

## Continuity or discontinuity in the decision of the application of income of private households?

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# CONTINUITY OR DISCONTINUITY IN THE DECISION OF THE APPLICATION OF INCOME OF PRIVATE HOUSEHOLDS?

*UWE FACHINGER*

## 1. Introduction

### 1.1 Some preliminary remarks

Why are we interested in the continuity or discontinuity of income decisions due to the application of income of private households? The following preliminary remarks will hint at some relevant economic aspects.

In micro-economic theory it is generally assumed, that the behaviour of people is risk averse. To explain the distribution of earnings or wealth, this assumption is partly eased and different attitudes towards risk are admitted. One result of the softened assumption is, that on average households with a higher propensity in risk taking gain higher earnings. It is argued, that this causes the special shape of the distribution of earnings or wealth. In other words, this means, that more households with a higher risk taking propensity are to be found in higher earnings classes.

As the opportunity costs of a wrong decision for a household with higher earnings are *ceteris paribus* lower, higher earnings could lead to lower risk aversion in buying products. So risky decisions are *ceteris paribus* more likely in higher income classes<sup>1</sup>. In this context it has to be mentioned, that the consequence of *ceteris paribus* high opportunity costs of gathering information about the product<sup>2</sup> could also lead to brand loyalty.

To trace the risk aversity of private households, many ways could be taken, for example:

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1 In the purchasing behaviour of households with lower income, opportunity costs of wrong decisions could lead for example to brand loyalty.

2 This depends on the characteristics of the special good, whether it is a neoclassical homogeneous good, for which these costs are very low, or not.

- direct consultation of people, asking about their risk behaviour as is done in the applied data base<sup>3</sup>,
- experiments by putting people in specific situations to examine their reactions<sup>4</sup>, or
- using surveys and identifying adequate indicators.

In economics the identification and analysis of the risk aversion of people is mainly based on experiments. But this is only one way to do so. Due to the existing longitudinal data sets, which are necessary for such analysis, the third mentioned possibility should more often be taken into account.

Another aspect belongs to the explanation of income distributions and empirical tests of the life-cycle theory. The shape of income distributions is always stable over time, but that does not mean, that the household income is constant over time. On the contrary, it could be shown in longitudinal income analyses, that a lot of income mobility exists<sup>5</sup>. Risk averters would prefer – given the same mean income – an income path with lower erratic fluctuations. Therefore, utility maximising would *ceteris paribus* lead to life-time income profiles with relative slight fluctuations. Hence it follows, that the life-cycle theory has a problem to deal with the observed income mobility. But income could be the wrong indicator: income decisions could be better planned out, because it is possible to smooth the fluctuations of actual income through dissolving savings. Another aspect is, that a lot of income decisions over short time periods are not free. The amount of spending money is fix e. g. for rents, credit redemption's or energy (exc. fuel). Therefore, the time-profiles of spending money may be better suitable as an indicator for testing the life-cycle theory.

A third aspect is characterized with the term "habit formation". Habit formation evolves over time and takes place with the ageing of the individuals. So, if habit formation is completed, the behaviour of people may be more continuous (and predictable) as in the case, where habit formation comes into being and therefore erratic behaviour occurs more often. As the latter may be more the case in younger ages, and it may be possible, that the behaviour of the elderly is more continuous.

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<sup>3</sup> But this reflects mainly the opinion of the people about themselves. For a theory, which relies on the behavioural and normative beliefs on people, and its application see Ajzen and Fishbein, 1980.

<sup>4</sup> See for a short description and overview e. g. Lunt, 1995.

<sup>5</sup> See for example Atkinson et al., 1988, Atkinson et al., 1992, Fabig, 1999, Fachinger, 1991, Meier, 1983, Müller and Frick, 1997, Trede, 1997, and Zurbrügg, 1990.

## 1.2 Scope of the paper

The main purpose is to test, whether it is possible to show differences in risk taking, as it is reflected in the continuity of the purchasing behaviour on the basis of goods for daily requirements. The underlying idea is, to identify risk averters through their daily behaviour. The data on household expenditures should give the possibility of identifying different behaviour of risk taking on the basis of income decisions, especially those decisions concerning products of daily requirements<sup>6</sup>.

The paper is structured as follows. First, some comments are given on the used method. As Papastefanou did already describe the data set in general, in the following, comments are only given on special issues of the data set. After the short description of the data and method, the results are presented in two sections. The first one contains a description of purchasing behaviour on the basis of the product-limit estimation. Within this section, the continuity res. discontinuity of the purchasing behaviour is identified. In the following section, results of the proportional hazards model, which is used only as an explanatory tool, are presented. The paper concludes with a short summary and outlook.

## 2. Some comments on the method

Income decisions of households are processes over time and the purchase of a good is a time discrete event, which can occur at any point of time. To examine such changes over time it is necessary to use a method, which enables the handling of the dynamic of the process. Statistical methods for analysing these kinds of processes are summarized under the terms event history analysis or survival analysis. The event history analysis res. survival analysis is an appropriate statistical method especially for processes where at every given time a discrete change can occur.

In the event history analysis there are two main variables for the description of a process and which have to be operationalized: the state and the event<sup>7</sup>:

- State means in the context mentioned here, that a special product in the household exists.

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<sup>6</sup> This approach follows a line, as it was stated for example by Griliches, 1985, 200: “We should be using the newly available data sets to help us find out what is actually going on in the economy and in the sectors that we are analysing, without trying to force our puny models on them. The real challenge is to try to stay open, to learn from the data, but also, at the same time, not drown in the individual detail. We have to keep looking for the forest among all the trees.”

<sup>7</sup> The basic terminology is stated e. g. in Blossfeld and Rohwer, 1995: 33 pp.

– Event means the change of the state, that is buying a new product.

The period between two successive events is called episode or spell. The elapsed time until an event occurs, or the duration of an episode, is the random variable  $T$ , which is the core variable of any event history analysis. For the description and explanation of the variable  $T$ , three terms are of special interest:

1. The distribution of the continuous random variable gives information about the level of the probability of a change up to a specific point of time.
2. The survival function  $S(t) = P(T \geq t)$  informs about the level of probability, that up to a specific point of time, no event occurs.
3. The hazard rate or hazard function is the instantaneous probability of having an event at time  $t$ , given that an event has not occurred before  $t$ .

$$\lambda(t) = \lim_{\substack{\Delta t \rightarrow 0 \\ \Delta t > 0}} \frac{1}{\Delta t} \cdot P(t \leq T < t + \Delta t | T \geq t)$$

One main problem arises, when the whole process over time can not be measured. When it is unknown

- how long the period of the state before the observation period has been – this is called left censoring –,
- when the last state in the observation period will end– the so called right censoring –, special assumptions have to be made<sup>8</sup>. If one can assume, that the process did not depend on the history, i. e. the prehistory has no impact on the process, left censoring would not be serious (Diekmann and Mitter, 1984: 23). In the case of right censoring, the information will not be dropped, instead it will be used for the description and the estimation of the process. Because to know, that the last state is longer than the remaining time of the observation period, means we know at least a little bit about the process and this information should be used.

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<sup>8</sup> For a detailed description see Blossfeld and Rohwer, 1995: 34 pp., or Kalbfleisch and Prentice, 1980: 39 pp.

### 3. Definitions and operationalization

As mentioned earlier, the dataset is suitable to analyse a process over time even so it makes special requirements. As usual, you have to deal with the data at hand. The main problem is, how to identify continuous res. discontinuous behaviour within a given data set. What are the indicators or proxy variables and how are they to be operated?

The event history analysis offers several options to model the process, which is of interest here. The „extreme positions“ are characterised in short:

1. the process of buying could be modelled as a multistate-model with reversible events (Diekmann and Mitter, 1984: 37 and 177 pp.)<sup>9</sup>. That means that several states are existing and, moreover, a state can be achieved several times in the observation period.
2. the process of buying as modelled as a two state model with absorbable finite state. That means only one, i. e. the first, event is of interest.

Some problems belonging to these definitions arise. In the following, short comments on the main problems are given.

#### *Problem one: Selection of the group of goods / commodity group.*

It is necessary to use commodity groups, in which the goods are substitutes and not complementary goods.

Suitable are mainly goods, which are only used once and of which not several goods with different objectives do exist at the same time in the household, as for example:

- WGS 35: Wine: ordinary wine for the „daily“ consumption and higher class wine for special occasions.
- WGS 39: Shoe polish and means for maintenance leather: the different colours of shoe polish,
- WGS 50: cream: cream and sour cream
- WGS 89: Rice: full grain rice and rice pudding.

For these groups, buying another good of the same group does not necessarily indicate discontinuity of household decisions.

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<sup>9</sup> It is also known as a multistate-multi-episode model; Blossfeld and Rohwer, 1995: 34.

So the following goods are qualified for the analysis:

- WGS 12: roasted pure coffee,
- WGS 21: universal detergent,
- WGS 44: sherry / port,
- WGS 75: filter paper only for coffee or only for tea,
- WGS 83: yeast,
- WGS 99: toilette paper.

Furthermore the product should be short-lived and may be multiply purchased in a year. So the group WGS 44 (sherry/port) is not suitable for the purpose of the analysis, because it is possible, that households buy sherry or port only once a year.

Also, the information of the product group must be available for the members of Panel 6. So the WGS 75 and WGS 99 can not be used.

Concerning the opportunity costs of a wrong decision it could be stated, that all products are of low price. Therefore, the opportunity costs of wrong decisions are low, even for households with low income and these costs are meaningless in the context of the analysis.

#### *Problem two: changing environmental conditions*

It has to be considered, that products res. product groups are chosen, whose purchase is not induced through (due to) changing environmental conditions. For example, purchasing a dishwasher reduces the amount and art of washingup liquid. The maintenance of the floor (ground care means ) is another example: to move house, with the older one having a carpeted floor and the new one having a parquet, changes the purchase of detergent.

#### *Problem three: seasonal commodity goods*

For seasonal goods and goods, for which the decision of purchase is dependent of the weather (for example ice cream), the buying decision is not continuous. On the given information in the data set, it is not possible to decide, whether the purchase depends only on household internals or is induced through other factors. Therefore, these goods must also be excluded.

#### *Problem four: Selection of the households*

As it is important to use covariables, which are constant over time, to identify those changes in the consumer behaviour of households that are not due to environmental changes, those households have been selected that showed no changes in the following variables between 1994 and 1996.

- V1: federal states,
- V2: number of inhabitants of the town,
- V5: professional life of the housekeeping person,
- V6: occupational group of the main earner,
- V8: Number of people living in the household,
- V9: housing condition, tenancy, distribution of property,
- V10: Rooms in the house,
- V12: secondary / college education of the main earner,
- V13: marital status of the housekeeping person,
- V36: Occupation of the main earner,

*Problem five: gifts*

It has to be considered that the acquired products would be consummated in the household and not used as gifts or something like that. In particular the variable v7: personal use, must have the status “yes”.

*Problem seven: relative price changes*

Changes in the purchasing behaviour could be induced by a lot of factors, for example changes in the environment as mentioned, but also changes in the relative prices. For the latter it is not possible to control such effects, because only a few goods are included in the data set.

*Problem eight: changes in income*

Another problem is the budget restraint. The decision of purchasing especially in lower income classes may only depend on the relative price of a good: a household would always buy the cheapest product. Because the data set contains only information on the average net income in 1995, the income mobility can not be measured. Therefore it is not possible to identify, whether purchasing a good is due to income changes.

*Problem nine: external factors*

For identifying risk behaviour the decision to buy a product should not depend on additional factors such as the cost of getting more information about the character of the good. Fortunately, the groups of goods which are analysed in the following, are cheap. Therefore, such opportunity costs are very low in respect to the net income of the household, even if the household belongs to the lowest income class.



## 4. Empirical analysis

### 4.1 Some comments on the methods used

Also the definition of the underlying process is given, there are three main categories of statistical techniques which could be used. Non-parametric, semi-parametric and parametric methods. In the analysis, only the first two methods come to application.

The most unrestricted methods are the non-parametric, in which only descriptive measures are used. To estimate the hazard and the survival function, two approaches exist: the life table estimator and the Kaplan-Meier estimator<sup>10</sup>.

The semi-parametric method, that is the so called proportional hazards model, is more restrictive<sup>11</sup>. But the baseline hazard is an unspecified function. Therefore, the proportional hazards model is a „robust“ model in respect to parametric models. But one necessary condition to work with this model is the homogeneity of the underlying population.

To measure the amount and the direction of the influence of  $n$  exogenous variables  $(x_1, \dots, x_n)$ , the proportional hazards model is used.

$$\lambda(t) = \lambda_0(t) \cdot e^{\beta_1 \cdot x_1 + \beta_2 \cdot x_2 + \dots + \beta_n \cdot x_n}$$

and

$\lambda_0(t)$  = baseline hazard rate, which is unknown and not specified,

$x_1, \dots, x_n$  = the exogenous variables, and

$\beta_1, \dots, \beta_n$  = the parameter of the exogenous variables  $x_i$  ( $i = 1, \dots, n$ ).

The use of the model requires the assumption, that the influence of the exogenous variables is monotone over time, i. e. the exogenous variables are time-independent. The most restrictive is the parametric method. Using parametric methods requires a completely specified functional form of the underlying process. To use such methods it is necessary to make specific assumptions about the shape of the survival function. That means also that the groups must be homogenous with the same underlying distribution.

<sup>10</sup> This procedure is also often referred to as the product-limit estimator; see for example Kalbfleisch and Prentice, 1980: 12 pp.

<sup>11</sup> These models also called Cox models; see for a general description e. g. Lawless, 1982: 275 p, and 343 pp., or Klein and Moeschberger, 1997: 229 pp.

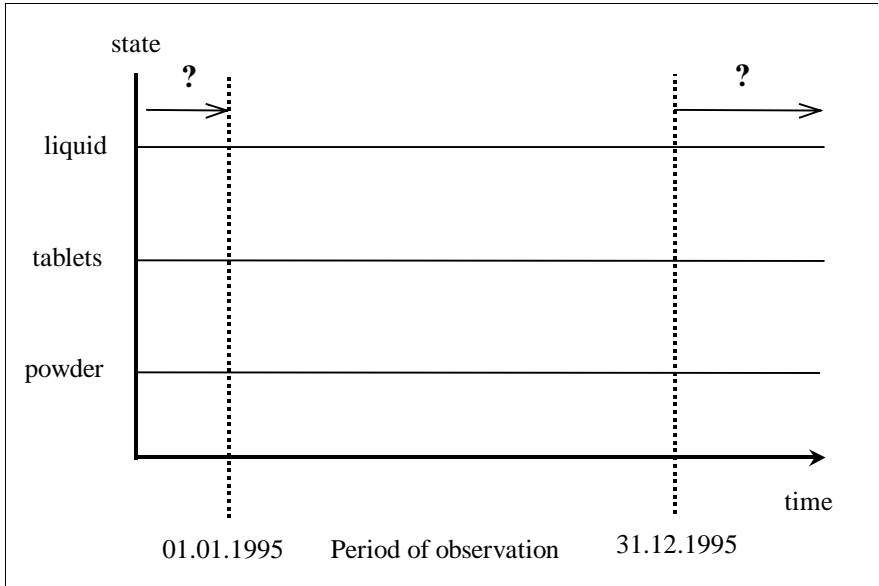
The approach is exploratory and the analysis is separated into two parts. First the hazard rate res. survival functions are computed. Second a semi-parametric model is carried out, to identify special variables which may influence the hazard rates or the survival function.

To gain a first insight in the process, a two state model with absorbed finite state is analysed. For further analysis, the terms „state“ and „event“ have to be substantiate. Whereas „event“ is easily defined as a change of the present state, there is more than one way to define „state“. The predefinition is essential for what continuity res. discontinuity means. For example: a state could be determined with the existents of a product of the same brand and the identical amount the household always buys. In this case, an event occurs by buying a good of another brand or another amount of the same good. But this seems too differentiate for a first insight of the time process of purchasing goods. To exclude to a larger part coincidence and to be conservative, a main aspect of the analysis is therefore, that the purchase of a good is not always an event. Only the purchase of a good of another class or category is stated as an event or as a state change. An event is therefore not a new acquisition of the same product. It is the change from a group of goods with the same characteristics to a group with other characteristics such as buying tablets or liquid detergent instead of washing powder.

What does this mean? To clarify the proceeding, the following figures enclosed two discontinuously and one continuously decision in a schematic manner. A specific peculiarity of the product „detergent“ is chosen as initial state. As state is mentioned the existence of the good in a specific characteristic in the household for consumption purposes. The question marks in the figures denote, that neither the state before the time of observation started is known nor the state after the end of the observation period. The former case is known as left censoring, the latter as „right censoring“.

In survival analysis especially left censoring can cause major problems. But in the present analysis, left censoring is not of larger concern, as it can be stated, that in former time periods, the attitudes of the household which are investigated here are mainly the same and have not altered. Figure 1 shows the underlying structure. The observation period started at January 1, 1995, and ended at December 31, 1995, i. e. the observation period covers a whole year. No information is available before and after 1995, so the process is left and right censored.

Figure 1: The underlying structure



In the following Figure 2 the change between the states „powder“ and „tablets“ is pictured. This is a household, which income decision is mentioned as discontinuous in respect to the specific product.

The continuity in decision is described in Figure 3, where no event occurs in the observation period. That denotes, that this household has chosen the same characteristic of goods in each purchase. But this holds true only for the observation period. It applies not for the time span before and after the observation period. Such case without any event is named as censored. These are households which have continuous income decision in the chosen approach here.

Figure 2: Left censored data with an event

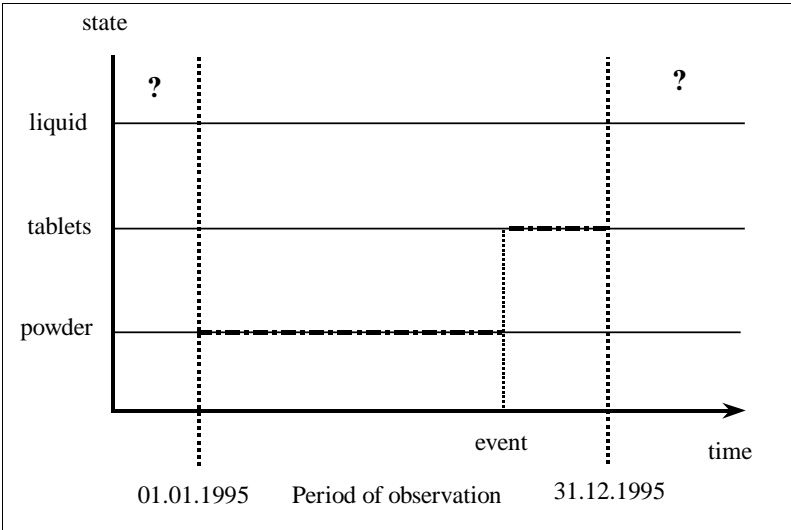
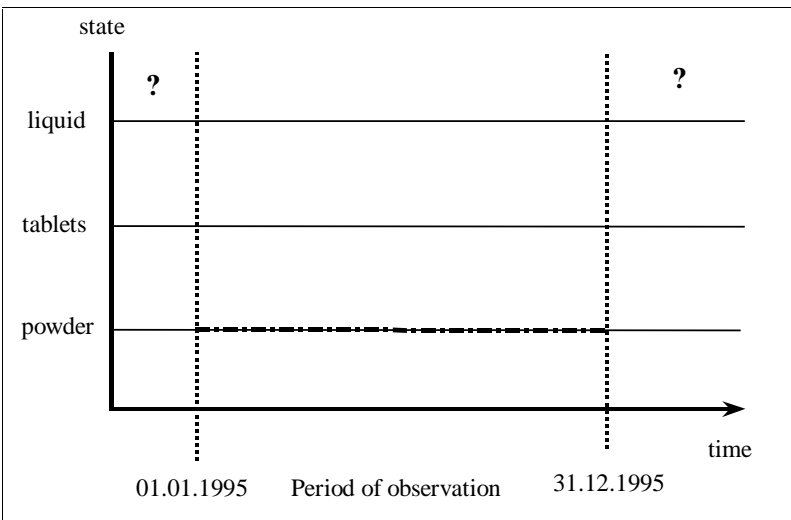


Figure 3: Left and right censored data



In comparing the survivor function or hazard rates for specific groups it is possible to identify differences in the continuity of the purchasing behaviour of households.

To gain more information about the reasons, which variables are of relevance to explain different behaviour, the Cox-Regression is used. As exogenous variables only objective variables are chosen. All subjective variables are neglected, because it is not the main goal of the analysis to test, whether the own view of ones behaviour is identical with the observable behaviour<sup>12</sup>.

All variables which could be mentioned as „objective“ are taken into account as exogenous with one restriction: for variables with a high correlation, for example age of the housekeeping person and the age of the main earner, it has to be decided, which one to use. In this case, the variable age of the main earner are omitted, because of the products which would be purchased. The purchase of low price goods are rather decided by the housekeeping person<sup>13</sup>.

The household panel 6 is used for the estimation, because only in this panel information about the income of the household and the number of persons, living in the household are known and these variables are notable as very important for income decisions.

## 4.2 Results

### Descriptive analysis

As already mentioned, only three WGS-groups could be analysed due to the chosen approach: roasted pure coffee, universal detergent, and yeast. The analysis is done separately for each commodity group. In the introduction it is mentioned that the differences in income decisions could depend mainly on two factors: the household income and the age<sup>14</sup> of the housekeeping person. These variables could be employed as proxies to represent household differences.

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<sup>12</sup> As this is another question of research, this will be done in a later state of the analysis after identifying specific groups with different behaviour in spending money. For a critical discussion about this point of view in gaining some information on the behaviour of people see for example Ajzen and Fishbein, 1980. They neglect the relevance of external (objective) variables in explaining and predicting the behaviour of people. But, for example, to demonstrate the utility of a theory, it is necessary to measure the behaviour itself.

<sup>13</sup> For the behaviour of customers and the variables which – depending on the product price – influence it, see for an overview e. g.: Kroeber-Riel, 1990.

<sup>14</sup> It has to be mentioned, that age is only a proxy variable for experience, risk aversity, earnings capacity in sense of human capital theory, or for physical capability and it can not be considered as an

Therefore, to gain information, whether the behaviour of households is different, two subgroups are created in respect to the given household income classes and to the classes of age of the housekeeping person.

**The WGS 12: roasted pure coffee**

In the good group WGS 12: roasted pure coffee, two characteristics are examined to try to identify household behaviour. The WGS group is

- separated into three kinds of coffee: (1) grind in the factory, (2) grind in the shop and (3) not grind, and
- discriminated into three sorts: (1) with caffeine, (2) mild res. caffeine reduced and (3) caffeine free.

In the category kinds of coffee, the dominant kind is the first peculiarity: grind in factory, with 85 % of all households (3,682), 11.5 % are in the initial state of grind in the shop and only 3.1 % are purchasing not grind coffee. The households are more even distributed over the characteristics of the category “sorts”: From 4,326 households 48.8 % are belonging to with caffeine, 36.5 % to caffeine reduced and 14.7 % to caffeine free. The results of the Kaplan-Meier estimation are stated in Table 1.

*Table 1: Results of the Kaplan-Meier estimation for Subgroups of WGS 12*

Subgroups of WGS 12	Mean survival time in days	Number of events	Censored data in %
<b>Kinds of coffee</b>			
(1) grind in the factory	184	12,764	82.5
(2) grind in the shop	24	10,322	14.2
(3) not grind	21	70,251	3.7
<b>Sorts of coffee</b>			
(1) with caffeine	53	36,414	50.1
(2) caffeine reduced	36	26,972	37.0
(3) caffeine free	24	63,521	12.9

Source: Own calculations.

explanatory variable for itself. Age should be viewed “...as an index of change, just as inches are an index of person’s height, ...”; Hayslip and Panek, 1989: 10.

For the category “kinds of coffee”, there are no remarkable age or income effects in the purchasing behaviour due to category 3. Only a few censored cases – about 3.7 % – occurred, what means that this state is only temporarily adopted: the mean survival time is about 21 days. Virtual the same holds for the category 2: the mean survival time is 24. Only the censored events are higher with around 14.1 %, so there is a little bit more continuity in the household behaviour due to the purchase of coffee which is grind in shops. Purchasing coffee, which is ground in the factory, is the most continuous case with 82.5 censored events and a mean survival time of 184 days.

Overall, in the category “sorts of coffee”, the results are the same regarding to the household classification. No income effects exist and an age effect in the purchasing behaviour appears only in the category 1: with caffeine. Here, the older the people, the lower is the mean survival time, but around 50.0 % of the events are censored, as shown in Table 2.

*Table 2: Results of the Kaplan-Meier estimation for the subgroup “with caffeine” of WGS 12*

Age classes	Mean survival time in days	95 % Confidence Intervall	Number of events	Censored data in %
20 to 24 years	100	(69 ; 131)	75	59.0
25 to 29 years	85	(76 ; 94)	897	55.6
30 to 34 years	67	(62 ; 72)	2,258	53.1
35 to 39 years	63	(59 ; 68)	2,869	53.4
40 to 44 years	52	(48 ; 57)	3,536	49.3
45 to 49 years	46	(43 ; 49)	3,654	47.1
50 to 54 years	55	(50 ; 60)	2,922	54.7
55 to 59 years	53	(49 ; 57)	4,012	49.3
60 to 64 years	49	(45 ; 52)	4,410	50.7
65 to 69 years	47	(43 ; 50)	4,269	41.6
70 or older	43	(41 ; 46)	6,057	49.9

Source: Own calculations.

Whether there are differences in the survivor function of the subgroups could also be tested by means of test statistics<sup>15</sup>. The SPSS program package – which is used for the analysis – yield the Log Rank statistic, the Breslow-statistic, and the Tarone-Ware statistic, which are sensible in different areas of the process. The null hypothesis is that all survival curves are the same.

<sup>15</sup> For a description of the tests for two or more samples see e. g. Klein and Moeschberger, 1997: 191.

All three statistics delivered results which are statistically highly significant<sup>16</sup>, so the null hypothesis has to be rejected: the survival functions for the age classes are different. This means, that parametric analysis is not appropriate for these data.

The WGS 21: universal detergent

The purchase behaviour for the group “universal detergent” is far more differentiated. The group is split up into six subgroups, as mentioned in Table 3. Also shown in Table 3 is the mean survival time, the number of events and the percentage of censored data for each subgroup. In totally, 21,042 purchases are done.

Table 3: Results of the Kaplan Meier estimation for Subgroups of universal detergent

Subgroups of WGS 21	Mean survival time in days	Number of events	Censored data in %
(1) detergent construction systems	56	20,053	4.7
(2) traditional powder	63	18,272	13.2
(3) liquid detergent	58	19,635	6.7
(4) tablets	54	21,042	0.0
(5) concentrate powder	99	11,397	45.9
(6) super concentrate powder	78	14,811	29.6

Source: Own calculations.

The Table 3 indicates clear differences in the continuity of the purchasing behaviour of households between the subgroups. The mean survival time for the subgroups (1), (3) and (4) is the lowest with 54 to 58 days and for (5) and (6) are the highest. In these two groups, the percentage of censored data is, in respect to the other sub-categories, high with 29,6 % res. 45,9 % cases without an event in 1995.

The question now is, whether the differences are due to the age of the housekeeping person or to the household income. For this reason, the households are divided into subgroups to these two variables.

For all subgroups of universal detergent, the following results obtained:

- in respect to the household income: the higher the income, the lower the mean survival time,

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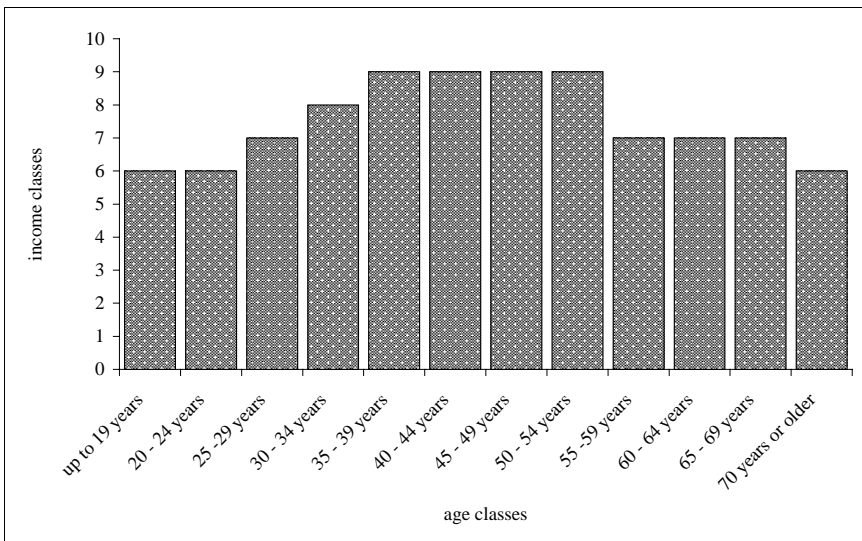
<sup>16</sup> The test statistics are 652.44 (Log Rank test), 549.17 (Breslow test), and 632.75 (Tarone-Ware-test), with 10 degrees of freedom.



- for the classification in age groups, no linear relationship occurs, but often an u-profile with higher mean survival time in the younger and older age classes.

The age profile is remarkable, but for the interpretation it has to be taken into consideration, that it could be caused by the income differences between the age classes. Households with young and old housekeeping persons have lower income than the middle-aged as shown in Figure 4, therefore it could be deduced, the u-shape profile is caused by the distribution of household income, which shows – as is well know from numerous analyses – an invers-U-shape profile.

Figure 4: The median household income in age classes



Note: 6 : 2.000 DM to 2.499 DM

7 : 2.500 DM to 2.999 DM

8 : 3.000 DM to 3.499 DM

9 : 3.500 DM to 3.999 DM

Source: Own calculations.

To gain an insight in the dependency of the purchase behaviour and age, the income has to be held constant. Unfortunately, the numbers of households are insufficient to make analysis in this direction. The numbers of households per cell are high enough (over 50

households) only for the middle income classes – between 2,000 DM and 4,000 DM – and for age groups older than 25 years. Even though the analysis contains hints, that the u-shape profiles may exist in special income classes, there is no simple pattern overall.

So only the differentiation between income classes yielded differences in the purchasing behaviour for this group of goods as stated as a hypothesis.

**The WGS 83: yeast**

The group 83, yeast, is differentiated into two subgroups: blowing yeast and dry yeast. For blowing yeast, the percentage of censored data for a change to dry yeast is about 92 %, and around 40.7 % for a change from dry to blowing yeast, as shown in Table 4. That means, that the continuity in buying blowing yeast is very high<sup>17</sup>.

*Table 4: Results of the Kaplan Meier estimation for Subgroups of yeast*

Subgroups of WGS 83	Mean survival time in days	Number of events	Censored data in %
(1) blowing yeast	237	606	92.0
(2) dry yeast	71	4,512	40.7

Source: Own calculations.

For the twelve age groups only about 50 events occur in the average, whereas the total number of cases is 7,606. The mean survival time for a household in the state “blowing yeast” is 237 days, whereas the mean time of being in the state “dry yeast” is only 71 days.

Although the differences in the survivor functions and hazard rates are statistically significant, no special pattern exists. Therefore, no systematic differences in respect to the behaviour of buying dry yeast could be detected.

**5. Summary**

All things considered, it must be stated, that only weak hints are detected on the continuity of the purchasing behaviour in respect to differences between households belonging to their income or to the age of the housekeeping person. An age effect appears only for one category of “sort of coffee”: the older the housekeeping person, the lower the mean survival time of the state “with caffeine”, and the numbers of censored events is slightly

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<sup>17</sup> It seems, as it is necessary to differentiate the group blowing yeast further into subgroups of special brands or something like that. Unfortunately, this is not possible with the data set at hand.

lower. An income effect occurs in the WGS 21 group as the higher the income-class, the lower the survival time.

It seems as if the differences due to continuous res. discontinuous behaviour belongs to the specific subgroups of the goods analysed because the differences in percentage of censored data for the subgroups in each commodity group are large. For example, 82.5 % of the households always purchase coffee, grind in the factory, whereas only 3.7 % data are censored in the subgroup “not grind”.

But this analysis could not yield any information about the reaction of households due to changes in the exogenous variables income or (the proxy variable) age. Even more, it is not possible to consider, whether the events – the discontinuity – are caused through price changes. Some hints due to this aspects could be gained using the method of semi-parametric analysis<sup>18</sup>.

### **Semi-parametric analysis**

The purpose of the semi-parametric analysis is not to test a theory about purchasing behaviour. The aim is rather to use the method as an explanatory approach and try to identify some variables, which could induce the differences in the survivor function.

As the previous pure descriptive analysis shows, the household income and the age of the housekeeping person should not be neglected as exogenous variables, although there are only weak hints on the effect. Besides the other objective variables in panel 6, the variable price per unit was used to deal with the price elasticity of the behaviour. The age of the housekeeping person and the age of the main earner are highly correlated (the Spearman correlation coefficient is 0.946). Therefore, only the first variable is used. Furthermore, the variable V1: federal states, is merged in only two data: West and East Germany. There are two variables on the occupation of the principal, so one has to be omitted and the variable occupation of the main earner is used. Concerning the variables number of people in the household and number of children, only the first one is chosen. The remaining variables are

- price per unit,
- regions: West res. East Germany,
- V3: age of the housekeeping person
- V5: professional life of the housekeeping person,

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<sup>18</sup> For the theoretical relevance of the relationship between the actual evolution of price and the demand over time in demand theory see for example Hildenbrand, 1994, chapter 1.

- V7: net income of the household1
- V8: number of people living in the household,
- V12: secondary / college education of the main earner,
- V13: marital status of the housekeeping person,
- V36: Occupation of the main earner.

In the following, I will only point out the main results of the analysis. First the results of the Cox-regression for the group roasted pure coffee are presented in Table 5. In Table 5, the so called  $\alpha_i$ -coefficients (or  $\alpha_i$ -effects) are presented. Their interpretation is easier than that of the original parameters  $\beta_i$ : they inform directly over the direction and the magnitude of the influence of the exogenous variable. As the function of the hazard rate is

$$\lambda(t) = \lambda_0(t) \cdot e^{\beta_1 \cdot x_1 + \beta_2 \cdot x_2 + \dots + \beta_n \cdot x_n}, \quad i = 1, \dots, 9,$$

the  $\alpha_i$ -effects are calculated as:  $\alpha_i = e^{\beta_i}$ .

Therefore, the  $\alpha_i$  are multipliers, which are always positive. If  $\alpha_i > 1$ , the effect of the variable on the rate is positive, for  $\alpha_i < 1$  the effect is negative and for  $\alpha_i = 1$ , no effect exists at all. The  $\alpha_i$  inform also about the magnitude of the effect on the hazard rate: with a change of the independent variable  $x_i$  of one unit ( $\Delta x_i = 1$ ), the rate alters about  $100 \cdot (1 - \alpha_i)$ -percent. A value of  $\alpha_i = 0.98$  means, that the effect of the exogenous variable is negative and the rate will be reduced by 2 percent, if the  $x_i$  increases by one unit with all other variables are constant.

First, the commodity group roasted pure coffee, divided in two specific groups, is considered. In the Table 5, the values of the  $\alpha_i$ -coefficients are presented, which are statistically significant at 0.05 level.

As Table 5 shows, not all variables are statistically significant. The effect of age and income is always positive, which means that positive changes in age ore income raise the hazard rate. The strength of the effect for both variables is not very high: between 2 % and 5 %. The direction of the effect for the variable education is always negative, but the effect with a percentage between around 1 % and 4 % is not very strong. The  $\alpha_i$ -effects of the variables price per unit and regions are the highest for most subgroups, but the direction is positive in the first subgroup (1) and negative in the others (2) and (3). For the other independent variables the effects are not clear: sometimes they are insignificant, sometimes the effect is positive or negative. Table 6 presents the results for the group W21: universal detergent.

Table 5:  $\alpha_i$ -coefficients for subgroups of WGS 12: roasted pure coffee

Variables	Kinds of coffee		
	(1) grind in the factory	(2) grind in the shop	(3) not grind
Price	4.204	0.731	0.924
Regions	0.227	1.210	1.104
Age	1.052	1.031	1.031
Professional life	n.s.	1.012	1.013
Net income	1.039	1.023	1.025
Number of people	1.014	1.028	1.029
Education	0.956	0.985	0.980
Marital status	n.s.	n.s.	n.s.
Occupation	0.997	n.s.	n.s.
Variables	Sorts of coffee		
	(1) with caffeine	(2) caffeine reduced	(3) caffeine free
Price	1.331	0.959	0.883
Regions	0.561	1.380	1.165
Age	1.035	1.036	1.028
Professional life	1.046	n.s.	n.s.
Net income	1.030	1.021	1.025
Number of people	n.s.	1.041	1.030
Education	0.963	0.984	0.988
Marital status	n.s.	0.980	n.s.
Occupation	n.s.	1.001	0.999

Note: n.s.: not statistically significant at 0.05 level. Source: Own calculations.

Table 6: Results of the Cox-regression for Subgroups of WGS 21: universal detergents

Variables	Subgroups of universal detergent					
	(1)	(2)	(3)	(4)	(5)	(6)
Price	0.846	1.869	0.985	1.225	3.765	0.415
Regions	1.162	n.s.	1.127	1.114	1.191	1.103
Age	0.981	0.961	0.974	0.973	0.991	0.968
Professional life	1.039	1.041	1.042	1.040	1.040	1.034
Net income	1.042	1.049	1.037	1.043	1.047	1.042
Number of people	1.039	1.040	1.041	1.041	1.041	1.043
Education	0.978	0.987	0.981	0.982	0.976	0.987
Marital status	1.079	1.075	1.078	1.071	n.s.	1.068
Occupation	n.s.	0.998	0.998	0.999	n.s.	n.s.

Note: (1) detergent construction systems; (2) traditional powder; (3) liquid detergent; (4) tablets, (5) concentrate powder; (6) super concentrate powder;

n.s.:not statistically significant at 0.05 level.

Source: Own calculations.

In this group, five variables provide the same results for all subgroups due to the direction of the effect: professional life, net income and the number of people affect the hazard rate positive, that holds also for the variables regions and marital status for most subgroups. That means, that, for example, the raise in net income or in the number of people living in the household, increase the hazard rate. The influence of the variables age and education on the hazard rate is in the opposite direction. In other words, households, in which the housekeeping person is older or has a higher education, are more continuous in purchasing, independent of the special subgroup. The effects of all the variable occupation is not significant in three of six subgroups. The price variable is a little bit suspicious, because the  $\alpha_i$ -effect is sometimes very high but the effect is not constant in one direction: for three subgroups the direction is negative and for the other three groups it is positive. Table 7 summarises the results for the group yeast.

Table 7: Results of the Cox-regression for Subgroups of WGS 83: yeast

Variables	Subgroups of yeast	
	Blowing yeast	Dry yeast
Price	1.069	1.024
Regions	0.954	0.829
Age	0.949	n.s.
Professional life	1.201	1.162
Net income	1.058	1.018
Number of people	n.s.	1.052
Education	n.s.	1.022
Marital status	0.860	n.s.
Occupation	n.s.	1.005

Note: n.s.: not statistically significant at 0.05 level. Source: Own calculations.

The group yeast is the only one, in which the effect of price change on the hazard rate is consistent for all subgroups: it is always positive but not the effect is not very high with 6.9 % res. 2.4 %. There is also a positive linkage between the hazard rate and the variables net income and professional life, with the latter has the strongest effect on the hazard rate with 20.1 % for blowing yeast and 16.2 % for dry yeast. Another strong  $\alpha_i$ -effect occurs for the variable region: for dry yeast, households in West-Germany are far more discontinuous than their counterparts in East-Germany, for those households the effect is 17.1 % lower. Another strong negative effect has to be stated for the variable marital status for blowing yeast with 14 %, whereas for dry yeast this independent variable is not statistically significant.

To summarize the results of the semi-parametric analysis, it has to be stated, that no simple pattern occurs even within the specific groups. The continuity res. discontinuity is not

always caused by the same variables and, moreover, the effects of the exogenous variables on the hazard rate between the subgroups of one commodity group are sometimes divergent. On the other hand, it could be shown, that it is possible to describe the purchasing behaviour – as it is operationalized here – with method of the semi-parametric analysis and to shed some light on the direction and amount of the influence of independent (objective) variables.

The results obtained in the analysis are not compatible with the micro-economic theory on the price elasticity of the goods, on the whole. The analysis delivers hints, that the reaction of households due to changes in the price of goods is not always high or even in the same direction for all subgroups within a commodity group. This is in contrast to the assumption, which is often made in consumption analysis and which may be correct for the group itself. It is also obvious, that the purchasing behaviour is far from being as simple as is often stated in economic theory. The analysis indicates that the influence of factors for which age is used as proxy variable or of income is not linear or even works in the same direction. In specific commodity groups, the effect of the chosen exogenous variables is often different for the subgroups. Therefore no empirical evidence could be obtained on the hypothesis on risk aversity res. continuity of purchasing behaviour, as it is operationalized in the analysis: the younger the people or the higher the income, the lower is the continuity.

## **6. Summary**

The main purpose of the paper was to analyse the purchasing behaviour of households due to aspects of continuity res. discontinuity. To describe the process, methods of survival analysis are applied. The process of purchasing was modelled as a two state model with absorbed finite state. Even this is a quite crude approach to model the process, it delivers a lot of information about purchasing behaviour.

In the descriptive analysis based on the product-limit estimation, large differences occur in respect to the subgroups concerning the continuity of the purchasing behaviour. But only a few hints are detected in regard to differences in the purchasing behaviour due to the household net income or the age of the housekeeping person. Therefore it seems as if these exogenous variables are not as important in explaining differences in the purchasing behaviour of households as often stated.

To throw some more light on the relevance of exogenous (objective) variables, a semi-parametric analysis was additionally carried out. To measure the direction and the amount of the influence of the exogenous variables, the proportional-hazards model was used. The

results of the analysis are for some parts encouraging: even in the relative coarse operationalisation of the discontinuity in the purchasing behaviour of households, it could be shown that, with the method used, it is possible to describe the direction and amount of the influence of the independent variables. This section of the analysis also delivers results, which are not compatible to the micro-economic demand theory concerning the price elasticity of the goods: The reaction of the households due to price changes are not coherent even within the same commodity group.

The data set is unique. It offers a lot more possibilities to analyse the purchasing behaviour than could be offered in this paper. So a lot is left to be done especially due to longitudinal analysis on the purchasing behaviour of households.

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