A Cohort Analysis of Food-at-Home and Food-away-from-Home Expenditures in Germany

Eine Kohortenanalyse des Inner- und Außer-Haus-Verzehrs in Deutschland

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Abstract

Over the last decades and across countries, eating patterns have changed in favour of increasing consumption of food away from home. According to Ando and Modigliani (1957), consumers pass through different stages of a life-cycle with different impacts on demand. The criticism that life-cycle theory neglects generational effects and concentrates only on ageing effects has led to the application of the cohort analysis, which decomposes not only age, but also period and cohort effects. This paper presents the results of a cohort analysis on food-at-home and food-away-from-home consumption covering 25 years of German consumption data. The results of seemingly unrelated regressions indicate that there are significant age, period and cohort effects on food-at-home and food-away-from-home expenditures, which are more distinct for food-at-home consumption. This paper also finds evidence for the significant effects of gender, occupation, household composition and region on both expenditure categories. For instance, the effect of being female is negative on both types of expenditures. Moreover, there is a non-linear relationship between household size and both food-at-home and food-away-from-home-consumption.

Key Words

cohort analysis; APC model; food-at-home expenditures; food-away-from-home expenditures; consumption; Germany

Zusammenfassung

Über Jahrzehnte und Länder hinweg haben sich die Ernährungsgewohnheiten der Verbraucher in Richtung einer Zunahme des Außer-Haus-Verzehrs verändert. Nach Ando und Modigliani (1957) durchlaufen Konsumenten verschiedene Stufen eines Lebenszyklus' mit unterschiedlichen Auswirkungen auf die Nachfrage. Da die Lebenszyklustheorie nur Alterseffekte berücksichtigt, wird die Kohortenanalyse eingesetzt, die neben Alterseffekten auch Zeit- und Kohorteneffekte einbezieht. Dieses Papier präsentiert die Ergebnisse einer Kohortenanalyse des Inner- und Außer-Haus-Verzehrs basierend auf 25 Jahre umfassenden Verbrauchsdaten aus Deutschland. Ergebnisse von SUR-Regressionen zeigen, dass signifikante Alters-, Zeit- und Kohorteneffekte des Inner- und des Außer-Haus-Verzehrs in Deutschland vorliegen. Diese Arbeit findet signifikante Unterschiede für beide Ausgabenkategorien nach Geschlecht, Beruf, Haushaltszusammensetzung und Region. So haben Frauen geringere Ausgaben sowohl für den Inner- als auch den Außer-Haus-Verzehr. Außerdem ergibt sich ein nichtlinearer Zusammenhang zwischen der Haushaltsgröße und dem Inner- und Außer-Haus-Verzehr.

Schlüsselwörter

Kohortenanalyse; APC Modell; Inner-Haus-Verzehr; Außer-Haus-Verzehr; Verbrauch; Deutschland

1 Introduction

Throughout the world, consumers' eating patterns have been subjected to drastic changes. A larger share of meals is consumed away from home, while the part of meals eaten at home is decreasing. Looking at Greece, the expenditure share for food-away-from-home increased from 8% in 1972 to 32.5% in 1998/99 (LAZARIDIS and DRICHOUTIS, 2005). In the United States, it has been projected that due solely to income growth, the expenditures for food away from home will increase by approximately 10% between 2000 and 2020 (BLISARD, VARIYAM and CROMARTIE, 2003). Turkey reports that the share of food-away-from-home consumption more than doubled (7% to 15%) from 1994 to 2000 (GÄL et al., 2007).

Many different reasons have been proposed for this change, for example, the convenience trend and increasing food availability, but also demographic changes such as a higher share of working women and an increasing number of single households (NAYGA and CAPPS, 1992). ZAN and FAN (2010) show for the US that the shift away from food-at-home consumption towards eating out more also reflects a generational change. Younger generations are much more used to eating away from home than consumers from previous generations. Despite generational effects, food consumption patterns might change as individual consumers grow older due to varying needs at different life stages.

When analysing consumption patterns over the life span, the life-cycle theory by ANDO and MODIGLIANI (1957) is oftentimes referred to. Obviously, as consumers grow older, they pass through different stages in the life cycle with different implications for demand (PEISER, 1991). There are different specifications of life-cycle models available. For example the family life-cycle model proposed by GILLY and ENIS (1982) connects age and the presence of children to divide cycle stages. This model assumes that people in the same life stage show similar consumption patterns, which then change from one stage to another. Other research fields argue that food consumption patterns, in particular, are transferred from one generation to another through direct social interactions (PEISER, 1991). Moreover, the so-called mere exposure effect is discussed, which describes how the simple availability of food items correlates with the acceptance of types of food (see PEISER, 1991).

Traditional life-cycle analysis has been criticised for ignoring generational effects and concentrating only on consumption changes due to the ageing effect (ZAN and FAN, 2010). Different generations or age groups have different consumption structures due to generation- or age-specific tastes and preferences as well as income situations (BLISARD, 2001). The time of birth of a cohort determines certain physiological and psychological characteristics with effects on consumption preferences (GLUCKMAN, HANSON and PIMAL, 2005; NORUM, 2003). For example regarding preferences, at the beginning of the 1990s in the United States, older adults had a higher consumption of coffee than younger adults, while the younger adults consumed more carbonated soft drinks. Thus, earlier-born cohorts have a distinct preference for coffee, while later-born cohorts are more used to and thus prefer carbonated soft drinks. Moreover, each succeeding generation tends to have a higher education level, and tastes and preferences can change across generations, resulting in different consumption patterns (MORI et al., 2000). Food consumption preferences within a generation are said to be extremely stable (ZAN and FAN, 2010).

To analyse the impact of the generational and age-specific effects on consumption patterns, such as food at home versus food away from home, the cohort analysis is regarded as an appropriate tool because it allows age (**A**), period (**P**) and cohort (**C**) effects to be separated. It is therefore also known as the APC model. The age effect describes the impact of the age category on consumption. The period effects describe the impact of macroeconomic and historical events on consumption, e.g., business fluctuations or epidemics (DEATON, 1997) whereas the cohort effect helps to identify generational differences in demand. The results of a cohort analysis can be helpful for forming education programs that are designed for a specific population group. The analysis provides implications for the well-being of a population because income and food consumption measure the standard of living (HARRIS and BLISARD, 2001; ZAN and FAN, 2010). Against the background of an ageing society, a knowledge of cohort effects is also important for retirement program planners.

This paper has the following objective. We aim to analyse age, period and cohort effects for food-at-home and food-away-from-home expenditure in Germany. To the best of the authors' knowledge, there is only limited evidence on the cohort effects of food-at-home and food-away-from-home consumption in Germany and therefore this missing research is provided here. A thorough cohort analysis would allow policymakers to identify population groups with a special need for support in their dietary choices (BLISARD, 2001). As a primary result, we find that there are significant age, period and cohort effects for both food-at-home and food-away-from-home consumption. Moreover, various socio-demographic determinants of food-at-home and food-away-from-home consumption were identified, such as occupational status and household size.

This paper has the following structure. Chapter 2 introduces the relevant literature on the cohort analyses. The model estimated here is presented in chapter 3. Chapter 4 introduces the data and presents descriptive results before the results of a multivariate analysis are shown in chapter 5. This paper concludes with a discussion in chapter 6.

2 Literature

This paper is based on studies that apply a general cohort analysis (the APC model) to food consumption. There are only few cohort studies on food consumption; RENTZ and REYNOLDS (1991) have noted the scarceness of such analyses (see also MORI et al., 2000). However, HARRIS and BLISARD (2001) explain the value of conducting a cohort analysis for food consumption: First, continuous economic growth makes successive cohorts better off than their predecessors. Second, different generations can have different tastes and preferences, and third, attitudes toward diet and health can vary across generations. The younger cohorts are usually better educated, which might change their preferences (e.g., for a low-fat diet).

VON ALVENSLEBEN, PLÖGER and FRICKE (1994) provide evidence on the demand for organic food in Germany. These authors apply a cohort analysis to a sample dating from 1984 and 1989 on the attitudes and the behaviour of organic food consumers and identify age, period and cohort effects. Most strikingly, they show that the observed increase in organic food consumption is not only explained by period effects but also by cohort effects. Somewhat surprisingly, the cohort effects are the highest for the third youngest cohort and are declining in the youngest cohort. Adding more data on organic consumption and attitudes for 1994, FRICKE (1996) also applies the APC model to explain the changes in attitudes towards organic food products and changes in their consumption. Looking at the consumption results, the author identifies a reduction in the rate of organic consumers from 1984 to 1996. In addition, the willingness to pay a price premium for organic products, which is observed from 1984 to 1989, cannot be replicated in 1996. While in 1984, the majority of organic consumers belonged to the age group of 24 to 34 year olds, in 1996, the highest organic consumption levels can be found for the subsequent age group (35 to 44 years old). Fresh organic products show a positive growth rate in consumption (with especially high consumption levels for fruits and vegetables followed by bread and potatoes). There is a less positive trend for processed organic food products.

HARRIS and BLISARD (2001) focus their cohort analysis on the expenditures for red meat, poultry and fish based on the American Consumer Expenditures Survey. Significant cohort effects are identified for all food groups considered. Younger cohorts have a clear preference for poultry while older cohorts prefer beef, pork and fish. Furthermore, declining beef expenditures with increasing age are documented.

MORI et al. (2000) provide a cohort analysis of Japanese food-at-home consumption for six food categories using the Japanese Family Income and Expenditure Surveys. Based on a Bayesian approach, a number of cohort and age effects are identified, for example, the lower rice demand of the younger cohorts, which mirrors the higher beef demand of the younger cohorts in Japan compared to the older cohorts.

In another American study (BLISARD, 2001), income and food expenditures are decomposed into age, time (period) and cohort effects using different years of the American Consumer Expenditures Survey. The expenditures for food at home are disaggregated into nine food subcategories, but the food-away-from-home expenditures are not disaggregated. Except for the groups of vegetables and sugar and sweets, there are significant cohort effects for all food groups. Consistent with other studies, BLISARD (2001) observes that younger cohorts have lower expenditures for food at home. Younger cohorts spend more on cereal and bakery goods as well as miscellaneous prepared foods than older cohorts. Contrary to other studies, BLISARD (2001) finds no evidence that younger cohorts have higher food-away-from-home expenditures than older cohorts.

In a censored demand model, ARISTEI, PIERALI and PIERONI (2005) observe age, period and cohort effects in the alcohol participation and consumption decisions of Italian households participating in six Italian National Institute of Statistics surveys. According to the results of a double-hurdle model, older cohorts consume more alcohol than younger cohorts in Italy. Additionally, the study reveals significant gender as well as regional differences between the cohorts.

STEWART and BLISARD (2008) analyse cohort effects focusing on at-home expenditures for the fresh vegetables group based on the American Consumer Expenditure Survey. The aim is to analyse changes in vegetable demand due to generational effects. In fact, they find that younger cohorts demand fewer fruits and vegetables. The authors explain this trend by pointing out that younger cohorts are less prone to cooking meals from scratch and that they may be more used to eating out. This trend could affect the future demand for vegetables because these are the main ingredients of home-made meals. Accordingly, the results have implications for public measures to promote healthy diets such as the 5-A-Day campaign or the dietary guidelines in the United States.

Against the background of the life-cycle theory, AGUIAR and HURST (2008) include APC variables in their life-cycle estimation and show, among other factors, that food, nondurable transportation and clothing explain the decrease in mean expenditure in the post-middle age and a great part of the rise in cross-sectional variance of expenditures over the life-cycle.

Using 23 years of the American Consumer Expenditure Survey, ZAN and FAN (2010) recently analysed the cohort effects of food-away-from-home expenditures. There is a general cohort trend in food-away-from-home consumption, i.e., later-born cohorts spend more and have a larger budget share for food away from home. These results suggest that successive generations will continue to have higher expenditures for food away from home in the future if no measures are implemented to reverse this trend.

KINSEY and WENDT (2007) provide a literature review for the age and cohort effect on the food consumption of the U.S. population. One of the main findings is that over all of the studies, the age effect appears to be greater than the cohort effect. The literature review shows that the age effect of dietary changes is explained by factors such as food availability, new information, new cumulative experiences and physiological changes. On the contrary, the cohort effect is more likely to result from income changes. The authors note that the number of studies focusing on the complete concurrent APC model is very small, while studies focusing on one aspect, such as age only, are much more common. It is recommended that the APC model is used and estimated concurrently.

3 Modelling a Cohort Analysis for Food-at-Home and Food-away-from-Home Expenditures

This chapter describes the method of cohort analysis and provides a model for analysing food-at-home and food-away-from-home consumption. Originally, the word "cohort" meant a group of warriors or soldiers (GLENN, 2005). In today's scientific literature, cohort means a subdivision of a population (HARRIS and BLISARD, 2001): a cohort is a group of people born within the same period of time. A cohort has similar experiences or life events, which impact their attitudes and preferences. Moreover, a cohort tends to enter the different life-cycle stages at approximately the same time (MORI et al., 2000).

The cohort analysis or APC model decomposes consumption into the age (**A**), period (**P**) and cohort (**C**) effect. **A** summarises the common effect of household heads from different birth years at the same age. The household heads' consumption patterns are observed from the different survey years and the age effect describes the impact of the age category on consumption. **P** summarises the common effect of household heads that have a different age and a different birth year by observing their consumption patterns at the same point in time (e.g., in the year 2000). The period effects describe the impact of concurrent macro-economic and historical events on consumption, e.g., business fluctuations or epidemics (DEATON, 1997). **C** summarises the common effect of household heads with the same birth years but at different ages. The household heads' consumption patterns are observed in different survey years. A cohort is defined as a group of people that is born within the same period of time (e.g., between 1952 and 1963).

Optimally, a cohort analysis is conducted using panel data that consist of different generations. Because these data sets are typically very scarce (BLISARD, 2001), repeated cross-sectional consumption survey data are pooled into one data set. The use of a repeated cross-sectional analysis avoids any panel-conditioning effects, which are the unwanted effects when participants adapt their attitudes or behaviour patterns because they are participating in a longitudinal survey. Instead, no household is analysed at more than one point in time, but different samples of individuals from each cohort are studied at different times (GLENN, 2005). Single cross-sectional data or average consumption data would only confound the APC effects (BLISARD, 2001; STEWART and BLISARD, 2008). In this paper multiple cross-sections of expenditure data are used.

Cohort analysis has a special feature that needs to be considered to obtain a consistent analysis. The APC variables explain themselves linearly; it is statistically not possible to separate age, cohort and time effects (GLENN, 2005). Each of the three effects is a linear function of the remaining two effects. In other words, "The year in which each household is observed is equal to the age of the household head, a, plus his year of birth, b." (ARISTEI, PIERALI and PIERONI, 2005: 13). Different solutions have been put forth to solve this identification problem. However, there is no consensus in the literature about the best solution (ZAN and FAN, 2010). DEATON and PAXSON (1994) suggest imposing two restrictions on the time effects. According to the first restriction, the time effects are orthogonal to a linear time trend and according to the second restriction, the sum of the year effects is zero.

In their paper, DEATON and PAXSON (1994) suggest that time effects are zero in the long run. This restriction allows short-run time effects such as business cycles to be considered (BLISARD, 2001; LÜHRMANN, 2007). This paper solves the identification problem by following the approach suggested in ZAN and FAN (2010). Based on the life-cycle hypothesis and the past literature, instead of using age-dummy variables, age and age squared are used to picture a possible curve-linear relationship between age and food expenditures (ANDO and MODIGLIANI, 1963). For the period effect, the authors propose using an annual growth rate of per-capita GDP and the annual relative price of food, other commodities and services as proxies because the period effects on food (at home and away from home) are likely related to aggregate income and the relative prices of food. Using these proxy variables for **A** and **P**, the identification problem dissolves and the cohort effect can be analysed using dummy variables for different cohort groups. Moreover, this approach will further reduce the multicollinearity among the APC variables (ZAN and FAN, 2010).

The basic APC model for analysing the cohort effects of food-at-home (1) and food-away-from-home (2) expenditure in Germany is as follows:

(1) $FAH = \beta_0 + \beta_1 A + \beta_2 P + \beta_3 C + \varepsilon$

(2) $FAFH = \beta_0 + \beta_1 A + \beta_2 P + \beta_3 C + \varepsilon$

where FAH defines food-at-home expenditures; $FAFH$ represents food-away-from-home expenditures; $\boldsymbol{A}$, $\boldsymbol{P}$, and $\boldsymbol{C}$ stand for the age, period and cohort effect variables as described above; β's are the coefficients to be estimated and ε is the error term.

To also capture any possible preference shifters, the basic APC model is extended in a second step to include a vector of control variables such as socio-demographic and socio-economic variables. The extended APC model with $\boldsymbol{Z}$ as the vector of controls is given as follows:

(3) $FAH = \beta_0 + \beta_1 A + \beta_2 P + \beta_3 C + \beta_4 \mathbf{Z} + \varepsilon$

(4) $FAFH = \beta_0 + \beta_1 A + \beta_2 P + \beta_3 C + \beta_4 \mathbf{Z} + \varepsilon$

4 Data and Empirical Specification

For the analysis, six years of the German Income and Consumption Survey data provided by the German Federal Statistical Office are used. These surveys are repeated cross-sectional data sets surveyed in five-year intervals covering a time span of 26 years from 1978 to 2003. The overall sample size is 265,699 households.

Conducting a multivariate analysis with such a large sample size naturally leads to significant coefficients because the standard errors decline with the sample size so that a meaningful interpretation of the results is no longer possible (MCCLOSKEY and ZILIAK, 1996). To concentrate the findings and following a convention for working with large data bases, a 10% sample is drawn at random, keeping exactly 10% of each of the nine cohort categories used in the analysis. For the final analysis, the sample is reduced to a size of 26,570 households.

The Income and Consumption Survey contains a large number of socio-economic variables. Based on the existing life-cycle theory and the literature on cohort analyses, several variables have been selected for inclusion in the cohort analysis. Table 1 shows the descriptive statistics for all variables used (n=26,570).

FAH and *FAFH* are the dependent variables of the models (1) to (4) from chapter 3. The *FAH* are the household equivalent expenditures for food, alcohol and tobacco consumption in €, and the *FAFH* are the €-values for the household equivalent expenditures for food-away-from-home consumption such as restaurant meals. While per-capita consumption or expenditures are often used in consumption studies, there are reasons to prefer consumption per adult equivalent measure. These measures allow the capture of differences in needs that vary, for example, by the respective stage in the life cycle as well as the consideration of household size and composition effects (HAUGHTON and KHANDKER, 2009). For the present study, the equivalent measure of the OECD equivalence scale is applied to the expenditures, which assign the first adult in the household a factor of 1. Every other adult or child aged 14 or older receives a factor of 0.5, and every child below the age of 14 receives a factor of 0.3.

The APC variables shown in table 1 are justified in chapter 3. *Age*, Age^2 ($\boldsymbol{A}$), the nine cohort dummies representing birth years from 1893 – 1902 in cohort 1 to 1973 -1983 in cohort 9 ($\boldsymbol{C}$), the CPIs for food, alcohol and tobacco and accommodation and restaurant services, and the yearly GDP growth rate in per capita terms ($\boldsymbol{P}$) are the main explanatory variables of the cohort analysis. The cohorts have been grouped into ten-year intervals (with the last cohort consisting of eleven years) following ZAN and FAN (2010). While five-year intervals have been used in the majority of

Table 1. Descriptive statistics of the variables used in the 10% sample of the pooled data[1]

Variable	Description	Mean (SD)	Min (Max)
Dependent variables			
FAH	Monthly equivalent expenditures for food-at-home (food, alcohol and tobacco) in € (deflated)	184.06 (85.46)	0 (1270.63)
FAFH	Monthly equivalent expenditures for food-away-from-home consumption (e.g., restaurant meals) in € (deflated)	58.49 (83.93)	0 (2414.22)
APC variables			
AGE	Age of the first person in the household	49.16 (14.90)	20 (85)
AGE²	Square of Age	2639.51 (1552.98)	400 (7225)
COHORT 1	Dummy variable, which is 1 if the household head is born in 1893-1902 and 0 otherwise	0.01 (0.10)	0 (1)
COHORT 2	Dummy variable, which is 1 if the household head is born in 1903-1912 and 0 otherwise	0.05 (0.22)	0 (1)
COHORT 3	Dummy variable, which is 1 if the household head is born in 1913-1922 and 0 otherwise	0.09 (0.29)	0 (1)
COHORT 4	Dummy variable, which is 1 if the household head is born in 1923-1932 and 0 otherwise	0.14 (0.35)	0 (1)
COHORT 5	Dummy variable, which is 1 if the household head is born in 1933-1942 and 0 otherwise	0.21 (0.40)	0 (1)
COHORT 7	Dummy variable, which is 1 of the household head is born in 1953-1962 and 0 otherwise	0.18 (0.39)	0 (1)
COHORT 8	Dummy variable, which is 1 if the household head is born in 1963-1972 and 0 otherwise	0.09 (0.29)	0 (1)
COHORT 9	Dummy variable, which is 1 if the household head is born in 1973-1983 and 0 otherwise	0.02 (0.13)	0 (1)
GDP PC GR	Yearly per capita growth rate of the German gross domestic product	3.73 (1.90)	0.97 (6.72)
FAH_CPI	Consumer price index (yearly) for food, alcohol and tobacco with 2003=100	82.99 (12.74)	62.34 (100)
FAFH_CPI	Consumer price index (yearly) for accommodation and restaurant services with 2003=100	74.04 (19.02)	44.76 (100)
Socioeconomic variables			
INCOME	Available equivalent income per year in € (deflated)	21021.5 (12577.93)	-48999.86 (178990.2)
INCOME²	Square of available income	6.00e+08 (1.20e+09)	1795858 (9.56e+10)
FEMALE	Dummy variable, which is 1 if the household head is female and 0 otherwise	0.24 (0.43)	0 (1)
PENSIONER	Dummy variable, which is 1 if the household head is a retiree/pensioner or indicates pension as main income source and is below the age of 45 and 0 otherwise	0.25 (0.43)	0 (1)
PENSIONER below 65*	Interaction effect of the dummy variable PENSIONER and AGE.	0.09 (0.28)	0 (1)
PRIVATE PENSION	Dummy variable, which is 1 if the household head has a private pension insurance	0.08 (0.28)	0 (1)
NONLABOR INCOME	Household equivalent income from assets (e.g., interests) in € (deflated)	17955.7 (32561.49)	-1565.5 (1729495)
MARRIED	Dummy variable, which is 1 if the household head is married and 0 otherwise	0.71 (0.45)	0 (1)
FARMER	Dummy variable, which is 1 if the household head is a farmer and 0 otherwise	0.01 (0.12)	0 (1)
SELF-EMPLOYED	Dummy variable, which is 1 if the household head is self-employed and 0 otherwise	0.04 (0.21)	0 (1)
PUBLIC SERVANT	Dummy variable, which is 1 if the household head is a public servant and 0 otherwise	0.13 (0.34)	0 (1)
BLUE-COLLAR WORKER	Dummy variable, which is 1 if the household head is a blue-collar worker and 0 otherwise	0.15 (0.36)	0 (1)
UNEMPLOYED	Dummy variable, which is 1 if the household head is an unemployed person and 0 otherwise	0.08 (0.27)	0 (1)
STUDENT	Dummy variable, which is 1 if the household head is a university student and 0 otherwise	0.01 (0.10)	0 (1)
KIDS	Number of children below 18 years of age living in the household	0.81 (1.05)	0 (6)
HHSIZE	Number of people living in the household	2.66 (1.31)	1 (9)
HHSIZE²	Square of the household size	8.84 (8.50)	1 (81)
EAST GERMANY	Dummy variable, which is 1 if the household lives in East Germany and 0 otherwise (East Germany only included since 1993 data)	0.10 (0.30)	0 (1)

[1]: Sample sizes of single Income and Consumption Survey years (full data set) are 46,242 (1978), 43,131 (1983), 44,054 (1988), 40,106 (1993), 49,578 (1998), 42,588 (2003) and 265,699 for the pooled data. For the pooled data: 4,611 (1978), 4,370 (1983), 4,362 (1988), 4,002 (1993), 4,895 (1998), 4,330 (2003).
Source: own calculations

consumption literature (HARRIS and BLISARD, 2001; BLISARD, 2001; STEWART and BLISARD, 2008; ARISTEI, PIERALI and PIERONI, 2005; MINIACI, MONFARDINI and WEBER, 2003), ZAN and FAN (2010) argue that using ten-year intervals for grouping cohorts is a convention in the sociological literature. It is questionable whether five-year intervals are sufficiently long to differentiate cohorts. Rather, generational changes take time before they manifest. For these reasons, ten-year intervals are constructed here. Typically in a cohort analysis, the cohort sizes differ considerably. The middle cohorts have the highest number. The oldest cohorts tend to be a smaller group because people pass away, while the youngest cohorts are a smaller group because there are only a few people whose consumption patterns can be observed (e.g., because they still live in the parent household). This pattern is visible in table 1. The mean of the respective dummy variable indicates the cohort size in percentage terms.

For the extended estimation shown in equations (3) and (4), the variables *INCOME* and the square of income, $INCOME^2$, are used. It is hypothesised that higher-income households have higher *FAH* and *FAFH* in absolute terms. A quadratic and not a linear income effect is expected. The hypothesis behind using the dummy variable *FEMALE* is that there are gender differences in food consumption (at home and away from home). *PENSIONER* is a combination of information about the households' social position, information about their main income source and the household head's age. First, the social position and the main income source variable are combined. If the social position is retiree, pensioner or not working, and pension or benefit is indicated as the main income source, the household is deemed a pensioner. MINIACI, MONFARDINI and WEBER (2003) note that there is a relatively wide age range over which people retire. Indeed, in our sample, we note that by combining social position and main income source, there are still some very young people that fall into the category of retirees, probably due to illnesses and an inability to work. According to LÜHRMANN (2007), the retirement probability of German household heads starts to increase considerably when the household head reaches the age of 45. Therefore, we excluded pensioners under 45 years of age from the analysis, regarding them as extreme cases. Overall, we deleted 1,735 pensioners under the age of 45 years from the full data set, which equals 0.65% of all cases.

The next three variables in table 1 reflect the asset situation of the household. The hypothesis behind the inclusion of asset information is that it is easier for wealthier households to compensate for a possible unexpected income drop, e.g. after retirement. *PRIVATE PENSION* describes the situation where the household head earns so much money that s/he is eligible for a private pension. For most of the time span that is covered by the available data (1978-2003), only wealthy people contracted private pension insurance in Germany. Poorer households usually contracted the social pension fund. *NONLABOR INCOME* describes the income from existing assets, e.g., interest rates on monetary assets in a savings account.

The marital status of the household is reflected by the dummy variable *MARRIED*. We hypothesise that married households have different food-at-home and food-away-from-home consumption patterns than unmarried households in that married household have lower (higher) *FAFH* (*FAH*).

The next seven variables indicate the occupational status of the household head because it can be expected that there are severe differences in food consumption, for example, between self-employed and unemployed households.

KIDS, *HHSIZE* and $HHSIZE^2$ capture household composition effects. The hypothesis is that the number of children in the household has a significant impact on both *FAH* and *FAFH*. We assume a quadratic, nonlinear relationship between the household size and *FAH* and *FAFH*.

Regional differences are supposed to be reflected by the dummy variable *EAST GERMANY*. It must be noted that the consumption patterns of East German households have only been observed by the German Federal Statistical Office since 1993. That is, the three previous survey years do not include any East German households. However, because consumption differences are likely to persist between East and West Germany, East Germany is included. Overall, 10% of all of the households in the pooled sample live in East Germany.

In addition to using equivalence scales on monetary values, several adjustments to the data have been made to allow for the large time span and the specifics of the cohort analysis. First, all expenditure and income variables have been converted using the € currency. From 1978 to 1998, all monetary variables have been reported in Deutschmarks (DM). Additionally, all monetary variables have been deflated with the Consumer Price Index (CPI) (2003=100). For *FAH*, the CPI for food, alcohol and tobacco is used and for *FAFH*, the CPI for accommodation and restaurant services is used. All of the remaining monetary variables are deflated with the overall CPI.

Several empirical specifications of the *FAH* and *FAFH* cohort models (1) to (4) have been computed to identify those results that are the most robust. Initially, we controlled for the number of households with zero observations in either *FAH* or the *FAFH*. As expected, the number of households with no *FAH* is very low, at 0.01% of our sample. There are 2,731 households, i.e., 11.31% of all observations in the sample that did not report any *FAFH*. There can be many reasons for zero observations, e.g., the survey period is too short, the prices are too high, the income is too low, or the consumer does not like to eat out. From the data, it remains unclear what the reason is for these zero observations. It is assumed that there is a latent variable that is not observable but that explains these zero expenditures. Models with zero censored observations are usually analysed using the Tobit estimation. The Tobit estimation consists of two stages. The first stage predicts this latent variable, which is then included in the second stage of the estimation. More information about the Tobit model can be found, for example, in MADDALA and LAHIRI (2009). BLISARD (2001), STEWART and BLISARD (2008), and ZAN and FAN (2010) all apply the Tobit estimation. Applying a Tobit model to equations (1) through (4) and comparing the results with an ordinary least square (OLS) regression shows that the results are almost identical. Therefore, we refrain from presenting the Tobit model results (results are available from the authors upon request).

Additionally, *FAH* and *FAFH* are not independent of each other. In fact, they could be substitutes. This lack of independence means that the error terms of the regressions (1) & (2) and (3) & (4) are correlated, which violates regression assumptions. To avoid this problem, (1) & (2) and (3) & (4) are instead estimated using a seemingly unrelated regression (SUR) model. SUR estimates provide more efficiency than OLS if the variables of the explanatory model are not identical. In fact, the explanatory variables used in (1 or 3) are not identical to those used in (2 or 4) because they differ in the usage of the CPI variables (food, alcohol and tobacco versus accommodation and restaurant services). SUR also allows the Breusch-Pagan Test of Independence to be conducted to detect the size of the correlation of both regressions' error terms as well as whether this correlation is significant.

5 Results

5.1 Descriptive Results

We first present some descriptive results for *FAH* and *FAFH*. As an overview, the descriptive results of the ***A***, ***P***, and ***C*** variables in combination with the *FAH* and *FAFH* are given first.

Table 2 shows *FAH* and *FAFH* separated by age, periods and cohorts. As age ranges from 20 to 85 years in the data set, age is divided into five categories for simplicity. In general, *FAH* increase with rising age. *FAH* are lowest for 20-29 year olds (150.54 € per month) and reaches a peak in the group of 50-59 year olds (on average 199.42 € per month). For those aged

Table 2. Mean *FAH* and *FAFH* expenditures by age, period and cohort variables

	***FAH* expenditures** Monthly equivalent expenditures for food-at-home (food, alcohol and tobacco) in € (deflated)	***FAFH* expenditures** Monthly equivalent expenditures for food-away-from-home consumption (e.g., restaurant meals) in € (deflated)
Age in categories		
20-29	150.54	68.66
30-39	176.42	58.52
40-49	191.90	59.75
50-59	199.42	62.11
>60	183.28	51.86
Periods		
1978	141.37	36.41
1983	216.40	71.40
1988	216.47	80.14
1993	222.84	67.03
1998	158.23	51.57
2003	157.58	47.08
Cohorts		
COHORT 1 (1893-1902)	144.14	35.09
COHORT 2 (1903-1912)	166.58	43.91
COHORT 3 (1913-1922)	185.79	51.58
COHORT 4 (1923-1932)	195.96	54.72
COHORT 5 (1933-1942)	195.62	63.18
COHORT 6 (1943-1952)	194.98	63.77
COHORT 7 (1953-1962)	178.92	61.68
COHORT 8 (1963-1972)	152.85	56.95
COHORT 9 (1973-1983)	110.32	43.50

Source: own calculations

60 and older, *FAH* drops. *FAFH* divided by age categories look very different. The highest *FAFH* per month are found for the youngest group (68.66 €). For the 30-39 year olds as well as for the 40-49 year olds, *FAFH* are lower. However, people in the category of 50 to 59 years have the second highest *FAFH* in the sample (62.11€ on average). As expected, *FAFH* is lowest in the oldest age category with 51.86 € per month.

Descriptive results regarding the period of data collection and *FAH* and *FAFH* are described next. In 1978, *FAH* is lowest. From 1983 to 1993, average *FAH* appear relatively stable at approximately 220 € per month. For 1998, there is a distinct drop in the average expenditures to report with approximately 158 € per month for the last two periods considered. This drop is puzzling and should be further researched in future studies. *FAFH* experience an increase from 1978 onwards to reach a maximum in 1988 with an average value of 80.14 € per month. *FAFH* decline after this year to reach 47.08 € per month in 2003. This result is also unexpected because food-away-from-home consumption has become much more common in recent years in Germany. However, BLISARD (2001) shows similar period effects for food-away-from-home consumption for the U.S.

Finally, the descriptive results for the cohorts are described. According to table 2, the two youngest cohorts spend less on *FAH* than the older cohorts (with the exception of the oldest cohort). While the cohorts 4-6 expend about 195 € per month on *FAH*, the youngest cohort (*C9*) only spends 110 € per month. For *FAFH*, there is an increase in the average expenditures from the oldest with average spending of 35 € to the maximum expenditures of cohort 6 with on average 64 €. Average expenditures decrease for the subsequent younger cohorts with the youngest cohort having on average 44 € monthly expenditures for food away from home.

5.2 Cohort Analysis

It is important to note that the data shown in table 2 do not disentangle age, period and cohort effects. Only econometric methods allow for a decomposition of these effects (ARISTEI, PIERALI and PIERONI, 2005). Next, we aim to see whether the ***A***, ***P*** and ***C*** effects suggested by the descriptive statistics are statistically significant if the estimation is controlled for joint influences and other variables. Because the results of the basic APC models (1) and (2) are almost identical in size and sign to the results of models (3) and (4), and in order to avoid omitted-variable bias, they are not presented here (results are available from the authors upon request). The results of the estimation of the extended APC model (3) and (4) that include further socio-economic variables, are presented in tables 3 and tables 4.

Interestingly, while the age effects (*AGE* and AGE^2) for *FAH* appear to be significant and quadratic, they are not for the *FAFH* in Germany. This result means that *FAH* increases with increasing age but only up to a maximum. After that, the negative sign of the AGE^2 coefficient indicates that expenditures decline with increasing age.

With regard to the cohort effects, table 3 reveals significant effects throughout the cohort dummies in the *FAH* model. Compared to cohort 6, which is the reference cohort born 1943-1952, the older cohorts (*C1-C5*) have significantly higher *FAH*. Those cohorts that are younger than cohort 6 (*C7-C9*) have significantly lower *FAH*. The results for *FAFH* in table 4 almost mirror those for *FAH*: the older cohorts have significantly lower *FAFH* than cohort 6. There is no significant difference between cohorts 5, 8 and 9 and cohort 6. However, cohort 7 has higher *FAFH* than the reference group.

The SUR estimation in tables 3 and 4 reveals significant period effects. Period effects are captured in this model with the GDP per capita growth rate and the CPIs for food, alcohol and tobacco and accommodation and restaurant services. The impact of a high GDP per capita growth rate is significantly negative for both *FAH* and *FAFH*. This result might indicate that in economically better times, food consumption is not as important as other expenditures. For *FAFH* this result is somewhat surprising, because it has been shown that in economically better times, people eat away from home more often (ZAN and FAN, 2010). The CPIs for food, alcohol and tobacco as well as for accommodation and restaurant services show the expected sign: that is, higher prices reduce *FAH* and *FAFH*.

With regard to the socio-economic variables, the hypothesis of a non-linear but quadratic influence of income can be confirmed. Increasing income leads to higher *FAH* and *FAFH* up to a maximum, but decreases afterwards. This result might be explained by the fact that there is only a limited amount of food that people can eat (neglecting their income situation). The existence of gender differences in *FAH* and *FAFH* are proven by the significant negative coefficients of *FEMALE*. Thus, female household heads have lower levels for both *FAH* and *FAFH*.

Table 3. Seemingly unrelated regression results of the extended APC model for the *FAH* [3]

Explanatory variables	*FAH* β-coefficient (3)	(t-value)	90% Conf. interval	
Age proxies				
AGE	0.591*	(1.67)	0.006	1.176
AGE²	-0.019***	(-5.50)	-0.024	-0.013
Cohort dummies				
COHORT 1 (1893-1902)	61.000***	(6.60)	45.806	76.191
COHORT 2 (1903-1912)	53.668***	(8.04)	42.689	64.647
COHORT 3 (1913-1922)	42.663***	(8.54)	34.449	50.876
COHORT 4 (1923-1932)	31.956***	(9.11)	26.184	37.728
COHORT 5 (1933-1942)	16.443***	(7.64)	12.904	19.982
COHORT 7 (1953-1962)	-22.207***	(-10.29)	-25.758	-18.655
COHORT 8 (1963-1972)	-53.875***	(-15.49)	-59.594	-48.155
COHORT 9 (1973-1983)	-84.424***	(-14.09)	-94.279	-74.570
Period proxies				
GDP PC GR	-39.164***	(-26.67)	-41.674	-36.654
FAH_CPI	-4.960***	(19.57)	-5.377	-4.543
Socioeconomic variables				
INCOME	0.003***	(34.14)	0.003	0.003
INCOME²	-1.41e-08***	(-19.19)	-1.53e-08	-1.29e-08
FEMALE	-2.513*	(-1.65)	-5.016	-0.010
PENSIONER	8.862***	(3.13)	4.208	13.515
PENSIONER below 65*	4.024	(1.53)	-0.298	8.346
PRIVATE PENSION	-39.233***	(-18.82)	-42.662	-35.803
NONLABOR INCOME	-0.000***	(-6.21)	-0.000	-0.000
MARRIED	20.309***	(10.57)	17.148	23.471
FARMER	29.165***	(7.07)	22.377	35.953
SELF-EMPLOYED	14.845***	(5.82)	10.646	19.044
PUBLIC SERVANT	5.315***	(3.35)	2.702	7.927
BLUE-COLLAR WORKER	4.841***	(3.19)	2.345	7.337
UNEMPLOYED	-24.388***	(-11.07)	-28.013	-20.764
STUDENT	16.909***	(3.44)	8.815	25.004
KIDS	2.773***	(2.43)	0.893	4.654
EAST GERMANY	-13.381***	(-7.80)	-16.202	-10.559
HHSIZE	10.371***	(5.18)	7.080	13.663
HHSIZE²	-2.212***	(-8.80)	-2.625	-1.799
CONSTANT	685.250***	(33.16)	643.000	727.500
R^2	17.04%			
RMSE	77.885			
F-value	181.73***			

[3] *** p<.01; ** p<.05; * p<.1
Source: own calculations

Table 4. Seemingly unrelated regression results of the extended APC model for *FAFH* [3]

Explanatory variables	*FAFH* β-coefficient (4)	(t-value)	90% Conf. interval	
Age proxies				
AGE	-0.143	(-0.39)	-0.744	0.459
AGE²	0.001	(0.28)	-0.005	0.007
Cohort dummies				
COHORT 1 (1893-1902)	-29.513***	(-3.02)	-45.609	-13.416
COHORT 2 (1903-1912)	-23.849***	(-3.32)	-35.665	-12.034
COHORT 3 (1913-1922)	-18.188***	(-3.40)	-26.994	-9.381
COHORT 4 (1923-1932)	-11.497***	(-3.07)	-17.656	-5.338
COHORT 5 (1933-1942)	-0.076	(-0.03)	-3.773	3.620
COHORT 7 (1953-1962)	5.767**	(2.55)	2.042	9.492
COHORT 8 (1963-1972)	1.027	(0.28)	-5.105	7.160
COHORT 9 (1973-1983)	-8.434	(-1.33)	-18.836	1.968
Period proxies				
GDP PC GR	-6.229***	(-4.85)	-8.344	-4.115
FAFH_CPI	-1.363***	(-8.86)	-1.616	-1.110
Socioeconomic variables				
INCOME	0.003***	(34.85)	0.003	0.003
INCOME²	-1.21e-08***	(-16.36)	-1.33e-08	-1.09e-08
FEMALE	-23.747***	(-15.52)	-26.264	-21.230
PENSIONER	1.398	(0.49)	-3.280	6.076
PENSIONER below 65*	-6.834**	(-2.58)	-11.183	-2.484
PRIVATE PENSION	-11.476***	(-5.53)	-14.889	-8.062
NONLABOR INCOME	-0.000***	(-3.62)	-0.000	-7.42e-06
MARRIED	-12.198***	(-6.31)	-15.375	-9.020
FARMER	-16.270***	(-3.92)	-23.095	-9.444
SELF-EMPLOYED	1.443	(0.56)	-2.779	5.664
PUBLIC SERVANT	-1.604	(-1.00)	-4.230	1.023
BLUE-COLLAR WORKER	-8.673***	(-5.68)	-11.182	-6.163
UNEMPLOYED	-14.163***	(-6.42)	-17.794	-10.532
STUDENT	17.089***	(3.45)	8.950	25.228
KIDS	-2.870**	(-2.49)	-4.762	-0.978
EAST GERMANY	-5.278***	(-3.06)	-8.115	-2.441
HHSIZE	-14.070***	(-6.99)	-17.379	-10.761
HHSIZE²	1.087***	(4.30)	0.671	1.502
CONSTANT	187.478***	(11.81)	161.364	213.593
R^2	13.04%			
RMSE	78.309			
F-value	132.19***			

[3] *** p<.01; ** p<.05; * p<.1
Source: own calculations

The *PENSIONER* dummy has a significant relation only with *FAH*, but not with *FAFH*. BURZIG and HERRMANN (2012) show, based on Engel curve estimations using German data, that retirement increases food-at-home expenditures (per capita), whereas it lowers those for food away from home. At the same time, the probability of food away from home increases. The authors conclude that retirement does not affect the ratio between food-at-home and food-away-from-home expenditures. The variable *PENSIONER*below 65* considers that early retirement might be a household-specific characteristics. The effect is not significant in the *FAH* (table 3), but it is in the *FAFH* estimation (table 4). This result means that the negative effect of *PENSIONER* on *FAFH* is significantly more negative for younger people in retirement. The variables *PRIVATE PENSION* and *NONLABOR INCOME* are supposed to mirror the asset situation of the household. For both *FAH* and *FAFH*, higher income from assets accompanies significantly lower expenditures. *NONLABOR INCOME* also reduces the amount of money dedicated to food at home and food away from home. This result might indicate two things: food consumed at home is not a luxury good and/or wealthy people do not like to eat out a lot.

Consistent with the assumption of the family lifecycle, *MARRIED* households have higher *FAH* but lower *FAFH* compared to the reference group of unmarried households. Starting a family and having children appears to keep households at home.

There are also occupational differences in *FAH* and *FAFH*. Compared to the reference group of white-collar workers, farmers, self-employed, public servants, blue-collar worker and interestingly students have significantly higher *FAH* (table 3). The *FAH* for unemployed are lower. *FAFH* (table 4) lower for farmers, blue-collar workers, and the unemployed, while students have significantly higher *FAFH*.

Also consistent with the results for marital status, the number of children in the household leads to lower equivalent-expenditures for food away from home but higher food-at-home equivalent-expenditures. People living in East Germany have significantly lower *FAH* and *FAFH* than a reference West-German household. There is a quadratic impact of household size on both expenditure groups. For *FAH*, an increasing number of people in the household increases the expenditures until a maximum is reached, and expenditures decline afterwards. The opposite happens for *FAFH*; with an increasing number of people, *FAFH* decrease until a minimum is reached, but they begin to increase afterwards.

The explanatory power of both models is good, with 17.04% for the *FAH* model and 13.04% for the *FAFH* model. The explanatory power is higher for the *FAH* model. Comparing it to the results of the estimates of equation 2 (not shown here), the *FAFH* model in particular benefited from the inclusion of socio-economic variables, which might indicate that the socio-economic determinants are more important for *FAFH* than age, period or cohort effects.

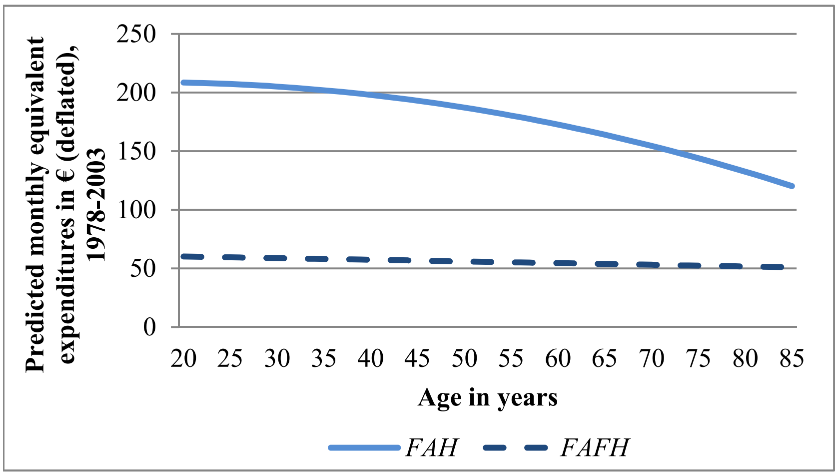
The correlation between the error terms of the SUR regression is 0.08. According to the Breusch-Pagan-Test of Independence, this correlation is significant at the 1% level ($chi^2(1) = 178.820$***), which means that the equations for *FAH* and *FAFH* are not independent of each other.

To get an overview of the estimation results, figures 1 and 2 graph the age and cohort effects based on the SUR estimation coefficients in tables 3 and 4. As proxies are used to capture the period effect (GDP per capita growth rate and the CPIs of *FAH* and *FAFH*), it is not possible to visualise the period effect based on the estimation presented.

Figure 1 shows the age effects of *FAH* and *FAFH* obtained from the estimations shown in table 3 and table 4. For age and *FAH* there is a downward shaped curve in monthly equivalent expenditures. The older people get, the less do they spend on *FAH*. Note that the impact of age has been estimated with a squared function (with age squared). For *FAFH*, the line is much flatter but is also indicating an overall downward trend. The reduction of *FAFH* with increasing age appears not so strong compared to the reduction for *FAH*.

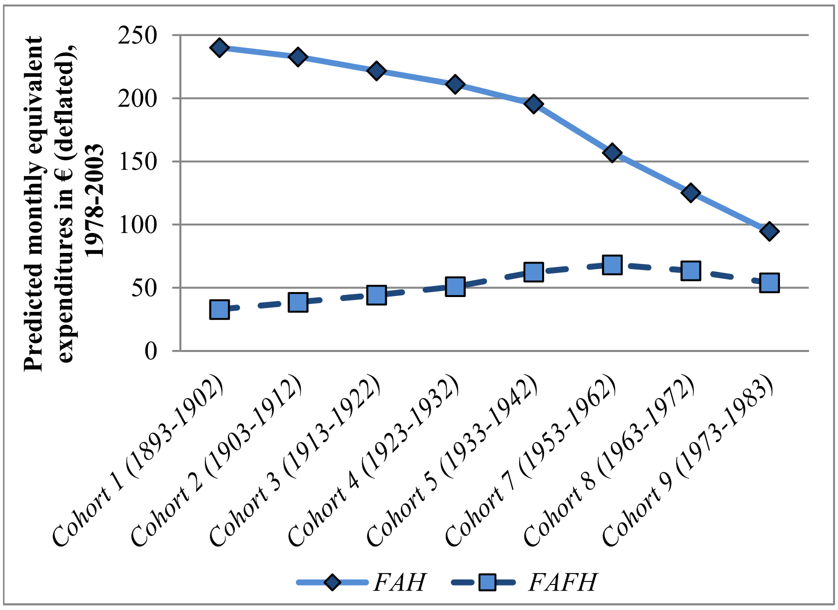
Figure 2 shows the cohort effects of *FAH* and *FAFH* derived from the estimation. In line with results described above, older cohorts spend more on *FAH* than the reference cohort 6 but also any other younger cohort while they spend less on *FAFH* than the younger cohorts. The younger cohorts have higher (lower) *FAFH* (*FAH*) than the older cohorts. Obvious from figure 2 is that the difference between *FAH* and *FAFH* is much higher for older cohorts but expenditures converge the younger the cohorts get. This confirms findings from other studies (ZAN and FAN, 2010): Food away from home becomes more common for younger generations.

Figure 1. Age effects on *FAH* and *FAFH* in Germany



Source: own calculations

Figure 2. Cohort effects on *FAH* and *FAFH* in Germany[1]



[1]: *Cohort 6* (1943-1952) serves as reference.
Source: own calculations

in food expenditures. Applying the cohort analysis allows the generational effects on consumption to be observed and accounts for the fact that food and food preference change between generations (ZAN and FAN, 2010). The data are decomposed into the age, the cohort and the period effect using seemingly unrelated regressions.

With regard to the research question, the existence of significant age, period and cohort effects can be confirmed for both *FAH* and *FAFH*. The importance of the APC variables is higher for the *FAH*. There is a significant quadratic impact of age on *FAH* but not for *FAFH*. Increasing age decreases both types of expenditures, while the decrease for *FAFH* with increasing age is higher. The cohort effects for *FAH* and *FAFH* almost mirror each other. Older cohorts spend significantly more on FAH than younger cohorts; some of the younger cohorts have higher expenditures than the middle reference group. What is more, the difference between *FAH* and *FAFH* continuously converges with younger cohorts, thus, eating out becomes more common. The period effects are consistent between *FAH* and *FAFH*: a higher GDP per capita growth rate lowers the expenditures as do higher prices for either food-at-home or food-away-from-home. There is a quadratic impact of household size and income on both *FAH* and *FAFH*. Moreover, this paper finds evidence for the significant effects of gender, occupation, and regional effects. For gender, there is a negative impact of being female on both expenditure types. Expenditures are also lower for the unemployed compared to white collar workers. *FAH* and *FAFH* for East German households are also significantly lower compared to households located in West Germany. The results provide implications for the well-being of different population groups. They may be helpful for forming age-specific educational programs, e. g., regarding the health consequences resulting from the trend to higher food-away-from-home consumption in the different age groups.

6 Conclusion

The main research objective of this paper was to identify age, cohort and period effects in a cohort analysis of German consumers' expenditures for food at home and food away from home. The knowledge of how consumption patterns have changed over time becomes relevant because demographic changes can predict future consumption structures and enable politicians to develop strategies geared to different population groups in different life stages. Referring to the Ando-Modigliani life-cycle, as well as to the extensions provided by cohort analysis, we approach the question by identifying cohort, age and period effects

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