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The Influence of Age on Consumption

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Abstract

The consequences of an ageing population for aggregate consumption and different consumption purposes are shown in this study. Germany is taken as example as the demographic change already set in. The reallocation of the age group shares until 2030 is large enough to observe changes in the consumption expenditures. Including age group coefficients in the estimation of consumption the effects of the single age groups on the consumption purposes proved to be significant. The estimation results are used to project consumption until 2030. The new development is compared to a baseline not explicitely considering age coefficients in the estimation function. Depending on the consumption purposes the deviations from the baseline can be considerably.

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1 Introduction

Ageing societies influence the development of industrialised countries. A changing age composition of the population not only affects pension and social security systems but also the infrastructure, housing market, available workforce and consumption patterns (Sachverständigenrat 2011). Though demographic change proceeds slowly, it has nevertheless considerable influence on economic growth (International Monetary Fund 2004). The study at hand aims at investigating the consequences of ageing for aggregate consumption and different consumption purposes. The life-cycle theory started by Fisher (1907, 1930) and enhanced by Ramsey (1928), Modigliani and Brumberg (1954) as well as Ando and Modigliani (1963) examines the relationship between consumption, saving, age-profile and economic growth. Since then many empirical studies were mainly subject to life-cycle saving (e.g. Masson *et al.* 1998, Horioka 1997, Deaton and Paxson 1994). Age and consumption – being the counterpart of saving – were inter alia explicitely addressed in Erlandsen and Nymoen (2008), Attfield and Cannon (2003), Fair and Dominguez (1991) and Heien (1972). Their findings show that aggregate consumption expenditures are affected by the age structure of the population.

Following the approach of age group coefficients in the estimation of consumption this study assesses the influence of the single age groups on the amount spent for different consumption purposes in Germany. It shows that the coefficients refering to the age structure are significantly different from zero confirming that the distribution of the age groups among the population matters for the total amount consumed. This means that during the life-cycle a private household adapts its consumption behaviour to the actual habits and needs as well as the income situation. Consequently, demographic change induces changes in the consumption patterns and affects the demand for consumption purposes. The estimation results are used for a stand-alone projection to quantify the impact of demographic change in Germany. The values are compared to a baseline not explicitely considering age in the estimation process. On the aggregate the projection does not reveal the complete impact of an ageing society. The difference between projection and baseline is rather small. But going into more detail the differences become obvious. Summarising, age should be considered when consumption is analysed. As the consequences have opposed effects depending on the consumption purpose disaggregated information is to be preferred.

The paper is structured as follows. In the next section the data of the Household Budget Survey is evaluated. The differences in the consumption expenditures by age groups give a first impression what to expect from the estimated age group coefficients. Section 3 is about the estimation. First, the data basis is described (section 3.1) followed by the estimation procedure (section 3.2) and the results (section 3.3). The coefficients then are used in

section 4 for a projection to analyse the consequences of demographic change. Again, first the procedure is introduced (section 4.1). Section 4.2 encompass the projection results. Section 5 concludes the study.

2 Private Household Consumption in Germany

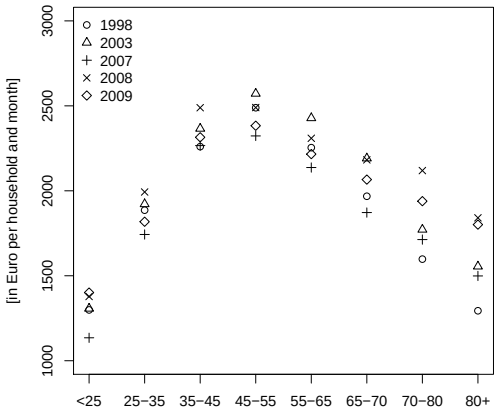
Several studies found age effects being significant in estimating the consumption function (see Erlandsen and Nymoen 2008, Attfield and Cannon 2003, Fair and Dominguez 1991). What also unifies those studies is the fact that they use aggregate data. In the best case the relationship would be directly investigated, i.e. information on micro level for each consumption purpose for each age group is available. In most countries those information does either not exist or does not provide enough data points for estimation.

The Household Budget Survey of the Statistical Office in Germany (Statistisches Bundesamt 2010) gives information on income and expenditures per household and month by social and socio-economic characteristics [1]. The level of detail is very high and would generally provide a good basis for extensive research but the survey is only conducted every fifth year. Next to that the research procedure and the classification structure was regularly revisioned making a comparison of the rare data points difficult. Within the five year turnus smaller surveys (laufende Wirtschaftsrechnungen) supplement the data. But it is only in the last two versions (Statistisches Bundesamt 2009, 2011) that the socio-economic information becomes more enriched and takes the age of the head of the household into account. Thus, the data basis is not sufficient for econometric analysis but it can be used for a first descriptive assessment of the differences in the consumption behaviour depending on age.

Figure 1 shows that the consumption expenses follow a hump-shaped curve irrespective of possible cohort effects. At all data points the youngest and oldest age groups spend the lowest amount for consumption. The peak is reached when the household head is aged between 45 and 55. Consequently, it can be assumed that the age composition of the population affects the level of consumption expenditures. Changes in the population structure should influence the development of consumption expenses.

[1] For example income and expenditures are structured by the number of persons within the household, the age of the head of the households, the social status (e.g. retired, employed, unemployed), or the type of household (e.g. single, couple with/without kids) etc.

Figure 1: Expenses for aggregate consumption per household and month differentiated by age groups



Source: Statistisches Bundesamt (2009, 2010, 2011), own calculations

3 The Impact of Age Groups on Consumption

In this section the impact of the age structure on consumption is empirically analysed. If the coefficients relating to the age groups are significant, the population composition matters for aggregate consumption or the consumption purposes respectively. Before describing the estimation procedure in detail, an overview of the data set is given.

3.1 Data

The applied method facilitates the use of data that does not explicitely include single household characteristics. The study bases on aggregate data from the System of National Accounts (SNA) and other time series data from the National Statistical Office and hence circumvents data shortage and challenges posed by micro data. Apart from population, the data is on a quaterly basis starting from the first quarter of 1991 and ending on the fourth quarter of 2011. Saisonality is excluded by adjustment of the time series. In case of the annual population data the quarterly information was gathered by linear interpolation. The final year was 2010 and has been prolonged to 2011 by using the growth rates given in the 12th coordinated population projection (Statistisches Bundesamt 2012*e*).

The data sets chosen from SNA were disposable income differentiated in income by wealth and other income (Statistisches Bundesamt 2012*c*) as

well as consumption of private households by twelve purposes, seven subgroups and one aggregate (Statistisches Bundesamt 2012*d*)[2]. Next to that prices – the consumer price index and prices for consumption purposes – as well as population data were included, provided by Statistisches Bundesamt (2012*b*) and Statistisches Bundesamt (2012*a*). The unemployment rate bases on data from the Federal Employment Agency (Bundesagentur für Arbeit 2012).

3.2 Estimation Procedure

The design of the estimation functions follows the method described in Fair and Dominguez (1991) and Erlandsen and Nymoen (2008). The explanatory variables included in the estimation process were disposable income (*dicc*) differentiated in wealth income (*wicc*) and non-wealth income (*nicc*), cross-price relations ($p_i/p_j, with i \neq j$) and the unemployment rate (*uer*)[3]. Income is supposed to have a positive impact on consumption; A rise in income should lead to an increase in consumption expenditures. Substitution effects between different conumption purposes is handled by the cross-price relations whereby the number of substitutional relations is not restricted. The unemployment rate represents uncertainty about future income. The higher the rate the higher the risk to get unemployed with the consequence of lower disposable income. Consequently, the private household starts to save additional amounts in case of the increasingly likely event of loosing income due to unemployment. Consumption would be lower and hence the coefficient has to be negative.

The income components were used in real terms by dividing them through the aggregate price level, i.e. the consumer price index (p). The consumption purposes (c_i) were also transformed in real values using the representative price index (p_i). Prices and income are in per capita terms, i.e. divided through the population aged 18 or older. Children are indirectly included in the consumption assuming that "they are part of their parents' consumption" (Samuelson 1958, p.468). The equations to be estimated for the single

[2]Consumption of private households including non-profit institutions serving households. The twelve consumption purposes are: (1) Food and non-alcoholic beverages, (2) Alcoholic beverages, tobacco, (3) Clothing and footwear, (4) Housing, water, electricity, gas and other fuels, (5) Furnishings, household equipment and routine household maintenance, (6) Health, (7) Transport, (8) Communication, (9) Recreation and culture, (10) Education, (11) Restaurants and hotels, (12) Miscellaneous goods and services. As subgroups the following consumption purposes are considered: (2.1) Alcoholic beverages, (2.2) Tobacco, (4.1-4.4) Housing, water, (4.5) Electricity, gas and other fuels, (7.1) Purchase of vehicles, (7.2) Operation of personal transport equipment, (7.3) Transport services.

[3]The interest rate proved not to be significant throughout the estimation process and is therefore not considered in the estimation function.

consumption purposes generally are of the following form:

$$log(\frac{c_{it}/p_{it}}{c_t/p_t}) = \alpha_0 + \beta_1 log(nicc_t/p_t) + \beta_2 log(wicc_t/p_t) + \beta_3 log(uer_t) + \beta_4 log(p_{it}/p_{jt}) + \sum_{k=1}^{8} \gamma_k pop_{kt} + \varepsilon_t$$

with $i = 1...12$ *consumption purposes and i.n sub-groups*[4]
and $k = 1...8$ *age groups* (pop)[5]
The function for aggregate consumption c_t is as follows.[6]

$$log(c_t/p_t) = \alpha_0 + \beta_1 log(nicc_t/p_t) + \beta_2 log(wicc_t/p_t) + \beta_3 log(uer_t) + \sum_{k=1}^{8} \gamma_k pop_{kt} + \varepsilon_t$$

The age group coefficients underlie two restrictions:

$$\sum_{k=1}^{8} \gamma_k = 0 \tag{1}$$

$$\gamma_k = \delta_0 + \delta_1 * k + \delta_2 * k^2 \tag{2}$$

The first restriction guarantees that aggregate consumption does not change if the distributional variables do not matter (Fair and Dominguez 1991, p.1279). The second one is used to reduce the number of unconstrained coefficients and hence to spare the degrees of freedom. It is based on the polynomial-distributed lag technique by Almon (1965). The second order polynomial is assumed to be adequate considering that the life-cycle curve is valid, i.e. having only one peak and that it is sufficient to show the differences in the behaviour between young, middle-aged and old people.[7] In combination with restriction (1) the number of age group coefficients

[4] $i.n = 2.1, 2.2, 4.1 - 4.4, 4.5, 7.1, 7.2, 7.3$ for the sub-groups. A missing index indicates the aggregate for consumption and the price level.

[5] The age groups are: 18 to 25 years, 25 to 35 years, 35 to 45 years, 45 to 55 years, 55 to 65 years, 65 to 70 years, 70 to 80 years, and 80 years and over. Out of convenience and for better comparability the age groups are the same as in the Household Budget Survey from the Statistical Office.

[6] The aggregation of the single consumption purposes to avoid the separate estimation of aggregate consumption is not possible as some estimation functions do not yield reliable results and has to be excluded. The consumption purposes in question are described in 3.3.

[7] In an earlier version the equation was also estimated with the assumption that the age group coefficients lie on a third order polynomial. The results did not show any improvement compared to the initial estimation function. Hence the approach was not considered in this contribution.

to be estimated reduces to two. The estimation functions for the different consumption purposes and the aggregate finally yields:

$$log(\frac{c_{it}/p_{it}}{c_t/p_t}) = \alpha_0 + \beta_1 log(nicc_t/p_t) + \beta_2 log(wicc_t/p_t) + \beta_3 log(uer_t) + \beta_4 log(p_{it}/p_{jt}) + \delta_1 Z_{1t} + \delta_2 Z_{2t} + \varepsilon_t$$

and for aggregate consumption:

$$log(c_t/p_t) = \alpha_0 + \beta_1 log(nicc_t/p_t) + \beta_2 log(wicc_t/p_t) + \beta_3 log(uer_t) + \delta_1 Z_{1t} + \delta_2 Z_{2t} + \varepsilon_t$$

with

$$Z_{1t} = \sum_{k=1}^{8} kpop_{kt} - 1/8 \sum_{k=1}^{8} k \sum_{k=1}^{8} pop_{kt}$$

$$Z_{2t} = \sum_{k=1}^{8} k^2 pop_{kt} - 1/8 \sum_{k=1}^{8} k^2 \sum_{k=1}^{8} pop_{kt}$$

$$\delta_0 = -\delta_1 1/8 \sum_{k=1}^{8} k - \delta_2 1/8 \sum_{k=1}^{8} k^2$$

The equations are estimated by generalised least squares with maximum likelihood. AR processes for the error terms were allowed when necessary.[8] During the estimation process, variables are excluded if the respective coefficent is insignificant or has the wrong sign. In the end the variables included might differ from consumption purpose to consumption purpose.

3.3 Estimation Results

The results show that age and respectively the composition of the population have significant influence on consumption. The coefficients proved to be significantly different from zero in almost all cases where the estimation yields reliable results.[9] Generally, the findings are supported by the information in the Household Budget Survey.

Nevertheless, some of the estimations have to be excluded from the results presented in this contribution. The estimation of consumption concerning hotels and restaurants (11) failed due to data problems. The time series

[8] Estimation with ordinary least squares yield inefficient coefficients due to heteroscedasticity and autocorrelation and hence invalid test statistics and standard errors. The distortions often appear when high frequency time series data is used. Additional reasons are that the employment of aggregate data neglects different responses to changes in income, employment etc. due to socio-economic effects. Another factor especially refering to heteroscedasticity is the reunification of Germany and distortions through consumption related catch-up effects. Consumer behaviour normalised during the 1990s.

[9] The only exception were the expenses for transport services (07.3) that seemed to be equally consumed by all age groups and showed nearly no age effects.

mainly consist of time trend and saisonality. The remaining part of the data is rather erratic and can hardly explained by other variables. Using the standard estimation approach the structure of the age group coefficients (though significant) is different to that one may expect and inconsistent with the data from the Household Budget Survey. Consequently, expenses for hotels and restaurants are not further considered. The expenditures of electricity, gas and other fuels (04.5) are independent of all explanatory variables including age effects and are neglected as well.

Estimations that need to be revisited are the consumption expenditures for furnishings, household equipment and routine household maintenance(03) as well as the purchase of vehicles (07.1). The estimation functions produced insatisfactory results which might be caused by missing explanatory variables. The degree of equipment ownership and the age of durables should influence the consumption behaviour. Regarding the purchase of vehicles the consumption decision not only depends on available savings and income but also on the age and the number of cars within the houshold. The inclusion of stock variables mosts probably would solve the problem. Other factors that are more difficult to integrate but take especially influence on the purchase of durables are emotional, ehtical and social aspects like security, consience, environment, public perception etc. (Luce *et al.* 2001). Thus, the consumption functions can be biased towards unknown characteristics of products and deteriorate the outcome of the estimations.

The regression for education (10) performed badly because of structural breaks. The time series are shortened to solve the problem.

Leaving the excluded cases aside, the estimations for the other purposes and the aggregate proved to be quite robust and reliable. The impact of age on the several consumption purposes ranges between -2.4% and +2.3% depending on the age group and the year[10].

In the following the estimates for aggregate consumption (00), food and non-alcoholic beverages (01) as well as health (06) given in table 1 are analysed. The other results are displayed in table 2 in the appendix. The coefficients for aggregate consumption confirm that income is the most important factor for consumption. Rising income by 1% induce an increase in aggregate consumption expenditures by 0.99% wherupon the impact of non-wealth income is with 0.67 twice as high as of wealth income. Uncertainty about future income affects consumption negatively but the impact is rather low.

[10]The impact of the age coefficient is calculated by the partial derivatives for the respective age groups:

$$\partial(c_{it}/p_{it})/\partial(pop_{kt}) = \gamma_k(c_t/p_t)(nicc_t/p_{1t})^{\beta_1}(wicc_t/p_{1t})^{\beta_2}(uer_t)^{\beta_3}e^{(\alpha_0+\sum_{k=1}^{8}\gamma_k pop_{kt})}$$

Throughout the paper the values given for the age impact refer to the last quarter of the year 2011. But generally the values do not change much over the years.

In contrast to the aggregate the shares of consumption purposes on overall consumption show lower or no responses to changes in income. In almost all cases the elasticities are below 0.5% disregarding the sort of income. Most of the analysed goods and services proved to be necessities, i.e. an increase in income leads to a reduction of the share in overall consumption. A reversed reaction can be found for tobacco (02.2), clothing and footwear (3), operation of personal transport equipment (07.2) as well as transport services 07.3).

The estimation results for food and non-alcoholic beverages (01) confirm the subsistence character of the consumption purpose. If (non-)wealth income increases by 1% the share of food and non-alcoholic beverages on overall consumption reduces by about -0.2%. The result comply with Engel's law: poorer households have a higher share of food in total expenditure than richer households (Engel 1895,p.28f).[11] Uncertainty about future income takes no influence on the share. The only cross-price effect that can be found is connected with transport. If prices for food and non-alcoholic beverages increase relative to transport prices by 1% then the budget share decreases by -0.3%. In contrast expenditure shares for health (06) are not affected by changes in non-wealth income. Only increases in wealth income lead to relative reductions in health. An explanation can be found in the well established relationship between socioeconomic status and health (see Feinstein 1993 for a literature review): The higher the social status the healthier the individual is or assesses itself. Assuming that wealth income is an indicator for social status getting wealthier reduces the need for health products relative to the increase as health becomes or is perceived better. Negative price effects can be detected for housing, water, electricity, gas and other fuels (04) and communication (08). In both cases the memory of shocks lasts one quarter year.

The influence of age is displayed in figure 2[12]. As suggested by the EVS data analysis in section 2 the income of the very young and very old is too small to positively affect aggregate consumption expenditures (top left picture). An increase of the age groups 18 to 25 years, 25 to 35 years, 70 to 80 years, and 80 years and more leads to a reduction in aggregate consumption while a rising number of middle aged has the opposed effect. The negative and positive impact is relatively symmetrically distributed between the age groups. If the youngest (18-25 years) or oldest (80+) age groups grow by 1% aggregate consumption reduces in each case by ca. -2.5%. The highest positive effect (1.8%) is reached when the share of the age groups in the very middle (45-55 and 55-65 years) is raised. The situation changes when

[11] Can be found in the Appendix as reprint of: "Die Productions- und Consumtionsverhaltnisse des Königreichs Sachsen", Zeitschrift des Statistischen Bureaus des Königlich-Sächsischen, Ministerium des Innern, No. 8 u. 9, pp. 1-54).

[12] The results for the other consumption purposes can be found in figure 6 in the appendix.

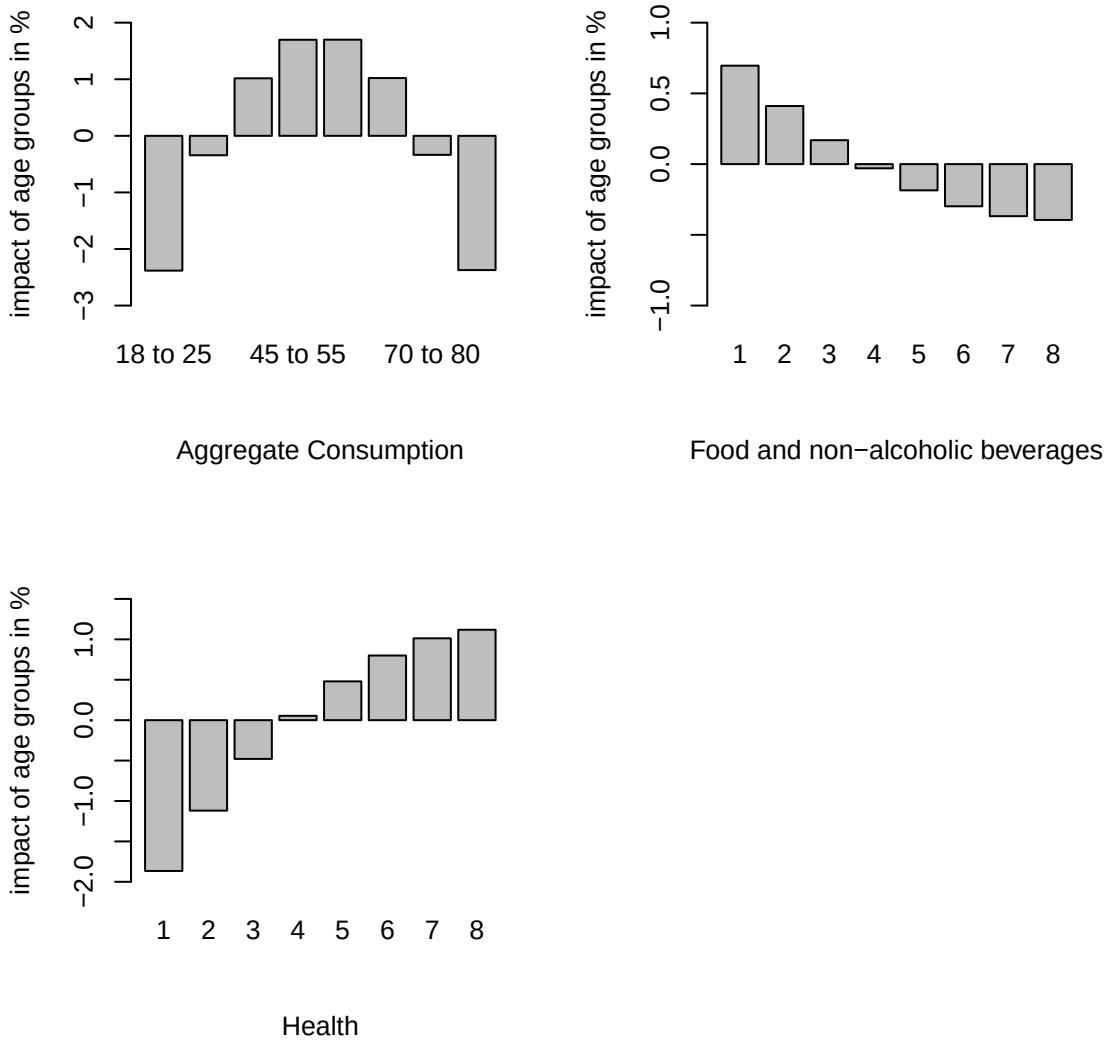
going into detail. While food and non-alcoholic beverages (01, top right picture) loose importance with increasing age of the consumer, expenditures for health (06) gain importance in the later part of the life-cycle. When the consumer reaches 45 years or older the expenses for food and non-alcoholic beverages (01) start to be negatively affected. An ageing society hence leads to a reduction in that consumption purpose. With regard to health (06) a growing share of people aged 45 or older due to demographic change produces higher expenditures.

The estimation results confirm the assumption that the consumer's age matters for consumption expenditures. If the composition of the population alters due to demographic change the consumption expenditures might differ a lot from a status quo calculation. In the next section the ageing effect is quantified.

Table 1: Regression summary for Aggregate Consumption (caps), Food and non-alcoholic beverages (c01s) and Health (c06s)

	caps	c01s	c06s
(Intercept)	0.417^{*}	-3.894^{***}	-3.637^{***}
	(0.176)	(0.384)	(0.263)
log(nicc/pc)	0.671^{***}	-0.232^{**}	
	(0.040)	(0.073)	
log(wicc/pc)	0.322^{***}	-0.201^{***}	-0.284^{***}
	(0.016)	(0.041)	(0.066)
log(uer)	-0.018^{*}		
	(0.009)		
Z1	0.661^{***}	-0.709^{***}	3.706^{***}
	(0.174)	(0.152)	(0.485)
Z2	-0.073^{***}	0.044^{**}	-0.218^{***}
	(0.021)	(0.016)	(0.049)
Phi1	0.138		
Phi2	0.251		
Phi3	−0.148		
Phi4	0.405		
log(pc01/pc07)		-0.315^{***}	
		(0.048)	
Phi		−0.183	0.380
log(pc06/pc04)			-0.688^{***}
			(0.094)
log(pc06/pc08)			-0.277^{***}
			(0.077)
sigma	0.006	0.011	0.023
AIC	−644.904	−499.438	−388.956
BIC	−618.165	−479.992	−369.510
Log-likelihood	333.452	257.719	202.478
N	84	84	84

Figure 2: Impact of changes in the age composition of the population in percent



4 Consequences of Demographic Change on Consumption

The estimation results of the previous section are used for a projection of the consumption purposes and the aggregate. The outcome is compared to a baseline that does not explicitely consider age effects. Thus, the impact

of ageing on consumption can be demonstrated.

4.1 Projection of Consumption

Demographic change in Germany set in years ago. The ageing process proceeds only slowly but the transformation in the population composition can already be recognised. Refering to the 12th coordinated population projection (Statistisches Bundesamt 2012*e*) the German population – defined as all people aged 18 or older – will diminish by 2460 thousand people from 2011 until 2030 which is a reduction by 3.6%[13]. As can be seen in figure 3 the decline is caused by the negative growth rates in the age groups from 25 to 55 years. Especially the number of retired people (aged 65 or older) will increase (+30%) so that the old-age dependency ratio[14] reaches 51%. Hence the impact of ageing on consumption expenditures should become noticeable.

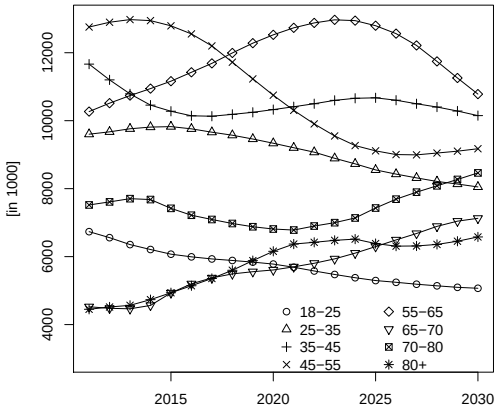
The development of the population was used for the projection. The other variables necessary for the calcualtion, i.e. the growth path of the explanatory variables wealth income and other income as well as unemployment rate, are taken from the GWS model INFORGE. INFORGE is a macro-econometric input-output model that follows the ideas of bottom up and full integration (Almon 1991). It bases on the system of national accounts and balancing items and incorporates interindustry relations. Demand as well as the supply side are equally considered. Irrationality and imperfect markets are allowed. The complete structure and methodology of the model is for example described in Ahlert *et al.* (2009) or as version for Austria in Stocker *et al.* (2011). It is annually updated and often combined with modules for specific projections and simulations (e.g. Maier *et al.* 2012, Ulrich *et al.* 2012, Drosdowski *et al.* 2010). The projections for income and unemployment are shown in figure 4. Per capita net income (wealth excluded) and wealth income grows by 2% p.a. and 2.2% p.a. between 2011 and 2030. The demographic change implies a lower number of working people or put differently a shrinking labour force supply. The unemployment rate therefore follows a downshift and reduces to 132.9%.

Using the new data set for income, unemployment rate and age group shares in combination with the predict command in R (version 2.14.1) aggregate consumption and its components were calculated for the years 2011 to 2030. The new development path was compared to the original baseline from INFORGE. The results are given in the next section.

[13]The following option was chosen: 1.4 children per woman, a positive migration balance of 100 thousand people per year and a life expectancy of 89.2 years for female and 85 years for male.

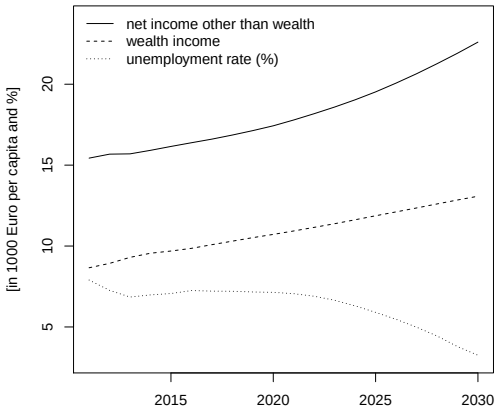
[14]The old-age dependency ratio is defined as the number of persons aged 65 or older divided by the number aged between 18 and 65

Figure 3: Population projection by age groups



Source: Statistisches Bundesamt (2012*e*), own calculations

Figure 4: Projection of income components (in thousand Euro per capita) and the unemployment rate (in %) based on INFORGE

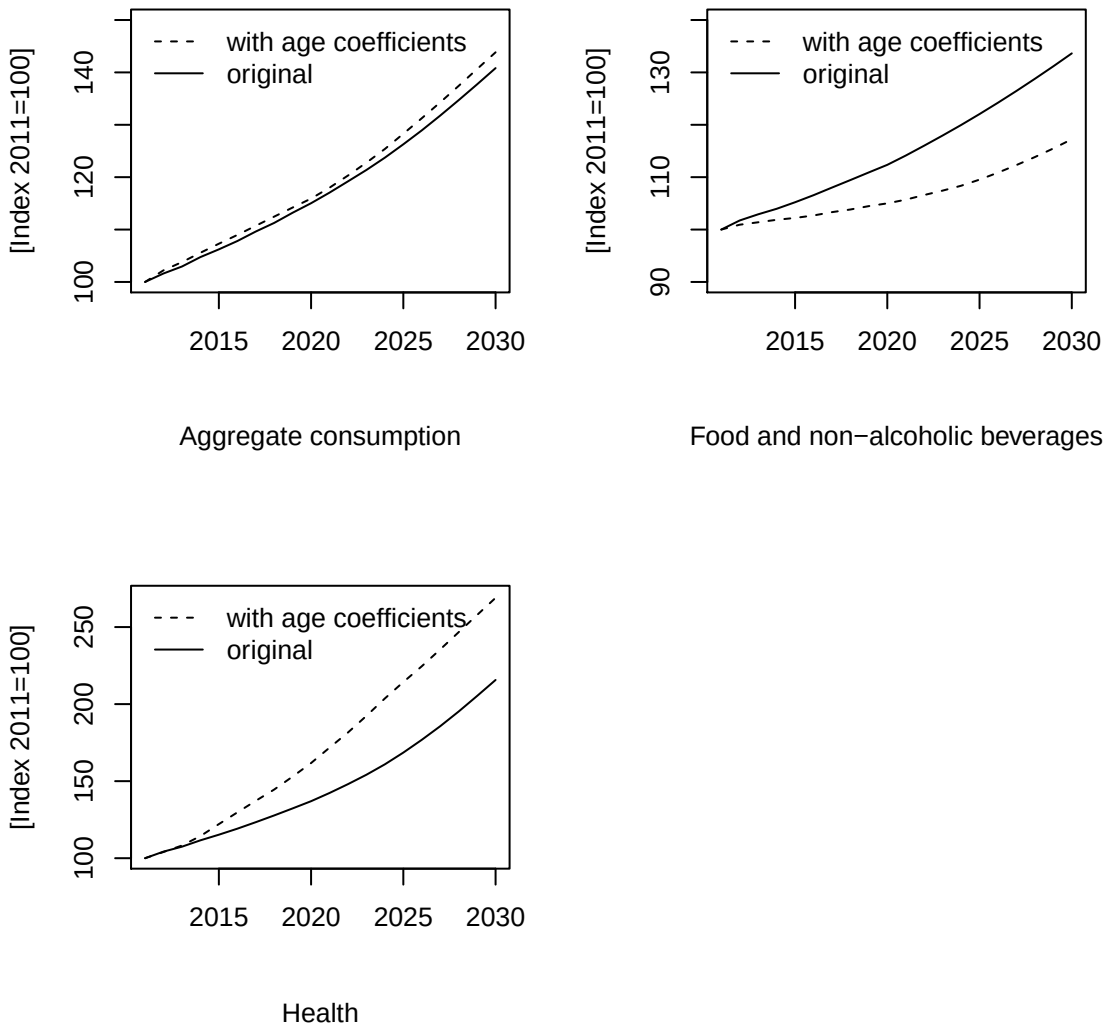


Source: GWSmbH (2012), own calculations

4.2 Projection Results

The development of aggregate consumption as well as the consumption of food, beverages and tobacco and recreation and culture is shown in figure 5. The figures for the other consumption purposes can be found in the appendix (figure 7). The continuous line represents the baseline, i.e. the original results from INFORGE. The dashed line is produced by the new projection results where the age coefficients are included. Aggregate consumption does not deviate much from the baseline which coincides with the picture given in figure 2 of section 3.3. The negative impact of the very young and the very old consumers on aggregate consumption is equalised by the opposed development of the representative population shares. The number of the young (18-35 years) and the old (70 years and older) people decrease/increase by about the same amount. So the accumulated negative influence remains approximately the same and leads to the low discrepancy between the two curves. But the development of aggregate consumption does not reveal the differences between the single consumption purposes. The pictures for food and non-alcoholic beverages (topright) as well as health (bottomleft) show that a change in the population composition can have visible impact. With regard to the consumption of food and non-alcoholic beverages the high negativity of the coefficients relating to the age groups 70 to 80 years and older in combination with the ageing process in the population results in a growth path that is much lower than the baseline. In 2030 the expenditures are only 88% of the originally assumed amount. On the other hand the demographic change has positive consequences for health consumption. Due to the decreasing share of the younger age groups the negative coefficients have less influence on the expenses. The age group coefficients of the increasing number of older people affect consumption positively. Demand for health products and services hence lies 25% above the baseline in 2030.

Figure 5: Consumption projections with and without age coefficients



5 Conclusion

The estimation and projection results stress the importance of considering age in the analysis of consumption. Though the deviation from a status-quo baseline is not very obvious at the aggregate consumption level the development can differ considerably between the single consumption purposes. Especially food and non-alcoholic beverages and health show opposed ef-

fects. While the first is positively influenced by a rising share of young people the latter reacts positively to a growing number of elderly. With regard to aggregate consumption the negative and positive impact follows a symmetric pattern: The young and old imply negative consequences, the middle aged positive.

The changes in the consumption structure affect final demand and production. Until now the estimation results were only used for a stand-alone prediction of future consumption. Interaction with other variables and economic sectors were neglected, i.e. it has been assumed that the changes in demand due to ageing will not affect other components of the economy. To include the new estimation functions into the macro-econometric model INFORGE could be interesting for future work. The interrelation of consumption with other sectors could then be considered. Changes in production and consequences for growth could be traced and quantified.

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Appendix

Regression Results for Consumption Purposes Related to section 3.3

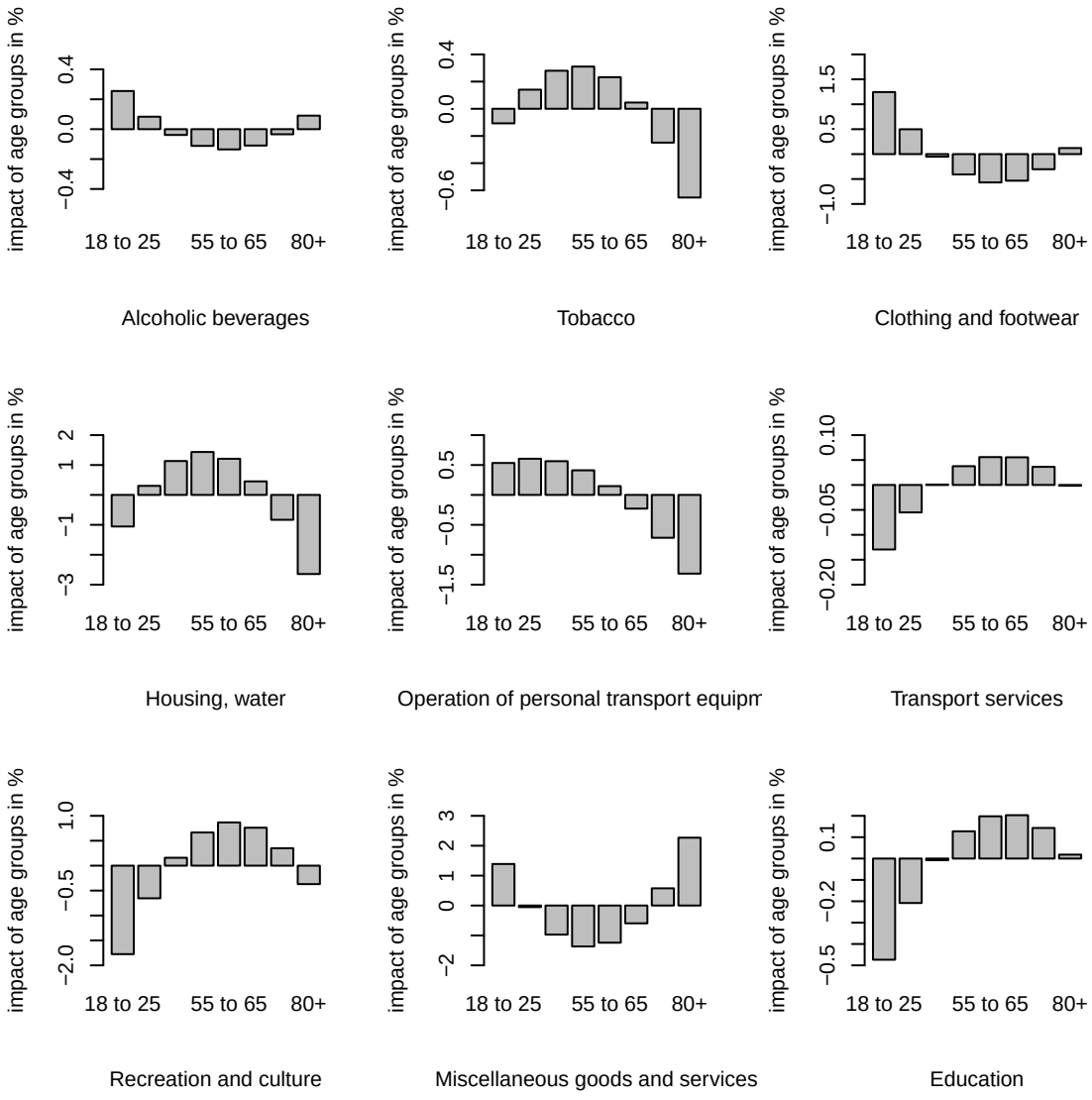
Table 2: Regression summary for Alcoholic beverages (c021s), Tobacco (c022s), Clothing and footwear (c03s), Housing, water (c0414s), Operation of personal transport equipment (c072s), Transport services (c073s), Recreation and culture (c09s), Education (c10s) and Miscellaneous goods and services (c12s)

	c021s	c022s	c03s
(Intercept)	-5.660^{***}	-3.011^{***}	-1.754^{***}
	(0.457)	(0.853)	(0.299)
log(nicc/pc)	-0.236^{**}	0.561^{*}	
	(0.081)	(0.248)	
log(wicc/pc)	-0.234^{***}		0.270^{***}
	(0.053)		(0.073)
log(pc021/pc07)	-0.360^{***}		
	(0.071)		
log(pc021/pc08)	-0.260^{***}		
	(0.028)		
Z1	-3.576^{***}	5.584^{***}	-4.424^{***}
	(0.131)	(1.215)	(0.375)
Z2	0.359^{***}	-0.738^{***}	0.416^{***}
	(0.015)	(0.160)	(0.041)
Phi1	-0.146	-0.006	0.380
Phi2	-0.432	0.150	-0.139
log(uer)		-0.163^{*}	
		(0.067)	
log(pc022/pc05)		-0.472^{***}	
		(0.115)	
log(pc03/pc10)			-0.137^{*}
			(0.060)
sigma	0.014	0.042	0.025
AIC	-478.243	-278.997	-375.547
BIC	-453.935	-257.120	-356.101
Log-likelihood	249.122	148.499	195.774
N	84	84	84

	c0414s	c072s	c073s
(Intercept)	-5.464^{***}	-3.733^{***}	-1.428^{**}
	(0.271)	(0.398)	(0.461)
log(nicc/pc)	-0.701^{***}	0.168	0.149
	(0.069)	(0.112)	(0.089)
log(wicc/pc)	-0.257^{***}		0.160^{***}
	(0.020)		(0.045)
log(pc0414/pc05)	0.697^{**}		
	(0.225)		
log(pc0414/pc11)	−0.252		
	(0.144)		
log(pc0414/pc12)	−0.333		
	(0.185)		
Z1	2.433^{***}	1.543^{*}	0.432
	(0.585)	(0.677)	(0.423)
Z2	-0.299^{***}	-0.361^{***}	−0.039
	(0.060)	(0.086)	(0.038)
Phi	0.859	0.104	
log(uer)		-0.106^{**}	-0.137^{***}
		(0.032)	(0.023)
log(pc072/pc02)		-0.398^{***}	
		(0.115)	
log(pc072/pc071)		1.021^{***}	
		(0.122)	
log(pc073/pc04)			-0.509^{***}
			(0.119)
log(pc073/pc072)			-0.144^{*}
			(0.058)
log(pc073/pc08)			-0.226^{***}
			(0.048)
sigma	0.013	0.019	0.011
AIC	−585.666	−407.973	−493.393
BIC	−561.358	−386.096	−469.084
Log-likelihood	302.833	212.987	256.696
N	84	84	84

	c09s	c10s	c12s
(Intercept)	−4.538***	−9.219***	−3.298***
	(0.354)	(0.815)	(0.634)
log(nicc/pc)	−0.467***	−0.711***	−0.150
	(0.085)	(0.169)	(0.158)
log(wicc/pc)	−0.155***	−0.504***	−0.229***
	(0.029)	(0.079)	(0.053)
log(uer)	−0.069**		0.170***
	(0.026)		(0.043)
log(pc09/pc03)	−0.642***		
	(0.102)		
Z1	3.035***	8.496***	−3.972***
	(0.604)	(1.313)	(0.993)
Z2	−0.294***	−0.761***	0.466***
	(0.071)	(0.139)	(0.123)
Phi1	0.821		
Phi2	−0.285		
Phi3	0.306		
log(pc10/pc04)		−0.899***	
		(0.042)	
log(pc12/pc02)			−0.171
			(0.136)
log(pc12/pc07)			−0.259
			(0.200)
D09			−0.050***
			(0.014)
Phi			0.581
sigma	0.014	0.014	0.019
AIC	−543.242	−256.791	−436.373
BIC	−516.503	−243.693	−409.634
Log-likelihood	282.621	135.395	229.186
N	84	48	84

Figure 6: Impact of changes in the age composition of the population in percent



Projection Results for Consumption Purposes Related to section 4.2

Figure 7: Consumption projections with and without age coefficients