the average car in both the United States and Italy looked like, under the assumption that respondents already had an accurate idea of US and Italian car sizes.

The data from both these double experiments on car positionality, for an average larger car and a US size car, and an average smaller car and an Italian size car, were merged into two data sets: downsized and supersized. The framing used was not chosen arbitrarily. Experts were consulted and the framing was tested in a pilot setting to confirm that it would result in respondents sufficiently liberating themselves from their current circumstances.

4. Data collection and respondent characteristics

Participants in the survey were selected from a Dutch national internet panel of TNS NIPO. This panel consists of about 140,000 households that all own personal computers with internet access. The panel is established through random sampling, meaning that each member of society has an equal chance to be added to the panel as long as he or she has conveyed the willingness to cooperate. From this panel, about 1600 participants were selected for whom car types and classes were known from previous surveys. This group was approached by e-mail to participate in the survey. A stratification was made to obtain sufficient respondents, a minimum of 50, for five car classes. The questionnaire was fielded in April 2008. After cleaning, 717, 753 and 779 complete and valid questionnaires remained for the choice experiments of current car size, downsized and supersized.

A comparison of few socio-economic parameters of the final sample reveals an overrepresentation of two-person households and an underrepresentation of single-person households. Households with incomes below €34000 a year and those of main breadwinners with middle education levels are also underrepresented. Finally, there was an overrepresentation of the 35–49 years age group.

5. Estimations

5.1. Methodology used

Parameter estimates for each choice experiment were obtained through maximum likelihood estimation of multinomial logit (MNL) models. This resulted in MNL models for the three data sets on current car size, downsized and supersized. Estimations resulted in utility values for each attribute level. Fifteen additional MNL models were estimated for the six identified car size classes for which, due to a lack of respondents, the classes 'large mid-range' and 'top-end' were combined. The aim of these models is to reveal differences in car positionality between drivers of small cars and those of larger, more luxurious cars. Monetary values were derived from the models by estimating the ratios between utility values of sets of car characteristics and price attributes, car purchase price or fuel price, multiplied by price changes.

5.2. Estimation results

Table 2 shows the (MNL) estimation results from the choice experiments *current car size*, *downsized* and *supersized*; 31 of 93 utilities are not statistically significant. The model estimation reports gave no indications of poor model fit. The number of iterations for each model until convergence never exceeded five. Root likelihood values were close to 0.30 indicating good model fit (Hensher et al., 2005). Generally speaking, the signs of the utilities are as would be expected. Downsizing of the

Table 2
Analysis of the choice experiments 'current car size', 'downsized' and 'supersized'.

	Choice experiment	Current car size		Down sized		Super sized	
Respondents		$N = 717$		$N = 753$		$N = 779$	
Observations ($N * 6$)		4302		4518		4674	
Log likelihood		−5320		−5503		−5805	
Root likelihood		0.29		0.30		0.29	
Attribute levels		Utility	T^2	Utility	T^2	Utility	T^2
Size class	−1	−14.0	−5.7	−37.3	−14.4	−26.6	−10.7
	Same	17.8	7.8	23.0	10.1	27.4	12.4
	+1	*−3.8*	*−1.6*	14.2	6.2	*−0.7*	*−0.3*
Engine capacity	−40%	−24.2	−6.3	−30.3	−7.9	−29.4	−7.8
	−20%	*−2.7*	*0.7*	−9.7	−2.7	*−4.2*	*−1.2*
	Same	18.1	5.2	18.9	5.4	21.2	6.2
	+20%	*5.0*	*1.4*	16.5	4.7	10.0	2.9
	+40%	*3.6*	*1.0*	*4.6*	*1.3*	*2.4*	*0.7*
Acceleration 0–100 kph	−30%	*0.5*	*0.1*	−8.0	−2.2	*−2.5*	*−0.7*
	−15%	*3.7*	*1.0*	*5.3*	*1.5*	*1.9*	*0.5*
	Same	*2.4*	*0.7*	*3.0*	*0.8*	*−6.7*	*−1.9*
	+15%	*−1.8*	*−0.5*	*4.5*	*1.3*	9.6	2.7
	+30%	*−4.8*	*−1.3*	*−4.8*	*−1.3*	*−2.3*	*−0.6*
Interior	−1	−21.7	−8.6	−31.4	−12.3	−26.8	−10.8
	Same	5.6	2.4	12.5	5.4	10.2	4.5
	+1	16.0	7.0	18.9	8.3	16.6	7.4
Fuel consumption	−30%	13.8	3.9	15.2	4.3	15.0	4.3
	−15%	8.4	2.4	*6.5*	*1.8*	8.3	2.4
	Same	*6.7*	*1.8*	*4.0*	*1.1*	8.0	2.3
	+15%	−7.9	−2.1	*−4.7*	*−1.3*	*−5.8*	*−1.6*
	+30%	−20.9	−5.5	−20.9	−5.6	−25.6	−6.8
Purchase price	−40%	23.7	6.8	16.7	4.8	12.7	3.7
	−20%	33.2	9.7	24.0	7.0	25.0	7.4
	Same	11.5	3.2	18.8	5.4	20.3	6.0
	+15%	−16.3	−4.3	*−7.1*	*−1.9*	*−4.6*	*−1.3*
	+30%	−52.2	−12.6	−52.4	−12.9	−53.5	−13.2
Fuel price (at pump)	€0.70	34.2	10.0	31.1	9.1	24.1	7.1
	€0.94	13.9	3.9	21.8	6.3	20.6	6.1
	€1.17	*−0.7*	*−0.2*	*−2.7*	*−0.8*	*6.6*	*1.9*
	€1.40	−16.8	−4.5	−18.9	−5.1	−15.6	−4.3
	€1.64	−30.6	−7.9	−31.3	−8.1	−35.6	−9.2

Italic values are not significant.

engine capacity leads to a decrease in utility. Higher fuel consumption, higher fuel prices, a less luxurious interior and higher car purchase prices are valued negatively.

For the 15 attribute levels of the attribute acceleration, 13 are not significant. Also, the importance of this attribute was the lowest of all attributes, and was therefore excluded from further analysis. Acceleration, which in advertisements is often used to illustrate a vehicle's performance, according to this experiment, does not significantly influence car choosing behaviour. The utility of the attributes size class and engine capacity are highest for the level 'same', which indicates a preference for the status quo. This could stem from a real preference for the current car, but also because people prefer to leave things unchanged, just because they were unable to select a better alternative. This may mean that some respondents perceived the design as too complex to make an informed choice.

Table 2 also shows differences in estimated utilities between the current real world situation in choice experiment current car size and the positionality experiments downsized and supersized. The differences are particularly apparent for the attribute of car size class. In a world where the average car would be smaller then in the respondents current situation (choice experiment downsized), the utility of a shift to car types that are smaller than respondents' current cars is more negative than in the real world situation. In other words, the relative change in utility is greater in the choice experiment downsized than in current car size. The substantial differences in utilities between the reference choice experiment current car size and the positionality experiments indicate that cars and the attributes selected are indeed positional.

Looking more closely at Table 2 reveals that in many instances changes in car attributes in the positionality experiments are valued more negatively than in the experiment current car size. In other words, the preference for the status quo is even higher in the positionality experiments than in the experiment current car size. This may indicate that respondents became more conservative in choosing downsized or supersized cars in the positionality experiments because they found it difficult to envision the imaginary situations.

5.3. Estimates on willingness to pay

Table 3 shows that almost all WTP values for changes from the current car are negative, whether they be improvements or deteriorations. This indicates that respondents strongly prefer the status quo. Respondents are only willing to pay for a more luxurious car in the supersized and downsized situations. Shifts towards a smaller car size class, a smaller engine capacity, or a less luxurious interior have negative values.

As Table 3 shows, the WTP for not having to drive a smaller car, a car with less engine capacity or a less luxurious interior is larger in the supersized situation than in the real world situation. This is consistent with relative consumption theory: in a world with on average larger cars than in the real world situation the relative differences between a smaller sized car than the respondent's car and the average car would become larger. Hence, the loss in utility or welfare because of these differences would also be larger, resulting in a lower utility for car downsizing. However, the WTP to prevent being worse off in the downsized situation is also higher than in the current situation, which is not consistent with the relative consumption theory. This could be an indication that the manipulation in the positional choice experiments did not work properly. The strong preference for the status quo probably does not stem from a real preference for the current situation. Respondents might prefer to leave things unchanged because they simply could not select a better alternative.

Mixed consistencies with the relative consumption theory were also found for the fifteen car size specific MNL models. According to relative consumption theory, changes in utility due to reduced engine capacity in the choice experiment downsized should be lower than in the choice experiments current car size and supersized. As is seen in Table 4, however, the change in utility of a 40% reduction in engine capacity for the compact car is higher in the choice experiment supersized than in current car size. The loss in utility for compact cars in the choice experiment downsized, on the other hand, is, as expected, higher than in current car size. For mid-sized cars it is seen that the utility loss of reduced engine size in the choice experiment supersized is smaller than in current car size, but that the utility loss in the choice experiment downsized is even smaller.

Table 5 gives some results for the attribute car size class. The gain in utility from a shift to larger cars in the choice experiment supersized was expected to be lower than in both downsized and current car size. The table shows this is not the case for owners of economy cars.

Table 3
Estimates of WTP for changes in car attributes.

Current car size, WTP for supersized and downsized	Current car size	Downsized	Supersized
Car size −1	−3430	−5930	−5120
Car size +1	–	−870	–
Engine capacity −40%	−4650	−4840	−4800
Engine capacity −20%	–	−2810	–
Engine capacity +20%	–	−240	−1060
Interior −1	−2950	−4320	−3510
Interior +1	−2400	6150	6810

Table 4
Changes in utility for the car classes compact and mid-sized, from reduced engine capacity, in the choice experiments current car size, supersized and downsized.

Choice experiment	Engine capacity	Compact		Mid size	
		Utility	Change	Utility	Change
Current car size	−40%	−0.32	−205%	−0.45	−271%
	Same	0.30	–	0.26	–
Supersized	−40%	−0.45	−276%	−0.34	−232%
	Same	0.26	–	0.26	–
Downsized	−40%	−0.34	−289%	−0.19	−159%
	Same	0.18	–	0.32	–

Note: Due to a lack of statistically significant utilities WTP could not be estimated for the car size specific MNL models.

Table 5
Changes in utility for economy and compact cars from a shift to smaller and larger car sizes in the choice experiments current car size, supersized and downsized.

Choice experiment	Size class	Economy		Compact	
		Utility	Change	Utility	Change
Current car size	−1	−0.65	−295%	−0.45	−208%
	Same	0.33	–	0.41	–
	+1	0.31	−5%	*0.03*[a]	*−92%*
Supersized	−1	−0.63	−335%	−0.23	−170%
	Same	0.27	–	0.33	–
	+1	0.36	35%	−0.10	−130%
Downsized	−1	−0.70	−361%	−0.60	−268%
	Same	0.27	–	0.36	–
	+1	0.43	61%	0.24	−32%

Note: Due to a lack of statistically significant utilities no WTP values could be estimated for the car size specific MNL models.
[a] Not significant.

The results for compact cars are consistent with the relative consumption theory. Respondents owning a compact-class car report a utility closer to the average, or, in other words, lower utility losses due to relative disadvantages compared to others. In a world with on average smaller cars, their relative advantage would increase. Consequently, a shift towards a smaller car in the choice experiment downsized would bring them closer to the average car, in which case they would lose relatively much utility. Table 5 shows that the decrease in utility of compact cars from a shift to a smaller car is higher in the choice experiment downsized than in current car size. Consistent with the relative consumption theory the utility loss in the choice experiment supersized is smaller than in downsized.

The results from the size-class-specific MNL models also indicate that utility losses from relative disadvantages are smaller than utility gains from relative advantages. This is consistent with the idea of the 'positional treadmill', in which people have a higher incentive to buy goods that give them relative advantage since this gives them a relatively large gain in utility. It is also consistent with the concept of loss aversion from prospect theory (Kahneman and Tversky, 1979).

6. Conclusions

The stated choice experiments presented in this paper showed that cars and specific car attributes, such as size, engine capacity and interior, are positional goods, even though not all outcomes were consistent with the relative consumption theory. Willingness-to-pay for these car attributes differed between situations in which respondents were asked to imagine living in a world with, on average, either smaller or larger cars. Car size and engine size appear to particularly add to positionality.

The choice experiments also showed that utility losses from relative disadvantages are smaller than utility gains from relative advantages, which is consistent with the idea of the 'positional treadmill' and the concept of loss aversion from prospect theory.

Ignoring positionality may result in an overestimation of welfare costs associated with CO_2 measures that lead to downsizing of the average passenger car. Moreover, the consumption of positional goods leads to consumption externalities that can be internalised through a corrective tax. This could limit the consumption of large cars that emit relatively high levels of CO_2, while increasing social welfare through the internalisation of external costs.

Our results also show that respondents have a strong preference for cars similar to the car they were driving at the time. Changing car size class, whether it be smaller or larger, results in negative utilities and WTP values. This is an indication that car buyers choose from a narrow pre-selected set of cars that do not differ much in size class. The same predisposition holds, albeit to a lesser extent, for engine capacity and interior. Although differences in WTP were found when respondents were confronted with relative changes in their position, the sign of these differences were not as expected in approximately half of these instances. This predisposition may thus indicate that positionality of cars does not stretch beyond the attribute levels chosen in this experiment.

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