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**Working Paper**

## Consumption modelling considering different socio-economic household types

GWS Discussion Paper, No. 2015/15

**Provided in Cooperation with:**

GWS - Institute of Economic Structures Research, Osnabrück

*Suggested Citation:* Drosdowski, Thomas; Stöver, Britta; Wolter, Marc Ingo (2015) : Consumption modelling considering different socio-economic household types, GWS Discussion Paper, No. 2015/15, Gesellschaft für Wirtschaftliche Strukturforchung (GWS), Osnabrück

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GWS DISCUSSION PAPER 2015 / 15

## Consumption modelling considering different socio-economic household types

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### TITLE

Consumption modelling considering different socio-economic household types

### PUBLICATION DATE

© GWS mbH Osnabrück, September 2015

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### FUNDING (OPTIONAL)

The results at hand have been prepared during the research project soeb 3 commissioned by the Ministry of Education and Research.

### PUBLISHER OF THE GWS DISCUSSION PAPER SERIES

**Gesellschaft für Wirtschaftliche Strukturforschung (GWS) mbH**

Heinrichstr. 30

49080 Osnabrück (Germany)

ISSN 1867-7290

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# 1 SOCIO-ECONOMIC ANALYSIS FROM AN ECONOMIC PERSPECTIVE

Socio-economic analysis can be understood and described from both economic and social perspectives, i.e. different methodical tools and concepts can be applied to the very same aspects. Objects that can be addressed encompass on the one hand people or social groups living in households and making decisions regarding their lifestyles, consumption or children (fertility) under given institutional circumstances. On the other hand, people or social groups are part of production activities generating income. Usually, they take place in labour markets. Both areas are characterised by distributional inequalities and different participation opportunities.

The focus in this contribution lies on economic modelling opportunities with regard to household consumer behaviour. The social perspective in economic models is usually not sufficiently taken into account. The proposed method aims at addressing this caveats and will be employed within the research project *soeb 3*, funded by the Federal Ministry of Education and Research (BMBF), that aims at analysing the social development in Germany (Sozioökonomische Berichterstattung, Reporting on socio-economic development, <http://www.soeb.de/en/>). *soeb 3* is the third report of this kind, scheduled for completion in 2016. Socio-economic modelling has been previously used in different forms for projections in *soeb 2* (2006-2012, see Drosdowski and Wolter 2008, 2012).

Private households can be considered as one of the central institutional sectors of the economy. Their consumption behaviour, expectations towards government (provision of social services, infrastructure, education etc. or redistribution of income) and labour market behaviour affect the other economic sectors. The heterogeneity of consumption across private households, driven by income inequality as well as other socio-economic characteristics such as age, status or household size, has significant macro-economic consequences. Examples include housing, health products or purchase and use of vehicles. Households do not only affect other economic sectors but have to adapt and react to economic changes as well. Shifts in production structures affect private households by alterations in the labour market and changing prices. The government redistributes household incomes by transfers, taxes and levies on social benefits in order to avoid considerable income differences between household groups that can be a source of discontentment and social tensions.

To reveal social imbalances, the consequences of demographic change or the impact of policy measures, economic models considering socio-economic characteristics should be preferred over purely aggregate models. The presented method at hand offers the opportunity to track socio-economic changes in Germany until 2030 from a macro-economic perspective. We concentrate on income generation and private household consumption on a high level of detail provided by the variety of observed household groups. The resulting socio-economic consumption module interacts with the macro-econometric input-output model INFORGE so that the interrelated macro-economic effects of social characteristics can be shown.

The text is structured as follows: Section 2 gives the motivation for the integration of socio-

economic information in economic models. Subsection 2.1 states the importance of household consumption for the economy. In Subsection 2.2 it is shown that the structure of private consumption depends considerably on the composition of private households and their specific income. Section 3 describes a way to integrate disaggregated household data into a macro-economic model. The structure and functioning of the economic model is given in Subsection 3.1 followed by an overview of the required data in Subsection 3.2. Subsection 3.3 gives a detailed description about the methodology of the consumption module DEMOS that connects socio-economic specific household behaviour with the macro-economic model. The conclusions are summarised in Section 4.

## 2 PRIVATE CONSUMPTION AND THE SIGNIFICANCE OF HOUSEHOLD STRUCTURE

### 2.1 IMPORTANCE AND STRUCTURE OF PRIVATE CONSUMPTION

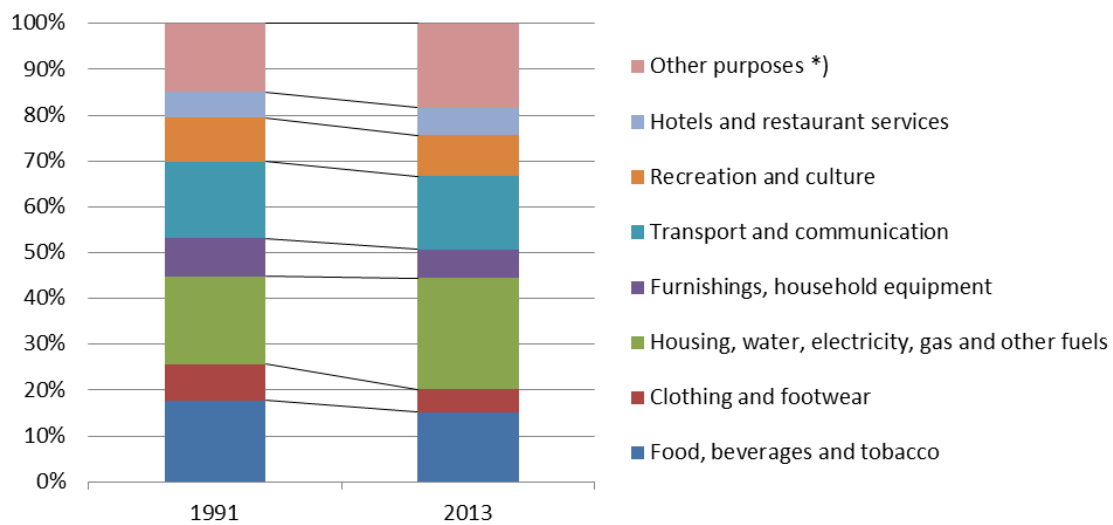
The German consumers are sometimes criticised for their extensive saving behaviour leading to annual saving ratios of more than 10% of the GDP. The low propensity to consume is also often used to legitimate the importance of the German export sector and the high foreign trade surplus.<sup>1</sup> Nevertheless, private consumption is still the main component of GDP in Germany: it has been contributing around 61% to domestic uses since the beginning of 2000 (Federal Statistical Office 2014). In 2013 final consumption expenditures of private households added up to 1.6 trillion Euros (ibid.).<sup>23</sup> More than half of private households consumption expenditures are for groceries (“food, beverages and tobacco”), habitation (“housing, water, electricity, gas and other fuels”) as well as “transport and communication” (see Figure 1). The importance of these three consumption purposes has persisted ever since 1991. However, the single weights of the different consumption purposes experienced a shift between 1991 and 2013: while habitation gained importance (+5.1%-points), the shares of groceries and “transport and communication” declined by 2.5%-points and 0.7%-points respectively. Other consumption purposes that were reduced in the average consumption bundle are “clothing and footwear”, “furnishings and household equipment” as well as “recreation and culture”. In comparison, proportional expenditure increases were observed for “hotels and restaurant services” as well as “other services”. The changes in the consumption structures can be partly explained by changes in income (necessary versus luxury goods). In addition, socio-economic characteristics of the household such as size, social position, age etc. play an important role in changing consumer behaviour. The next Subsection gives an overview of differences in income and consumption expenses across different household groups, defined by these characteristics.

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<sup>1</sup> For a discussion of the foreign trade surplus and the relatively low consumption expenditures see for example van Treeck (2013), Schrooten, & Teichmann (2010), Stockhammer, Hein and Grafl (2011).

<sup>2</sup> Private households include non-profit institutions serving households (NPISHs). The latter have only a minor share of 3% (2013) of the total consumption expenditures.

<sup>3</sup> In comparison, exports reached 1.4 trillion Euro, the trade balance running a trade surplus of 174 billion Euros (Federal Statistical Office 2014).

**Figure 1. Composition of private consumption expenditures in 1991 and 2013.**

\*) "Other purposes" includes health, education, personal care, personal effects, social protection, insurance and financial services, other services

Source: Federal Statistical Office (2014), own calculation.

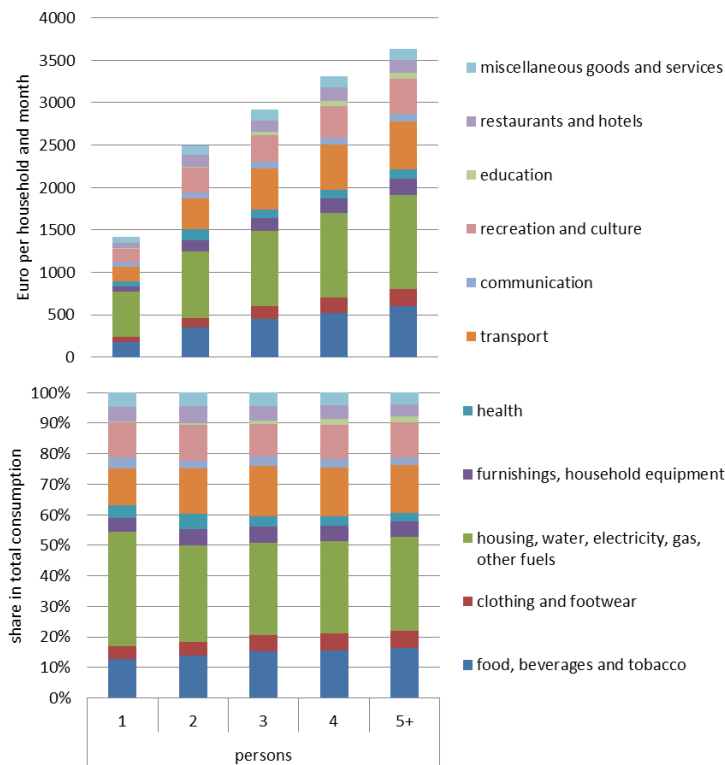
## 2.2 CONSUMPTION AND INCOME ACROSS HOUSEHOLD GROUPS

The consumption behaviour of households varies with their income, preferences and needs. This variation can be shown by data that differentiates between households, based on socio-economic characteristics of their main income earner. In some cases, different characteristics coincide with similar behaviour because the same households are addressed. Families for example often are big households with three or more members and can be found in middle age groups. Pensioners can typically be found in small households and in the age groups of 65 years and older. "White collar" employees are more often found in higher income groups than "blue collar" workers etc. To keep matters simple, only some aspects – household size, social status and household income – are selected to show the differences in consumption expenditures and income composition.

The bigger a household is (in terms of people) the more it spends on consumption (see Figure 2). However, the increase in consumption expenditures is not linear with household size. The bigger households can benefit from economies of scale. A two-person household consumes only 1.8 times more (in Euros) than a single household. The gap per capita increases with the household size, resulting in only 2.6 times more consumption for a five-and-more-person household compared to a single household. The economies of scale become particularly apparent for the share of habitation expenditures in total consumption. Living alone implies that, on average, 38% of total consumption has to be devoted to housing, water and energy. This share reduces to 32% for a two-person household and to 30% for even bigger households. The opposite case can be observed for groceries, clothing, transport and education. The consumption shares of these purposes increase with a growth in household size. All other consumption purposes hold similar shares regardless the size

of the household.<sup>4</sup>

**Figure 2. Consumption expenditures by household size.**



Source: Statistisches Bundesamt (2010a), own calculation.

The differences in the consumption structure are more explicit when looking at the expenditures by social status (Figure 3) or household income (Figure 4). Both dimensions are interconnected, since a certain social status usually entails a certain level of income. “White collar” employees are more likely to have higher salaries than “blue collar” workers and are usually found in the middle to high income groups. The highest income groups often correspond to (retired) civil servants („Beamte“) and self-employed. The lowest income groups are usually identical with households of the unemployed. An average pensioner (not a former “Beamter”) can be associated with a middle income group.

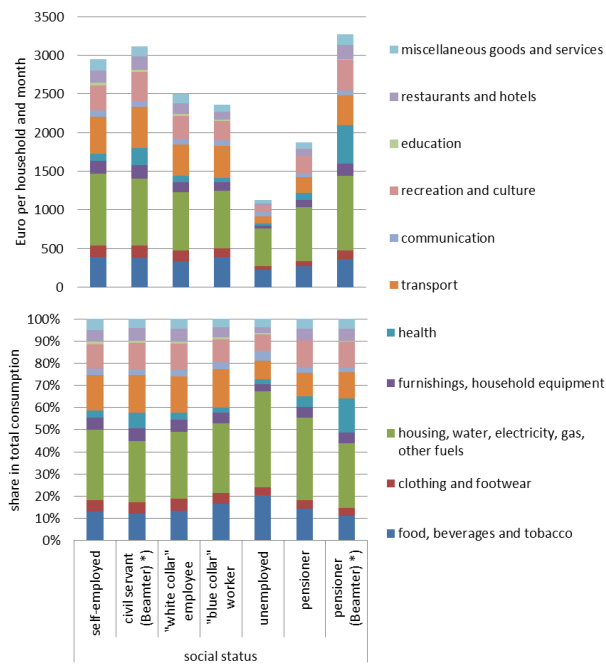
Consumption spending increases with income level, i.e. the more money is at one’s disposal the more is consumed. Moreover, the shares of the single consumption purposes change as well: the consumption of high-quality goods and services increases disproportionately with a rise in income (Engel 1895). Thus, with growing income, expenses for necessities such as “food, beverages and tobacco” decrease relative to all other expenses, so that (retired) civil servants and self-employed persons use less of their income for food products, while the unemployed and pensioners have comparably higher shares. The same is true for “housing, water, electricity, gas and other fuels”. Consumption purposes that can be classified as being more luxurious are “transport”, “recreation and culture”, “furnishings and

<sup>4</sup> The reason for this result lies in the nature of the consumption purposes. In many cases the underlying consumption items have to be purchased by individual persons (tickets for theater, meals in restaurants for example), which eliminates the economies of scale.



household equipment” as well as “restaurants and hotels”. With higher income their share in the consumption bundle increases. The consumption purpose “health” is less connected to income but depends more on the age of the consumer. Hence, the consumption shares spent for health products and services are highest for pensioner households. Civil servants spend a high share of their consumption expenditures on health as well, which is due to their special legal status and their specific health security system.<sup>5</sup>

**Figure 3. Consumption expenditures by social status of the main income earner.**

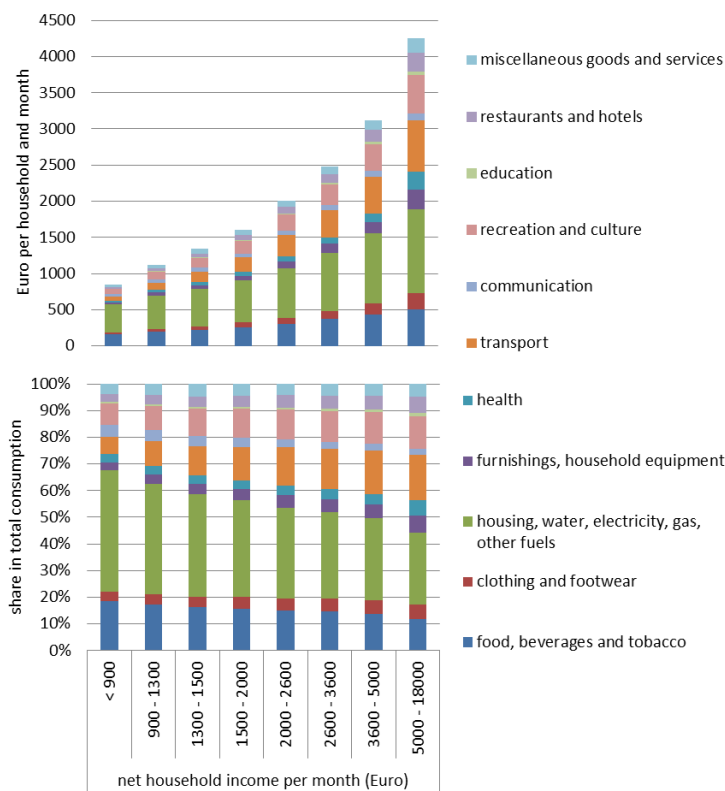


Note: \*) Civil servants („Beamte“) are subject to a special legal status.<sup>6</sup>

Source: Statistisches Bundesamt (2010b), own calculations.

<sup>5</sup>50% of the health care expenses are paid by the “Beihilfe”, i.e. a special form of public health security system. The remaining 50% are covered by the civil servants themselves mainly by a private health insurance. The latter is part of the consumption purpose “health”. For more information see Otto (2007).

<sup>6</sup>The particular legal status includes a special remuneration and social security system. For more information see again Otto (2007).

**Figure 4. Consumption expenditures by household (net) income.**

Source: Statistisches Bundesamt (2010c), own calculations.

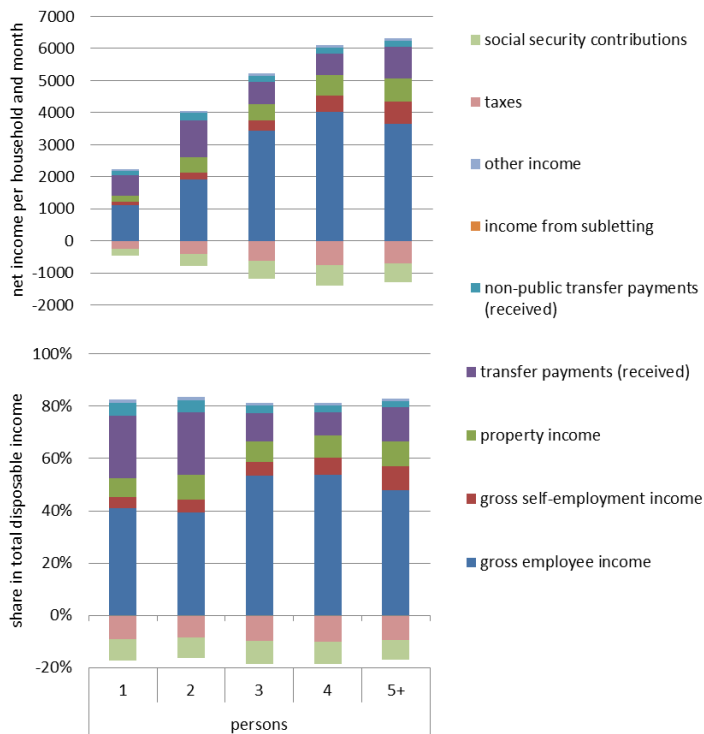
The analysis so far has shown that the overall consumption structure and expenditures depend on the household composition with regard to the population. For example, a growing number of pensioner households due to demographic change would imply that the consumption expenditures for housing (including electricity etc.) and health would gain importance relative to all other purposes. Their total consumption expenditures however should decline given their considerably smaller consumption budget. The latter is influenced by the income structure that varies with socio-economic characteristics as well.

Income components which are subject to changes by redistributive policies (via income taxes, social welfare payments or transfers) or the labour market situation are main determinants of consumption. Policy measures, wage negotiations by labour unions and employers' associations as well as the labour demand affect households and their income differently, depending on the income structure. The differences in income should hence be considered for consumption analysis as well.

The disposable household income is composed of the sum of gross employee income, gross self-employment income, property income, transfer payments (received), non-public transfer payments (received), income from subletting as well as other income minus taxes

and social security contributions.<sup>7</sup> Labour income plays the dominant role: it is the main income component for households of working age. Past labour income affects the level of present pensions contributing mainly to pensioner households.

**Figure 5. Income components by household size.**



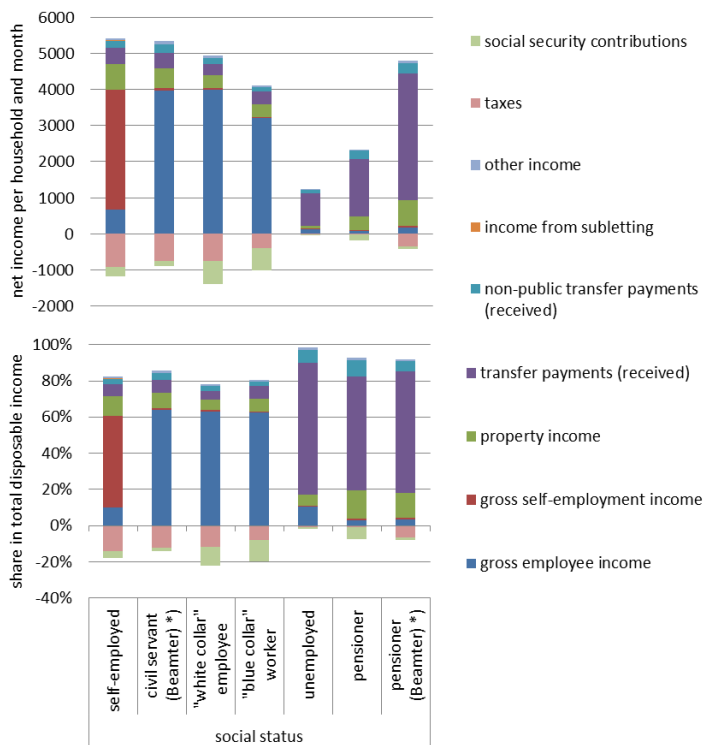
Source: Statistisches Bundesamt (2010a), own calculation.

The share of gross employee income is lowest in one- and two-person households and highest in households with three members (see Figure 5). With growing household size this share declines again, never reaching the low level of the small households, though. Pensioners can be almost solely found in the category of small households (1-2 persons) which reduces the relative amount of labour income of the respective household group and leads to a relatively high level of received (non-)public transfer payments (pensions from social pension funds, company pension schemes or private insurance schemes). A household with three persons most probably consists of two income earners and one child. Higher household sizes imply more children that add to the weight of received public transfer pay-

<sup>7</sup>Gross employee income + gross self-employment income + property income + transfer payments (received) + non-public transfer payments (received) + income from subletting = gross household income. Gross household income – taxes – social security contributions = net household income. Net household income + other income = disposable income. Property income includes among others income from rent and lease as well as imputed rents, i.e. the money that one saves on rent by living in one's own accommodation. Transfer payments consist mainly of pensions, unemployment benefits, short-time working allowance, child benefits, maternity benefits, housing benefits, social benefits, Elterngeld (parenting benefit)/child-raising allowance, education advancement grants (BAföG), Pflegegeld (allowance for nursing care). Taxes are composed of income tax, church tax and solidarity tax. Other income is defined as income from the sale of goods, lottery winnings, bottle deposit returns etc.

ments (child benefits, maternity benefits, Elterngeld (parenting benefit)/child-raising allowance etc.). Property income has the highest relevance – i. e. the highest share in income – for households with five and more members, followed by two-person households and four-person households. More than 60% of this income component consists of imputed rents.<sup>8</sup> The higher weight of property income for big households suggests that families are likely to live in self-owned dwellings. Over time, when the children move out, the parents live as two-person households in their houses, which explains the relatively high importance of property income for them as well.

**Figure 6. Income components by social status of the main income earner.**



Note:\*) Civil servants („Beamte“) are subject to a special legal status.

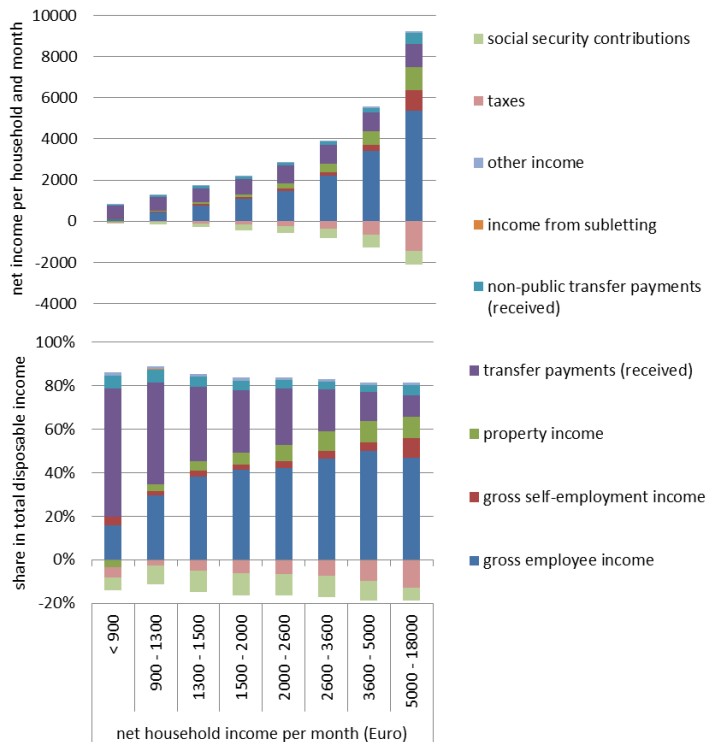
Source: Statistisches Bundesamt (2010b), own calculations.

The relative importance of the single income components changes slightly when looking at the social status in Figure 6. While “white” and “blue collar” employees and the self-employed receive their main income from work, the unemployed and pensioners (regular and former “Beamte”) rely on transfer payments. The nature of the transfer payments differs

<sup>8</sup> The dwellings are fixed assets that their owners use to produce housing services for their own consumption. The rents may be imputed by the rents payable on the market for equivalent accommodation or by user costs. The imputed rents of these housing services should be valued at the estimated rent that a tenant pays for a dwelling of the same size and quality in a comparable location with similar neighbourhood amenities (OECD 2007).

between pensioners and the unemployed consisting by about 90% of public pension payments for the first and by over 80% of unemployment benefits for the latter.<sup>9</sup> The proportion of property income is highest for regular pensioners, self-employed persons and former “Beamte”. The highest amount of taxes is paid by the self-employed and employees due to their (often) higher income levels compared to workers. Civil servants (“Beamte”) have an exceptional position by not paying social security contributions, but they are obliged to pay taxes after retirement.

**Figure 7. Income components by household income (net).**



Source: Statistisches Bundesamt (2010c), own calculations.

The dominant position of labour income also shows in the composition of households by household income in Figure 7: the higher the wage from (self-)employment the higher is the overall household income. This also holds true for the respective share on income. The same characteristic (absolute and relative) can also be found for property income but to a much lower extent. Transfer payments are the counterpart for these two income components when looking at the shares. Their portions are highest in the lowest income groups and decrease with increasing labour income. However, in absolute terms the level of transfer payments is growing with household income. The reason behind this is that in the higher income groups transfer payments mostly consist of pensions and child benefits, whereas in the two lowest income groups it is mostly unemployment benefits securing the means of

<sup>9</sup> Public pension payments include pensions under the statutory pension insurance scheme, pensions for former “Beamte”, pensions from the compulsory supplementary public-service pension scheme and pensions from the statutory accident insurance scheme. The unemployment benefits are distinguished into type I and II. The unemployment benefit I is paid at most for 24 months directly after the job loss. Type II represents a safety net afterwards to guarantee subsistence level.

subsistence.

Taxes increase in relation to the household income and hence they are highest in the highest income group. The absolute amount of social security contributions increases with income as well, which is also valid for the shares except for the highest income group. This group most probably includes a large number of the self-employed and civil servants (“Beamte”). By their differing legal status they are privately insured, which is a part of their consumption expenditures and thus not considered as a part of income.

In summary, consumption and income vary considerably in structure and magnitude depending on household characteristics. Changes that affect the household composition, such as demographic change or household-formation behaviour, influence household income and the amount and type of goods and services consumed. Policy instruments aiming at redistribution for example have an impact on the consumption structure via income. The changes in demand eventually translate to adjustments in production: the production structure and its supply need to adapt to the new consumption structure. Participation possibilities of households are altered as well. Consequently, the variables considering household characteristics should be integrated in economic models, in order to increase the plausibility of their results.

In the next Section a modelling and integration concept is presented.

### 3 SOCIO-ECONOMIC MODELLING OF PRIVATE CONSUMPTION

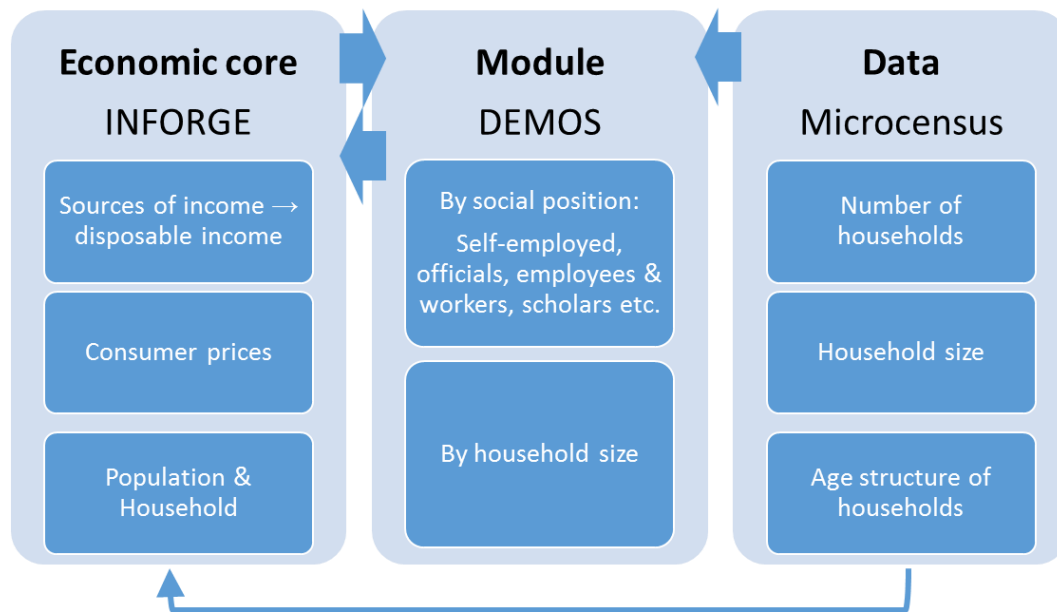
Household-specific consumption behaviour is of interest for understanding various social and economic issues. The “Report on Poverty and Wealth” of the German Federal Government, for example, uses the information on income and consumption expenditures by different household types in the context of social participation.<sup>10</sup> Other important subjects related to private consumption include sustainability, redistribution or implications of demographic change.

Many of these topics can be analysed by means of advanced socio-economic modelling. In the following a modelling approach is presented that provides a possibility to integrate more advanced socio-economic structures (DEMOS) in a macro-economic model environment (INFORGE). Figure 8 gives an overview over the modelling structure. The consumption module DEMOS with detailed socio-economic information on income components and consumption structure receives input from the Microcensus (see Section 3.2, p. 14) and the economic model INFORGE (see Section 3.1). The former provides information on changes in the household structure (number of households, size and age of households). The latter offers projections (until 2030) on income components and consumption expenditures by purpose for all households. The information is used to project the detailed data within the consumption module DEMOS. Changes in the aggregate consumption that result from changes in the household or income composition can finally be reintegrated into the model INFORGE. The economic consequences of e.g. ageing then can be quantified.

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<sup>10</sup> For the latest edition see Federal Ministry of Labour and Social Affairs (2013).

Figure 8. Inputs in the household module DEMOS.



Source: own figure.

In the next sections the functioning of the economic model INFORGE (Section 3.1) and the structure of the data basis (3.2) is described. The detailed modelling procedure and the functional relationship between model and socio-economic data set (DEMOS) are given in Section 3.3.

### 3.1 THE ECONOMIC MODEL INFORGE

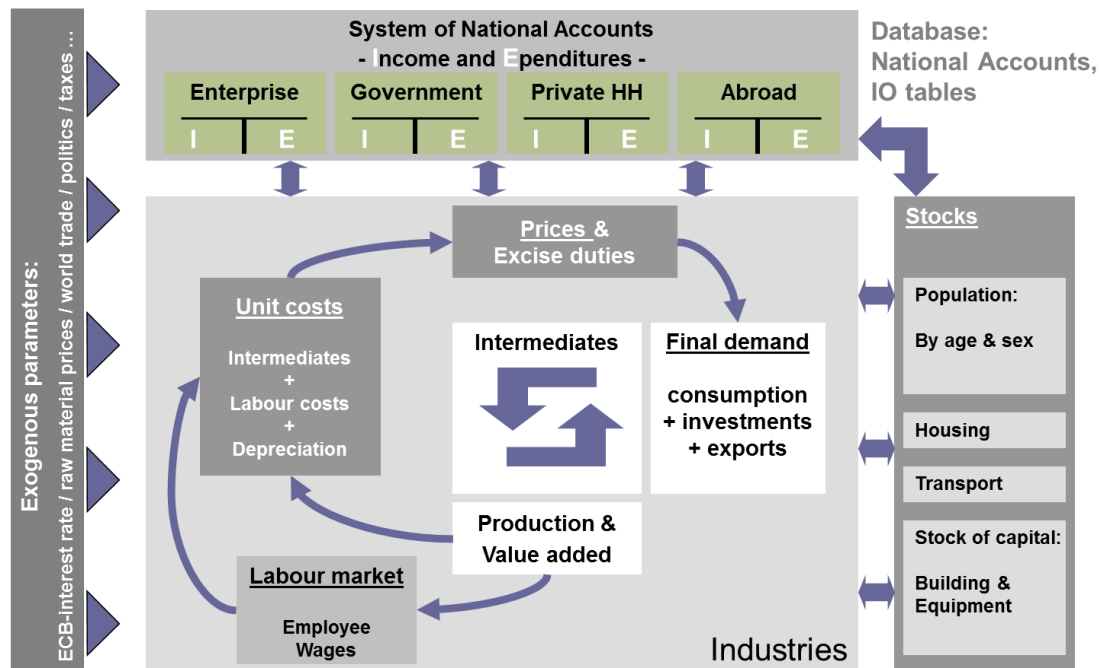
INFORGE (INterindustryFORecastingGERmany) is a macro-econometric input-output model for Germany (see Figure 9). The model has been used for economic forecasts, projections and scenario analyses in many projects and studies (e.g. an der Heiden et al 2012, Helmrich 2013, Stöver 2013). It is established among European input-output models (EUROSTAT 2008, pp. 527) and is well documented (Distelkamp et al. 2003, Ahlert et al. 2009).

The model belongs to the INFORUM family of modelling (Almon 1991) and follows the ideas of bottom up and full integration. Each industrial sector is modelled individually and macro-economic variables are calculated through explicit aggregation. This way, each individual sector is embedded within the economic context and industrial interdependencies are explicitly incorporated and used to explain economic interaction. The model is based on the System of National Accounts and Balancing items (SNAB) including input-output tables as its economic core. Thus, interindustry relations are incorporated on a high level of detail. The demand as well as the supply side is equally considered by taking the interacting relationship between production sectors, private household demand and price effects into account. Bounded rationality and imperfect markets are allowed. It is annually updated and often combined with modules for specific questions and objectives (e.g. Maier, Mönnig and Zika 2013, Ulrich, Distelkamp and Lehr 2012, Drosdowski and Wolter 2012). The model calculates projections until the year 2030.

Some variables have to be set exogenously by adequate assumptions. This is the case for

fiscal policy instruments such as taxes, interest rates of the European Central Bank, exchange rates and commodity prices. The global economic development is given by the GDP forecasts of the International Monetary Fund (World Economic Outlook), the European Commission (AMECO) and the International Energy Agency (World Energy Outlook). The international economic performance determines the worldwide trade volume (imports). The German exports can hence be derived using bilateral trade matrices.

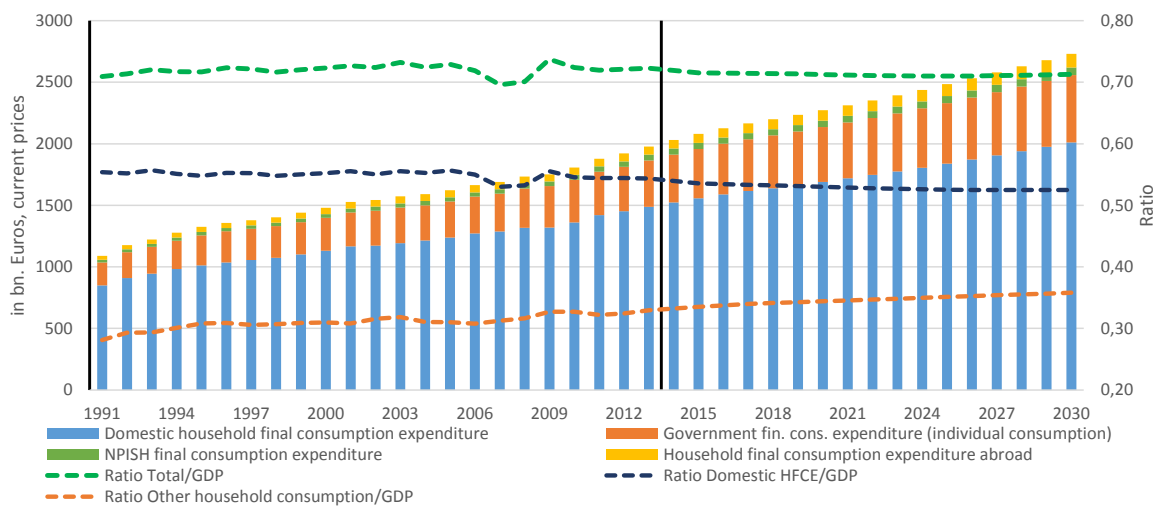
Figure 9. The macro-econometric model INFORGE.



Source: own figure.

INFORGE is a powerful tool to analyse a wide variety of socio-economic issues on the aggregate level and to generate numerous socio-economic indicators related to private and public consumption or wage and capital income, as can be seen in the example given by Figure 10. The figure shows the development of consumption expenditures by institutional sectors.



**Figure 10. Household consumption – a socio-economic indicator generated with INFORGE.**

Source: Statistisches Bundesamt 2014, INFORGE.

Although its basic version is not designed to trace developments on the household level, the INFORGE model offers the opportunity for a variety of extensions: energy and environment, labour market disaggregated by occupation and qualification, world trade or regional aspects, to name a few. One of the extensions, DEMOS, focuses on private consumption differentiated by household groups, using more disaggregated data. The former version of the module was already successfully used within the project *soeb 2*, as well as in studies related to distributional effects of environmental policies (Blobel et al. 2011, EEA 2011). The former version of DEMOS contained labour market modelling focused on qualifications. These issues, however, are currently examined using the model extension QINFORGE within the ongoing QuBe project (see for example Helmrich et al. 2013).

The most relevant and important information for the consumption module is the development of income and receipts by different sources and of consumption expenditures by 41 consumption purposes.

### 3.2 DATA REQUIREMENTS AND AVAILABILITY

The relevant data set containing disaggregated socio-economic information on private households with regard to income and consumption in Germany is the Household Budget Survey (HBS) published by the German Federal Statistical Office (Statistisches Bundesamt). It provides data in Euros on income and expenditures per household and month, differentiated by household size, age group, social status, household type, income group and cross combinations of these characteristics.<sup>11</sup> The level of detail is very high and provides an opportunity for extensive research on structure, behaviour and participation opportunities of households. Nevertheless, there are some deficiencies: the survey is only conducted every fifth year and the research procedure and classification structure have been subject to frequent revisions, making an inter-temporal comparison of the rare data points difficult. The currently available data stem from the latest HSB wave for the year 2008. New

<sup>11</sup> The characteristics are classified by the main income earner.

data for 2013 is not expected to become available before 2015.

Within the five year cycle of data provision smaller surveys – called “Laufende Wirtschaftsrechnungen” – supplement the data. However, they are less reliable and cannot be directly compared with the HBS results. Thus, the data basis may not be sufficient for econometric analysis relying on time series. A direct integration into the economic model INFORGE, which uses time series to estimate behavioural relationships between income, prices and consumption, is hence difficult. Nevertheless, an indirect link is still a valid option: the economic model can create an adequate stimulus for the socio-economic data set and the changes can be fed back to the economic model.

An additional important data source is the Microcensus – an official representative statistic of the population and the labour market in Germany (the largest annual household survey in Europe) with a general sampling fraction of 1% of the population for all variables.<sup>12</sup> Using the Microcensus information, it is possible to analyse the evolution of household structures. The Microcensus provides data for the consumption module DEMOS as well as information for the household projection of the economic model INFORGE.

### 3.3 METHODOLOGY OF THE HOUSEHOLD MODULE DEMOS

Figure 11 gives a simplified overview of the functional relationship between INFORGE and the socio-economic module DEMOS that consists of four main steps:

1. The growth rates for income and receipts (by sources) from the economic model INFORGE are applied to the respective income components of DEMOS. The income components of DEMOS are the same as in INFORGE, but they are differentiated by household size and social status.<sup>13</sup> As shown in Section 2.2, the composition and level of income varies considerably between household groups. Different growth rates for different sources of income hence result in different household income developments depending on socio-economic characteristics. If pension payments within the economic model INFORGE increase because of a legislative reform for example, this should have the same effect on the respective value in DEMOS. As a result, the socio-economic group “pensioner household” can profit and has a higher disposable income.
2. The same procedure as in (1) applies for the shares of consumption expenditures (by purposes) in disposable income.
3. The changing shares of consumption purposes are multiplied by the disposable income of each household type resulting in household specific consumption expenditures.
4. The expenditures are then summed up over all household types and reintegrated

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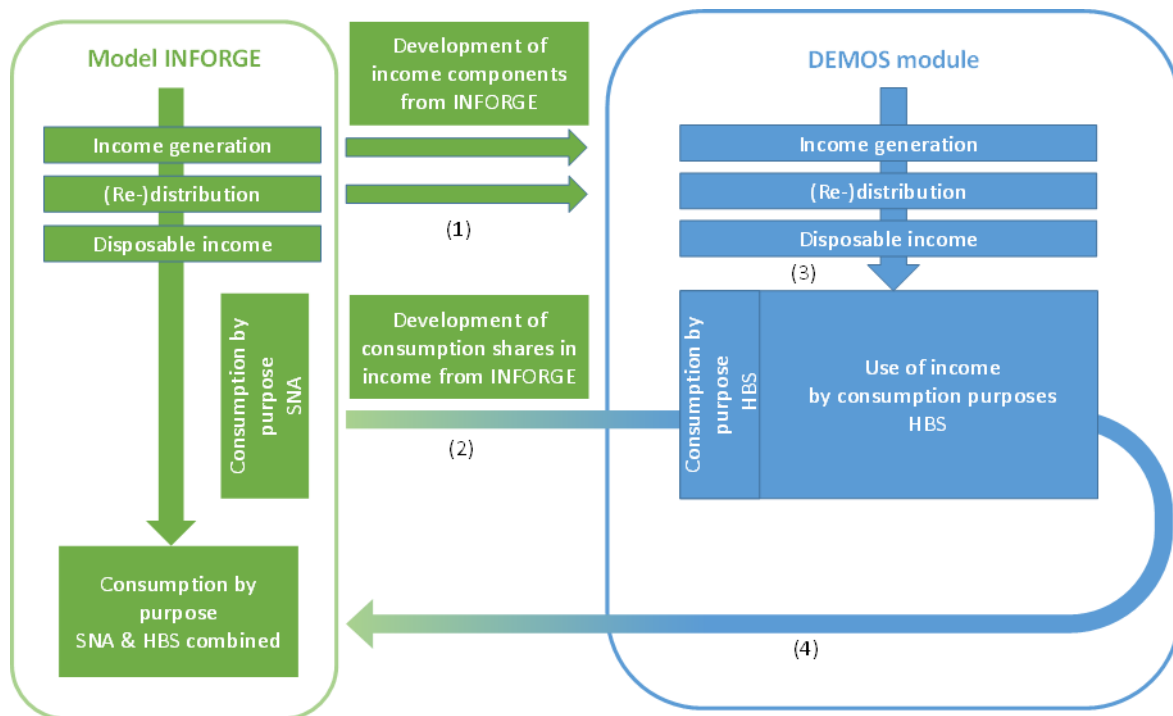
<sup>12</sup> For basic information on the Microcensus see [https://www.destatis.de/EN/Meta/abisz/Mikrozensus\\_e.html](https://www.destatis.de/EN/Meta/abisz/Mikrozensus_e.html).

<sup>13</sup> The social characteristics household size and social position are linked with each other resulting in a 5x10 matrix. Household size has a dimension of 5 (1, ..., 4 and 5+ person households), social status of 10 being self-employed farmer, self-employed (except farmer), “Beamter”, employee, worker, unemployed, pensioner, pensioner (former “Beamter”), student (university), other non-working population.

into the economic model INFORGE.

Thus, the consumption expenditures for different consumption purposes and household types can be projected until 2030. Changes that occur due to alterations in the household composition (e.g. more pensioner households) are included.

**Figure 11. Interaction between INFORGE and DEMOS.**



Source: own figure.

The process (2) – (4) can also be described in detail by the following equations.<sup>14</sup> The changes of the consumption purposes in INFORGE are obtained by empirically estimated relations. According to equation [1] the consumption expenditures in current prices ( $cpv_n$ ) for purpose  $j$  depend on disposable income ( $B6N00BH$ ) and their own price development ( $pcpv_j$ ).<sup>15</sup> Additional explanatory variables can be changing habits, demographic change and information from the housing stock or from the stock of vehicles.

$$cpv_{n,j,t} = f(B6N00BH_t, pcpv_{j,t}, Pop, House, Car) \quad [1]$$

$cpv_{n,j}$  ~ consumption expenditures for consumption purpose  $j$

$pcpv_j$  ~ consumer price of consumption purpose  $j$

$B6N00BH$  ~ disposable income (all private households)

$Pop$  ~ change in habits, demographic change

$House$  ~ results from the module "housing stock"

$Car$  ~ results from the module "transport and vehicles"

<sup>14</sup> The systematic of the equations for step (1) is similar to that for step (2) and is therefore omitted. They can be made available by the authors upon request.

<sup>15</sup> More precisely, consumption expenditures in INFORGE are estimated in "real" terms, using price indices as deflators. The expenditures are then multiplied with prices. For simplicity, equation [1] and its explanation are given in nominal terms.

The estimated consumption expenditures  $cpvn_j$  along with disposable income  $B6N00BH$  resulting from INFORGE provide the growth path for the shares of the consumption purposes in disposable income  $qcpvnevs_{i,j}$  for the consumption module DEMOS:

$$qcpvnevs_{i,j,t} = qcpvnevs_{i,j,t-1} * \frac{cpvn_{j,t}/B6N00BH_t}{cpvn_{j,t-1}/B6N00BH_{t-1}} \quad [2]$$

$qcpvnevs_{i,j}$  ~ HBS-consumption share for household  $i$  und consumption purpose  $j$   
 $cpvn_j$  ~ consumption expenditures for consumption purpose  $j$   
 $B6N00BH$  ~ disposable income (all private households)

Using this procedure it is assumed that

- a) the changes in the consumption shares are the same for all household types.<sup>16</sup>
- b) the price changes and the related substitutional or complementary adjustments in consumption are the same for all household types.

Thus, fundamental movements of the consumption structure apply to all households in the same way. Differences occur due to household specific weights of the consumption shares. For example, if a rise in energy prices induces higher energy expenses and thus an increase of the share of electricity in disposable income, then the rate of increase will be the same for all household types. The reactions to price changes concerning other consumption shares across households are equal in intensity and direction as well. However, the impact of a price change is different for each household type: Households with e.g. high levels of energy expenditures relative to income are more affected than those with smaller shares. Households with very low disposable income may even be forced to dissave.

Additional differences arise from the household specific disposable income. The amount spent by household  $i$  for consumption purpose  $j$  ( $cpvnevs_{i,j}$ ) depends on the respective household income  $b6n00bh_i$ :

$$cpvnevs_{i,j,t} = qcpvnevs_{i,j,t} * b6n00bh_{i,t} \quad [3]$$

$cpvnevs_{i,j}$  ~ consumption expenditures for purpose  $j$  by household  $i$   
 $qcpvnevs_{i,j}$  ~ HBS-consumption share for household  $i$  und consumption purpose  $j$   
 $b6n00bh_i$  ~ disposable income of household  $i$

Multiplying the resulting consumption expenditures of [3] with the number of households of each household type ( $hhevs_i$ ) and aggregating over all households yields the total consumption level of purpose  $j$  ( $cpvnevs_{j,t}$ ):

$$cpvnevs_{j,t} = \sum_i (cpvnevs_{i,j,t} * hhevs_{i,t}) \quad [4]$$

$cpvnevs_{j,t}$  ~ total consumption expenditures for purpose  $j$   
 $hhevs_i$  ~ number of households of household type  $i$

The resulting changes in consumption behaviour from DEMOS are applied to the initial value for consumption purpose  $j$  ( $cpvn_j$ , equation [1]) in the economic model INFORGE.

$$cpvn_{new_{j,t}} = cpvn_{j,t-1} * \frac{cpvnevs_{j,t}}{cpvnevs_{j,t-1}} \quad [5]$$

<sup>16</sup> The household types are differentiated by social status linked with household size.

$cpvn\_new_j$  ~ newly calculated consumption expenditures (INFORGE) for consumption purpose  $j$   
 $cpvn_j$  ~ initial consumption expenditures (INFORGE) for consumption purpose  $j$   
 $cpvnews_j$  ~ total consumption expenditures (DEMOS) for purpose  $j$

The newly calculated values for each consumption purpose  $j$  ( $cpvn\_new_j$ ) replace the original values  $cpvn_j$  [6]:

$$cpvn_{j,t} = cpvn\_neu_{j,t} \quad [6]$$

$cpvn_j$  ~ consumption expenditures (INFORGE) for consumption purpose  $j$   
 $cpvn\_new_j$  ~ newly calculated consumption expenditures (INFORGE) for consumption purpose  $j$

The resulting consumption expenditures in the economic model INFORGE are now different from the previously estimated ones, as they include the behavioural shifts resulting from socio-economic information from the consumption module DEMOS. The changes in private consumption affect all other parts of the model and have an impact on the performance of the other economic sectors and hence the results.

The connection between macro-economic model and socio-economic information offers various opportunities for scenario analyses. Policy measures that address the redistribution of income by taxes or levies on social benefits, for example can be analysed considering the direct impact on households, their income and consumption structure. Indirect effects on production, prices as well as on the labour market induced by the changes in consumption can be shown as well.

## 4 CONCLUSIONS

The discussion of private consumption in Germany has shown that it is enormously important for the economy, despite the export orientation and rather conservative savings behaviour of the households. Since 1991, structural shifts in consumption have occurred and they are likely to continue in the future. Across various household groups there is a considerable heterogeneity in consumption patterns, which is also apparent with regard to incomes.

The proposed modelling approach provides a possibility to integrate more advanced socio-economic structures in a macro-economic model environment and hence to facilitate a combination of micro-based and macro data. To track social imbalances, resulting, for example, from demographic change or as an effect of policy measures, economic models taking into account “deeper” socio-economic characteristics appear to be more adequate than purely aggregate models. The macro-economic effects of socio-economic characteristics on the household level can be shown more explicitly and provide an extension to the original model output.

Using the forecasting capabilities of the underlying macro-econometric input-output model INFORGE, scenarios addressing demographic change, social transformation and/or changes in income can be generated and calculated. In collaboration with other institutions involved in *soeb 3*, simulations relating to consumption poverty (see for example Pfeiffer, Ritter and Hirsland 2011) and sustainable consumption (see for example Leßmann and Rauschmayer 2013) are planned. Moreover, the socio-economic modelling will be used for the calculation of a variety of socio-economic indicators.

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