Does Size Matter? The Impact of Changes in Household Structure on Income Distribution in Germany

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Abstract

Income inequality in Germany has been continuously increasing during the past 20 years. In general, this is understood as an increase in inequality of wages due to changes in bargaining power of employees. However, the role of changing household structure is widely neglected. Societal trends like a decline in birth rate and an increase in the risk of divorce affect per capita incomes, which has repercussions for the income distribution even if wages remain constant. The aim of this paper is to quantify the proportion of changing household structures in the increase in inequality. We find that the rise in inequality was indeed more due to changes of household structure and employment behavior rather than changes in wages. Moreover, a large part of this increase is compensated by the welfare state.

JEL-Code: D31, D63, J11.

Keywords: income distribution, demography, household size, decomposition, Germany.

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1 Introduction

Since reunification in 1990, inequality as well as poverty and richness of the equivalent disposable income distribution in Germany have increased considerably (see OECD (2008); Bach, Corneo, and Steiner (2009); Peichl, Schaefer, and Scheicher (2010) and Figure 1). From a policy perspective it is important to understand the driving forces behind a widening income gap. If, for instance, the rise in inequality is caused by a widening of the distribution of market incomes due to a weakening of bargaining power of unions, the appropriate answer might differ from the one in a situation where rising inequality is predominantly caused by structural shifts in household formation due to long-ranging societal trends. The latter explanation is linked to rising inequality, since a declining average number of individuals living together is affecting the income distribution as well. This is due to the fact that the analysis of income distributions is normally based on *equivalent* income as a proxy for individual well-being. In this way, individual incomes can be compared to each other irrespective of household size. So, what one actually measures is the distribution of "living standards among artificial quasi-homogeneous individuals" (Bönke and Schröder, 2008, p. 2). Furthermore, changing household structure is accompanied by changes in employment patterns, which themselves have an impact on the distribution of income. Therefore, everything else equal, the income distribution changes if the household structure changes (see e.g. Burtless (1999, 2009)).[1]

The aim of this paper is to quantify the effect of such changes on income distribution in Germany. The case of Germany is of special interest for the analysis of the impact of changing household structure as the demographic development is not only characterized by incremental ageing, but also by a sharp fall in average household size. Despite its very pronounced development towards smaller households there has not been much research that systematically analyzes the effect of demographic trends on income distribution for Germany. The Organisation for Economic Co-Operation and Development erroneously reports in its recent study on inequality (OECD, 2008) that a share of 88% of total (absolute) change in the Gini coeffi-

[1] For instance average real income per household has *decreased* by about 2% since 1991, while equivalent average income has *increased* by 2% (Statistisches Bundesamt, 2008b, p. 147).

cient of disposable incomes in West Germany from 1985 to 2005 is due to changing household structure, which would by far be the highest share among OECD countries. However, in the course of our analysis we were not nearly able to replicate the OECD's result. Upon request, the authors of the OECD study confirmed that the result for Germany is *not* correct and a misprint.[2] Therefore, there is good reason to re-assess the effect of changing household structures on inequality in Germany.

A priori, it remains unclear in which direction changes of household structure are affecting the income distribution. The noticeable decline of the number of births, for example, means that couples nowadays tend to stay childless. This leaves them with higher equivalent incomes than in a situation with more children. In addition, this alleviates double-earnership, which makes them even better-off. Whether this leads to an increase or a decrease in inequality depends on the average income position of the related household types. Similarly, the increase in the number of single households results in a growing number of individuals with lower equivalent incomes, since they cannot share fixed costs of living expenses. This makes them worse-off than in a situation where cohabitation would occur more frequently. Here again, the effect on income inequality depends on the average income position of the related household types.

With regard to causality, the described patterns may result from changes in mating behavior due to higher levels of education and more frequent labor market participation among (young) women. This could lead to modifications in scope and selectivity of fertility. Hence, it is conceivable that household formation behavior in turn depends on one's position in the income distribution, i.e. there is some form of reverse causality. For instance, one can think of educated and employed women improving their income position which again might coincide with remaining single for a longer time. In this example, one's location within the income distribution affects household formation and vice versa. In addition, demographic change can have different effects on pre and post fisc income distributions depending on the way how implicit equivalence scales are defined and compensate for different household

[2]So far the OECD has not provided a corrected number for Germany. In our attempt to replicate their findings, we get a value of 64% for pre fisc incomes and 14% for disposable incomes when restricting our sample to West Germany 1985–2005 and applying the same selection criteria and equivalence scales as in the OECD report.

behavior. Hence, the tax benefit system can also provide incentives for a certain behavior, e.g. through the system of joint taxation which provides incentives for a one-earner family.

In order to assess the impact of the changing household structure between 1991 and 2007, in principle, it is possible to use two different methods: subgroup decomposition and re-weighting. The first one is an exact decomposition of the distributional change by population subgroups (Shorrocks, 1980; Mookherjee and Shorrocks, 1982; Shorrocks, 1984). This is the common approach in studies analyzing the effect of demographic change on inequality for the United Kingdom (Jenkins, 1995) and the United States (Martin, 2006). For Germany, this decomposition technique has been applied to regional differences in income inequality after reunification (Schwarze, 1996). Bargain and Callan (2010) decompose the effects of tax-benefit reforms on income distribution. In addition to the subgroup decomposition, a re-weighting procedure in the tradition of the Oaxaca-Blinder decomposition (Oaxaca, 1973; Blinder, 1973) is applied in order to obtain new counterfactual income distributions while keeping the marginal distributions of other characteristics fixed (Di Nardo, Fortin, and Lemieux, 1996; Hyslop and Maré, 2005). These procedures have already been applied by OECD (2008) to assess the importance of demographic change on income inequality as well as to other contexts that are related to wage and wealth inequality respectively (Lemieux, 2006; Bover, 2010). Conclusions may then be derived from a comparison of inequality measures based on the observed income distribution and on the counterfactual income distribution. Re-weighting and subgroup decomposition will lead to identical results if the relationship between demographic change and inequality is linear.

We contrast the results from the subgroup decomposition technique with a re-weighting approach. Due to the possible existence of non-linearities and as a sensitivity analysis, we check if both approaches lead to similar results. Note that both approaches remain descriptive, i.e. based on these results one cannot state that there is a *causal* relationship between household structure and income inequality. In addition to quantifying the impact of changing household structure on inequality, our paper contributes to the existing literature by deriving analogous decomposition

techniques for changes in poverty and richness measures. Using these additional decomposition methods enables us to conduct a more detailed analysis of the tails of the income distribution. Our analysis is based on data of the German Socio-Economic Panel Study (GSOEP).

The results show to what extent the development of overall inequality, poverty, and richness may be attributed to changes in household structure and and related changes in employment behavior. We find that the growth of the income gap in Germany (East and West, 1991–2007) is indeed strongly related to such changes. For inequality of incomes before taxes and transfers we find a fraction of 78%. However, the result for incomes after taxes and transfers is only 22%. This means that the welfare state has largely compensated for inequality induced by changes of household structure. The same holds for the change in poverty, but only to a much lesser extent for richness measures. Similar results occur when using a counterfactual re-weighting procedure.

The paper is organized as follows: Section 2 gives an overview of the demographic trend towards smaller households in Germany while Section 3 reviews relevant definitions and methods. In Section 4 these methods are applied to German survey data. The results are presented in Section 5. The paper is concluding in Section 6.

2 Demographic Trends in Germany

The demographic development in Germany is not only characterized by incremental ageing, but also by a sharp fall in average household size, which is now – together with Sweden – lowest among OECD countries (OECD, 2008, p. 59). Especially the proportion of one- and two-person households has increased dramatically. The increase in the number of single households can be primarily explained by a higher risk of divorce and a lower frequency of marriages. The increase in two-person households is related to two developments: First, the number of childless couples has grown and, second, the increase in life expectancy has led to a growing number of elderly two-person households.

Place Figure 1 here.

Figures 1 and 2 illustrate the demographic trend towards smaller households. The average number of individuals living together in a household has decreased from 2.27 to 2.05 between 1991 and 2008 (by about 9.7 per cent) according to the German Micro Census 2008. In East Germany this decrease was even twice as large: While average household size was 2.31 in 1991, there were only less than two individuals (1.91) sharing a household on average in 2008. This corresponds to a decrease by 17.3%.

Place Figure 2 here.

While population size increased by 2.6% between 1991 and 2008 (from 80.2 to 82.3 million), the number of private households increased by 13.6% to 40.1 million. This was predominantly driven by the rising number of households with two members at most. The number of one- and two-person households increased by 33.2% and 25.5% respectively while the number of households with at least three members has been decreasing (Statistisches Bundesamt, 2008c).[3] To a large part, this development can be explained by the drastic and continuous decline of Germany's birth rate. In 1991, the number of live births was about 830.000, while there were only 686.000 in 2005. This corresponds to a decrease by 17.4%. The number of births reached its maximum of 1.36 million in 1964 (Statistisches Bundesamt, 2008a). In addition, one can argue that the trend towards individualization due to increasing relevance of modern life styles such as "living apart together" (see e.g. Asendorpf, 2009) also accounted for a large part of this observation.

3 Methodology: Re-weighting and Decomposition

In this section, we describe methods for the measurement and decomposition of inequality, poverty, and richness and for re-weighting.

[3] Although the trend towards smaller households according to the German Micro Census might be somewhat overstated due to statistical artifacts (see Statistisches Bundesamt (2009) for details), the direction and magnitude of this trend nevertheless seem to be clear cut. Moreover, the authors' calculations based on data from the GSOEP are not significantly different (see Figure 1).

3.1 Decomposition Techniques

3.1.1 Inequality

In the literature, there are several measures of inequality (see e.g. Atkinson and Bourguignon (2000)).[4] In the context of our approach, for analyzing the effect of household structures on income inequality, the class of Generalized Entropy (GE) inequality measures (Shorrocks, 1980) is the most suitable one. The GE measures can be decomposed in a way such that total inequality results as the sum of inequality *within* and *between* population subgroups. The class of GE measures is defined for an income distribution $Y = (y_1, \ldots, y_n)$, where y_i denotes income of individual $i \in \{1, \ldots, n\}$, while w_i denotes individual i's population weight. Finally, $\bar{y} = \sum_{i=1}^{n}(w_i/\sum_{i=1}^{n}) \cdot y_i$ denotes the arithmetic mean of individual incomes.

For the purpose of this paper we choose $I_0 = \sum_{i=1}^{n} \frac{w_i}{\sum_{i=1}^{n} w_i} \cdot ln\left(\frac{\bar{y}}{y_i}\right)$ from the GE inequality measures, which is also known as *mean logarithmic deviation* (Mookherjee and Shorrocks, 1982, p. 889).[5] If one divides total population into K disjoint and exhaustive subgroups that are denoted by $k \in \{1, \ldots, K\}$ the inequality measure I_0 can be written as

$$I_0 = \sum_{k=1}^{K} \frac{\sum_{i \in k} w_i}{\sum_{i=1}^{n} w_i} \cdot I_{0k} + \sum_{k=1}^{K} \frac{\sum_{i \in k} w_i}{\sum_{i=1}^{n} w_i} \cdot ln\left(\frac{\bar{y}}{\bar{y}_k}\right) \tag{1a}$$

$$= \underbrace{\sum_{k=1}^{K} v_k \cdot I_{0k}}_{W} + \underbrace{\sum_{k=1}^{K} v_k \cdot ln\left(\frac{\bar{y}}{\bar{y}_k}\right)}_{B}, \tag{1b}$$

where $\sum_{i \in k} w_i$ denotes the weighted number and v_k the weighted proportion of individuals belonging to population subgroup k. The mean income of subgroup k is denoted with $\bar{y}_k$ and group inequality with $I_{0k} = \sum_{i \in k}(w_i/\sum_{i \in k} w_i) \cdot ln\,(\bar{y}_k/y_i)$. Hence, total inequality can be written as a weighted sum of inequality within (W) and between (B) population subgroups. Population ratios v_k thereby serve as weighting

[4] In addition to a representation of the income distribution with the help of summary measures there are also more general representations, e.g. graphical ones (see e.g. Jenkins and Van Kerm (2005)). However, another way of representing our results does not reveal additional findings.)

[5] According to Shorrocks the features of this measure are best suitable for decomposition analysis, since total inequality can be exactly decomposed into within- and between-group inequality. Moreover, the weighting factors sum up to unity (Shorrocks, 1980, p. 625).

factors. Inequality decomposition within and between population subgroups provides a basis for decomposing the change in total inequality between period t and $t+1$ into changes within population subgroups and changes that result from shifting population ratios. According to Mookherjee and Shorrocks (1982) this can be formally written as

$$\Delta I_0 = I_0^{t+1} - I_0^t \approx \underbrace{\sum_{k=1}^{K} \bar{v}_k \cdot \Delta I_{0k}}_{A} + \underbrace{\sum_{k=1}^{K} \bar{I}_{0k} \cdot \Delta v_k}_{B} + \underbrace{\sum_{k=1}^{K} \left[\bar{\lambda}_k - \overline{ln\left(\lambda_k\right)}\right] \cdot \Delta v_k}_{C} + \underbrace{\sum_{k=1}^{K} \left(\bar{\theta}_k - \bar{v}_k\right) \cdot \Delta ln\left(\bar{y}_k\right)}_{D}, \quad (2)$$

where Δ is the difference-operator. In addition, $\lambda_k = \bar{y}_k/\bar{y}$ denotes the ratio of population subgroup k's mean income to total population's mean income and $\theta_k = v_k \cdot \lambda_k$ the income ratio of group k. A symbol with a bar denotes the particular value averaged over periods t and $t+1$.[6] Thus, the change in total inequality from one point in time to the next can be decomposed into four components denoted by A, B, C and D (Mookherjee and Shorrocks, 1982, p. 897):

Summand A summarizes the effect of inequality changes within population subgroups (ΔI_{0k}). In particular, it contains the contribution of inequality changes that solely result from changes within population subgroups. It abstracts from changes in population composition by fixing population ratios on averaged values ($\bar{v}_k$). Accordingly, changes in inequality within groups with higher proportions in population would therefore be of more importance than changes within relatively small groups.

Summand B on the other hand contains the effect of changes in population composition (Δv_k) on inequality *within* population subgroups. It analogously abstracts from changes in within-group inequality by fixing it on averaged values ($\bar{I}_{0k}$), since changes in population ratios are crucial for summand B. If, for example, the

[6] Alternatively, it would be possible to use base or final period weights. However, Mookherjee and Shorrocks (1982) point out that this choice is unlikely to make a difference to the results (p. 896). In addition, this corresponds to the weight that would be assigned by the Shapley value algorithm (Shorrocks, 1999; Jenkins and Van Kerm, 2005).

proportions of groups with relative high levels of inequality increase, total inequality will increase accordingly and vice versa.

Summand C describes the effect of changes in population composition (Δv_k), though, contrary to summand B, on inequality *between* population subgroups. Again, changes in population ratios are crucial for the direction of change. It fixes the ratio of group mean incomes to total mean income (λ_k), which becomes apparent in the term in squared brackets, although it has no intuitive interpretation for it. So, summand C sums up the contribution to total inequality change that results when proportions of groups with relative high or low mean incomes (compared to total mean income) increase or decrease.

Summand D finally represents the contribution of changes in population subgroup mean incomes ($\Delta ln\left(\bar{y}_k\right)$). It fixes the difference between group proportions of total income and population respectively. The change in the logs of population subgroup mean income is of importance here. The higher the income ratio of a group relative to its population ratio the larger the effect on total income inequality when the mean income of that group changes.

In summary: summand A represents changes in pure inequality within population subgroups. Since all individuals belonging to a particular group are identical with respect to certain characteristics, summand A displays changes in inequality that result from other characteristics (e.g. differences in education levels affecting wage and hence income inequality). Summands B and C together represent the contribution to inequality change resulting from demographic change, since they are based on shifting population ratios. Summand D represents the effect of changes in the distribution of population subgroup mean incomes. With respect to the purpose of this paper, the relative importance of summands B and C compared to total change in inequality ΔI_0 is of prior interest.

3.1.2 Poverty

A well-known and widely used class of poverty measures, which is decomposable by population subgroups, was introduced by Foster, Greer, and Thorbecke (1984).

Total poverty P_α is defined as

$$P_\alpha(y;z) = \sum_{i=1}^{q} \frac{w_i}{\sum_{i=1}^{n} w_i} \cdot \left(\frac{g_i}{z}\right)^\alpha \text{ for } y_i \leq z, \tag{3}$$

where $\alpha \geq 0$ is a parameter of poverty aversion[7] and $g_i = z - y_i$ denotes the income shortfall between individual i's income y_i and a poverty line z. The number of poor is denoted by q. They receive an income not exceeding the poverty line z (Foster, Greer, and Thorbecke, 1984, p. 761 f.).

If one divides the population into K disjoint and exhaustive population subgroups, one can write the FGT measure as (Foster, Greer, and Thorbecke, 1984, p. 764)

$$P_\alpha(y;z) = \sum_{k=1}^{K} v_k \cdot P_{\alpha,k}(y_k;z), \tag{4}$$

where v_k denotes the population share. Subgroup k's income vector is denoted by y_k and poverty measured within each group by $P_{\alpha,k}(y_k;z) = \sum_{i=1}^{q_k}(w_i/\sum_{i\in k} w_i) \cdot \left(\frac{g_i}{z}\right)^\alpha$ for $y_{i\in k} \leq z$, where q_k denotes the number of poor units within group k. Hence, total poverty can be expressed as a weighted sum of poverty in population subgroups with population share weights (Bourguignon and Ferreira, 2005, p. 26).

In order to assess how much of an observed change in total poverty can be attributed to demographic changes, it is necessary to decompose the change into components accordingly. One can show that (Shorrocks, 1999, p. 13 f.)

$$\Delta P_\alpha = P_\alpha^{t+1} - P_\alpha^t = \underbrace{\sum_{k=1}^{K} \bar{v}_k \cdot \Delta P_{\alpha,k}}_{A} + \underbrace{\sum_{k=1}^{K} \bar{P}_{\alpha,k} \cdot \Delta v_k}_{B}. \tag{5}$$

This decomposition of change also corresponds to the one that results from a Shapley value decomposition (Shorrocks, 1999). So, the change in total poverty (ΔP_α) can be decomposed into the change in levels of group poverty (labeled A) and changes in the composition of population (demographic change, labeled B).

[7] For a larger α there is more emphasis on the "poorest poor" (Foster, Greer, and Thorbecke, 1984, p. 763). For $\alpha = 0$ the measure reveals the head-count index.

3.1.3 Richness

Income richness is a less considered field than income poverty. Peichl, Schaefer, and Scheicher (2010) propose measures that are decomposable by population subgroups and allow for a consideration of the intensity of affluence analogous to the FGT poverty measure. The richness measure that we employ is defined as

$$R_\beta(y;\rho) = \sum_{i=1}^{s} \frac{w_i}{\sum_{i=1}^{n} w_i} \cdot \left[1 - \left(\frac{\rho}{y_i}\right)^\beta\right] \text{ for } y_i \geq \rho. \tag{6}$$

Here, $\beta > 0$ is a parameter for the sensitivity to intensive richness. For greater values of β the richness measure puts more weight on the "very rich". The richness line is denoted by ρ. Individuals with an income above this line are defined as the rich in the society. As in the cases of inequality and poverty it is possible to express richness as a weighted sum of richness within population subgroups $k \in \{1, \ldots, K\}$:

$$R_\beta(y;\rho) = \sum_{k=1}^{K} v_k \cdot R_{\beta,k}(y_k;\rho), \tag{7}$$

where richness within each group k is denoted with $R_{\beta,k}(y_k;\rho) = \sum_{i=1}^{s_k}(w_i/\sum_{i\in k} w_i) \cdot \left(1 - (\rho/y_i)^\beta\right)$ for $y_{i\in k} \geq \rho$ and s_k denotes the number of rich within each group. Analogous to the decomposition of poverty change over time it is straightforward to decompose the change in richness between periods t and $t+1$:

$$\Delta R_\beta = R_\beta^{t+1} - R_\beta^t = \underbrace{\sum_{k=1}^{K} \bar{v}_k \cdot \Delta R_{\beta,k}}_{A} + \underbrace{\sum_{k=1}^{K} \bar{R}_{\beta,k} \cdot \Delta v_k}_{B}. \tag{8}$$

The interpretation of this decomposition is the same as for poverty: summand B is the fraction of the overall change in richness that is related to demographic change.

3.2 Re-weighting Procedure

In order to assess the impact of the changing household structure between 1991 and 2007, we need to compare the counterfactual distribution of 2007 incomes and 1991 household structure with the observed 2007 income distribution. In order to

do so, we follow the approach suggested by Di Nardo, Fortin, and Lemieux (1996) and extended by Hyslop and Maré (2005) to estimate the counterfactual density function using a re-weighting technique.

Each individual household can be described by a vector (y, x, t) consisting of an income y, a vector x of household characteristics, and a date t (1991 or 2007). Each observation belongs to a joint distribution function $F(y, x, t)$ of income, characteristics and date. The joint distribution of income and characteristics is the conditional distribution $F(y, x|t)$. The density of income at one point in time, $f_t(y)$, can be written as the integral of the density of income conditional on a set of characteristics and on a date t_y, over the distribution of individual characteristics $F(x|t_x)$ at date t_x.

$$f_t(y) = \int dF(y, x|t_{y,x} = t) = \int f(y|x, t_y = t)dF(x|t_x = t) \tag{9a}$$

$$\equiv f(y, t_y = t, t_x = t). \tag{9b}$$

Since the estimation of counterfactual densities combines different dates, the notation in the last line accounts for these. Under the assumption, that the 2007 distribution of incomes, $F(y|x, t_y = 2007)$, does not depend on the 1991 distribution of characteristics, $F(x|t_x = 1991)$, the hypothetical counterfactual density is:

$$f(y, t_y = 2007, t_x = 1991) = \int f(y|x, t_y = 2007)dF(x|t_x = 1991) \tag{10a}$$

$$= \int f(y|x, t_y = 2007)\psi_x(x)dF(x|t_x = 2007), \tag{10b}$$

where the re-weighting function $\psi_x(x)$ is defined as

$$\psi_x(x) \equiv \frac{dF(x|t_x = 1991)}{dF(x|t_x = 2007)}. \tag{11}$$

The counterfactual density can be estimated by weighted kernel methods. The difference between the actual 2007 density and the hypothetical re-weighted density represents the effect of changes in the distribution of household's characteristics.

To estimate the impact of the changing household structure between 1991 and 2007, we compare measures of distribution $M(\cdot)$ for the counterfactual distribu-

tion of 2007 incomes and 1991 household structure with the observed 2007 income distribution:

$$\delta = M(f(y, t_y = 2007, t_x = 2007)) - M(f(y, t_y = 2007, t_x = 1991)). \tag{12}$$

4 Empirical Foundation

4.1 Data: The German Socio-Economic Panel Study

The German Socio-Economic Panel Study (GSOEP) is a panel survey of households and individuals in the Federal Republic of Germany that has been conducted annually since 1984. The study is maintained by the German Institute for Economic Research (DIW) in Berlin. A weighting procedure allows to make respondents' data to be representative for the German population as a whole. A detailed overview of the GSOEP is provided by Haisken-DeNew and Frick (2005) or Wagner, Frick, and Schupp (2007). Issues concerning sampling and weighting methods or the imputation of information in case of item or unit non-response is well documented by the GSOEP Service Group. We use waves from the GSOEP that contain income information on an annual basis for the longest possible period 1991–2007, in order to include East Germany after reunification. The data sets contain relevant information from 17,921 individual observations in 6,665 survey households for 1991. For 2007, the sample increased to 25,366 individuals and 11,072 households.

4.2 Income Concept

The decomposition of the change in measures of distribution from Equations (2), (5), and (8) can be computed for any concept of income. We compute it for equivalent pre fisc incomes and are also are interested in post fisc incomes. The progressive German tax-benefit system induces an inequality-reducing redistribution of incomes and by and large takes into account household structures of tax-payers and recipients of benefits respectively. Looking at pre- and post fisc incomes allows us to assess to what extent the German tax benefit system compensates for changes in household

structure.

Data sets from the GSOEP contain appropriate income variables that are defined as follows (Grabka, 2007, p. 41 f.): A household's pre fisc income consists of labor earnings, asset flows, private retirement income and private transfers from all household members. A household's post fisc income encompasses pre fisc income, public transfers, and social security pensions from all household members minus total tax-payments of all household members. Both concepts of income are deflated in order to compute real incomes. Moreover, we add household imputed rental values for owner-occupied housing, which is common in empirical research (Yates, 1994; Canberra Group, 2001; Smeeding and Weinberg, 2001; Frick and Grabka, 2003; Eurostat, 2006). For population weights w_i we use the according weights from the GSOEP (Grabka, 2007, pp. 181 ff.). In the following analysis, we define the poverty line z to be 60% and the richness line ρ is defined as 200% of the median of equivalent pre- and post government incomes respectively.[8]

Computations are conducted as follows: individual incomes y_i are equivalent pre and post fisc incomes respectively. Our main results that are presented and discussed in Section 5 rely on calculations using the modified OECD equivalence scale assigning a weight of one to the first adult household member, a weight of 0.5 to every additional adult, and a weight of 0.3 to every child (OECD, 2005). In Section 5.1.2 we discuss the role of the choice of equivalence scale and present results obtained for alternative specifications of the equivalence scale.

4.3 Definition of Population Subgroups

Like the definition of an income concept, a definition of how to divide a population into disjoint and exhaustive subgroups is of great importance for the following analysis.[9] According to our research question, household composition with respect

[8] Alternative definitions of the poverty and richness line respectively do not alter the qualitative findings of our analysis or the interpretation of our results.

[9] Note that, compared to the population in private households, the population in institutionalized households is underrepresented in the GSOEP (Haisken-DeNew and Frick, 2005, p. 182 f.). This may be selective with respect to household composition and poverty risks. Due to increasing longevity more and more elderly can be assumed to move into nursery and old age homes, i.e. the bias may have increased over time. However, since there is no information available for this group, we refer to the population in private households only.

to number and age of household members is of relevance. As we already pointed out, household formation is also related to labor market participation. Hence, in order to capture these effects, our definition of population subgroups proceeds in two steps: In a first step, we distinguish population subgroups according to two criteria: The first criterion is the number of adult household members (aged 18 or over), the second one is the presence of children (younger than 18) in the household. In a second step, we further distinguish these groups according to the number of employed persons within the household as a third criterion. Differences in the results for the subgroup decomposition (see next section) are related to changing patterns in labor force participation. However, we cannot identify the causal effect thereof since this is already partly captured by household structure because household formation and labor force behavior can be viewed as a joint decision.

In the first step, we distinguish between singles, couples, and households with more than three adult members. We further split up our distinction into households with and without children of minor age. I.e., in total we have six population subgroups according to household composition (see Table 1).

Place Table 1 here.

It appears that between 1991 and 2007 the population shares of three of these groups increased, while they decreased for the remaining groups. Single households made up about 16% of the population in 1991 and up to 2007 this share increased to 20%. The largest group in 2007 is represented by individuals living in two-adult-households. Their share increased from 26% to over 30%. Hence, in 2007 more than half of the population lived in households with one or two adults and without children. In addition, the share of individuals in single households increased from 2.8% to about 3.7%. Other types of households are on the retreat. Especially the proportion of individuals in two-adult households with children decreased from nearly one third by nearly seven percentage points. Note that those groups with growing population shares are characterized by above average (and growing) levels of income inequality. Moreover, their group mean incomes display much more variation around the population's mean. I.e. we observe that an increasing share of the

population is becoming more heterogenous in terms of within-group as well as in terms of between-group inequality.

The declining relative number of individuals in group 6, i.e. living in households with several adults and children, partly means that multiple generation-households as a form of cohabitation obviously is on the retreat in Germany: According to the GSOEP, the proportion of individuals in multiple generation-households decreased from 2.4% to 1.3% between 1991 and 2007 and hence can be seen as a marginal phenomenon. This retreat is assumed to contribute to increasing income inequality because of the diminishing incidence of redistribution *within households*. This is existent when the oldest and youngest generations, i.e. those most in need of redistribution, cohabit with the working-age generation. Hence, to the degree to which this form of cohabitation is reduced, there will be less redistribution within the household and accordingly more inequality.

The definition of subgroups of the second step takes into account the employment status of household members. Hence, we further split up the beforehand defined groups based on the number of employed persons in the household. We now have 16 groups in total. In Table 2 we present the group characteristics in terms of population shares, mean incomes, and measures of income distribution.

Place Table 2 here.

It becomes apparent that population subgroups defined according to household structure only are internally quite heterogenous and there is much variation in mean incomes. This is not surprising, since additional employed household members tend to increase household earnings. About three quarters of the percentage point increase in the number of single households is accounted for by employed singles, while most of the relative growth of two-adult households without children is due to more couples out of employment, presumably among which many of retirement age.

5 Estimation Results

5.1 Decomposition Results

In this subsection we present the decomposition results for different measures, income concepts, and regions.[10] We first discuss our results for the subgroup decomposition based on the definition of population subgroups according to household structure *and* employment status and then compare these to results from a decomposition analysis for subgroups distinguished by household structure only.

5.1.1 Inequality

The results for the decomposition of income inequality change according to Equation (2) are displayed in Table 3. For pre fisc incomes overall inequality in reunified Germany has increased by about 25% between 1991 and 2007. About 19.4 percentage points of this change can be attributed to changes in household structure and employment status (summands B and C). This corresponds to 77.5% of the overall increase in pre fisc income inequality.

Noticeably, although the contribution of summand B is somewhat larger in magnitude, both summands B and C contribute to this result. Summand B describes the effect of the change in population structure on within-group inequality while summand C captures the effect of changing population structure on between-group inequality. Obviously, population subgroups that are characterized by smaller household size exhibit greater within-group inequality than others over time. Thus, the increase in relative size of these groups has considerably contributed to the overall increase in income inequality. Moreover, these groups have mean incomes quite different from the overall mean. Hence, their growth contributes to increasing in-

[10] Note that the decomposition results according to Equations (2), (5), and (8) are presented as percentages and percentage points respectively. For example, ΔI_0 and the summands A to D are divided by I_0^t and multiplied by 100 each. The fraction $\frac{B+C}{\Delta I_0}$ is multiplied by 100. The same holds analogously for the decompositions of poverty and richness. The differentiation into East and West Germany is appropriate as there are still significant income differentials between the two parts of the country. The non-convergence of income inequality is indirectly explained by much higher rates of unemployment in East Germany which causes a high level of inequality in labor income, which is of greater importance relative to capital income in East Germany (Frick and Goebel, 2008, p. 571). In addition, as becomes clear from Figure 1, the demographic trend is more pronounced in the East.

equality irrespective of increasing heterogeneity within groups. At the same time, the contribution to inequality growth from summand A, which comprises changes in within-group inequality, is quite pronounced as well. This clearly indicates that population subgroups defined by household composition have become more heterogenous over time. This is especially true for the largest part of the population, i.e. those people living in one- or two-person households.

Place Table 3 here.

In West Germany, pre fisc income inequality has increased by 16.3% between 1991 and 2007, less than in the whole of Germany. The proportion of summands B and C (83%) is even larger. The increase in overall pre fisc inequality in East Germany since reunification in 1991 (about 70%) is much more pronounced than in the West. Shrinking household size makes up 76% of the overall increase in Germany's "new states". Note that in 2007 inequality in East Germany is higher for pre fisc incomes compared to the West, while it is lower for post fisc incomes. The interpretation of this pattern is related to considerably different levels of unemployment in both parts of the country: In East Germany, the unemployment rate is on average nearly twice as high as it is in the West. Hence, the proportion of people whose pre fisc income, i.e. without transfer payments, is close to zero is much higher there, so the relevance of higher unemployment is clearly to be considered as a "driving force" for pre fisc income inequality in Eastern Germany.

Our results for post fisc income inequality decomposition show that the effect of changing household structures is less pronounced than for pre fisc income inequality. Altogether, post fisc income inequality has increased by 37.8% which is larger than the increase for pre fisc income, although the level of inequality is still much lower for post fisc incomes than for pre fisc incomes. The proportion of summands B and C amounts to 22.2% between 1991 and 2007 which is significantly lower than for pre fisc income. This results implies that the German tax-benefit system takes into account household structure and compensates for most (not all) of inequality increases that can be related to demographic changes. Poorer people tend to have more children than rich people and especially among the latter fertility is declining the most. The implicit equivalence scales in the tax benefit system rather generously

compensate for the presence of children (Fuest, Niehues, and Peichl, 2010) and, hence, the relative position of the poor is getting better. Furthermore, due to the highly progressive income tax system, a large fraction of the increasing income of double earner couples is taxed away which leads to post fisc inequality increasing less than pre fisc inequality. Looking at West Germany separately reveals that the proportion of summands B and C between 1991 and 2007 (15.9%) is lower than for Germany as a whole. In East Germany, income inequality has grown by 38.8%. Summands B and C account for about 16.8%.

The results discussed beforehand are based on the definition of population subgroups according to household structure and employment status. This definition allows to capture effects of labor market participation and household size that are related to household formation. In order to get an idea of the relative importance of changing household size only, we now present results based on the narrower definition of subgroups which ignores the employment status of the household. The according results are presented in Table 3, lower panel . Their characteristics in terms of population share, mean incomes, and group-specific measures of income distribution are listed in Table 1 (see above).

We find that the relative importance of demographic change turns out to be somewhat smaller in magnitude. For pre fisc incomes we have a fraction of 61.4% for summands B and C (West: 73%, East: 50.5%), for post fisc incomes we have 17.4% (West: 13.3%, East: 21%). Hence, without accounting for the employment status, the explanatory contribution of household structure is reduced by 16.1 (4.8) percentage points for pre (post) fisc incomes. These differences are due to smaller importance of summand C. This means, shifts in population shares play a minor role for increasing between-group inequality. This is not surprising for this specification of population subgroups since there is not as much variation within groups with similar household structure but differences in labor market participation.

For this specification of subgroups summand B almost solely accounts for the joint proportions of summands B and C (see Table 3). Hence it seems as if summand C, i.e. the effect of changing population structure on between-group inequality, plays no role at all. However, this is only true on the aggregate level.

Note that summands A to D are themselves aggregations over population subgroups (see Equation 2). So, if one of them turns out to be of small magnitude or even close to zero, this does not necessarily imply that the contribution of each single group to this particular summand is close to zero, too. It could rather be the case that some groups' contributions are large in magnitude but with a negative sign while others' contributions have a positive sign and so both effects are offset. The latter is exactly what we find for summand C. Table 4 displays the contributions of each single population subgroup to the components of inequality change for pre- and post fisc incomes respectively.[11]

Place Table 4 here.

It becomes apparent that for both summands B and C the results presented in Table 4 are mainly "driven" by certain subgroups. Not surprisingly, especially the growth of groups 1 and 3 (single- and two-adult-households) is positively contributing to overall inequality change, since these are the only ones with noticeably growing proportions among the population. Another group with a smaller but still positive contribution is group 2 (single parent households). These groups exhibit above-average *and* increasing levels of inequality, within as well as between subgroups (see Table 1). That is why their contributions to summands B and C are disproportionably large. Increasing heterogeneity within the group of single-households is due to the fact that nowadays this group is no more dominated by elderly people (pensioners, widows) with low pension incomes but more and more also consists of young- and middle-aged at different positions in their educational or professional careers. So heterogeneity in incomes partly comes from more heterogeneity in age. Moreover, income inequality is comparatively high among single-households, because they are not able to re-distribute income *within* the household, while multi-person households share resources and hence individual household members' income shocks, e.g. due to unemployment or retirement, can be cushioned.

[11] Note that according to Equation (2) it holds that $A_k = \bar{v}_k \cdot \Delta I_{0k}$, $B_k = \bar{I}_{0k} \cdot \Delta v_k$, $C_k = \left[\bar{\lambda}_k - \overline{ln\,(\lambda_k)}\right] \cdot \Delta v_k$, and $D_k = \left(\bar{\theta}_k - \bar{v}_k\right) \cdot \Delta ln\,(\bar{y}_k)$.

5.1.2 Role of the Equivalence Scale

In Section 4.2 we stated that we use the modified OECD equivalence scale to obtain equivalent incomes. However, the choice of equivalence scale is not irrelevant with respect to our research question. E.g. inequality rankings in cross-country comparison are sensitive to different values of the equivalence-scale elasticity (Buhmann, Rainwater, Schmaus, and Smeeding, 1988; Hagenaars, de Vos, and Zaidi, 1994; Ebert and Moyes, 2003; Bönke and Schröder, 2008). In addition, it is possible not only to control for size and age of household members, but also for health-related needs (Burchardt and Zaidi, 2005). Most of the equivalence scales (ES) used in practice (e.g. Cowell and Jenkins (1994) and Burkhauser, Smeeding, and Merz (1996)) can be written in the general form of

$$ES = (\theta_1 + \theta_2 \cdot N_A + \theta_3 \cdot N_C)^{\gamma}, \tag{13}$$

where θ_1 denotes an extra weight for the (adult) head of the household and θ_2 denotes the weight for (additional) adult household members (N_A) and θ_3 denotes the weight of children (N_C, see e.g. Cutler and Katz (1992); Banks and Johnson (1994)). For smaller values of the parameter γ the importance of economies of scale in household consumption increases.[12]

Place Table 5 here.

In order to make sure that these results are not due to a specific choice of equivalence scale we calculated the fraction of summands B and C for the inequality decomposition for various specifications of the general form of the equivalence scale in Equation 13. The results for both definitions of population subgroups are presented in Table 5. We find that the choice of equivalence scale does not alter the results significantly. Not surprisingly, it turns out that the proportion of the demographic effect is somewhat larger in specifications when large economies of scale are assumed (i.e. for smaller values of γ). Moreover, we find that even for per-capita incomes,

[12] Note that for $\theta_1 = \theta_2 = 0.5$, $\theta_3 = 0.3$, and $\gamma = 1$ we arrive at the modified OECD scale, for $\theta_1 = 0$, $\theta_2 = \theta_3 = 1$, and $\gamma = 0.5$ at the square-root scale, while using a scale with $\theta_1 = 0$, $\theta_2 = \theta_3 = 1$, and $\gamma = 1$ is equivalent to using per-capita incomes, i.e. assuming no economies of scale.

i.e. in the absence of scale economies, a quite sizeable fraction of inequality change (60%/77% for pre and 17%/21% for post fisc income) can be attributed to changing household and employment structure.

5.1.3 Poverty and Richness

The results for the decomposition of poverty (Equation (5)) and richness (Equation (8)) change are presented in Table 6. Note that we restrict our analysis to post fisc incomes which is the measure usually used as a proxy for well-being in the context of poverty (and richness) analysis. Moreover, these results are based on the definition of population subgroups according to household structure and employment status. Below we present the according results for subgroups based on household structure only and briefly discuss the role of certain groups.

Place Table 6 here.

For post fisc incomes, the demographic effect on poverty change sums to more than half of total change (between 50.3 and 75.1%). The richness measures for post fisc incomes increased quite considerably between 1991 and 2007 by more than 76% for $\beta = 1$ and by two thirds for $\beta = 3$. The head count ratio for richness (HC) increased by more than 46%. The considerable growth of income richness coincides with increasing values of inequality measures which are more sensitive to changes in the upper tail of the income distribution (see inequality measures I_c for higher values of the parameter c in Table 8). Frick and Grabka (2010) provide evidence for the increasing relevance of (net) income from returns on investments, i.e. from capital income and from imputed rent for owner-occupied housing (also see Section 4.2). This source of income is especially concentrated in top income households. Based on the same data and for the same period of time, they find a dampening effect of imputed rent on inequality, while capital income clearly contributes to rising inequality. Since both income types serve as old-age provision in addition to public pensions it is not surprising that – in the light of an ageing society in Germany – we find evidence for more concentration at the top of the income distribution.

The fraction of overall post fisc richness change that can be attributed to demographic changes amounts to minuscule values between -1% and 2%. Hence, we find that changing population structure contributed literally nothing to the change in income richness. However insignificant, the result for the richness headcount below zero means that changing population structure even marginally dampened the growth in richness. I.e. those groups with relatively high levels of richness are becoming smaller while "poorer" groups with low levels of richness are growing.

In Table 6, lower panel, we also present results of the decomposition for poverty and richness based on the distinction of population subgroups according to household structure only. Although the resulting values for the fraction of summand B are smaller in magnitude the picture is qualitatively the same: The proportion amounts to values between 35.8% and 37.5% in case of income poverty and between 7.4% and 9% in case of richness. I.e. changing patterns in household formation contributed much more to the growth at bottom than to the upper tail of the income distribution. If one looks at a disaggregation of the poverty and richness decompositions respectively, i.e. examining the contributions of each single population subgroups it turns out that again the population subgroups of one- and two-adult as well as single parent households are those positively contributing to summand B, while the others' contributions have a negative sign (see Table 7).

Place Table 7 here.

This means, one can reason that the observed increase in relative poverty rates is not only related to increasing poverty rates *within* groups, but to a large extent also to the growth of population groups with above average levels of poverty (37.5%, see Table 6). E.g. single households and even more single parent households are characterized by a poverty rate of 24 and 43% (in 1991) respectively. In 2007 nearly every second individual, many of them children, living in a single parent household is considered as poor. However, less than 10% of the sizeable increase of overall richness measures are related to changes in population structure. I.e. the increase in richness is more due to increasing richness within groups rather than the growth of "rich" population subgroups.

5.2 Re-weighting

Since we are interested in the effect of changing household structure on income distribution over time, we want to compare the actual change in values of distributional measures to the change that would have occurred when household structure would have remained unchanged between the base period of our analysis (the year 1991) and the most recent period available (2007), everything else equal. To do so, one has to assign counterfactual population weights to the sample population of 2007 in order to arrive at a marginal distribution of household structure identical to the one in 1991.

As it is pointed out in subsection 3.2 this is done by re-defining population weights by multiplying the actual population weights with a re-weighting factor that is equal to the ratio of the population shares in the base and final period. Formally, one can write the counterfactual population weights as

$$\widetilde{w}_i^{2007} = w_i^{2007} \cdot \frac{v_{k,i}^{1991}}{v_{k,i}^{2007}} = w_i^{2007} \cdot \psi_x(x), \tag{14}$$

where w_i^{2007} denotes the actual population weight of individual i in 2007 and $v_{k,i}$ denotes the population share of subgroup k to which individual i belongs. The re-weighting function $\psi_x(x)$ reduces to the fraction of population shares in case of not controlling for further characteristics. Hence, if individual i belongs to a group whose share increased between 1991 and 2007, the re-weighting factor is smaller than one and its weight is downsized. It is enlarged if the re-weighting factor is greater than one, i.e. the respective subgroup's population share has decreased. This way of re-weighting has been applied in the OECD report (OECD, 2008, p. 66) in order to calculate counterfactual changes in income inequality assuming a constant population structure with respect to household and age structure respectively.[13]

We apply this type of re-weighting for Germany and report calculations for different GE inequality measures (I_0, I_1, and I_2) as well as for the Gini coefficient

[13]It would be possible to include additional controls in the reweighting procedure. However, when doing so, we find rather similar results (available upon request). Therefore, in order to make the reweighting procedure and the decomposition approach directly comparable, as well as in order to compare our results to OECD (2008) we concentrate on simple reweighting here. Note that this also corresponds to the first counterfactual in the analysis of Hyslop and Maré (2005).

(I_{Gini}) and the measures for poverty and richness that were already introduced in the previous sections. We compute how large the change in measures of distribution would have been if the marginal distribution of household structure would not have changed between 1991 and 2007. Table 8 reports several measures of inequality, poverty, and richness and distinguished between pre and post fisc incomes. We denote this counterfactual change as

$$\Delta^{rew} = \frac{M^{rew,07} - M^{rew,91}}{M^{rew,91}}, \tag{15}$$

where rew stands for re-weighted, and the actual observed change is denoted by

$$\Delta^{act} = \frac{M^{act,07} - M^{act,91}}{M^{act,91}}. \tag{16}$$

One can easily show that the following holds

$$\frac{\Delta^{act} - \Delta^{rew}}{\Delta^{act}} = \frac{M^{act,07} - M^{rew,07}}{M^{act,07} - M^{act,91}}. \tag{17}$$

This term denotes the share of the changing household structure in the total change of the respective measure $M \in \{I, P, R\}$. Note that it would equal zero if the re-weighted counterfactual value in 2007 would resemble the actual one ($M^{act,07} = M^{rew,07}$). In this case, the changing household structure would not affect the change at all. In the other extreme case the term would equal 100% if the re-weighted value of the measure under consideration in 2007 would be equal to the actual value of the base year 1991 ($M^{rew,07} = M^{act,91}$). Then the household structure would be related to the total change of the measure. The results are displayed in Table 8, which reveals that the share of changing household structure varies between measures for poverty (highest), inequality (medium), and richness (lowest) and between pre and post fisc incomes respectively.

Place Table 8 here.

For the re-weighting procedure, one can summarize that actual growth rates of the measures of distribution – without exception – are larger than the counterfactual re-weighted growth rates for pre fisc as well as for post fisc incomes. In other words,

the results of our re-weighting procedures state that inequality, poverty, and richness would not have increased as much as they actually did if there would have been no trend towards smaller households. According to our results, up to 80% of the rise in inequality in terms of pre fisc incomes may be attributed to changes in household size alone, not accounting for additional changes in employment behavior.

6 Conclusions

The aim of this paper is to quantify the effect of continuously decreasing average household size on measures of income distribution in Germany. By means of a re-weighting procedure and decompositions of changes in measures of income distribution (inequality, poverty, and richness) and based on income data from the German Socio-Economic Panel, we compute to what extent the overall changes in income distribution result from changes in population structure with respect to household composition.

Irrespective of the choice of methodology, it appears that the changing structure of German population with respect to household composition during the period between 1991 and 2007 is associated with increasing values for all indices of inequality, poverty, and richness under consideration. Without the demographic trend towards smaller households inequality, poverty, and richness would also have increased. But the levels would be tremendously lower than they actually are. Even the rest could not be exclusively attributed to a declining bargaining power of the unions but also to changes in the distribution of human capital as well as changes in occupational choices, see Bourguignon, Fournier, and Gurgand (2001); Hyslop and Maré (2005)). Investigating these factors is left to future research.

It turns out that the re-weighting approach and the decomposition reveal similar results for inequality, while the results for poverty and richness partly differ substantially. Hence, when looking at the income distribution as a whole the choice of methodology does not matter, while it does so at the tails of the distribution. In addition, we state that the effect of demographic change on income distribution is lower for post fisc than for pre fisc incomes, since we find much greater proportions

of the demographic effect in cases of the latter. This means, the tax benefit system in Germany provides – at least implicitly – some form of compensation for changing household structure. However, one could also argue that the fact that the German tax-benefit system compensated for most demographic change based increase in inequality, poverty, and richness itself has an effect on the demographic trend. So, as far as one can think of a causal relationship anyway, this could be reverse. In this context, it is not implausible to think of household formation as an endogenous process which is partly shaped by incentives provided by macro conditions and tax-benefit systems.[14] However, analyzing this is beyond the scope of this paper.

In summary, we conclude that the rise in income inequality is not a well suited argument for wage claims. A public policy aiming at reducing the income gap should rather consider strategies that allow for a better compatibility of family and work in order to alleviate labor force participation for parents.

[14] For instance, the reform measures concerning German labor market policy in 2005 (the so-called "Hartz" reforms) generated incentives for young unemployed adults to leave their parents' house earlier in order to receive a certain social benefit (or at least a higher amount). However, these incentives were reduced by legislation in 2006. Gallie and Paugam (2000) and Klasen and Woolard (2009) among others deal with this issue in European and developing countries respectively.

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A Tables and Figures

Table 1: Population subgroups according to household structure, 1991–2007

k	adults	children	$v_{k,1991}$	Δv_k	$\bar{y}^{0,post}_{k,1991}$	$\Delta\bar{y}^{0,post}_{k}$	$I^{k,1991}_{0,post}$	$\Delta I^{k}_{0,post}$	$I^{k,1991}_{0,pre}$	$\Delta I^{k}_{0,pre}$	$P^{k,1991}_{0,post}$	$\Delta P^{k}_{0,post}$	$R^{k,1991}_{0,post}$	$\Delta R^{k}_{0,post}$
1	1	no	0.158	0.042	17,332.28	1,383.65	0.152	0.020	1.301	-0.272	0.240	-0.010	0.051	0.008
			(0.004)	(0.006)	(415.05)	(556.09)	(0.011)	(0.019)	(0.050)	(0.067)	(0.013)	(0.017)	(0.007)	(0.008)
2	1	yes	0.028	0.009	12,273.86	-848.18	0.141	-0.056	0.345	0.427	0.431	0.061	0.026	-0.023
			(0.002)	(0.003)	(477.12)	(517.93)	(0.012)	(0.014)	(0.033)	(0.062)	(0.031)	(0.034)	(0.010)	(0.009)
3	2	no	0.258	0.053	20,899.99	2,542.07	0.117	0.039	0.763	0.090	0.089	-0.000	0.091	0.036
			(0.005)	(0.007)	(207.51)	(359.32)	(0.005)	(0.009)	(0.022)	(0.032)	(0.005)	(0.008)	(0.005)	(0.008)
4	2	yes	0.326	-0.068	17,317.43	2,665.31	0.074	0.038	0.149	0.117	0.089	0.022	0.031	0.038
			(0.005)	(0.007)	(118.68)	(230.06)	(0.002)	(0.005)	(0.005)	(0.011)	(0.004)	(0.008)	(0.003)	(0.005)
5	$\geq$3	no	0.150	-0.032	21,742.21	469.53	0.064	0.044	0.190	0.074	0.041	0.032	0.063	0.024
			(0.003)	(0.004)	(202.62)	(350.81)	(0.003)	(0.007)	(0.010)	(0.015)	(0.005)	(0.008)	(0.005)	(0.009)
6	$\geq$3	yes	0.080	-0.005	17,917.01	28.00	0.075	0.012	0.141	0.088	0.087	0.071	0.048	-0.021
			(0.002)	(0.003)	(200.71)	(317.63)	(0.003)	(0.005)	(0.006)	(0.012)	(0.007)	(0.016)	(0.006)	(0.007)
Total	–	–	1.000	0.000	18,816.32	1,782.19	0.105	0.040	0.500	0.125	0.115	0.026	0.056	0.026
			(0.000)	(0.000)	(106.66)	(162.88)	(0.002)	(0.004)	(0.010)	(0.016)	(0.003)	(0.005)	(0.002)	(0.003)

Note: Own calculations based on GSOEP. Bootstrapped standard errors in parentheses (500 replications). The population share of group k is denoted with v_k. Δ denotes the difference-operator. Group mean incomes ($\bar{y}_k$) are annual equivalent post fisc incomes (in Euro, prices of 2006, modified OECD scale).

Table 2: Population subgroups according to household structure and employment status, 1991–2007

k	adults	children	employed	$v_{k,1991}$	Δv_k	$\bar{y}^{0,post}_{k,1991}$	$\Delta\bar{y}^{0,post}_{k}$	$I^{k,1991}_{0,post}$	$\Delta I^{k}_{0,post}$	$I^{k,1991}_{0,pre}$	$\Delta I^{k}_{0,pre}$	$P^{k,1991}_{0,post}$	$\Delta P^{k}_{0,post}$	$R^{k,1991}_{0,post}$	$\Delta R^{k}_{0,post}$
1	1	no	0	0.090	0.011	14,102.35	1,718.73	0.125	0.029	1.216	-0.096	0.356	-0.032	0.019	0.018
				(0.003)	(0.005)	(391.15)	(471.03)	(0.012)	(0.014)	(0.074)	(0.086)	(0.020)	(0.024)	(0.005)	(0.008)
2	1	no	1	0.067	0.031	21,660.89	48.648	0.135	0.031	0.212	0.142	0.084	0.047	0.095	-0.012
				(0.003)	(0.004)	(679.42)	(1.008).64	(0.019)	(0.030)	(0.026)	(0.037)	(0.011)	(0.015)	(0.015)	(0.016)
3	1	yes	0	0.007	0.006	8,218.39	834.19	0.132	-0.077	0.437	0.635	0.732	-0.014	0.000	0.000
				(0.001)	(0.002)	(566.93)	(635.94)	(0.025)	(0.028)	(0.052)	(0.145)	(0.052)	(0.062)	(0.000)	(0.000)
4	1	yes	1	0.021	0.004	13,726.20	-1,003.54	0.112	-0.032	0.218	0.191	0.323	0.046	0.035	-0.030
				(0.001)	(0.002)	(517.46)	(543.96)	(0.011)	(0.014)	(0.020)	(0.046)	(0.030)	(0.037)	(0.013)	(0.013)
5	2	no	0	0.093	0.040	16,110.03	3,103.29	0.102	0.034	0.912	0.133	0.174	-0.030	0.034	0.030
				(0.003)	(0.005)	(370.28)	(509.75)	(0.011)	(0.014)	(0.047)	(0.062)	(0.012)	(0.017)	(0.007)	(0.008)
6	2	no	1	0.072	0.014	20,820.02	3,177.36	0.104	0.072	0.228	0.191	0.069	0.011	0.079	0.042
				(0.003)	(0.003)	(418.13)	(1.006).93	(0.008)	(0.025)	(0.020)	(0.037)	(0.008)	(0.014)	(0.012)	(0.016)
7	2	no	2	0.094	0.000	25,701.18	3,201.73	0.087	0.029	0.128	0.056	0.021	-0.001	0.157	0.065
				(0.003)	(0.004)	(418.21)	(527.45)	(0.007)	(0.009)	(0.009)	(0.014)	(0.004)	(0.007)	(0.011)	(0.017)
8	2	yes	0	0.005	0.012	12,826.74	187.29	0.063	0.065	0.813	0.119	0.372	0.137	0.000	0.021
				(0.001)	(0.001)	(601.46)	(857.11)	(0.013)	(0.020)	(0.189)	(0.215)	(0.056)	(0.066)	(0.000)	(0.008)
9	2	yes	1	0.137	-0.041	15,573.69	2,257.36	0.070	0.023	0.157	0.096	0.139	0.004	0.012	0.032
				(0.003)	(0.004)	(146.15)	(245.92)	(0.003)	(0.006)	(0.009)	(0.017)	(0.009)	(0.014)	(0.003)	(0.007)
10	2	yes	≥2	0.185	-0.039	18,723.81	3,474.51	0.070	0.034	0.111	0.068	0.046	-0.001	0.045	0.045
				(0.003)	(0.005)	(157.71)	(346.61)	(0.003)	(0.006)	(0.005)	(0.010)	(0.003)	(0.006)	(0.005)	(0.008)
11	≥3	no	0	0.006	0.002	18,819.59	-3,352.69	0.125	0.007	1.159	-0.403	0.279	0.064	0.103	-0.072
				(0.001)	(0.001)	(1506.98)	(1718.37)	(0.015)	(0.023)	(0.148)	(0.159)	(0.066)	(0.079)	(0.052)	(0.053)
12	≥ 3	no	1	0.031	-0.003	19,508.20	359.316	0.079	0.055	0.264	0.088	0.090	0.044	0.031	0.019
				(0.002)	(0.003)	(507.53)	(908.68)	(0.009)	(0.023)	(0.026)	(0.045)	(0.016)	(0.023)	(0.010)	(0.015)
13	≥3	no	≥2	0.113	-0.031	22,502.53	1,171.95	0.054	0.033	0.091	0.051	0.015	0.011	0.069	0.035
				(0.003)	(0.004)	(217.405)	(388.02)	(0.002)	(0.005)	(0.003)	(0.009)	(0.002)	(0.005)	(0.006)	(0.011)
14	≥3	yes	0	0.000	0.003	11,030.41	157.85	0.020	0.018	0.839	-0.407	0.549	0.096	0.000	0.000
				(0.000)	(0.000)	(1.165).37	(1.386).60	(0.007)	(0.017)	(0.323)	(0.322)	(0.262)	(0.275)	(0.000)	(0.000)
15	≥3	yes	1	0.015	0.004	16,383.19	-544.04	0.110	0.007	0.271	0.072	0.184	0.173	0.067	-0.052
				(0.001)	(0.002)	(596.22)	(758.52)	(0.012)	(0.013)	(0.028)	(0.039)	(0.027)	(0.046)	(0.016)	(0.016)
16	≥3	yes	≥2	0.065	-0.012	18,302.44	811.29	0.066	0.003	0.102	0.031	0.063	-0.006	0.044	-0.011
				(0.002)	(0.003)	(216.89)	(358.60)	(0.003)	(0.005)	(0.004)	(0.009)	(0.007)	(0.014)	(0.007)	(0.009)
Total	–	–	–	1.000	0.000	18,816.32	1,782.19	0.105	0.040	0.500	0.125	0.115	0.026	0.056	0.026
				(0.000)	(0.000)	(106.66)	(162.88)	(0.002)	(0.004)	(0.010)	(0.016)	(0.003)	(0.005)	(0.002)	(0.003)

Note: Own calculations based on GSOEP. Bootstrapped standard errors in parentheses (500 replications). The population share of group k is denoted with v_k. Δ denotes the difference-operator. Group mean incomes ($\bar{y}_k$) are annual equivalent post fisc incomes (in Euro, prices of 2006, modified OECD scale).

Table 3: Inequality decomposition 1991–2007

income	region	I_0^{1991}	I_0^{2007}	ΔI_0	A	B	C	D	$\frac{B+C}{\Delta I_0}$
household structure and employment status									
pre fisc	Germany	0.500	0.625	25.027	15.973	11.800	7.596	-10.148	77.500
		(0.010)	(0.011)	(3.542)	(2.274)	(1.211)	(0.973)	(1.716)	(8.150)
	West	0.480	0.558	16.284	15.892	7.982	5.542	-12.870	83.052
		(0.012)	(0.012)	(4.042)	(2.658)	(1.210)	(1.048)	(1.836)	(16.407)
	East	0.514	0.872	69.567	15.711	28.931	23.860	-0.584	75.885
		(0.022)	(0.024)	(8.524)	(3.743)	(3.154)	(3.097)	(3.691)	(5.311)
post fisc	Germany	0.105	0.144	37.755	28.917	5.354	3.024	0.560	22.189
		(0.002)	(0.004)	(4.463)	(3.991)	(0.682)	(0.586)	(1.415)	(2.851)
	West	0.104	0.149	42.990	35.679	4.689	2.145	0.564	15.896
		(0.003)	(0.004)	(5.268)	(4.635)	(0.694)	(0.656)	(1.508)	(2.248)
	East	0.070	0.097	38.801	44.055	-0.731	7.239	-16.178	16.773
		(0.002)	(0.003)	(6.022)	(4.886)	(1.639)	(1.938)	(2.479)	(8.656)
household structure only									
pre fisc	Germany	0.500	0.625	25.027	9.015	14.997	0.380	0.638	61.439
		(0.010)	(0.011)	(3.530)	(2.860)	(1.243)	(0.110)	(0.508)	(7.659)
	West	0.480	0.558	16.284	3.704	11.489	0.417	0.702	73.118
		(0.012)	(0.012)	(4.040)	(3.430)	(1.221)	(0.131)	(0.569)	(18.986)
	East	0.514	0.872	69.567	35.308	34.034	1.071	-0.781	50.462
		(0.022)	(0.024)	(8.597)	(6.383)	(3.289)	(0.312)	(1.476)	(5.618)
post fisc	Germany	0.105	0.144	37.755	29.430	5.394	1.161	1.713	17.363
		(0.002)	(0.004)	(4.552)	(4.354)	(0.587)	(0.287)	(1.053)	(2.047)
	West	0.104	0.149	42.990	34.792	4.413	1.293	2.485	13.274
		(0.003)	(0.004)	(5.364)	(5.149)	(0.574)	(0.347)	(1.250)	(1.782)
	East	0.070	0.097	38.801	38.093	4.393	3.736	-6.753	20.951
		(0.002)	(0.003)	(6.036)	(6.329)	(1.709)	(0.668)	(2.138)	(6.049)

Note: Own calculations based on GSOEP. Bootstrapped standard errors in parentheses (500 replications). Results for ΔI_0 and $\frac{B+C}{\Delta I_0}$ are displayed as percentages. Results for A–D are displayed as percentage points. See Footnote 10. Results are based on the modified OECD equivalence scale.

Table 4: Inequality decomposition 1991–2007: results per group (household structure only)

income	k	adults	children	A_k	B_k	C_k	D_k	$\frac{B_k+C_k}{\Delta I_0}$
pre	1	1	no	-9.138	9.825	8.649	-1.032	73.815
				(2.146)	(1.412)	(1.198)	(0.442)	(11.902)
	2	1	yes	2.548	0.936	2.007	1.154	11.758
				(0.374)	(0.284)	(0.583)	(0.205)	(3.528)
	3	2	no	5.144	8.667	10.725	0.083	77.484
				(1.850)	(1.198)	(1.492)	(0.071)	(13.793)
	4	2	yes	7.018	-2.838	-13.701	0.415	-66.084
				(0.673)	(0.328)	(1.518)	(0.105)	(9.531)
	5	≥3	no	2.032	-1.447	-6.510	0.004	-31.794
				(0.424)	(0.205)	(0.928)	(0.127)	(5.514)
	6	≥3	yes	1.411	-0.146	-0.790	0.013	-3.740
				(0.209)	(0.129)	(0.697)	(0.012)	(3.428)
	Total	–	–	9.015	14.997	0.380	0.638	61.439
				(2.860)	(1.243)	(0.110)	(0.508)	(7.659)
post	1	1	no	3.467	6.493	40.258	-1.123	123.825
				(3.306)	(0.996)	(5.692)	(0.507)	(20.629)
	2	1	yes	-1.755	1.005	9.920	0.898	28.937
				(0.433)	(0.296)	(2.834)	(0.532)	(8.287)
	3	2	no	10.722	6.932	51.223	3.917	154.030
				(2.474)	(0.997)	(7.389)	(0.668)	(27.263)
	4	2	yes	10.533	-6.042	-64.943	-2.301	-188.014
				(1.389)	(0.666)	(6.888)	(0.258)	(26.354)
	5	≥3	no	5.600	-2.628	-30.780	0.332	-88.485
				(0.846)	(0.363)	(4.146)	(0.259)	(15.051)
	6	≥3	yes	0.862	-0.365	-4.517	-0.010	-12.930
				(0.350)	(0.266)	(3.293)	(0.111)	(9.500)
	Total	–	–	29.430	5.394	1.161	1.713	17.363
				(4.354)	(0.587)	(0.287)	(1.053)	(2.047)

Note: Own calculations based on GSOEP. Bootstrapped standard errors in parentheses (500 replications). Results for $\frac{B_k+C_k}{\Delta I_0}$ are displayed as percentages. Results for A_k–D_k are displayed as percentage points. See Footnote 10. Results are based on the modified OECD equivalence scale.

Table 5: Inequality decomposition 1991–2007: $\frac{B+C}{\Delta I_0}$ for different equivalence scales

	$\theta_1 = \theta_2 = 0.5$						$\theta_1 = 0;\ \theta_2 = 1$					
	$\theta_3 = 0.3$		$\theta_3 = 0.5$		$\theta_3 = 1$		$\theta_3 = 0.3$		$\theta_3 = 0.5$		$\theta_3 = 1$	
income	$\gamma = 0.5$	$\gamma = 1$	$\gamma = 0.5$	$\gamma = 1$	$\gamma = 0.5$	$\gamma = 1$	$\gamma = 0.5$	$\gamma = 1$	$\gamma = 0.5$	$\gamma = 1$	$\gamma = 0.5$	$\gamma = 1$
	household structure and employment status											
pre fisc	79.143	77.500	79.319	78.139	78.931	76.762	78.497	77.941	78.698	78.591	78.307	77.322
	(6.336)	(5.798)	(6.391)	(5.972)	(6.315)	(5.740)	(6.064)	(5.618)	(6.084)	(5.747)	(6.080)	(5.594)
post fisc	23.259	22.189	23.353	22.853	22.797	20.054	21.658	24.296	22.264	26.476	20.751	21.075
	(2.285)	(2.482)	(2.570)	(3.212)	(2.027)	(1.925)	(2.145)	(2.888)	(2.373)	(3.498)	(1.958)	(2.471)
	household structure only											
pre fisc	65.103	61.439	65.367	62.065	65.815	63.018	62.869	58.081	63.119	58.634	63.621	59.658
	(8.662)	(7.659)	(8.740)	(7.839)	(8.932)	(8.369)	(8.106)	(6.839)	(8.146)	(6.922)	(8.265)	(7.220)
post fisc	21.796	17.363	21.817	17.433	21.061	13.439	18.290	15.148	18.739	16.543	19.124	17.124
	(2.450)	(2.047)	(2.509)	(2.287)	(2.657)	(2.912)	(2.067)	(2.163)	(2.141)	(2.455)	(2.323)	(3.101)

Note: Own calculations based on GSOEP. Bootstrapped standard errors in parentheses (500 replications). Note that for $\theta_1 = \theta_2 = 0.5$, $\theta_3 = 0.3$, and $\gamma = 1$ we arrive at the modified OECD scale, for $\theta_1 = 0$, $\theta_2 = \theta_3 = 1$, and $\gamma = 0.5$ at the square-root scale, while using a scale with $\theta_1 = 0$, $\theta_2 = \theta_3 = 1$, and $\gamma = 1$ is equivalent to using per-capita incomes, i.e. assuming no economies of scale (see Section 4.2).

Table 6: Poverty and richness decomposition 1991–2007 for post fisc income

	α	P_α^{1991}	P_α^{2007}	ΔP_α	A	B	$B/\Delta P_\alpha$
household structure and employment status							
Poverty	HC	0.115	0.141	22.602	5.628	16.974	75.101
		(0.003)	(0.004)	(5.091)	(4.697)	(2.000)	(18.493)
	1	0.024	0.033	36.355	15.452	20.903	57.498
		(0.001)	(0.001)	(7.757)	(6.785)	(2.666)	(12.234)
	2	0.008	0.012	47.238	23.474	23.764	50.307
		(0.000)	(0.001)	(11.477)	(10.132)	(3.334)	(13.983)
	β	R_β^{1991}	R_β^{2007}	ΔR_β	A	B	$B/\Delta R_\beta$
Richness	1	0.011	0.019	76.062	74.621	1.441	1.895
		(0.001)	(0.001)	(11.513)	(12.016)	(1.896)	(2.433)
	3	0.023	0.039	65.751	65.034	0.718	1.092
		(0.001)	(0.001)	(9.654)	(10.105)	(1.752)	(2.548)
	HC	0.056	0.081	46.623	47.043	-0.419	-0.899
		(0.002)	(0.002)	(7.124)	(7.384)	(1.494)	(3.162)
household structure only							
Poverty	HC	0.115	0.141	22.602	14.116	8.485	37.543
		(0.003)	(0.004)	(5.081)	(4.673)	(1.238)	(8.808)
	1	0.024	0.033	36.355	23.145	13.210	36.337
		(0.001)	(0.001)	(7.746)	(6.890)	(1.843)	(7.690)
	2	0.008	0.012	47.238	30.342	16.895	35.767
		(0.000)	(0.001)	(11.472)	(10.130)	(2.425)	(9.442)
	β	R_β^{1991}	R_β^{2007}	ΔR_β	A	B	$B/\Delta R_\beta$
Richness	1	0.011	0.019	76.062	70.404	5.658	7.439
		(0.001)	(0.001)	(11.574)	(11.624)	(1.244)	(1.886)
	3	0.023	0.039	65.751	60.716	5.036	7.659
		(0.001)	(0.001)	(9.675)	(9.739)	(1.146)	(1.973)
	HC	0.056	0.081	46.623	42.424	4.200	9.008
		(0.002)	(0.002)	(7.111)	(7.124)	(1.008)	(2.525)

Note: Own calculations based on GSOEP. Bootstrapped standard errors in parentheses (500 replications). Results for ΔP_α and $B/\Delta P_\alpha$ are displayed as percentages. Results for A and B are displayed as percentage points. See Footnote 10. Results are based on the modified OECD equivalence scale.

Table 7: Poverty and richness decomposition 1991–2007 for post fisc income: results per group (household structure only)

	k	adults	children	A_k	B_k	$\frac{B_k}{\Delta P_0} / \frac{B_k}{\Delta R_0}$
Poverty	1	1	no	-1.576	8.632	38.193
				(2.560)	(1.249)	(9.764)
	2	1	yes	1.739	3.740	16.548
				(0.994)	(1.087)	(5.403)
	3	2	no	-0.035	4.126	18.257
				(1.923)	(0.599)	(5.500)
	4	2	yes	5.477	-5.917	-26.180
				(1.949)	(0.646)	(6.832)
	5	$\geq$3	no	3.769	-1.592	-7.043
				(0.925)	(0.248)	(2.055)
	6	$\geq$3	yes	4.743	-0.504	-2.232
				(1.082)	(0.373)	(1.940)
	Total	–	–	14.116	8.485	37.543
				(4.673)	(1.238)	(8.808)
Richness	1	1	no	2.602	4.225	9.061
				(2.767)	(0.659)	(1.964)
	2	1	yes	-1.343	0.247	0.530
				(0.562)	(0.127)	(0.277)
	3	2	no	18.362	10.435	22.382
				(4.277)	(1.527)	(4.258)
	4	2	yes	20.034	-6.082	-13.046
				(3.025)	(0.733)	(2.239)
	5	$\geq$3	no	5.711	-4.307	-9.239
				(2.151)	(0.669)	(1.905)
	6	$\geq$3	yes	-2.942	-0.317	-0.680
				(0.991)	(0.236)	(0.515)
	Total	–	–	42.424	4.200	9.008
				(7.124)	(1.008)	(2.525)

Note: Own calculations based on GSOEP. Bootstrapped standard errors in parentheses (500 replications). Results for $\frac{B_k}{\Delta P_0}$ are displayed as percentages. Results for A_k and B_k are displayed as percentage points. See Footnote 10. Results are based on the modified OECD equivalence scale.

Table 8: Actual and re-weighted changes of inequality, poverty, and richness measures 1991–2007

	pre fisc			post fisc		
measure	Δ^{act}	Δ^{rew}	$\frac{\Delta^{act}-\Delta^{rew}}{\Delta^{act}}$	Δ^{act}	Δ^{rew}	$\frac{\Delta^{act}-\Delta^{rew}}{\Delta^{act}}$
I_{Gini}	18.39	9.16	50.21	16.14	12.45	22.85
	(1.44)	(1.26)	(3.21)	(1.65)	(1.53)	(2.54)
I_0	25.03	4.97	80.14	37.76	28.82	23.67
	(3.59)	(2.92)	(9.42)	(4.46)	(3.91)	(2.54)
I_1	39.97	20.69	48.24	54.24	43.11	20.51
	(5.45)	(4.24)	(3.90)	(10.34)	(8.47)	(2.75)
I_2	107.12	66.74	37.70	187.16	148.65	20.58
	(37.28)	(26.45)	(4.11)	(81.27)	(65.29)	(3.14)
	post fisc incomes					
	poverty			richness		
P_0/R_0	22.60	10.65	52.87	46.62	40.26	13.64
	(5.11)	(4.52)	(13.06)	(7.20)	(7.24)	(4.58)
P_1/R_3	36.36	21.08	42.03	65.75	56.79	13.63
	(7.74)	(6.95)	(9.28)	(9.69)	(9.54)	(2.93)
P_2/R_1	47.24	29.44	37.68	76.06	65.90	13.36
	(11.48)	(10.22)	(10.65)	(11.54)	(11.36)	(2.85)

Note: Own calculations based on GSOEP. Bootstrapped standard errors in parentheses (500 replications). Note that the results for actual (Δ^{act}) and re-weighted changes (Δ^{rew}) as well as the term $\frac{\Delta^{act}-\Delta^{rew}}{\Delta^{act}}$ are displayed as percentages, i.e. they were multiplied by 100. Results are based on the modified OECD equivalence scale.

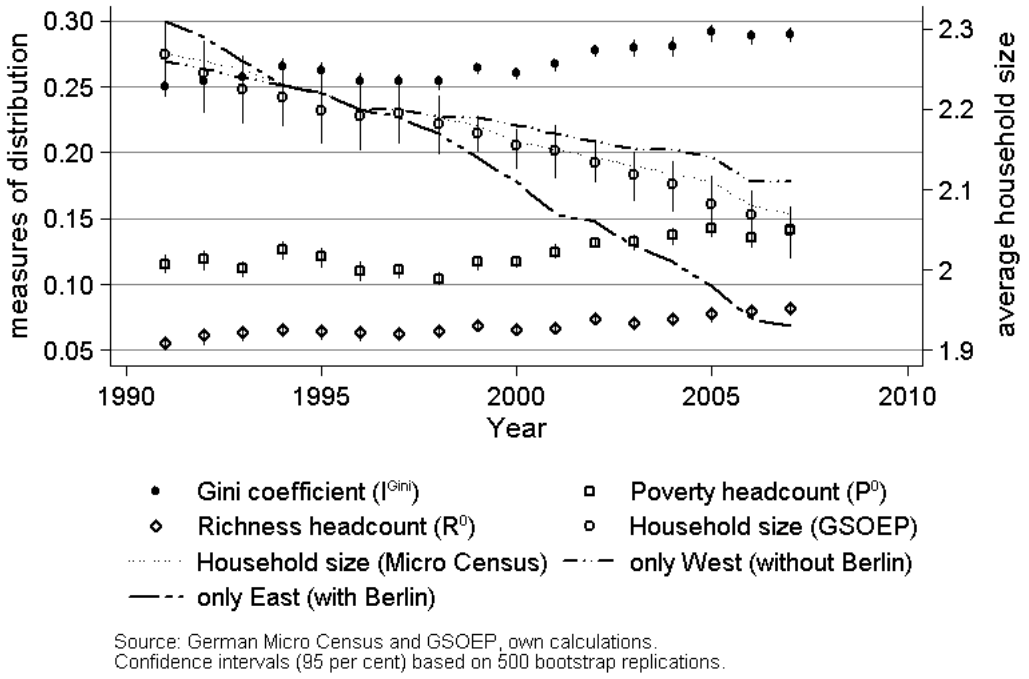

Figure 1: Household size, inequality, poverty, and richness (Germany 1991–2007)

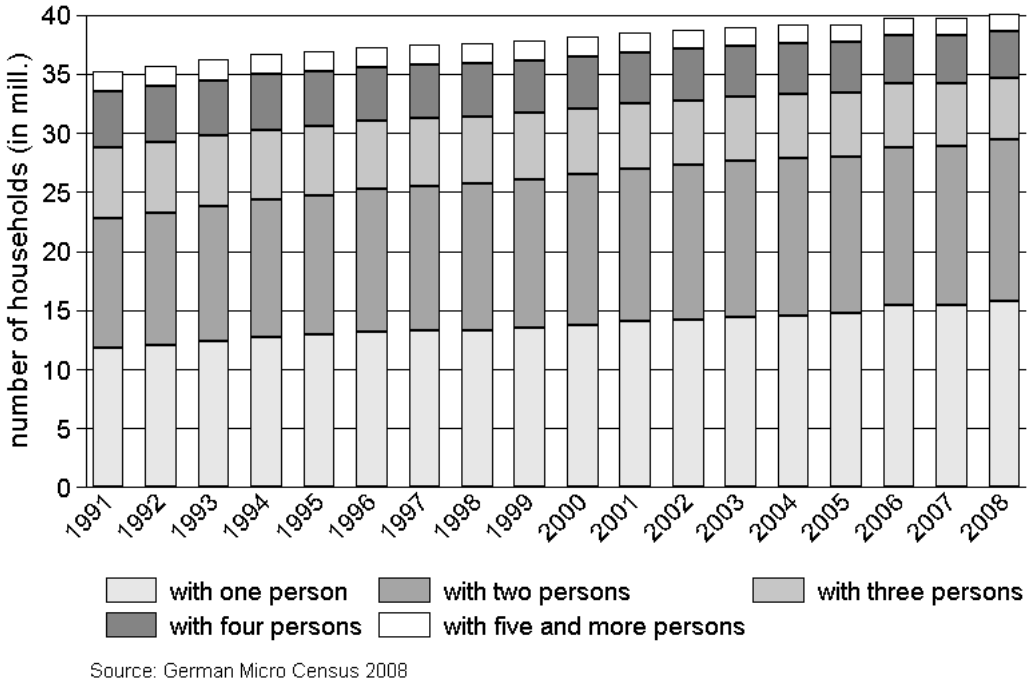

Figure 2: Number of different-sized households (Germany 1991–2008)

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