The impact of ageing on income inequality

Thomas Drosdowski

Britta Stöver

Marc Ingo Wolter

Impressum

AUTHORS

Dr. Thomas Drosdowski,

Tel: +49 (541) 40933-220, Email: drosdowski @ gws-os.com

Britta Stöver

Tel: +49 (541) 40933-250, Email: stoever @ gws-os.com

Dr. Marc Ingo Wolter

Tel: +49 (541) 40933-150, Email: wolter @ gws-os.com

TITLE

The impact of ageing on income inequality.

PUBLICATION DATE

© GWS mbH Osnabrück, September 2015

DISCLAIMER

Opinions expressed in this paper are those of the authors and do not necessarily reflect the views of the GWS mbH.

TABLE OF CONTENTS

1   AGEING AND INEQUALITY

In Germany, demographic change and ageing is mainly seen negatively. The scientific, public and political perception is dominated by issues such as labour force shortage, instability of the pension system or exploding costs for the health care system to name only few. With regard to private households, poverty among the elderly, intergenerational fairness or the wealthy prime agers are frequently mentioned in this context. However, it is not entirely clear whether the distribution of income will become less fair and poverty among the elderly will be a severe problem of many households. Papers that examine the interaction between demographic change (ageing) and income inequality stress the point that there is no simple and clear-cut answer whether ageing leads to more or less inequality (Mookherjee & Shorrocks, 1982, Pestieau, 1989, von Weizsäcker, 1996, Lam, 1997): ageing has many different and in part opposed effects on household income, wages, distributional policies, pension schemes and household behaviour. The combination of the different influencing factors determines the overall relation between ageing and inequality. Additionally, the outcome is sensitive to the weight of the single drivers. They may change e.g. due to the political power of the increasing number of elderly people or by necessary adjustments of the health care contribution rates. Nevertheless, the population – its composition and magnitude – could be seen as explorative starting point for the evolvement of inequality. Considering the different positive and negative impacts of ageing on inequality most empirical findings so far show that income inequality increases with demographic ageing (see e.g. (Faik, 2012, Peichl et al., 2012, Guerin, 2013).

This paper attempts to shed some light on this issue, using empirically-based modelling. However, we do not distinguish between age groups but compare the income situation of different household types. These types comprise pensioner, working and other (non-working) households, whose disposable incomes are being compared with the mean income of all households in Germany.[1] The aim is to show the development (2016-2030) of inequality represented by the distance of each household type from the average income. Additionally, we identify the quantity and structural effect of ageing on income and inequality. For that purpose we combine the macro-econometric input-output model INFORGE with the socio-economic module DEMOS. Due to the applied methodology we can consider the feedback of the labour market and the production on the income components.

The income of pensioner households is almost 20 % below average. The model outcomes show that the distance to the average will increase from 2015 to 2030 implying a growing inequality due to ageing. As demographic change progresses, income inequality even accelerates from 2025 on. The increasing inequality is mainly driven by the structural effect. Ageing causes labour market shortages that translate in high wage rises. The increases in pensions stay behind the wage rises resulting in the growing income deviations.

The remaining paper is structured as follows. Section 2 gives an overview over the income structure of different household types provided by the Household Budget Survey. In Section

---

[1] The household type complies with the social status of the main income earner, i.e. the household member with the highest net income. The category "working household" encompasses all households whose main income earner is (self-) employed and receives its main income from wage income.

3 the methodology is described, i.e. the macro-econometric input-output model (subsection 3.1), the data set (subsection 3.2), the socio-economic module DEMOS (subsection 3.3) and the scenario settings (subsection 3.4). The results are presented in section 4. Section 5 concludes.

2 PENSIONER HOUSEHOLDS IN GERMANY: INCOME STRUCTURE AND RELATIVE INCOME POSITION

Pensioner households represent an important part of the German population. They constitute 31 % of all households (Statistisches Bundesamt, 2014). Due to demographic change their share will increase in the future, giving their household budgets and consumption behaviour more weight. This fact alone shows the enormous socio-economic importance of these households. To gauge the economic significance of old-age households for the economy, it is instructive to first compare their (gross) income structure, provided by the Household Budget Survey (HBS) (Statistisches Bundesamt, 2010), with other household groups as well as the average household.[2] This way, the extent of income inequality between households can be explained in an easy and plausible way.

Figure 1 presents the income structure of working households (employees and self-employed), pensioner households and remaining ("other") households (students, unemployed and other non-working population), as well as of the average household.

Figure 1: Differences in income composition by household Groups (2008)
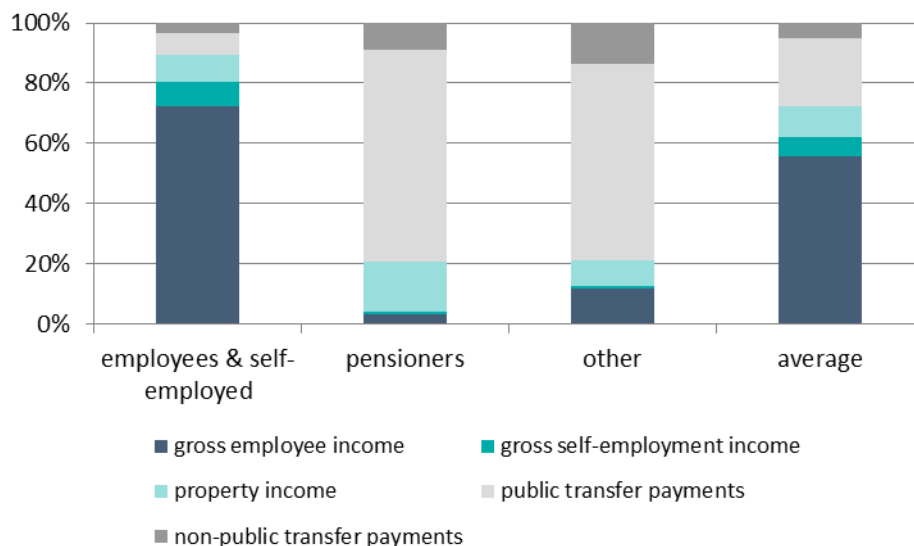
Source: HBS (Statistisches Bundesamt, 2010), own calculation

The figure shows a clear diversity among household groups. The working households rely on wage income (gross employee and self-employment income) which constitute around 80 % of their gross income. Since they represent almost 60 % of all households (in 2008),

---

[2] The Household Budget Survey (Statistisches Bundesamt, 2010) is one of the main data sets in this research area and is described in detail in Section 3.2.

their income structure is strongly reflected by the average income structure. The average household, however, has a significant share of gross income stemming from social transfers (around 28 %), which is the predominant source of income received by non-working households. In the case of pensioner households, property income is also an important income component, while employee and self-employment incomes do not play a significant role due to retirement.

Given the discrepancy between wage and profit income levels and the transfer payment level, it is not surprising that working households have higher incomes at their disposal than the other household groups, even after taking into account their much higher tax burden and social security contributions, diminishing their net and disposable income. Figure 2 displays the inequality between household groups after redistribution, i.e. the deviation of their disposable income from the average household (depicted by the zero line) in %.

Figure 2: Deviation of disposable income from average in % (2008)
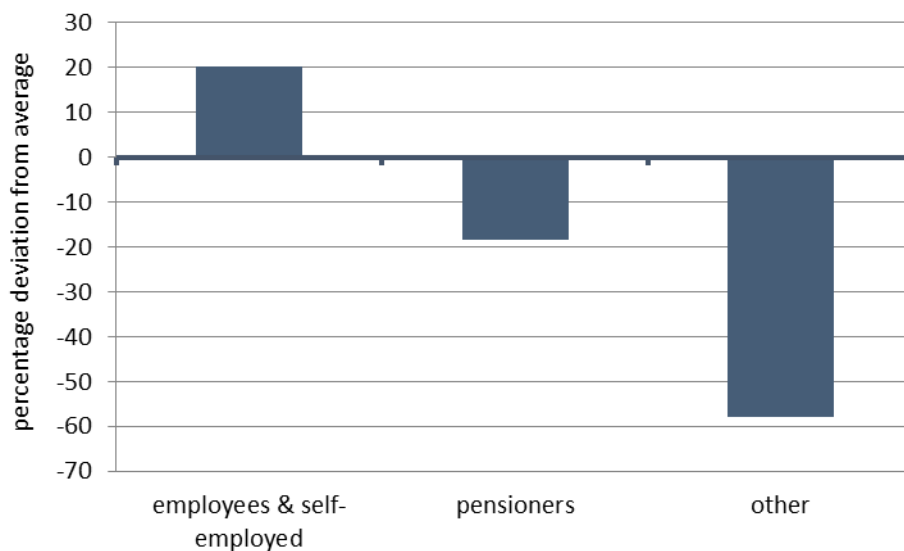
Source: HBS (Statistisches Bundesamt, 2010), own calculation.

While the working households' disposable income is 20 % higher than the average, the pensioner households' disposable income is more than 18 % below the average. Other households' income is even lower, by 58 % of the average household's income. Before we discuss the impact of demographic change on the income distribution and the development of income inequality between household groups (Section 4), Section 3 introduces the modelling tools applied in the analyses, as well as the scenario assumptions used for this task.

3 METHODOLOGY – SOCIO-ECONOMIC MODELLING

3.1 THE ECONOMIC MODEL INFORGE

INFORGE (INterindustryFORecastingGErmany) is a macro-econometric input-output model for Germany (see Figure 3). The model has been used for economic forecasts, projections and scenario analyses in many projects and studies (An der Heiden et al., 2012,

Helmrich et al., 2013, Stöver, 2013). It is established among European input-output models (EUROSTAT, 2008) and well documented (Distelkamp et al., 2003, Ahlert et al., 2009).

INFORGE follows the INFORUM modelling principles (Almon, 1991) such as bottom-up modelling and full integration. Hence, each industrial sector is modelled individually and macro-economic variables are calculated through explicit aggregation. This way, each individual sector is embedded within the broad economic context and industrial interdependencies are explicitly incorporated and used to explain economic interactions. The model is based on the System of National Accounts and Balancing items (SNAB) including input-output tables as its economic core. Thus, inter-industry relations are incorporated on a high level of detail. Both the demand and the supply side are equally well considered by taking into account the interacting relationship between production sectors, private household demand and price effects. In addition, bounded rationality and the existence of imperfect markets are allowed. The model is annually updated and often combined with modules to deal with specific questions and objectives concerning energy and environment, labour market disaggregated by occupation and qualification, world trade or regional aspects, to name a few (Maier et al., 2013, Ulrich et al., 2012, Drosdowski & Wolter, 2012). Currently, the model calculates projections until the year 2035.

Some of its variables have to be set exogenously reflecting 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), which, in turn, is used to derive the German exports with the help of bilateral trade matrices.

Figure 3: THE MACRO-ECONOMETRIC MODEL INFORGE
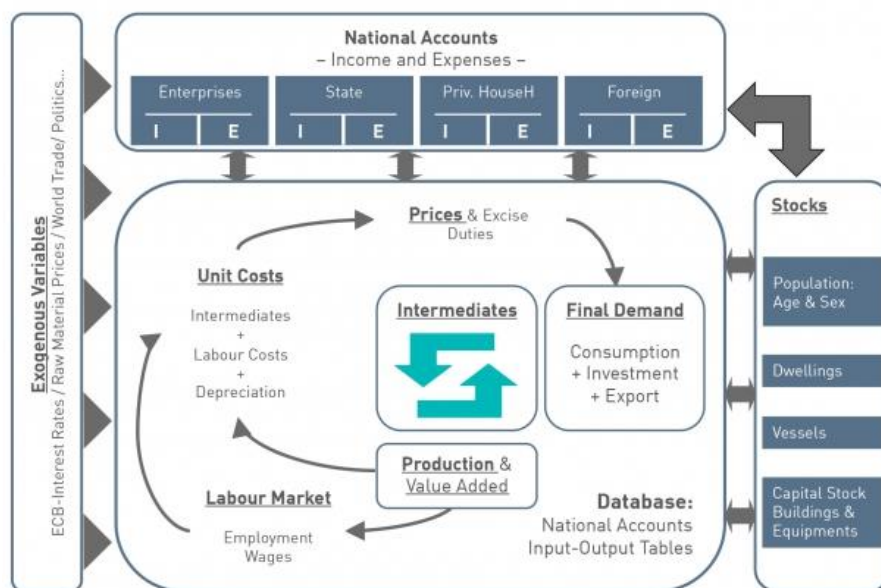
Source: own figure.

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 income generation, distribution and use. Although its basic version is not designed to trace developments on the household level, one of its extensions, DEMOS, focuses on income and private consumption differentiated by household groups, using more disaggregated data. The household module DEMOS was already successfully used within the project *soeb 2* (Drosdowski & Wolter, 2012), as well as in studies related to distributional effects of environmental policies (Blobel et al., 2011, EEA, 2011). Its former version also contained labour market modelling focused on qualifications. These issues, however, are currently examined using the model QINFORGE within the ongoing QuBe project (Helmrich et al., 2013).[3]

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.[4] The level of detail in the data 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 data for 2013 is not expected to become available before 2016.

Within the five year cycle of data provision, smaller annual surveys – called "Laufende Wirtschaftsrechnungen" – supplement the data. However, they are less reliable and cannot be compared directly 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 labour market in Germany (the largest annual household survey in Europe) with a general sampling fraction of 1 % of the population for all variables.[5] Using the Microcensus information, it is possible to analyse the evolution of household structures in DEMOS as well as to support the households' projection in INFORGE.

---

[3] The QuBe project is a collaboration between the Federal Institute for Vocational Education and Training (Bundesinstitut für Berufsbildung – BIBB), the Institute for Employment Research (Institut für Arbeitsmarkt- und Berufsforschung – IAB), the Fraunhofer Institute for Applied Information Technology (Fraunhofer Institut für Informationstechnik – FIT) and the Institute of Economic Structures Research (Gesellschaft für wirtschatliche Strukturforschung – GWS).

[4] The data are classified by the characteristics of main income earner.

[5] For basic information on the Microcensus see https://www.destatis.de/EN/Meta/abisz/Mikrozensus_e.html.

3.3 METHODOLOGY OF THE HOUSEHOLD MODULE DEMOS

Figure 4 provides a simplified overview of the functional relationship between INFORGE and the socio-economic module DEMOS. The modelling consists of four main steps:

1. The growth rates for income and receipts (by sources) per household 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.[6] 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, for example, pension payments within the economic model INFORGE increase because of a legislative reform, this should have the same positive effect on the respective payments received by the households in DEMOS. As a result, the socio-economic group "pensioner household" increases its (average) disposable income, other things being equal.

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 group resulting in household-specific consumption expenditures.

4. The expenditures are then summed up over all household groups and reintegrated into the economic model INFORGE, which adjusts its solutions iteratively leading to changing variable values.

Thus, the development of incomes and consumption expenditures for different household groups can be projected until 2030, including household composition changes due to demography (e.g. increasing number of pensioner households).

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 and the labour market induced by the changes in consumption can be shown as well.

In this paper, however, we analyse and quantify the economic consequences of ageing concentrating on the German pensioner households and the income inequality arising from demographic change.

---

[6] The social characteristics household size and social status 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.

Figure 4: Socio-economic modelling combining THE MACRO-ECONOMETRIC MODEL IN-FORGE with Module demos
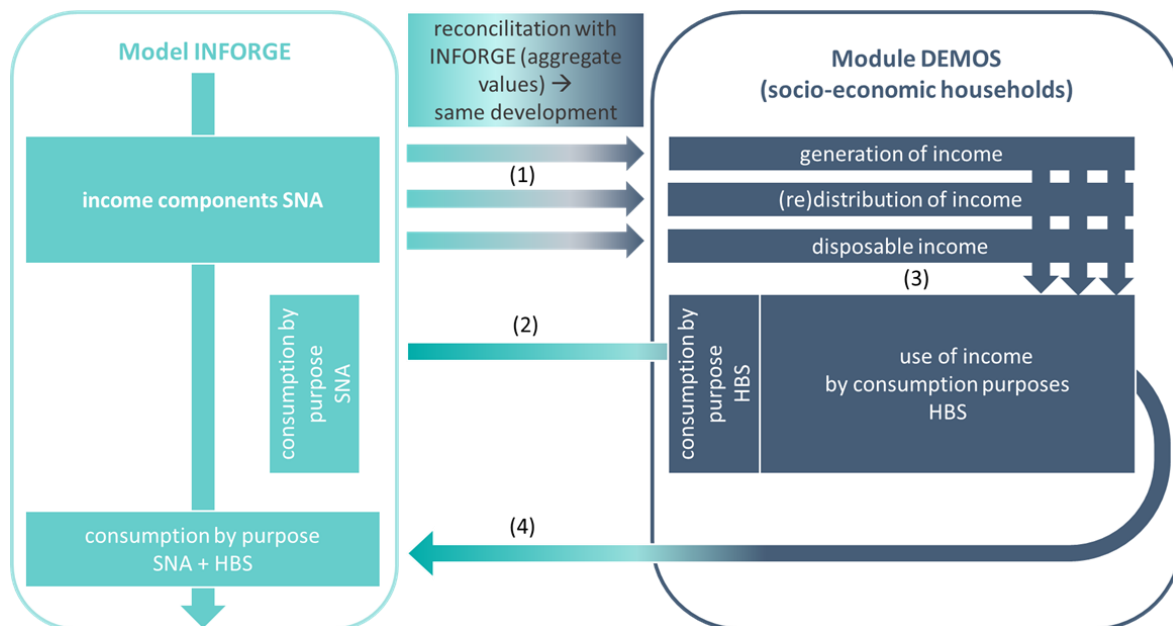
Source: own figure.

3.1 SCENARIO SETTINGS

In order to examine whether ageing is likely to increase the inequality of income distribution over the next 15 years, a scenario analysis is undertaken using the modelling system IN-FORGE and DEMOS and the following assumptions. The aim is to quantify separately and in total the impact of the changing population composition and the population size on inequality.

The exogenously given population can be changed both in size and structure. The four resulting combinations offer the possibility to discriminate between the effects of quantity and structural effects. Additional settings are included if they are necessary for the model consistency.

In detail (see Table 1), the baseline or reference scenario (called "decline & ageing") includes the most probable development given by the official population projection variant 1 migration balance 2 (V1W2) (Statistical Office 2009). Starting with 82.5 million people in 2015, the population decreases by 2.1 % (-0.1 % p. a.), resulting in 80.8 million people in 2030. At the same time the share of older people increases, leading to an average age of 47 years in 2030. Opposed to that is the scenario "constant size & constant structure" where the population of 2015 is left unchanged. Therefore the population stays at 82.5 million people with an average age of 44 years throughout the projection period 2015 to 2030. Compared to "decline & ageing" the population is bigger and younger. The scenario "constant size & ageing" differs from the reference only in the number of people, leaving the population size as in 2015. The population is therefore larger but ages in the same way. The scenario "decline & constant structure" keeps the population composition constant (2015) but diminishes in size.

Additional assumptions refer to the development of the labour force participation rates and the rate of social security contributions. Increases in the labour force participation rates –

especially for women and elderly – can be observed for the last ten years. In the scenarios with an ageing population it is therefore assumed that the trend continues but to a somewhat lower extent. On the contrary, in the scenarios with constant population composition it is assumed that the willingness to work is constant as well. As the age structure does not change, behavioural changes are unlikely to occur. The adjustments in the social security contribution rates were necessary to avoid immense social security surpluses (constant structure) or deficits (constant size & ageing) compared to the reference scenario. With the different contribution rates it is secured that the balance is equal for all different scenarios.

The comparison of the scenarios with changing population to the scenarios with constant conditions reveals different effects:

1. The quantity effect

When comparing the scenarios "decline & constant structure" to the overall constant scenario the main difference is the size of the population. The deviation between both scenarios hence shows the impact of quantity.

2. The structural effect

The scenario "constant size & ageing" differs from "constant size & constant structure" only by the age composition of the population. The deviation quantifies the structural effect of an ageing population.

3. The total effect

The scenario "decline & ageing" encompasses both the quantity and the structural effect. In comparison to the completely constant scenario the total effect of demographic change can be quantified.

Table 1: Scenario settings

| Scenarios	Population		Additional adjustments		Effect
	size	age structure	labour force participation rate	social security contributions rate	
constant size & constant structure	status in 2015	status in 2015	unchanged	declining	
decline & constant structure	population projection (V1W2)	status in 2015	unchanged	declining	quantity effect
constant size & ageing	status in 2015	population projection (V1W2)	increasing	increasing	structural effect
decline & ageing (reference scenario)	population projection (V1W2)	population projection (V1W2)	increasing	unchanged	total effect

Source: own table.

4   RESULTS

The total effect of ageing entailing decreasing population and increasing number of elderly people and households after 2015, as well as wide-spread economic consequences are obtained by comparison of the results from scenarios "decline & ageing" (dealing as the reference) and "constant size & constant structure".

The model projection for the scenario analysis starts in 2016. All missing historical data, i.e. the socioeconomic information from 2008 onwards, is calculated using the historical data base of INFORGE.

While the resulting structure of the received (gross) income does not differ much from the structure in 2008 which is discussed in Section 2, Figure 5 shows slight changes in the distribution of disposable incomes for the selected household groups in percent of the average disposable income in Germany. In 2015 the average pensioner household's disposable income is nearly 25 % lower than the average (a jump of around 7 %-points from the 18 % mark in 2008), whereas the working households still have 20 % of the average income at their disposal. The household income of the remaining other households (students, unemployed and others) is still almost 60 % lower than the average household's disposable income.

**Figure 5: Deviation of disposable income from average in % (2015)**
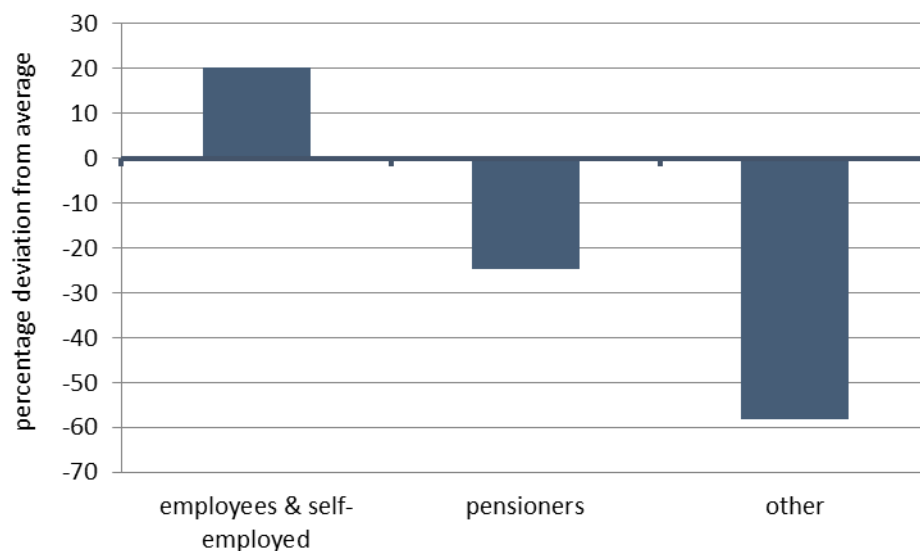
Source: own figure.

Due to economic effects induced by demographic change, the gap between the household groups (in terms of average income) increases over time, as displayed by Figure 6.[7] The dashed lines denote income level deviations from the average in the scenario "constant size & constant structure", while the solid lines denote the income level deviations from the average in the scenario "decline & ageing". While under constant conditions the distance between working and pensioner households' income and the average almost does not change, demographic change causes a widening of the distance in opposite directions. In 2030 working households are 26 % above, pensioner households 29 % below average. Compared to 2015 this is an increase in deviation by 6 %-points for working and by 5 %-points for pensioner households respectively.
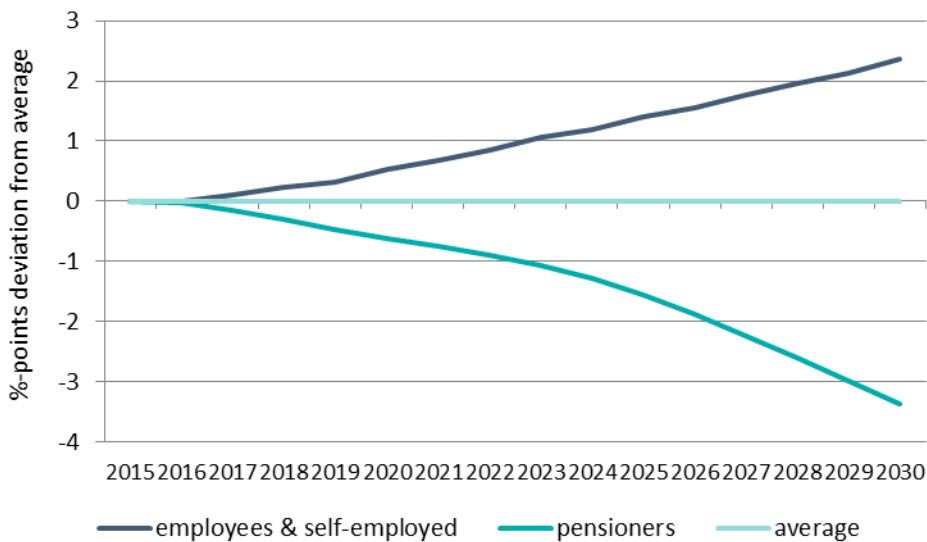
---

[7] For sake of clarity the results for other households are omitted in Figure 6, but are available upon request.

Figure 6: income deviation (%) from average under constant conditions and under demo-graphic change (2015-2030)
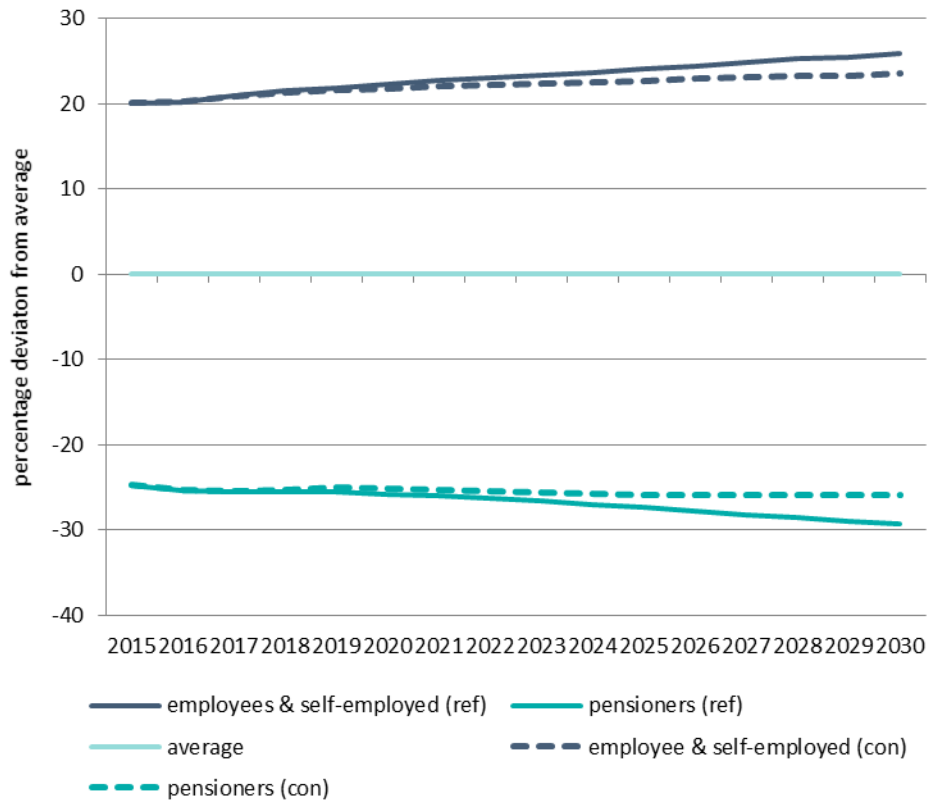
Source: own figure.

Figure 7: Total effect of demographic change on income deviation from average (2015-2030)
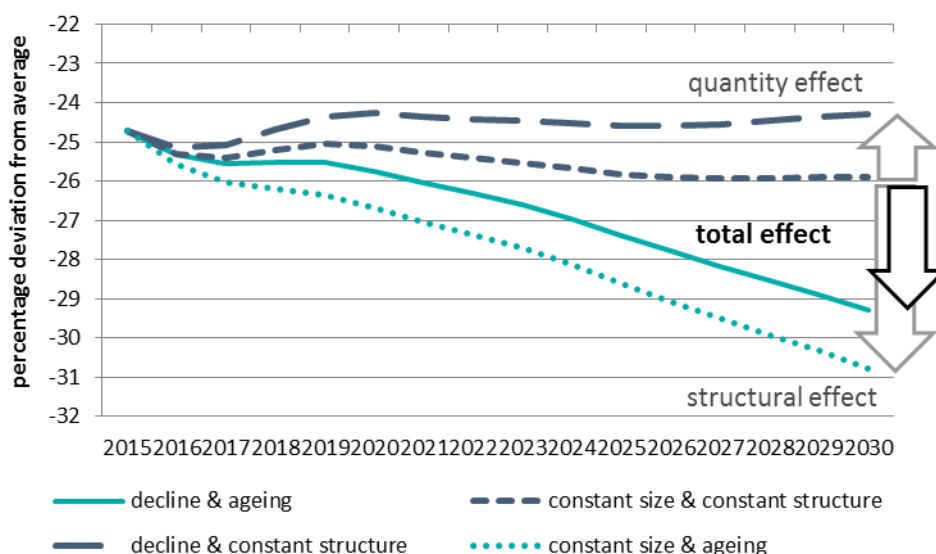

Source: own figure.

The distance between the solid and dashed lines can be interpreted as the total effect of demographic change on inequality for each household type. Figure 7 shows this total effect expressed in %-point deviations from the average. In 2030, the total effect accounts for 2

%-points of growing income inequality for working households and -3 %-points for pensioner households. Thus, the inequality on the part of pensioner households increases faster than that of working households. However, the accelerated drifting apart of wage and pensioner income from the average does not start before 2025.

Why does the income disparity increase when population size decreases and its age structure tilts towards older households? The main reason is the labour market situation, characterised by declining labour force and rising demand for workers, which results in increasing wages due to this shortage. The growth of salaries clearly surpasses the growth of pensions, rewarding households whose income composition is dominated by labour income far more than households relying on pension payments (and other social transfers). This inequality-enhancing effect could be partly moderated by the changing structure of private households, as the share of pensioner households increases in the "decline & ageing" scenario by 7 %-points in 2030 compared to the "constant size & constant structure" scenario. Hence, this partial effect increases the weight of pensioner households in the household structure, which shifts the average income structure towards their structure and might have an equalising effect on disposable incomes. However, this effect is quite the opposite when additional considerations come into play.

The total effect of demographic change can be separated into two effects described in section 3.4 – the quantity effect and the structural effect, which allow further understanding of the mechanisms at work (see Figure 8). Due to the structural effect, the share of older persons increases, while the population remains constant. Correspondingly, the number and share of pensioner households increases (by 6 %). However, the labour market shortages become much bigger and the wages increase much stronger than pensions, so that the shift in the household structure is overcompensated and the gap in disposable incomes widens. Thus, the disposable income of the working population households in relation to the average rises by almost 3.5 %, while the disposable income of the pensioner households in relation to the average decreases by some 5 %.

Figure 8: Structural, quantity and Total effect of demographic change on income inequality for pensioner households (2015-2030)

This structural effect is only slightly compensated by the quantity effect which leaves the population age structure as well as the households structure basically unchanged. Due to the fact that a proportionally declining population size does not exert additional pressure on the labour market, the disposable income of the employee & self-employed households declines by 1 % in relation to the average, while the disposable income of pensioner households increases by 1.5 % in relation to the average.

5 CONCLUSIONS

The projected demographic change in Germany is likely to increase income inequality between working population households and pensioner households due to labour market shortage and the resulting disproportionate labour income increases.

While the (ceteris paribus) declining population size has a slightly equalising effect on the main sources of income accruing to working population households and pensioner households, the spread between these incomes becomes significantly wider due to a structural effect resulting from a (ceteris paribus) growing share of old-age population which leads to a faster growth of labour income due to a rapidly declining size of labour force.

Since the anticipated inequality increase poses several social challenges for the upcoming decades, adequate policy measures such as promoting immigration, raising the retirement age, increasing the labour market participation rates of the elderly or raising pension transfers may be conducive to moderate potential tensions.

The 13th coordinated population projection has not yet been considered in this paper. With regard to the high net migration Germany has experienced since 2009 an update of the population projection would be important. However, the main findings should stay the same even if the ageing process is delayed.

REFERENCES

Ahlert, G., Distelkamp, M., Lutz, C., Meyer, B., Mönnig, A., & Wolter, M. I. (2009). Das IAB/INFORGE-Modell. In P. Schnur & G. Zika (Eds.), *Das IAB/INFORGE-Modell. Ein sektorales makroökonometrisches Projektions- und Simulationsmodell zur Vorausschätzung des längerfristigen Arbeitskräftebedarfs* (pp. 15–175). Nürnberg: IAB-Bibliothek.

Almon, C. (1991). The Inforum approach to interindustry modeling. *Economic Systems Research*, 3(1), 1–8.

An der Heiden, I., Meyrahn, F., Schweitzer, M., Großmann, A., Stöver, B., Ulrich, P., & Wolter, M. I. (2012). Demografischer Wandel – Auswirkungen auf die Bauwirtschaft durch steigenden Bedarf an stationären und ambulanten Altenpflegeplätzen. *Abschlussbericht (Langfassung) im Auftrag des Bundesministeriums für Wirtschaft und Technologie (BMWi)*, 1.

Blobel, D., Gerdes, H., Pollitt, H., Barton, J., Drosdowski, T., Lutz, C., Wolter, M. I., & Ekins, P. (2011). Implications of ETR in Europe for Household Distribution. In P. Ekins & S. Speck (Eds.), *Environmental Tax Reform (ETR). A Policy for Green Growth* chapter 10. Oxford: University Press.

Distelkamp, M., Hohmann, F., Lutz, C., Meyer, B., & Wolter, M. I. (2003). Das I-AB/INFORGE-Modell: Ein neuer ökonometrischer Ansatz gesamtwirtschaftlicher und länderspezifischer Szenarien. *Beiträge zur Arbeitsmarkt - und Berufsforschung (BeitrAB)*, 275.

Drosdowski, T. & Wolter, M. I. (2012). Projektion der Sozioökonomischen Entwicklung bis 2020. In *Berichterstattung zur sozioökonomischen Entwicklung in Deutschland – Teilhabe im Umbruch, Zweiter Bericht*. Wiesbaden: Forschungsverbund Sozioökonomische Berichterstattung.

EEA (2011). Environmental tax reform in Europe: implications for income distribution. *EEA Technical report*, 16/2011.

EUROSTAT (2008). Eurostat manual of supply, use and input-output tables. *Methodologies and Working papers*, 2008 edition.

Faik, J. (2012). *Impacts of an Ageing Society on Macroeconomics and Income Inequality: The Case of Germany since the 1980s*. Technical Report 518, DIW Berlin, The German Socio-Economic Panel (SOEP).

Guerin, B. (2013). *Demography & Inequality – How Europe's changing population will impact on income inequality*. Technical Report RR-183-EC, RAND Corporation.

Helmrich, R., Wolter, Marc Ingo, G., & Maier, T. (2013). Future Skilled-Labour Markets in Germany: from Model-Based Calculations to Scenarios. *Statistika, Statistics and Economy Journal*, 93(3).

Lam, D. (1997). Chapter 18 demographic variables and income inequality. volume 1, Part B of *Handbook of Population and Family Economics* (pp. 1015 – 1059). Elsevier.

Maier, T., Mönnig, A., & Zika, G. (2013). Trade and qualification - linking qualification

needs to Germany's export flows. *IAB-Discussion Paper*, 7/2013.

Mookherjee, D. & Shorrocks, A. (1982). A decomposition analysis of the trend in uk income inequality. *The Economic Journal*, 92(368), pp. 886–902.

Peichl, A., Pestel, N., & Schneider, H. (2012). Does Size Matter? The Impact of Changes in Household Structure on Income Distribution in Germany. *Review of Income and Wealth*, 58(1), 118 – 141.

Pestieau, P. (1989). The demographics of inequality. *Journal of Population Economics*, 2(1), pp. 3–24.

Statistisches Bundesamt (2010). Wirtschaftsrechnungen – Einkommens- und Verbrauchsstichprobe. Einnahmen und Ausgaben privater Haushalte 2008. Fachserie 15 Heft 4.

Statistisches Bundesamt (2014). Haushalte und Familien - Ergebnisse des Mikrozensus 2013. Fachserie 1 Reihe 3.

Stöver, B. (2013). The power of elderly consumers – How demographic change affects the economy through private household demand in Germany. In: M. Radvanský and I. Lichner. Impacts of Ageing on Public Finances and Labour Markets in EU Regions - Theoretical Models and Empirical Analyses.

Ulrich, P., Distelkamp, M., & Lehr, U. (2012). Employment Effects of Renewable Energy Expansion on a Regional Level - First Results of a Model-Based Approach for Germany. *Sustainability*, 4(2), 227–243.

von Weizsäcker, R. K. (1996). *Does an Aging Population Increase Inequality?* Technical Report 1322, C.E.P.R. Discussion Papers.