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# **School milk consumption in Germany –what are important product attributes for children and parents?**

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# **School milk consumption in Germany –what are important product attributes for children and parents?**

## **1. Introduction**

From the viewpoint of nutrition, dairy products are part of a well balanced diet - especially for children - due to the animal protein, vitamins and minerals they contain (HEINE, 1999). Although younger children consume almost enough dairy products on average, consumption declines quite often with increasing age and will become insufficient (MENSINK ET AL., 2007). Subsidised school milk is one possibility to improve milk consumption. The school milk programme developed by the European Union covers various types of milk products including drinking milk or certain plain or flavoured fermented milk products (EC No 657/2008, EC No 1234/2007). Originally established as a consumption aid ((VO (EWG) No. 1080/77) the current programme states, in addition, two further objectives: firstly, to improve children's nutritional status and knowledge, and, secondly, to win new consumers. All children visiting nursery, primary, or secondary schools, are entitled to receive a maximum quantity of 250 ml of subsidized school milk products per school day. The subsidy has been reduced over time and is currently 18.15 cents per kg milk.

In Germany, however, participation of the school milk programme has dropped dramatically. Between 1993/94 and 2008/09 school milk sales declined by 72 % to 36,746 tonnes of full milk equivalent<sup>1</sup>. In order to identify caveats and to get recommendations for improved programme features, the German Federal Ministry of Food, Agriculture and Consumer Protection initiated a comprehensive federal project for the period 2008-2010. Accompanying research is assigned to analyse the whole value chain.

Besides identifying problems and solutions along the value chain, research is asked to investigate whether new school milk products can contribute to higher sales of school milk. This, in turn, may directly improve nutritional conditions of school children, but also indirectly, due to better knowledge. The paper answers this question focusing on (i) the end of the above mentioned chain, i.e. children and parents and (ii) children's and parents' attitude to different attributes of school milk products. Since preferences and needs change over time an up-to-date view of consumers' willingness to buy novel school products and their perceived attributes of school milk products is desired.

A main issue of this paper is to capture preferences for school milk products of parents who principally decide on purchase but also of children who conduct the actual act of purchase. Hereby especially the difference between the perceived utility of children and parents regarding different school milk attributes are featured. In an online survey which included a choice experiment respondents were asked to choose school milk products with different attributes. Applying this approach allows identifying attributes that are more important than others in choice decision. Recommendations for increased school milk consumption can only be given if it is known whether for example a high or low fat content or the use of artificial sweetener is preferred by consumers. The paper also highlights the question why some respondents refused to choose novel products at all. Furthermore, it is analysed and discussed whether lexicographic preferences are relevant and plausible in the context of school milk buying decisions.

In this paper preferences of school children and parents are analysed as follows: first, the underlying methodological framework will be presented in detail. Then, a short

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<sup>1</sup> Data from German Ministry of Food, Agriculture and Consumer Protection, 8. February 2011

overview of the collected primary data is given. In section four the results of our econometric model are shown. A final section provides qualifications and conclusions.

## 2. Methodological Framework

The methodological approach consists of a choice experiment carried out with school children and parents, the concept of lexicographic preferences and a nested logit model. These three components are presented in the following subsections.

### 2.1 Choice Experiments

Choice experiments (CE) are a type of stated preference method that arose from conjoint analysis. In contrast to the latter the respondents do not rank or rate the different alternatives, but just choose one among several alternatives (ADAMOWICZ ET AL (1998), LOUVIERE (2001)). During the 1970ies CE were developed for transportation problems (BEN-AKIVA AND LERMAN, 1974) and in the 1980<sup>th</sup> they were developed further by LOUVIERE AND HENSHER (1982). While they were first used for transportation problems (BEN-AKIVA AND LERMAN, 1974; BEN-AKIVA, 2000; MOREY AND ROWE, 1993; MCFADDEN, 1999), they also have been applied to other research areas in recent years such as environmental economics (ADAMOWICZ ET AL., 1997; HANLEY ET AL., 1998) or food consumption (LUSK ET AL., 2003; LUSK AND SCHROEDER, 2004). Compared with other approaches, CE have several advantages: (i) for respondents it is easier to choose the most preferred product than ranking 10 or more different alternatives as in conjoint analyses (ADAMOWICZ ET AL., 1998; HAIR ET AL., 1998; P.394); (ii) CE are less susceptible to respondents' strategic behaviour what could be a problem in contingent valuation methods (BREYER ET AL., 2005, P. 61); (iii) compared to the alternative methods it is easier to check internal consistence, to compute single attribute parameters, to detect substitutive relationships between different attributes and to allow for respondents' heterogeneity using different econometric models (HANLEY ET AL., 1998A). HANLEY ET AL. (1998B) summarize that contingent valuation is more suitable for valuing an overall concept. If particular attributes should be evaluated CE should be favoured. Therefore, CE is used in this research project.

CE are based on Lancaster's approach on consumer theory (LANCASTER, 1966) and McFadden's random utility model (MCFADDEN, 1974). They describe the alternatives being chosen from using a number of attributes  $k$ . Individual  $n$  chooses alternative  $i$  resulting in utility  $U_{ni} = U(X_{ni})$ , where  $X_{ni}$  is a vector describing the attributes embedded in alternative  $i$ . Applying McFadden's random utility model, utility is composed of a deterministic and a random part:  $U_{ni} = V_{ni} + \varepsilon_{ni}$ . Here  $V_{ni} = f(X_{ni})$  is deterministic and depends on the product attributes whereas  $\varepsilon_{ni}$  presents the random component. Total product utility is the sum of all single utilities that arise from different attributes (HENSHER ET AL., 2006; LOUVIERE, 2001).

If the product price is one of these attributes, willingness to pay (WTP) can be measured (BENNETT AND ADAMOWICZ, 2001; LUSK ET AL., 2003). From

$$U_{ni} = \beta_{n1} * \text{Price} + \sum_{k=2}^K (\beta_{nk} * X_{nk}) + \varepsilon_{ni}$$

one can derive willingness to pay by dividing the parameter  $\beta_{nk}$  and  $\beta_{n1}$

$$WTP_{nk} = \frac{\beta_{nk}}{\beta_{n1}}$$

The product used within this choice experiment for WTP estimation is school milk. Attributes selected for the CE are listed in Table 1 whereas content levels were chosen based on widely available products in Germany and other countries. Price was included as an attribute as well.

**Table 1: Attributes and attributes levels**

Parents		Youth (15-18 years)	
Attribute	Levels	Attribute	Levels
Products	novel school milk, yoghurt, conventional school milk	Products	novel school milk, yoghurt, conventional school milk
Price (in Cents)	30-35-40	Price (in Cents)	30-35-40
Fat content	0.3%-1.5%-3.5%	Fat content	0.3%-1.5%-3.5%
Sweetening agent	sugar, artificial sweetener	Sweetening agent	sugar, artificial sweetener
Calcium	120 mg, 160 mg, 200 mg		
Lactose-free	yes, no		

Source: own illustration, \* Children younger than 15 years were not asked to answer a CE

Choice scenarios were constructed using orthogonal main-effects designs (COMPARE HENSHER ET AL., 2006, P. 116). There are 32 product combinations for the adults' CE and 27 for the youths'. To facilitate the decision making, the number of choices was limited to four for parents and to three for youths. In each decision respondents had three choices, two novel school milk products and one conventional. The latter was a constant 'opt-out' option in all sets. An example question from the CE is given in Figure 1.

**Figure 1: Sample choice experiment question**

Please check the option (A, B, or C) that you would most likely purchase.			
Product attribute	Novel school milk	Novel yoghurt	Conventional school milk
Price in Cents	40	30	35
Fat content	0.3%	1.5%	3.5%
Sweetening agent	sweetener	Sugar	Sugar
Calcium content	200mg/100ml	160mg/100ml	120mg/100ml
Lactose-free	no	No	No
I would choose.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Source: own illustration

## 2.2 Theory of Lexicographic Preferences

By evaluating product utility using CE one should keep in mind that utility arises from individual preferences for a particular product. In microeconomic theory these preferences are presented using indifference curves. Every single point on such an indifference curve will represent the same amount of utility. These curves also imply that the person is willing to substitute one good by another. This type of preferences is called "normal preferences" (VARIAN, 1995, P.43). In analysing consumer behaviour it is an observable phenomenon that some consumers are not willing to substitute goods. This can be explained with the existence of lexicographic preferences. If these preferences exist it will be impossible that two different products are preferred with the

same intense (EDWARDS, 1986) implying that there is no trade-off between the products (SPASH AND HANLEY, 1995). Hence, from an economic point of view the ordering of individual preferences cannot be shown with utility functions and indifference curves (CAMPBELL ET AL., 2006; DEATON AND MUELLBAUER 1999). This is: Whatever someone offers in exchange for a particular good it will not be accepted. If these preferences were relevant for school milk it would not make sense to invest efforts to convince parents or youths buying other products.

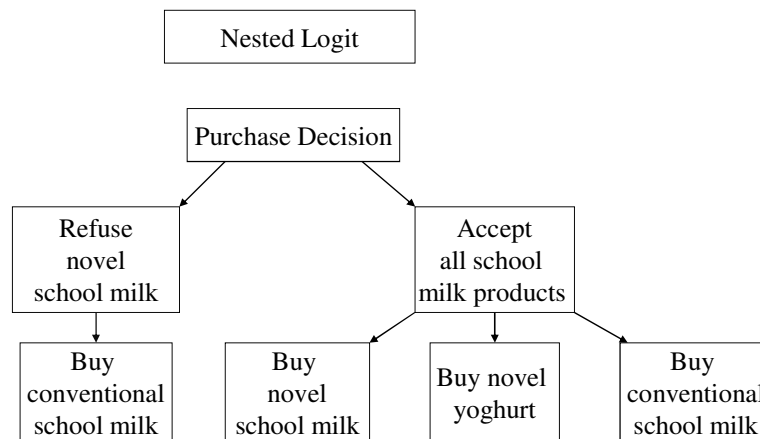
The concept of lexicographic preferences has been applied in different scientific fields. While SPASH (2000), CAMPBELL ET AL. (2006) and SUH AND HARRISON (2006) use them for environmental problems, GELSO AND PETERSON (2005) adopt the concept for recreation areas, EDWARDS (1986), STEVENS ET AL. (1991) and NAKATANI ET AL. (2007) for the examination of special kind of animals. Just little attention is payed to possible lexicographic preferences in the case of food (SCHEIBEHENNE ET AL., 2007).

### 2.3 Nested Logit Model

Lexicographic preferences can be analyzed with different models; e.g. using Nested or Mixed Logit Models or Single and Double Hurdle Models (RYAN AND SKATUM, 2004; CAMPBELL ET AL., 2006; VON HAEFEN ET AL., 2005). One major part of the analysis is to explain why some respondents refuse to buy novel school milk products. Following VON HAEFEN ET AL. (2005) a Nested Logit model (NL) is appropriate in this case.

The earlier discussed utility function  $U_{ni} = V_{ni} + \varepsilon_{ni}$  is the starting point for the NL. The following analysis is based on the assumption that different product alternatives can be divided in different segments. In the case of school milk there is one segment that is free from any novel product and other segments containing novel as well as conventional school milk (compare Figure 2). Thus, the decision tree allows buying conventional school milk due to two different attitudes, once because of the total rejection of novel products and once because of selecting the most favoured product attributes.

**Figure 2: Purchase decision process**



Source: Based on RYAN AND SKÅTUN (2004)

Total utility is  $U_{si} = V_{si} + \varepsilon_{si}$  where  $s$  describes the different segments ( $s = 1, \dots, S$ ). Probability Pr that a particular alternative belonging to a particular segment is chosen

results from the arithmetic product of the probability that alternative  $i$  from segment  $s$  is chosen and the probability that segment  $s$  is chosen at all.

$$Pr_{si} = P_{ils} * P_s$$

Using a logit model, this decision problem might be written as

$$Pr_{ils} = \frac{e^{V_{si}}}{\sum_{i=1}^{J_s} e^{V_{si}}}$$

While estimating  $Pr_s$  two different decision problems have to be considered. The first one is the decision whether a novel product is accepted in general and the second one is the particular purchase decision. These two decisions can be linked using the concept of expected maximum utility (=EMU) that is also known as inclusive value (IV-Parameter). Formally, the IV-Parameter can be noted as

$$IV_s = \ln \sum_{i=1}^{J_s} \exp^{V_{si}}$$

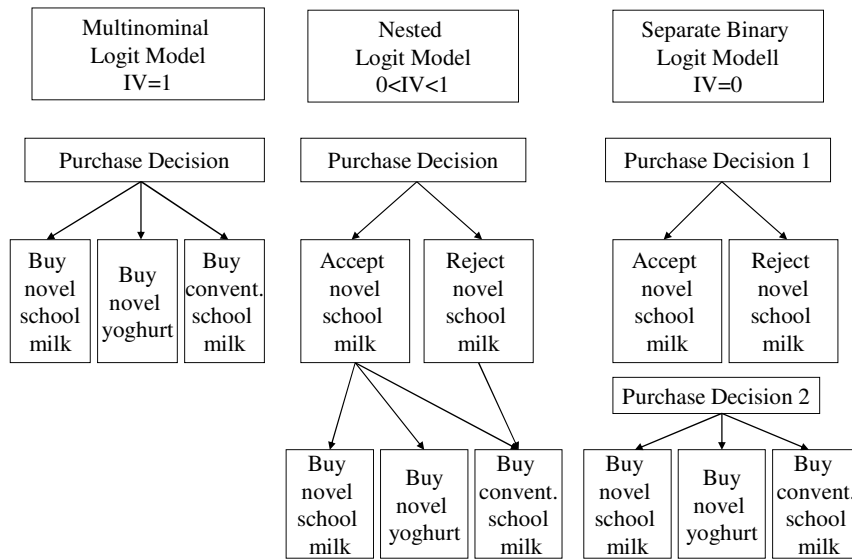
After integrating this parameter into the mentioned product groups (just conventional versus all products) consumer's probability to choose segment  $s$  is

$$Pr_s = \frac{e^{(V_s + IV_s)}}{\sum_{s=1}^S e^{(V_s + IV_s)}}$$

(HENSHER ET AL.,2006 p.479; LOUVIERE ET AL., 2000, p.186; URBAN, 1993, p.141, TUTZ, 2000, p.194 ).

An IV-Parameter within the [0,1] bound is the sufficient condition for a NL. If it is not statistically significantly different from 1 a multinomial logit model is appropriate. In case the IV-Parameter is not significantly different from zero there are two independent choice models for the two decision problems (HENSHER ET AL., 2006) p.493). From this it follows, that lexicographic preferences are relevant. Following RYAN AND SKÅTUN (2004) Figure 3 shows the different decision problems and the appropriate statistical models.

**Figure 3: Choice modelling considering lexicographic preferences**



Source: Based on RYAN UND SKÅTUN (2004)

### 3. Data

After having explained the methodological framework, in this section the collection of primary data and some descriptive statistics are presented. The analysis is based on online-surveys developed in 2010 and filled in by 1000 parents of school children, 500 children aged 10 to 14 years and 509 youths aged 15 to 18 years in Germany. Participants were equally distributed regarding age, gender and regions. Questionnaires consist of three parts: (i) First, information on milk products regularly consumed, preferred product attributes as well as general attitudes towards milk products and nutrition were collected. Also the question whether the child is assessed as overweight or whether the children/youths assesses themselves as overweight was raised. (ii) The second part comprises a choice-experiment (CE) for parents and youths only, and a paired-comparison test for children only. Cognitive pretesting showed that younger children were not able to give consistent answers within the CE. Thus children aged below 15 will not be considered in the analysis. (iii) Socio-demographic variables were asked for in the third part containing variables like age, gender, household size, (im)migration background for all questionnaires, school year and type of school in case of the children's and youths' questionnaire and educational achievement and income in the parent's one.

Table 2 presents some descriptive characteristics of the data set. It is obvious that the variables gender, mean household size and immigration background share are quite equally distributed in the two samples considered. Therefore, the differences in estimated weight are obvious.

While just 6% of the parents assess their child to be overweight, 31% of the youths assess themselves as overweight. Beside socio-economic variables we asked for attitudes towards and preferences to milk products. Most parents state to take care of a healthy nutrition of their children.



**Table 2: Sample characteristics**

Variable	Definition	Parents	Youths
Gender	1 if female, 0 if male	0.55	0.50
Mean age	Years	42.99	16.28
Mean household size	Persons	3.74	3.64
Immigration background	1 if appropriate	0.08	0.07
Overweight	1 if appropriate	0.06	0.31
Completed vocational training	1 if appropriate	0,65	-
Supplementary calcium to milk product is useful	1 if appropriate	0,56	-
Supplementary vitamins to milk product are useful	1 if appropriate	0,49	-
Take care of healthy nutrition	1 if appropriate	0,96	-
Fat reduced milk products are healthier	1 if appropriate	0,45	-
Low fat content is important	1 if appropriate	-	0,47
Low sugar content is important	1 if appropriate	-	0,55
Low price is important	1 if appropriate	-	0,73
Like milk products	1 if appropriate	-	0,92
Would like to eat milk products daily	1 if appropriate	-	0,78

-: not significant/not asked;

Due to lack of space just those variables that were significant are presented in this table.

Source: own calculations

Asked to judge whether supplementary calcium and vitamins to milk products are useful, more than 50% agree for calcium and almost 50% for vitamins. 45% think that fat-reduced milk products are healthier than those containing the natural fat content. Youths prefer products with low fat and sugar content and a low price. Most of them like milk products and would like to consume them daily.

#### 4. Results

In the choice experiment fifty parents and 24 youths refused to choose any of the presented products. Hence NL estimation is carried out with 950 parents (3649 cards in total) and 485 youths (1419 cards in total). Results for the parents and the youths are presented in Table 3.

For the parents, the model explains 22.4% of total variance. IV-Parameter remains within the [0,1] bound but is not significant. Following HENSHER ET AL (2006, P. 547) the Wald-test was carried out. This test proves the hypothesis whether the IV-parameter is statistically equal to zero dividing the IV-parameter by the standard deviation. The critical value is  $\pm 1.96$  for the 95% confidence interval.

$$\frac{\text{IV - Parameter}}{\text{Standard deviation}}; \frac{0.00893665}{0.30679235} = 0.02912931$$

The result of 0.029 is below the critical value of 1.96. This implies that the Null-hypothesis, i.e. that the IV-parameter is equal to zero, cannot be rejected. Consumers buying school milk make two independent decisions. First they decide whether to buy a novel school milk product at all and then they select the specific product based on its attributes. We find this kind of decision making in line with lexicographic preferences.

Both novel products have a positive constant what implies that product utility is higher for those who consume the novel product compared to the conventional one (constant of

the conventional product is normalized to zero). This result is expected because consumers who do not reject the novel products are explicitly analyzed. The estimated price parameter is negative. Increasing this attribute declines product utility.

**Table 3: Results of Nested Logit Estimation**

Parameter		Parents	Youths
<i>Utility from school milk</i>			
Constant of novel school milk utility	-	0.19911725*** (0.07701110)	0.77549326*** (0.09780955)
Constant of novel yoghurt utility	-	0.15206330** (0.07743421)	0.25610889** (0.10341516)
Price	Kategorial	-0.03394806*** (0.00637914)	-0.08581953*** (0.01086664)
Fat content	Kategorial	-0.06677456*** (0.02024625)	-0.05034443 (0.03253812)
Sweetening agent	Dummy	-0.37848050*** (0.05272111)	-0.27960680*** (0.09279655)
Calcium content	Kategorial	0.00518363*** (0.00078769)	-
Lactose content	Dummy	0.07134643 (0.05282638)	-
<i>Whether to take novel school milk</i>			
Constant	-	0.80475289*** (0.28615981)	1.35753225** (0.68773188)
Overweight	Dummy	0.66378820** (0.27008910)	0.75170747*** (0.21467340)
Agreement: Supplementary Calcium intake to dairy products is useful	Dummy	0.41753076*** (0.12676584)	-
Agreement: Supplementary vitamins to dairy products are useful	Dummy	0.59958667*** (0.12805908)	-
Fat-reduced milk products are more healthy	Dummy	0.90135008*** (0.11117394)	-
Immigration background	Dummy	-0.50058375*** (0.18184555)	-
Completed vocational training	Dummy	-0.49018204*** (0.11363189)	
Take care of healthy nutrition	Dummy	0.50664499** (0.20947573)	-0.5000795*** (0.17926549)
Low fat content is important	Dummy	-	0.55579521** (0.21971890)
Low sugar content is important	Dummy	-	0.78783253*** (0.20961751)
Low price is important	Dummy	-	-0.43985891** (0.19416944)
Like milk products	Dummy	-	1.00848060*** (0.33852929)
Would like to eat milk products daily	Dummy	-	-0.67167304** (0.26574676)
<i>IV-Parameter</i>			
Non-Refusers		0.00893665 (0.30679235)	-0.01688365 (0.37742162)
R <sup>2</sup>		0,224	0.244

-: not significant/not asked;

\* Significance Level = 0,1; \*\* Significance Level = 0,05; \*\*\* Significance Level = 0,001.

Standard Error in parentheses.

Source: own calculations.

Utility declines also with increasing fat content and if an artificial sweetener is used. In contrast, it increases with rising calcium content and if the product is lactose-free. Hence, parameter of the latter is not significant.

As most important on the decision for novel school milk products the dummy “fat reduced milk products are more healthy” is listed. Consumers who agree to this statement are more likely to opt for a novel product compared to those consumers who disagree. The same holds for parents who assess their child to be overweight, who judge supplementary calcium and vitamins to dairy products as useful and who state more often that they pay attention to their children’s diet.

Probability to opt for the novel products is lower for parents with an immigration background and completed vocational training compared to those who have neither (no completed vocational training nor a university degree).

Youths’ model explains 24.4% of total variance. Again, the IV-parameter is insignificant and between zero and one. Once more, the Wald-test is carried out.

$$\frac{\text{IV - Parameter}}{\text{Standard deviation}}; \frac{-0.01688365}{0.37742162} = -0.04474134$$

Once more, the critical value is below 1.96 and lexicographic preferences can be found. Results are similar to the parents’ estimation. Both novel products have a positive constant. Thus, product utility is increased for those who consume the novel product compared to the conventional one. Product utility declines, as expected, with increasing price, use of an artificial sweetener, and increasing fat content. However, the latter is not significant. Probability to choose a novel school milk product is increased for those youths who prefer products with a lower fat or sugar content, who like milk products and assess themselves as overweight. However, they do not eat dairy products every day and they pay less attention to a healthy diet.

Results of the two estimates are quite similar. Factors reducing parents’ utility also reduces the youths’ one. Youths’ utility is more increased by novel products than parents’ one. Surprisingly, youths also react more on price than parents do. In return, parents react more on the fat content and artificial sweetener. That youths are entitled the products on their own while parents choose them for their children might be one reason for this. Parents might tend to focus more on ingredients than on the product itself.

Table 4 presents willingness to pay in Euro-Cents per percentage change in attribute for both parents and youths. Obtained results can be interpreted as follows: the base-price is those of the conventional product (35 Euro-Cents). A positive WTP means that the amount of money has to be added up to the base price, a negative amount has to be subtracted. One-percent of additional fat reduces the base price for the parents by 1.97 cents. If an artificial sweetener is used instead of sugar WTP will decrease by even 11.15 cents. An additional milligram of calcium will increase WTP by 0.15 cents. Similar to the parents, youths’ WTP decreases if a sweetener is used. However, the effect is less strong.

Comparing the WTP estimates, it is obvious that parents decrease in WTP is much higher compared to the youths’ one. This arises from the stronger decrease in utility for the attribute fat content and artificial sweetener.

**Table 4: Willingness to pay in Euro-Cents**

Attribute	Parents	Youths
Fat content	-1.97 (-3,6169;-0,8660)	-0.59* (-0,1696; 1,3819)
Artificial sweetener	-11.15 (-18,5235;-7,3904)	-3.26 (-5,9388;-1,1568)
Calcium content	0.15 (0,0976; 0,2532)	-
Lactose free	2.10* (-5,6320;0,8602)	-

In parentheses 95%-confidence interval based on Krinsky and Robb with 1000 iterations,

\* = not significant

<sup>1</sup>Because of the found lexicographic preferences WTP is just valid for the non-refusers.

Source: own calculations

## 5. Qualification and conclusions

11.8% of our parents refused to buy a novel school milk product and 12.6% of our youths rejected to buy one, too. Using a nested logit model we are able to detect lexicographic preferences. But is it plausible that lexicographic preferences exist for a product like school milk? This implies that there is no substitute for school milk, no amount of money can compensate for a school milk reduction, and all other products (or at least everything above a minimum level) would be given away to get even a little bit more school milk. But this is quite unlikely. Hence, following Saelensminde (2002) we conclude that we identified a lexicographic ordering but no lexicographic preferences.

Several reasons for the phenomenon of refusing particular products or detecting lexicographic choices in CE are discussed in scientific literature. SAELENSMINDE (2002) discusses the fact that these alternatives are too expensive compared to the status quo while CAMPBELL ET AL (2006) explain that the chosen product attributes are not relevant for their purchase behaviour. And DHAR (1997) argues that consumers might be overstrained with the decision process. In the present case it is reasonable to assume that respondents were either overstrained with their task in the case of youths, or were trying to shorten the survey. This seems plausible as the respondents did not spend much time for the decision process because school milk is not regarded as relevant enough. "Social desirability" could also explain the result, since some of the respondents could tend to give socially desired answers, i.e., they prefer answers which they think are more in line with the majority's attitude.

Summarizing, we conclude that our econometric model is suitable for detecting lexicographical orderings. And in some research questions it will appropriate to prove if this ordering might even arise out of lexicographic preferences.

School milk choice is driven by various factors. Utility analysis indicate that on average utility will decrease if fat content increases, if an artificial sweetener is used, and with increasing price. It will increase with additional calcium content and maybe due to lactose-free milk. The latter is not significant in our analysis. This is not surprising. Lactose-free milk has just a benefit for those who are lactose intolerant. So, if in our sample are not enough parents of lactose intolerant children it is reasonable that we are not able to detect a significant result. We also detect some attitudes that affect the choice for a concrete product.

The following preliminary conclusions can be drawn based on our results:

- School milk products with reduced fat content but sweetened with sugar are most likely to become preferred products. With artificial sweeteners dulcified products are just interesting for a smaller share of parents and youths.
- Especially parents who assess their children and youths who assess themselves to be overweight will be potential purchasers or consumers of these products. The same holds for parents who regard fat-reduced milk product to be healthier.
- Attitudes towards fat and sugar influence youths' choice decision, for parents attitude towards fat is important
- Offering more different products in schools is one possibility to increase school milk consumption. It might also increase total consumption of milk products if school milk is consumed additionally to the daily consumption of milk products at home. If there are compensation effects in daily milk consumption benefits of school milk increase will be questionable.

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