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DOES SIZE MATTER? THE IMPACT OF CHANGES IN HOUSEHOLD STRUCTURE ON INCOME DISTRIBUTION IN GERMANY

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Income inequality in Germany has been continually increasing during the past 20 years. One cause of this development, among others, could be structural shifts in household formation due to long-term societal trends. These 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 growth of the income gap in Germany (for both East and West from 1991 to 2007) is indeed strongly related to changes in household structure and employment behavior, and a large part of this increase is compensated by the welfare state.

JEL Codes: D31, D63, J11

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1. Introduction

Since reunification in 1990, inequality as well as the incidence of poverty and richness of the equivalent disposable income distribution in Germany have increased considerably (see OECD, 2008; Bach *et al.*, 2009; Peichl *et al.*, 2010; and Figure 1). From a policy perspective it is important to understand the driving forces behind this widening income gap. One cause of this development, among others (e.g. changes in returns to education, skill-biased technological change, deunionization or the weakening bargaining power of unions; see Lemieux, 2010), could be structural shifts in household formation due to long-term societal trends. These might be linked to rising inequality, since a decrease in the number of individuals living together affects the income distribution because of income sharing within households. Furthermore, changing household structure is

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accompanied by changes in employment patterns, which also have an impact on the income distribution. Therefore, everything else equal, the income distribution is affected by household structure changes (Burtless, 1999, 2009).

The aim of this paper is to quantify the effect of such changes on the income distribution. The case of Germany is of special interest, as the demographic development is not only characterized by an ageing population, but also by a sharp fall in average household size. Despite this very pronounced development, there has not been much research that systematically analyzes these effects on income distribution for Germany.[1]

Two different methods can be used to assess the impact of changing household structure: subgroup decomposition and re-weighting. The first is an exact decomposition of the distributional change by population subgroups (Shorrocks, 1980, 1984; Mookherjee and Shorrocks, 1982). This is the common approach in studies analyzing the effect of demographic change on inequality in 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) and to differences in poverty by region and household type (Bönke and Schröder, 2011). 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 (Blinder, 1973; Oaxaca, 1973) is applied in order to obtain counterfactual income distributions while keeping the marginal distributions of other characteristics fixed (DiNardo *et al.*, 1996; Hyslop and Maré, 2005). These procedures have already been applied in the OECD (2008) study to assess the importance of demographic change on income inequality as well as to other contexts related to wage and wealth inequality (Lemieux, 2006; Bover, 2010).

In this study we contrast the results from both techniques. Due to the possible existence of non-linearities, and as a sensitivity analysis, we check whether both approaches lead to similar results. Note that both approaches remain descriptive, i.e. based on the 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. This enables us to conduct a more detailed analysis of the tails of the income distribution. Our analysis is based on micro data from the German Socio-Economic Panel Study (GSOEP).

We find that the growth of the income gap in Germany (East and West, from 1991 to 2007) is indeed strongly related to such changes. For inequality of incomes before taxes and transfers we find a fraction of 78 percent. However, the result for incomes after taxes and transfers is only 22 percent. This means that the welfare state has largely compensated for inequality induced by changes in household structure. The same holds for the change in poverty, but less for the change in richness measures. Similar results occur when using a counterfactual re-weighting

[1]In a recent study on inequality, the OECD (2008) erroneously reports that a share of 88 percent of the total (absolute) change in the Gini coefficient of disposable incomes in West Germany from 1985 to 2005 is due to changing household structure. However, the authors have stated that this is a misprint. The true figure is 12 percent.

procedure. The role of the welfare state is important, since it not only enables the pure existence of poor households by providing a minimum income, but it also affects the income situation of specific population groups. For example, the welfare state compensates low-income households with children but burdens double-earner couples with high marginal income tax rates.

The paper is organized as follows. Section 2 provides an overview of the demographic trends in Germany, and 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, and the paper concludes in Section 6.

2. Demographic Trends in Germany

The demographic development in Germany is not only characterized by an ageing population, but also by a sharp drop in average household size, which is now—together with Sweden—lowest among OECD countries (OECD, 2008). 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 rate of divorce and a lower rate of marriage. The increase in two-person households is related to two developments: first, the number of childless couples has increased; and second, the increase in life expectancy has led to a growing number of elderly two-person households.

Figures 1 and 2 illustrate the demographic trend toward smaller households. According to data from the German Micro Census, the average number of individuals living together in a household decreased from 2.27 to 2.05 between 1991

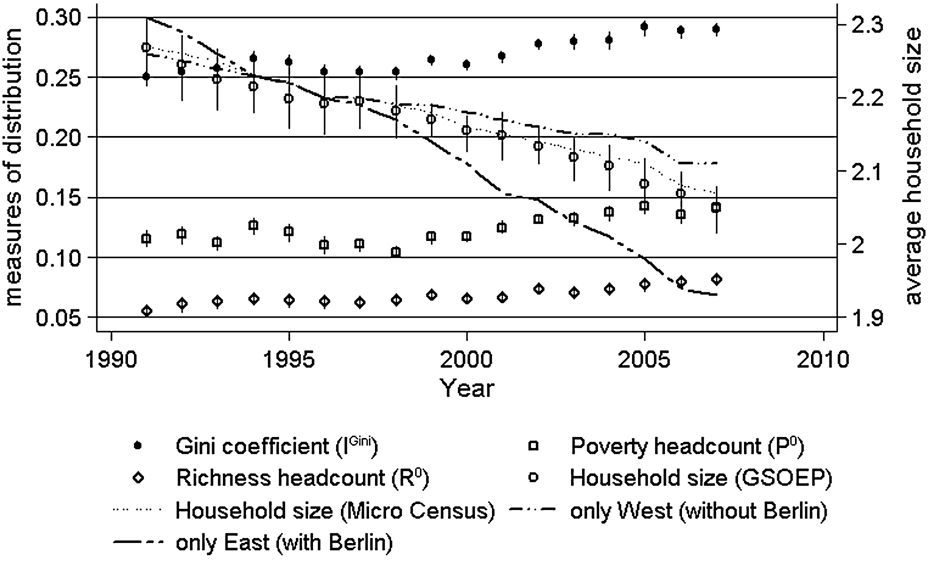

Figure 1. Household Size, Inequality, Poverty, and Richness (Germany 1991–2007)

Source: German Micro Census and GSOEP, own calculations.

Confidence intervals (95%) are represented by vertical lines and are based on 500 bootstrap replications.

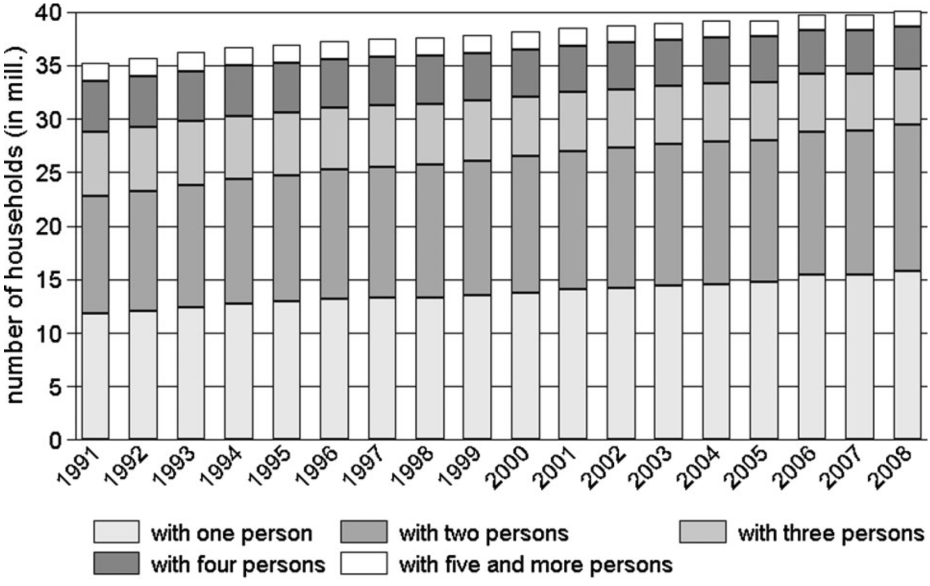

Figure 2. Number of Different-Sized Households (Germany 1991–2008)
Source: German Micro Census 2008.

and 2008. In East Germany this decrease was twice as large: while the average household size was 2.31 in 1991, it was only 1.91 in 2008.

Although Germany's population increased by 2.6 percent between 1991 and 2008 (from 80.2 to 82.3 million), the number of private households increased by 13.6 percent to 40.1 million. This was predominantly driven by the rising number of households with two persons at most. The number of one- and two-person households increased by 33.2 and 25.5 percent respectively, while the number of households with at least three persons has been decreasing (Statistisches Bundesamt, 2008b).[2] To a large extent, this development can be explained by the drastic and continual decline of Germany's birth rate, which decreased by 17.4 percent between 1991 and 2005 (Statistisches Bundesamt, 2008a). In addition, the trend toward individualization due to increasing relevance of modern lifestyles such as "living apart together" (see, e.g. Asendorpf, 2009) accounted for a large part of this observation.

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 women. This could lead to modifications in scope and selectivity of fertility. Hence, it is conceivable that household formation in turn depends on one's position in the income distribution, i.e. there is some form of reverse causality. For instance, educated and employed women may be

[2]Although according to the German Micro Census, the trend towards smaller households 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, our calculations based on data from the GSOEP are not significantly different (see Figure 1).

improving their income position, which again might coincide with remaining single for a longer time. In addition, demographic change can have different effects on pre and post fisc income distributions depending on how implicit equivalence scales are defined and compensate for different household behavior. Hence, the tax-benefit system can also provide incentives for a certain behavior, e.g. through a system of joint taxation which provides incentives for one-earner families.

As a result, it remains *a priori* unclear in which direction changes of household structure affect income distribution. The noticeable decline in the number of births, for example, means that many couples nowadays tend to stay childless. This leaves them with higher equivalent incomes than in a situation with children. In addition, childless couples are more likely to be double-earner which makes them even better-off. 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 if they were cohabiting. Whether these effects lead to an increase or a decrease in inequality depends on the average income position of the respective household types.

3. Methodology: Re-Weighting and Decomposition

In this section we describe methods for the measurement and decomposition of inequality, poverty, and richness. While re-weighting techniques seem to dominate traditional subgroup decompositions in labor economics literature, this is not true for the literature on income distribution. We employ both approaches here, since each has specific advantages. The re-weighting approach allows the calculation of different measures of distribution, since it is not restricted to a decomposable specific summary index, as is the case with the decomposition method. However, it is only possible to compare actually observed and counterfactual values to assess the importance of changes in the composition of the population. In contrast, using the decomposition approach allows the interpretation of each single component beyond simply within and between group inequality. Furthermore, using the subgroup decomposition approach allows our results to be compared to those of previous studies (Jenkins, 1995; Martin, 2006).

3.1. *Decomposition Techniques*

3.1.1. Inequality

There are several measures of inequality (see Atkinson and Bourguignon, 2000). In the context of our approach, the class of Generalized Entropy (GE) inequality measures (Shorrocks, 1980) is the most suitable one, as they can be decomposed so total inequality results from the sum of inequality *within* and *between* population subgroups. They are defined for an income distribution $Y = (y_1, \ldots, y_n)$, where y_i is the income of individual $i \in \{1, \ldots, n\}$, w_i is i's population weight, and $\bar{y}$ is the population mean.

For the purpose of this paper we choose $I_0 = \sum_{i=1}^{n} w_i / \sum_{i=1}^{n} w_i \, . \; ln(\bar{y}/y_i)$ from the GE family.[3] If one divides the total population into K disjoint and exhaustive subgroups, denoted by $k \in \{1, \ldots, K\}$, the measure I_0 can be written as

$$I_0 = \underbrace{\sum_{k=1}^{K} v_k \cdot I_{0k}}_{within} + \underbrace{\sum_{k=1}^{K} v_k \cdot ln\left(\frac{\bar{y}}{\bar{y}_k}\right)}_{between}, \tag{1}$$

where v_k denotes the weighted proportion of individuals belonging to population subgroup k. Hence, total inequality can be written as a weighted sum of inequality within and between population subgroups. This allows decomposing the *change* in total inequality over time into changes within subgroups and changes resulting from shifting population ratios, which can be written as

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

where Δ is the difference-operator; $\lambda_k = \bar{y}_k / \bar{y}$ denotes the ratio of population subgroup k's mean income to total population's mean income and $\theta_k = v_k \cdot \lambda_k$, which is the income ratio of group k. A symbol with a bar denotes the particular value averaged over time.[4] Thus, the total change in inequality can be decomposed into four components (Mookherjee and Shorrocks, 1982, p. 897). **Summand** *A* contains the contribution of inequality changes that result solely from changes *within* population subgroups (ΔI_{0k}) and abstracts from changes in composition by fixing population ratios to averaged values ($\bar{v}_k$). Accordingly, changes in inequality within groups with higher proportions would therefore be of greater importance. **Summand** *B*, on the other hand, contains the effect of changes in composition (Δv_k) on inequality *within* population subgroups. It analogously abstracts from changes in within-group inequality by fixing it on averaged values ($\bar{I}_{0k}$). If proportions of groups with relatively high levels of inequality increase, total inequality will increase accordingly and vice versa. **Summand** *C* describes the effect of changes in composition (Δv_k) on inequality *between* population subgroups. Again, changes in population ratios are crucial for the direction of change. Summand *C* sums up the contribution to total inequality change that results when proportions of groups with relatively high (or low) mean incomes increase (or decrease). **Summand** *D* represents the contribution of changes in population subgroup mean incomes

[3]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).

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

($\Delta ln\ (\bar{y}_k)$). It fixes the difference between group proportions of total income and population respectively. The higher the income ratio of a group relative to its share, the greater the effect on total income inequality when the mean income of that group changes.

To summarize, summand A represents changes in inequality within population subgroups. Summands B and C both 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. The relative importance of summands B and C in accounting for the total change in inequality ΔI_0 is of prior interest for our analysis.

3.1.2. Poverty and Richness

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

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

where $\alpha \geq 0$ is a parameter of poverty aversion, and $g_i = z - y_i$ denotes the income shortfall between individual i's income y_i and a given poverty line z. The number of poor is denoted by q. They receive an income not exceeding the poverty line z. In order to assess how much of an observed change in poverty can be attributed to demographic changes, it is necessary to decompose the change into components accordingly. If one divides the population into K disjoint and exhaustive population subgroups, one can show that (Shorrocks, 1999)

$$\Delta P_\alpha = P_\alpha^{t+1} - P_\alpha^t = \underbrace{\sum_{k=1}^{K} \bar{v}_k \cdot \Delta P_{\alpha,k}}_{A} + \underbrace{\sum_{k=1}^{K} \bar{P}_{\alpha,k} \cdot \Delta v_k}_{B}, \tag{4}$$

where v_k denotes the population share. Subgroup k's income vector is denoted by y_k, and poverty is measured within each group by $P_{\alpha,k}(y_k;z) = \sum_{i=1}^{q_k}(w_i/\sum_{i\in k} w_i)\cdot(g_i/z)^\alpha$ for $y_{i\in k} \leq z$, where q_k denotes the number of poor individuals within group k. The change in poverty (ΔP_α) can be decomposed into the change in levels of group poverty (labeled A) and changes in the composition of the population (demographic change, labeled B). This decomposition of change also corresponds to the one that results from a Shapley value decomposition (Shorrocks, 1999).

Income richness is a less studied field than income poverty. Peichl *et al.* (2010) propose measures that are decomposable by population subgroups and allow for a consideration of the intensity of richness analogous to the Foster–Greer–Thorbecke (FGT) poverty measure. The richness index we employ is defined as

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

where $\beta > 0$ 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, where individuals with an income above this line are defined as rich. As in the cases of inequality and poverty, it is possible to express richness as a weighted sum of richness within population subgroups $k \in \{1, \ldots, K\}$, where richness within each group k is denoted with $R_{\beta,k}(y_k;\rho) = \sum_{i=1}^{s_k} (w_i / \sum_{i \in k} w_i) \cdot (1 - (\rho/y_i)^\beta)$ 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 $t+1$:

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

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 by means of re-weighting, 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 DiNardo *et al.* (1996) and extended by Hyslop and Maré (2005) to estimate the counterfactual density function using a re-weighting technique.

Each household can be described with a vector (y, x, t) consisting of 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 a given 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.

(7a) $$f_t(y) = \int dF(y, x | t_{y,x} = t) = \int f(y | x, t_y = t)\, dF(x | t_x = t)$$

(7b) $$\equiv f(y, t_y = t, t_x = t).$$

The estimation of counterfactual densities combining different dates is accounted for in the last line of the notation. 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:

(8a) $$f\left(y, t_y = 2007, t_x = 1991\right) = \int f\left(y|x, t_y = 2007\right) dF(x|t_x = 1991)$$

(8b) $$= \int f\left(y|x, t_y = 2007\right) \psi_x(x) dF(x|t_x = 2007),$$

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

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

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 characteristics. To estimate the impact of the changing household structure, we compare inequality measures for the counterfactual distribution of 2007 incomes and 1991 household structure with the observed 2007 income distribution. Re-weighting and subgroup decomposition will lead to identical results if the relationship between demographic change and inequality is linear.

4. Empirical Foundation

4.1. *Data: The German Socio-Economic Panel Study*

The GSOEP is a panel survey of households and individuals that has been conducted annually since 1984. A weighting procedure means that respondents' data are representative for the German population (see Haisken-DeNew and Frick, 2005; Wagner *et al.*, 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 that contain information on annual income for the longest possible period, 1991–2007, in order to include East Germany after reunification. The dataset contains information from 17,921 (25,366) individual observations in 6665 (11,072) households for 1991 (2007).

4.2. *Income Concept*

We compute the change in measures of distribution (from equations (2), (4), and (6)) for equivalent pre and post fisc incomes. The progressive German tax-benefit system induces an inequality-reducing redistribution of incomes and takes into account household structures through implicit equivalence scales. Examining pre and post fisc incomes allows us to assess to what extent the German tax-benefit system compensates for changes in household structure.

GSOEP data contain appropriate income variables defined as follows (Grabka, 2007): pre fisc income includes labor earnings, asset flows, private retirement income, and private transfers; post fisc income includes pre fisc income, public transfers, and statutory pensions, minus any tax payments. Both concepts of income are deflated in order to compute real incomes. Moreover, we add household imputed rental values for owner-occupied housing (Yates, 1994; Canberra Group, 2001; Smeeding and Weinberg, 2001; Frick and Grabka, 2003; Eurostat, 2007). For population weights w_i we adopt the weights from the GSOEP (Grabka, 2007). In the following analysis we define the poverty line z to be 60 percent and the richness line ρ to be 200 percent of the median of equivalent pre- and post-government incomes.[5] Our main results rely on calculations using the modified OECD equivalence scale, which assigns a weight of 1 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 for alternative specifications.

4.3. *Definition of Population Subgroups*

The partition of the population into disjoint and exhaustive subgroups is of great importance for the following analysis.[6] According to our research question, household composition with respect to the number and age of household members is of relevance. We have already indicated that household formation is also related to labor market participation. Hence, in order to capture employment effects, our definition of population subgroups proceeds in two steps. We begin by distinguishing population subgroups according to two criteria. The first is the number of adult household members (aged 18 or over), and the second is the presence of children (younger than 18) in the household. We further distinguish these groups according to the number of employed individuals within the household as a third criterion. Differences in the results for the two definitions are related to changing patterns in labor force participation. However, we cannot identify the causal effect, since this is already partly captured by household structure because household formation and labor force behavior can be viewed as a joint decision.

We distinguish between singles, couples, and households with more than three adults, with and without children. In total we have six population subgroups according to household composition (see Table 1). 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 around 16 percent of the population in 1991, and by 2007 this share increased to 20 percent. The largest group in 2007 is represented by individuals living in two-adult households. Their share increased from 26 to over 30 percent. Hence, in 2007 more than half of the population lived in households with one or two adults without children. In addition, the share of individuals in single parent households increased from 2.8 to around 3.7 percent. Other types of households are on the retreat. One of the greatest reductions was the proportion of individuals in two-adult households with children which dropped by nearly seven percentage points to 26 percent. Note that

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

[6]Note that compared to the population in private households, the population in institutionalized households is underrepresented in the GSOEP (Haisken-DeNew and Frick, 2005). 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 retirement and nursing homes, i.e. the bias may have increased over time. However, since there is no information available for this group, we only refer to the population in private households.

TABLE 1

Population Subgroups According to Household Structure, 1991–2007

k	Adults	Children	$v_{k,1991}$	Δv_k	$\bar{y}^{post}_{k,1991}$	$\Delta\bar{y}^{post}_k$	Empl.	ΔEmpl.	Hours	ΔHours	$I^{k,1991}_{0,post}$	$\Delta I^{k}_{0,post}$	$I^{k,1991}_{0,pre}$	$\Delta I^{k}_{0,pre}$	$P^{k,1991}_{0,post}$	$\Delta P^{k}_{0,post}$	$R^{k,1991}_{0,post}$	$\Delta R^{k}_{0,post}$
1	1	no	0.158	0.042	17,332	1,384	0.43	0.06	17.0	1.6	0.152	0.020	1.301	–0.272	0.240	–0.010	0.051	0.008
			(0.004)	(0.006)	(415)	(556)	(0.02)	(0.02)	(0.7)	(0.8)	(0.011)	(0.019)	(0.050)	(0.067)	(0.013)	(0.017)	(0.007)	(0.008)
2	1	yes	0.028	0.009	12,274	–848	0.34	–0.05	11.7	–3.6	0.141	–0.056	0.345	0.427	0.431	0.061	0.026	–0.023
			(0.002)	(0.003)	(477)	(518)	(0.03)	(0.04)	(1.0)	(1.2)	(0.012)	(0.014)	(0.033)	(0.062)	(0.031)	(0.034)	(0.010)	(0.009)
3	2	no	0.258	0.053	20,900	2,542	0.53	–0.05	19.9	–2.5	0.117	0.039	0.763	0.090	0.089	–0.000	0.091	0.036
			(0.005)	(0.007)	(208)	(359)	(0.01)	(0.01)	(0.4)	(0.5)	(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	2,665	0.46	0.00	16.9	–1.2	0.074	0.038	0.149	0.117	0.089	0.022	0.031	0.038
			(0.005)	(0.007)	(119)	(230)	(0.01)	(0.01)	(0.3)	(0.5)	(0.002)	(0.005)	(0.005)	(0.011)	(0.004)	(0.008)	(0.003)	(0.005)
5	≥3	no	0.150	–0.032	21,742	470	0.69	–0.06	25.2	–3.5	0.064	0.044	0.190	0.074	0.041	0.032	0.063	0.024
			(0.003)	(0.004)	(203)	(351)	(0.01)	(0.02)	(0.5)	(0.7)	(0.003)	(0.007)	(0.010)	(0.015)	(0.005)	(0.008)	(0.005)	(0.009)
6	≥3	yes	0.080	–0.005	17,917	28	0.53	–0.07	19.5	–4.3	0.075	0.012	0.141	0.088	0.087	0.071	0.048	–0.021
			(0.002)	(0.003)	(201)	(318)	(0.01)	(0.02)	(0.6)	(0.9)	(0.003)	(0.005)	(0.006)	(0.012)	(0.007)	(0.016)	(0.006)	(0.007)
Total	–	–	1.000	0.000	18,816	1,782	0.51	–0.03	19.0	–1.8	0.105	0.040	0.500	0.125	0.115	0.026	0.056	0.026
			(0.000)	(0.000)	(107)	(163)	(0.01)	(0.01)	(0.2)	(0.3)	(0.002)	(0.004)	(0.010)	(0.016)	(0.003)	(0.005)	(0.002)	(0.003)

Notes: 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 euros, prices of 2006, modified OECD scale).

those groups with growing population shares are characterized by above average and increasing levels of income inequality. Moreover, their group mean incomes display much more variation around the population's mean, i.e. the population is becoming more heterogenous in terms of both within- and between-group inequality.

The declining relative number of individuals living in households with several adults and children partly means that multiple generation-households as a form of cohabitation is clearly decreasing in Germany: The proportion of individuals in multiple generation-households decreased from 2.4 to 1.3 percent between 1991 and 2007. This drop contributes to increasing income inequality because of the diminishing incidence of redistribution *within households* and *between generations*. Hence, to the degree to which this form of cohabitation is reduced, there will be more inequality.[7]

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 with respect to this definition. Population subgroups defined according to household structure and employment status are internally less heterogenous and there is less variation in mean incomes. This is not surprising, since additional employed household members increase household earnings. Employed singles account for around three-quarters of the percentage point increase in the number of single households, while most of the growth of two-adult households without children is due to more couples not in employment—presumably 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.[8]

5.1.1. Inequality

Pre fisc incomes. For pre fisc incomes overall inequality in reunified Germany increased by 25 percent between 1991 and 2007 (see Table 3). Around 19.4 percentage points (pp) of this increase can be attributed to changes in household structure and employment status (summands B and C, corresponding to 77.5

[7]Note that our income concept includes private transfer payments. Hence, we take into account redistribution of income occurring *between households* but (in most cases) *within families*. Which is why our results highlight the effect of less redistribution within households.

[8]Note that the decomposition results according to equations (2), (4), and (6) are presented as percentages and percentage points. For example, ΔI_0 and the summands A to D are divided by I_0^t and multiplied by 100 each. The same holds 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). In addition, as is clear from Figure 1, the demographic trend is more pronounced in the East.

TABLE 2

Population Subgroups According to Household Structure and Employment Status, 1991–2007

k	Adults	Children	Employed	$v_{k,1991}$	Δv_k	$\bar{y}^{post}_{k,1991}$	$\Delta\bar{y}^{post}_k$	Hours	ΔHours	$I^{k,1991}_{0,post}$	$\Delta I^k_{0,post}$	$I^{k,1991}_{0,pre}$	$\Delta I^k_{0,pre}$	$P^{k,1991}_{0,post}$	$\Delta P^k_{0,post}$	$R^{k,1991}_{0,post}$	$\Delta R^k_{0,post}$
1	1	no	0	0.090	0.011	14,102	1,719	0.2	–0.0	0.125	0.029	1.216	–0.096	0.356	–0.032	0.019	0.018
				(0.003)	(0.005)	(391)	(471)	(0.1)	(0.1)	(0.012)	(0.014)	(0.074)	(0.086)	(0.020)	(0.024)	(0.005)	(0.008)
2	1	no	1	0.067	0.031	21,661	49	39.5	–1.8	0.135	0.031	0.212	0.142	0.084	0.047	0.095	–0.012
				(0.003)	(0.004)	(679)	(9)	(0.7)	(0.9)	(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	834	0.9	–0.7	0.132	–0.077	0.437	0.635	0.732	–0.014	0.000	0.000
				(0.001)	(0.002)	(567)	(636)	(0.6)	(0.6)	(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	–1,004	15.5	–3.1	0.112	–0.032	0.218	0.191	0.323	0.046	0.035	–0.030
				(0.001)	(0.002)	(518)	(544)	(1.2)	(1.5)	(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	3,103	0.0	0.0	0.102	0.034	0.912	0.133	0.174	–0.030	0.034	0.030
				(0.003)	(0.005)	(370)	(510)	(0.0)	(0.0)	(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	3,177	22.1	–0.3	0.104	0.072	0.228	0.191	0.069	0.011	0.079	0.042
				(0.003)	(0.003)	(418)	(1,007)	(0.7)	(1.0)	(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	3,202	37.8	0.1	0.087	0.029	0.128	0.056	0.021	–0.001	0.157	0.065
				(0.003)	(0.004)	(418)	(527)	(0.4)	(0.6)	(0.007)	(0.009)	(0.009)	(0.014)	(0.004)	(0.007)	(0.011)	(0.017)
8	2	yes	0	0.005	0.012	12,827	187	0.3	0.5	0.063	0.065	0.813	0.119	0.372	0.137	0.000	0.021
				(0.001)	(0.001)	(601)	(857)	(0.2)	(0.5)	(0.013)	(0.020)	(0.189)	(0.215)	(0.056)	(0.066)	(0.000)	(0.008)
9	2	yes	1	0.137	–0.041	15,574	2,257	12.1	0.2	0.070	0.023	0.157	0.096	0.139	0.004	0.012	0.032
				(0.003)	(0.004)	(146)	(246)	(0.5)	(0.8)	(0.003)	(0.006)	(0.009)	(0.017)	(0.009)	(0.014)	(0.003)	(0.007)
10	2	yes	≥2	0.185	–0.039	18,724	3,475	20.9	–1.2	0.070	0.034	0.111	0.068	0.046	–0.001	0.045	0.045
				(0.003)	(0.005)	(157)	(347)	(0.4)	(0.6)	(0.003)	(0.006)	(0.005)	(0.010)	(0.003)	(0.006)	(0.005)	(0.008)
11	≥3	no	0	0.006	0.002	18,820	–3,353	0.2	0.8	0.125	0.007	1.159	–0.403	0.279	0.064	0.103	–0.072
				(0.001)	(0.001)	(1,507)	(1,718)	(0.2)	(0.5)	(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	359	14.1	1.5	0.079	0.055	0.264	0.088	0.090	0.044	0.031	0.019
				(0.002)	(0.003)	(508)	(909)	(1.1)	(1.6)	(0.009)	(0.023)	(0.026)	(0.045)	(0.016)	(0.023)	(0.010)	(0.015)
13	≥3	no	≥2	0.113	–0.031	22,503	1,172	29.5	–3.7	0.054	0.033	0.091	0.051	0.015	0.011	0.069	0.035
				(0.003)	(0.004)	(217)	(388)	(0.5)	(0.8)	(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	158	0.0	0.3	0.020	0.018	0.839	–0.407	0.549	0.096	0.000	0.000
				(0.000)	(0.000)	(1,165)	(386)	(0.0)	(0.3)	(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	–544	11.4	–1.3	0.110	0.007	0.271	0.072	0.184	0.173	0.067	–0.052
				(0.001)	(0.002)	(596)	(759)	(1.5)	(1.9)	(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	811	21.4	–3.5	0.066	0.003	0.102	0.031	0.063	–0.006	0.044	–0.011
				(0.002)	(0.003)	(217)	(359)	(0.6)	(1.0)	(0.003)	(0.005)	(0.004)	(0.009)	(0.007)	(0.014)	(0.007)	(0.009)
Total	–	–	–	1.000	0.000	18,816	1,782	19.0	–1.8	0.105	0.040	0.500	0.125	0.115	0.026	0.056	0.026
				(0.000)	(0.000)	(107)	(163)	(0.2)	(0.3)	(0.002)	(0.004)	(0.010)	(0.016)	(0.003)	(0.005)	(0.002)	(0.003)

Notes: 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 euros, 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	$\frac{B+C}{\Delta I_0}$	$\frac{B+C}{A+B+C}$
Household structure and employment status										
pre fisc	Germany	0.500	0.625	25.0	16.0	11.8	7.6	−10.2	77.5	54.8
		(0.010)	(0.011)	(3.5)	(2.3)	(1.2)	(1.0)	(1.7)	(8.2)	(4.3)
	West	0.480	0.558	16.3	15.9	8.0	5.5	−12.9	83.1	45.9
		(0.012)	(0.012)	(4.0)	(2.7)	(1.2)	(1.1)	(1.8)	(16.4)	(5.4)
	East	0.514	0.872	69.6	15.7	28.9	23.9	−0.6	75.9	77.1
		(0.022)	(0.024)	(8.5)	(3.7)	(3.2)	(3.1)	(3.7)	(5.3)	(4.7)
pre fisc	Germany	0.105	0.144	37.8	28.9	5.4	3.0	0.6	22.2	22.5
		(0.002)	(0.004)	(4.5)	(4.0)	(0.7)	(0.6)	(1.4)	(2.9)	(2.8)
	West	0.104	0.149	43.0	35.7	4.7	2.2	0.6	15.9	16.2
		(0.003)	(0.004)	(5.3)	(4.6)	(0.7)	(0.7)	(1.5)	(2.3)	(2.4)
	East	0.070	0.097	38.8	44.1	−0.7	7.2	−16.2	16.8	12.8
		(0.002)	(0.003)	(6.0)	(4.9)	(1.6)	(1.9)	(2.5)	(8.7)	(5.5)
Household structure only										
pre fisc	Germany	0.500	0.625	25.0	9.0	15.0	0.4	0.6	61.4	63.1
		(0.010)	(0.011)	(3.5)	(2.9)	(1.2)	(0.1)	(0.5)	(7.7)	(8.3)
	West	0.480	0.558	16.3	3.7	11.5	0.4	0.7	73.1	76.3
		(0.012)	(0.012)	(4.0)	(3.4)	(1.2)	(0.1)	(0.6)	(19.0)	(17.8)
	East	0.514	0.872	69.6	35.3	34.0	1.1	−0.8	50.5	49.9
		(0.022)	(0.024)	(8.6)	(6.4)	(3.3)	(0.3)	(1.5)	(5.6)	(5.5)
post fisc	Germany	0.105	0.144	37.8	29.4	5.4	1.2	1.7	17.4	18.3
		(0.002)	(0.004)	(4.6)	(4.4)	(0.6)	(0.3)	(1.1)	(2.1)	(2.1)
	West	0.104	0.149	43.0	34.8	4.4	1.3	2.5	13.3	14.1
		(0.003)	(0.004)	(5.4)	(5.2)	(0.6)	(0.4)	(1.3)	(1.8)	(1.9)
	East	0.070	0.097	38.8	38.1	4.4	3.7	−6.8	21.0	17.5
		(0.002)	(0.003)	(6.0)	(6.3)	(1.7)	(0.7)	(2.1)	(6.1)	(4.4)

Notes: Own calculations based on GSOEP. Bootstrapped standard errors in parentheses (500 replications). Results for ΔI_0 and $(B+C)/\Delta I_0$ are displayed as percentages. Results for A to D are displayed as percentage points. See Footnote 8. Results are based on the modified OECD equivalence scale.

percent of the increase), 16.0 pp to summand A, whereas summand D reduces inequality by 10 pp.[9] So the rise in inequality to be explained by A, B, and C together is actually 35 percent, whereof A accounts for 45 percent and $B + C$ for 55 percent. In the remainder of the paper we focus on the first definition but also report the fraction $(B+C)/(A+B+C)$ in Table 3 for completeness. We find that the results differ quantitatively in these cases, but one cannot draw divergent conclusions.

Although the contribution of summand B is somewhat larger in magnitude, both summands B and C contribute to this result; 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 contributed considerably to the overall increase in inequality. Moreover, these groups have mean incomes quite different from the overall mean, and their growth

[9]Although it is straightforward to interpret the fraction $(B+C)/\Delta I_0$ as the changing population's contribution to inequality change (Jenkins, 1995; Martin, 2006), one might argue that the effects are overstated when single summands have the opposite sign of the total change. This applies to summand D in our case.

contributes to increasing inequality 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 rather 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.

In West Germany pre fisc income inequality increased by 16.3 percent between 1991 and 2007. The share of summands *B* and *C* is 83 percent. The increase in overall pre fisc inequality in East Germany since reunification, in 1991 (around 70 percent), is much more pronounced than in the West. Shrinking household size makes up 76 percent of the overall change.[10]

Post fisc incomes. 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 increased by 37.8 percent, which is larger than the increase for pre fisc income, although the level of inequality is still much lower. The proportion of summands *B* and *C* amounts to 22.2 percent between 1991 and 2007, which is significantly lower than for pre fisc income. Examining West Germany alone reveals that the proportion of summands *B* and *C* between 1991 and 2007 (15.9 percent) is lower than for Germany as a whole. In East Germany income inequality grew by 38.8 percent. Summands *B* and *C* account for around 16.8 percent.

Welfare state effects. Our results imply that the German tax-benefit system takes into account household structure and compensates for most (but not all) increases in inequality that can be related to demographic changes. There are several policies at work. For example, we observe an increase in the number of single parents. This population group is rather poor, since they typically exhibit low employment rates, which decreased from an already low level of 34 percent in 1991 to below 30 percent in 2007 and, if employed, only work for a small number of hours (see Table 1). Hence, their position in the pre fisc income distribution is much worse compared to other groups. However, single parents receive important benefits, targeting children in low-income households, as the implicit equivalence scales in the tax-benefit system generously compensate for the presence of children (Fuest *et al.*, 2010), and hence their relative position is improving. The same holds for poor households in general, since poorer people tend to have more children than rich people. Especially among the latter group, fertility is declining the most.

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. In particular, the high marginal tax rates on secondary earners' income—inherent in the German system

[10]Note that in 2007 inequality in East Germany is higher for pre fisc incomes compared to the West, but 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 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 considered as a "driving force."

of income taxation—reduces considerably post fisc income compared to market income of married double-earner couples. This lowers the relative position of this demographic group in the income distribution. Another example where the tax-benefit system had a direct impact on household formation is concerned with the Hartz reforms: these reforms of German labor market policy in 2005 generated incentives for young unemployed adults to leave their parents' house earlier in order to receive certain social benefits (or at least a higher amount).[11]

Household structure only. In order to obtain an idea of the relative importance of changing household size, we now present results based on the narrower definition of subgroups, which ignores the employment status of the household (see lower panel of Table 3). 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 percent for summands *B* and *C* (West: 73 percent, East: 50.5 percent); for post fisc incomes we have 17.4 percent (West: 13.3 percent, East: 21 percent). Hence, without accounting for the employment status, the explanatory contribution of household structure is reduced by 16.1 (4.8) pp for pre (post) fisc incomes. These differences are due to the declining importance of summand *C*, i.e. shifts in population shares play a minor role for increasing between-group inequality.

Summands *A* to *D* are themselves aggregations over population subgroups (see equation (2)). Table 4 displays the contributions of each single population subgroup to the components of inequality change for pre and post fisc incomes respectively. It becomes apparent that for both summands *B* and *C* the results presented in Table 4 are mainly "driven" by certain subgroups. Not surprisingly, it is especially the growth of one- and two-adult households (groups 1 and 3) which is positively contributing to overall inequality change, since these are the only ones whose proportions among the population are noticeably increasing. Another group with a smaller, but still positive, contribution is single-parent households (group 2). All these groups exhibit above-average *and* increasing levels of inequality, within as well as between subgroups (see Table 1). Increasing heterogeneity within the group of single-adult households is due to the fact that nowadays this group is no longer dominated by elderly people (pensioners, widows/widowers) with low pension incomes but consists more and more of young- and middle-aged individuals at different positions in their educational or professional careers. This is confirmed by the fact that the employment rate of singles increased from below average in 1991 (43 percent) to slightly above average in 2007 (49 percent). Moreover, income inequality is comparatively high among single-adult households because they are not able to redistribute 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]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.

TABLE 4

Inequality Decomposition 1991–2007: Results per Group (household structure only)

Income	k	Adults	Children	A_k	B_k	C_k	D_k	$(B_k + C_k)/\Delta I_0$
pre	1	1	no	–9.1	9.8	8.7	–1.0	73.8
				(2.2)	(1.4)	(1.2)	(0.4)	(11.9)
	2	1	yes	2.6	0.9	2.0	1.2	11.8
				(0.4)	(0.3)	(0.6)	(0.2)	(3.5)
	3	2	no	5.1	8.7	10.7	0.1	77.5
				(1.9)	(1.2)	(1.5)	(0.1)	(13.8)
	4	2	yes	7.0	–2.8	–13.7	0.4	–66.1
				(0.7)	(0.3)	(1.5)	(0.1)	(9.5)
	5	≥3	no	2.0	–1.5	–6.5	0.0	–31.8
				(0.4)	(0.2)	(0.9)	(0.1)	(5.5)
	6	≥3	yes	1.4	–0.2	–0.8	0.0	–3.7
				(0.2)	(0.1)	(0.7)	(0.0)	(3.4)
	Total	–	–	9.0	15.0	0.4	0.6	61.4
				(2.9)	(1.2)	(0.1)	(0.5)	(7.7)
post	1	1	no	3.5	6.5	40.3	–1.1	123.8
				(3.3)	(1.0)	(5.7)	(0.5)	(20.6)
	2	1	yes	–1.8	1.0	9.9	0.9	28.9
				(0.4)	(0.3)	(2.8)	(0.5)	(8.3)
	3	2	no	10.7	6.9	51.2	3.9	154.0
				(2.5)	(1.0)	(7.4)	(0.7)	(27.3)
	4	2	yes	10.5	–6.0	–64.9	–2.3	–188.0
				(1.4)	(0.7)	(6.9)	(0.3)	(26.4)
	5	≥3	no	5.6	–2.6	–30.8	0.3	–88.5
				(0.9)	(0.4)	(4.2)	(0.3)	(15.1)
	6	≥3	yes	0.9	–0.4	–4.5	–0.0	–12.9
				(0.4)	(0.3)	(3.3)	(0.1)	(9.5)
	Total	–	–	29.4	5.4	1.2	1.7	17.4
				(4.4)	(0.6)	(0.3)	(1.1)	(2.1)

Notes: Own calculations based on GSOEP. Bootstrapped standard errors in parentheses (500 replications). Results for $(B_k + C_k)/\Delta I_0$ are displayed as percentages. Results for A_k to D_k are displayed as percentage points. See Footnote 8. Results are based on the modified OECD equivalence scale.

5.1.2. Role of the Equivalence Scale

The choice of equivalence scale is not irrelevant with respect to our research question. Inequality rankings in cross-country comparison are sensitive to different values of the equivalence-scale elasticity (Buhmann *et al.*, 1988; Hagenaars *et al.*, 1994; Ebert and Moyes, 2003; Bönke and Schröder, 2008). Most of the equivalence scales (*ES*) used in practice (e.g. Jenkins and Cowell, 1994; Burkhauser *et al.*, 1996) can be written in the general form of

$$ES = (\theta_1 + \theta_2 \cdot N_A + \theta_3 \cdot N_C)^{\gamma}, \tag{10}$$

where θ_1 denotes an extra weight for the (adult) head of the household, θ_2 denotes the weight for (additional) adult household members (N_A), and θ_3 denotes the weight of children (N_C). For smaller values of the parameter γ the importance of

TABLE 5
Inequality Decomposition 1991–2007 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	79.1	77.5	79.3	78.1	78.9	76.8	78.5	77.9	78.7	78.6	78.3	77.3
	(6.3)	(5.8)	(6.4)	(6.0)	(6.3)	(5.7)	(6.1)	(5.6)	(6.1)	(5.8)	(6.1)	(5.6)
post fisc	23.3	22.2	23.4	22.9	22.8	20.1	21.7	24.3	22.3	26.5	20.8	21.1
	(2.3)	(2.5)	(2.6)	(3.2)	(2.0)	(1.9)	(2.2)	(2.9)	(2.4)	(3.5)	(2.0)	(2.5)
Household structure only												
pre fisc	65.1	61.4	65.4	62.1	65.8	63.0	62.9	58.1	63.1	58.6	63.6	59.7
	(8.7)	(7.7)	(8.7)	(7.8)	(8.9)	(8.4)	(8.1)	(6.8)	(8.2)	(6.9)	(8.3)	(7.2)
post fisc	21.8	17.4	21.8	17.4	21.1	13.4	18.3	15.2	18.7	16.5	19.1	17.1
	(2.5)	(2.1)	(2.5)	(2.3)	(2.7)	(2.9)	(2.1)	(2.2)	(2.1)	(2.5)	(2.3)	(3.1)

Notes: 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).

economies of scale in household consumption increases.[12] In order to make certain that these results are not due to a specific choice of equivalence scale, we calculate the fraction of summands B and C for the inequality decomposition for various specifications of the general form of the equivalence scale in equation (10). 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, i.e. in the absence of scale economies, a sizeable fraction of inequality change (60/77 percent for pre and 17/21 percent 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 and richness change are presented in Table 6.[13] We find that the demographic effect on poverty change sums to more than half of total change (between 50.3 and 75.1 percent). The richness measures for post fisc incomes increased quite considerably between 1991 and 2007—by more than 76 percent for $\beta = 1$ and by two-thirds for $\beta = 3$. The head count ratio for richness (HC) increased by more than 46 percent. Frick and Grabka (2011) 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 (see also Section 4.2). This source of income is especially concentrated in top income households. Based on the same data and for the same

[12]See, e.g. Cutler and Katz (1992) and Banks and Johnson (1994).

[13]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.

TABLE 6

Poverty and Richness Decomposition 1991–2007 for post fisc Income

Household structure and employment status							
Poverty	α	P_{α}^{1991}	P_{α}^{2007}	ΔP_{α}	A	B	$B/\Delta P_{\alpha}$
	HC	0.115	0.141	22.6	5.6	17.0	75.1
		(0.003)	(0.004)	(5.1)	(4.7)	(2.0)	(18.5)
	1	0.024	0.033	36.4	15.5	20.9	57.5
		(0.001)	(0.001)	(7.8)	(6.8)	(2.7)	(12.2)
	2	0.008	0.012	47.2	23.5	23.8	50.3
		(0.000)	(0.001)	(11.5)	(10.1)	(3.3)	(14.0)
Richness	β	R_{β}^{1991}	R_{β}^{2007}	ΔR_{β}	A	B	$B/\Delta R_{\beta}$
	1	0.011	0.019	76.1	74.6	1.4	1.9
		(0.001)	(0.001)	(11.5)	(12.0)	(1.9)	(2.4)
	3	0.023	0.039	65.8	65.0	0.7	1.1
		(0.001)	(0.001)	(9.7)	(10.1)	(1.8)	(2.6)
	HC	0.056	0.081	46.6	47.0	–0.4	–0.9
		(0.002)	(0.002)	(7.1)	(7.4)	(1.5)	(3.2)
Household structure only							
Poverty	α	P_{α}^{1991}	P_{α}^{2007}	ΔP_{α}	A	B	$B/\Delta P_{\alpha}$
	HC	0.115	0.141	22.6	14.1	8.5	37.5
		(0.003)	(0.004)	(5.1)	(4.7)	(1.2)	(8.8)
	1	0.024	0.033	36.4	23.2	13.2	36.3
		(0.001)	(0.001)	(7.8)	(6.9)	(1.8)	(7.7)
	2	0.008	0.012	47.2	30.3	16.9	35.8
		(0.000)	(0.001)	(11.5)	(10.1)	(2.4)	(9.4)
Richness	β	R_{β}^{1991}	R_{β}^{2007}	ΔR_{β}	A	B	$B/\Delta R_{\beta}$
	1	0.011	0.019	76.1	70.4	5.7	7.4
		(0.001)	(0.001)	(11.6)	(11.6)	(1.2)	(1.9)
	3	0.023	0.039	65.8	60.7	5.0	7.7
		(0.001)	(0.001)	(9.7)	(9.7)	(1.2)	(2.0)
	HC	0.056	0.081	46.6	42.4	4.2	9.0
		(0.002)	(0.002)	(7.1)	(7.1)	(1.0)	(2.5)

Notes: 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 8. Results are based on the modified OECD equivalence scale.

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 richness change that can be attributed to demographic changes amounts to minuscule values—between –1 and 2 percent. Although insignificant, the negative value for the richness headcount implies that changing population structure 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.

Household structure only. In the lower panel of Table 6 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 percent in the case of income poverty and between 7.4 and 9 percent in the case of richness. That is, changing patterns in household formation contributed much more to the growth at the bottom than to the upper tail of the income distribution.

5.2. *Re-weighting*

A different approach to assess the effect of changing household structure on income distribution over time is to compare the actual change in distributional measures to the change that would have occurred had household structure remained unchanged between the base period of our analysis (1991) and the most recent period available (2007), everything else being 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 pointed out in Section 3.2, this is done by redefining 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

$$\tilde{w}_i^{2007} = w_i^{2007} \cdot \frac{v_{k,i}^{1991}}{v_{k,i}^{2007}} = w_i^{2007} \cdot \psi_x(x), \tag{11}$$

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 reweighting function $\psi_x(x)$ reduces to the fraction of population shares in case of not controlling for further characteristics.[14]

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 (I_{Gini}) and the measures for poverty and richness introduced in the previous sections. We compute how large the change in measures of distribution would have been had the marginal distribution of household structure not have changed between 1991 and 2007 (Δ^{rew}) and compare it to the actual observed change (Δ^{act}). One can easily show that the following holds:

$$\frac{\Delta^{act} - \Delta^{rew}}{\Delta^{act}} = \frac{M^{act,07} - M^{rew,07}}{M^{act,07} - M^{act,91}}. \tag{12}$$

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 resembled the actual one, i.e. the changing household structure would not affect the change at all. In the other extreme

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

TABLE 7

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}	18.4	9.2	50.2	16.1	12.5	22.9
	(1.4)	(1.3)	(3.2)	(1.7)	(1.5)	(2.5)
I_0	25.0	5.0	80.1	37.8	28.8	23.7
	(3.6)	(2.9)	(9.4)	(4.5)	(3.9)	(2.5)
I_1	40.0	20.7	48.2	54.2	43.1	20.5
	(5.5)	(4.2)	(3.9)	(10.3)	(8.5)	(2.8)
I_2	107.1	66.7	37.7	187.2	148.7	20.6
	(37.3)	(26.5)	(4.1)	(81.3)	(65.3)	(3.1)
	post fisc incomes					
	Poverty			Richness		
P_0/R_0	22.6	10.7	52.9	46.6	40.3	13.6
	(5.1)	(4.5)	(13.1)	(7.2)	(7.2)	(4.6)
P_1/R_3	36.4	21.1	42.0	65.8	56.8	13.6
	(7.7)	(7.0)	(9.3)	(9.7)	(9.5)	(2.9)
P_2/R_1	47.2	29.4	37.7	76.1	65.9	13.4
	(11.5)	(10.2)	(10.7)	(11.5)	(11.4)	(2.9)

Notes: 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.

case the term would equal 100 percent if the household structure were related to the total change of the measure. The results are displayed in Table 7.

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 had there not been a trend toward smaller households.

For I_0 we find results which are very close to our decomposition results. A fraction of around 80 percent (23.7 percent) of the increase in pre (post) fisc inequality is related to changes in household size. This is not surprising given the way we employ the re-weighting, i.e. only accounting for changing household structure and not adding further control variables when defining the re-weighting function. Examining other inequality measures reveals that the magnitude of the relative importance of household structure differs, but the general pattern of rather high fractions for market income inequality and much lower values for inequality in disposable income inequality still holds. For example, around half of the increase in the Gini coefficient before taxes and transfers is related to changing population structure. Here one has to take into account that different measures highlight different parts of the income distribution differently. While the decomposable measure I_0 is more sensitive to changes in the lower tail of the distribution, the Gini coefficient is known to be less sensitive to changes in the extreme tails.

Furthermore, the pre fisc fractions for the GE measures I_1 and I_2 (48 and 38 percent, respectively) are somewhat lower, but still rather large. These measures are more sensitive to the distribution's upper tail. The relative importance for post fisc inequality varies much less—between 20.5 and 24 percent.

The re-weighting results for poverty and richness indices differ somewhat from the decomposition results with respect to the point estimates. However, the standard errors are quite large and hence confidence bands overlap. So these differences are not statistically significant. Moreover, they can be explained by the fact that the poverty and richness measures we employ are non-linear, since the value functions are concave. In particular, we find that between 38 and 53 percent of the increase in poverty measures relates to changing population structure. The fraction decreases for poverty measures which are more sensitive to extreme poverty. The corresponding result for the richness indices varies around 13–14 percent.

6. Conclusions

The aim of this paper is to quantify the effect of continually 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 based on GSOEP data, 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 Germany's changing population structure with respect to household composition during the period between 1991 and 2007 is associated with increasing values for indices of inequality, poverty, and richness under consideration. Without the demographic trend toward smaller households, inequality, poverty, and richness would have also increased. However, the levels would be far lower than they actually are. The remaining increase could be attributed to a declining bargaining power of unions, to changes in the distribution of human capital, as well as to changes in occupational choices (Bourguignon *et al.*, 2001; Hyslop and Maré, 2005; Lemieux, 2010). Investigating these factors is left to future research.

We find that the effect of demographic change on income distribution is much lower for post fisc than for pre fisc incomes. This means that 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 German tax-benefit system itself has an effect on the demographic trend, i.e. the causal relationship could go in both directions. 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. However, analyzing this is beyond the scope of this paper.

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