

UNDERSTANDING RISING INCOME INEQUALITY IN GERMANY,  
1999/2000–2005/2006

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We examine the factors behind rising income inequality in Europe's most populous economy. From 1999/2000 to 2005/2006, Germany experienced an unprecedented rise in net equivalized income inequality and poverty. At the same time, unemployment rose to record levels, part-time and marginal part-time work grew, and there was evidence for a widening distribution of labor incomes. Other factors that possibly contributed to the rise in income inequality were changes in the tax and transfer system, changes in the household structure (in particular the rising share of single parent households), and changes in other socio-economic characteristics (e.g., age or education). We address the question of which factors were the main drivers of the observed inequality increase. Our results suggest that the largest part of the increase was due to increasing inequality in labor incomes, but that changes in employment outcomes and changes in the tax system also contributed considerable shares. By contrast, changes in household structures and household characteristics, as well as changes in the transfer system only seem to have played a minor role.

**JEL Codes:** C14, D31, I30

**Keywords:** income inequality, kernel density estimation, poverty

## 1. INTRODUCTION

There has been a clear trend of increasing income inequality in industrialized countries over the past three decades, although with differences in the timing and intensities across countries (see OECD, 2008, 2011). This trend was first observed in Anglo-Saxon countries such as the United States, where pronounced changes in the wage and earnings distribution in the 1980s and 1990s sparked a large body of literature examining the possible causes of increasing inequalities in labor market returns (see, e.g., Bound and Johnson, 1992; Levy and Murnane, 1992; Murphy and Welch, 1992; Juhn *et al.*, 1993; DiNardo *et al.*, 1996). Wage incomes, which have been the focus of many previous studies, are only one component in the

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distribution of *overall incomes*. The distribution of overall incomes seems particularly policy-relevant as the distribution of personal financial possibilities is closely linked to personal economic well-being. An analysis of the distribution of overall incomes requires a comprehensive view of the income distribution including its different economic, social, and institutional determinants such as demographic aspects, employment outcomes, remuneration of market activities, taxes, and government transfers (such a comprehensive view of the income distribution has been adopted in a recent study by Checchi and Garcia-Penalosa, 2010).

Germany's distribution of overall incomes is particularly interesting as it remained quite stable until the end of the 1990s (see Steiner and Wagner, 1998; Biewen, 2000; Prasad, 2004), but witnessed a sharp increase in inequality and poverty after 1999/2000. At the same time, a number of factors that are likely candidates for explaining changes in the income distribution underwent substantial changes. For example, there was a steep increase in unemployment and an increase in part-time and marginal part-time work. Moreover, wage inequality grew in a pronounced way from the end of the 1990s onwards. There is a consensus that the pronounced changes in the structure of wages that were observed in other countries reached Germany with considerable delay, although the changes were less drastic than those observed in countries such as the United States (see Kohn, 2006; Gernandt and Pfeiffer, 2007; Dustmann *et al.*, 2009; Fuchs-Schündeln *et al.*, 2010; Antonczyk *et al.*, 2010). Changes in employment structures and rising wage dispersion are not the only factors that may have been responsible for the increasing inequality in Germany. Other factors include demographic changes, changes in living arrangements, changes in characteristics such as age or educational qualifications, and changes in the tax and transfer system (see OECD, 2008, 2011).

While a large number of studies have focused on such individual factors, surprisingly little is known about the relative importance of the different factors for the observed changes in the overall distribution. Although possible reasons for changes in the distribution have been well-documented for many countries (see OECD, 2008, 2011, and the references therein), it remains unclear which of the many possible candidates are the main drivers of distributional change. This is all the more surprising as knowledge about which factors are most important is highly policy-relevant. For example, it is relevant to know whether rising income inequality in Germany is more the result of a widening wage distribution, or the result of rising unemployment or changes in employment structures.

In this paper, we provide a detailed examination of the main reasons for rising income inequality in Germany in a unified framework. Building on previous work by Hyslop and Mare (2005) for New Zealand, and Daly and Valetta (2006) for the United States, we use the semi-parametric kernel density reweighting method originally developed by DiNardo *et al.* (1996), in order to shed light on the factors behind the increase in inequality and poverty between 1999/2000 and 2005/2006. We consider in particular: (i) changes in the distribution of household types; (ii) changes in the distribution of household characteristics such as age or educational qualifications; (iii) changes in employment outcomes conditional on such characteristics; (iv) changes in labor market returns; (v) changes in the transfer system; and (vi) changes in the tax system. Our results complement previous studies on the German income distribution, which have documented some of the developments

considered here, but which did not attempt to quantify their relative importance for the overall development of the distribution (see, e.g., Hauser and Becker, 2003; Federal Government of Germany, 2008; German Council of Economic Experts, 2009; Grabka and Frick, 2010). An exception is the study by Peichl *et al.* (2012), who provide an explicit estimate of how much changes in household structures contributed to changes in the German income distribution (they do not consider other factors, however).

The remainder of this paper is structured as follows. Section 2 provides an informal discussion of the development of the German income distribution and its possible determinants. In Section 3, we describe our methodological setup. Section 4 discusses some data and specification issues. In Section 5, we present our empirical analysis. Section 6 concludes.

## 2. POSSIBLE SOURCES OF INCREASING INEQUALITY

As mentioned in the introduction, there was a significant increase in inequality and poverty in Germany between 1999/2000 and 2005/2006. The aim of this section is to embed the period of interest 1999/2000 to 2005/2006 into the more comprehensive period 1994 to 2008 in order to prove that 1999/2000–2005/2006 is the period in which “there is something to explain,” and to give an informal discussion of possible factors behind the increase. As Figures 1 and 2 show, the

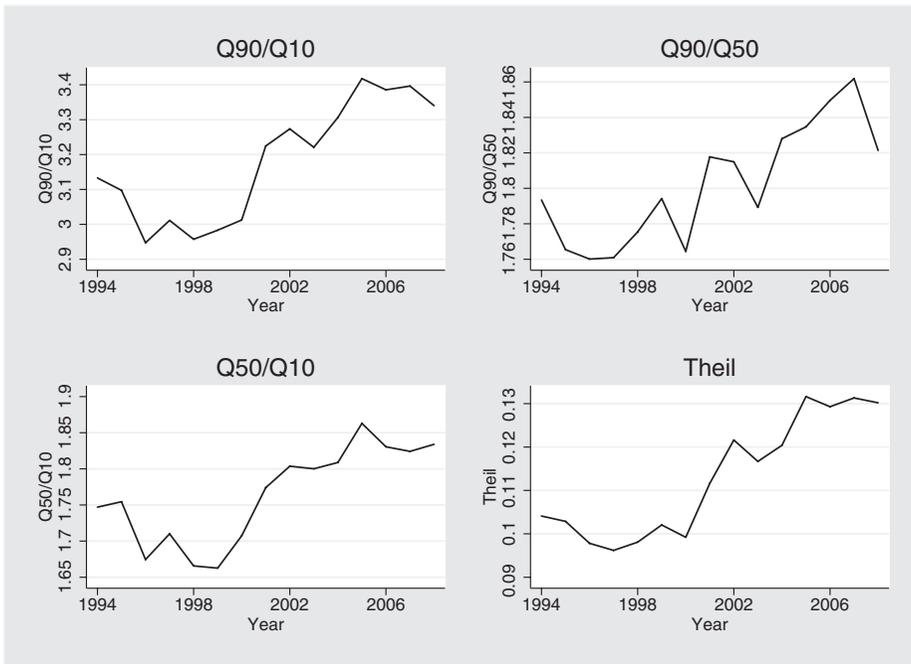


Figure 1. Trends in Inequality and Poverty, 1994–2008

Source: SOEP. Inequality in yearly equalized post-government personal income.

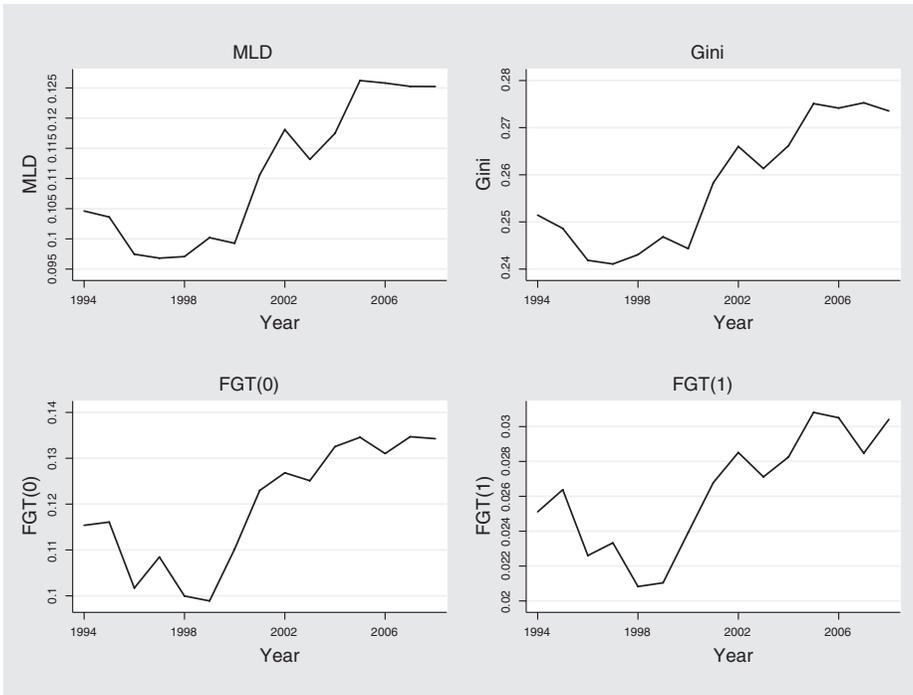


Figure 2. Trends in Inequality and Poverty, 1994–2008

Source: SOEP. Inequality in yearly equalized post-government personal income.

inequality increase between 1999/2000 and 2005/2006 was considerable.<sup>1</sup> In the following, we provide an informal discussion of possible factors behind these changes in the distribution.

### *Changes in Employment and Unemployment*

As Figure 3 shows, the period 1999 to 2005 was one of steep unemployment growth. At the peak in 2005, there were almost 5 million registered unemployed in Germany. Figure 3 also shows that overall employment stagnated during the period 1999 to 2005. After 2006, employment started to grow significantly, while unemployment fell back to a level comparable to that in 1999. The fact that unemployment fell again after 2005 while inequality and poverty remained at their high levels suggests that the rise in unemployment is unlikely to be the only reason for the inequality increase between 1999 and 2005.

In addition to changes in unemployment, there were other changes in employment that may have influenced the distribution of incomes. Figure 4 displays the

<sup>1</sup>Inequality stayed relatively constant before 1999 and after 2005 (see Biewen, 2000; Grabka and Frick, 2010). Our income concept is yearly equalized post-government personal income, which is calculated as the sum of income from all sources in a given household (including government transfers), net of taxes and social security contributions. The resulting value is then divided by an equivalence scale and distributed equally among household members. More details on the definition of our variables are given below.



Figure 3. Trends in Employment and Unemployment, 1994–2008

Source: German Federal Employment Office.

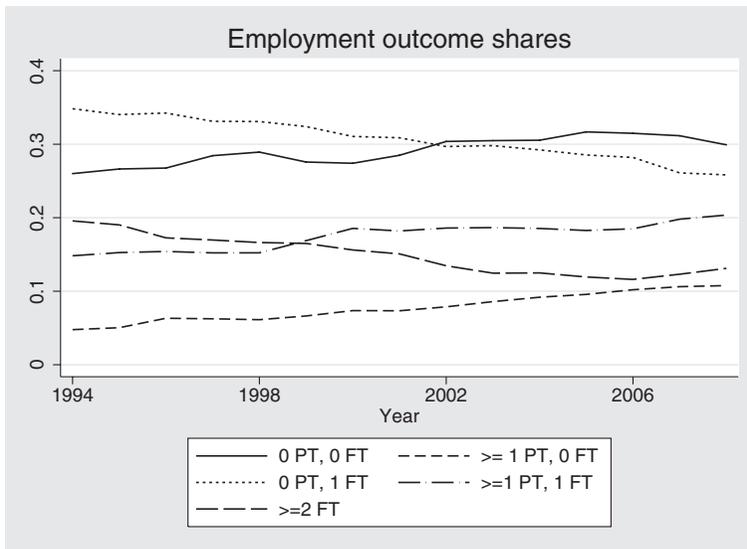


Figure 4. Share of Individuals Living in Households with Different Employment Outcomes, 1994–2008

Note: FT = full-time, PT = part-time or marginal employment.

Source: SOEP.

evolution of the share of individuals living in households with different employment outcomes. On the one hand, the figure reflects the development of unemployment as, for example, the share of individuals living in households with no employment continuously increased between 1999 and 2005, but fell after 2005. Similarly, the share of individuals living in households with at least two full-time workers fell between 1999 and 2005, and increased again after 2005. On the other hand, the share of individuals in households with exactly one full-time worker kept decreasing independently of the development of unemployment, while the share of individuals in households with at least one part-time worker—including marginal

part-time—steadily increased. The growth of these kinds of households even accelerated after 2005.

### *Changes in Labor Market Returns*

A second possible source of increasing income inequality is increasing inequality in labor market returns. This has been the focus of many previous studies. The common perception is that the effects of skill-biased technological progress, which is seen as the main cause for the widening wage distribution in Anglo-Saxon countries since the 1980s (Bound and Johnson, 1992; Levy and Murnane, 1992; Murphy and Welch, 1992; Gosling *et al.*, 2000) reached the German labor market with a delay. In Germany, wage inequality started to grow in a clear way from the mid-1990s onwards (Kohn, 2006; Gernandt and Pfeiffer, 2007; Dustmann *et al.*, 2009; Antonczyk *et al.*, 2010; Fuchs-Schündeln *et al.*, 2010). The evidence suggests that wage inequality increased both between and within skill groups, and that increases at the top are well explained by skill-biased technical progress, while increases in the lower tail of the distribution are better explained by additional factors such as deunionization and supply side effects (Dustmann *et al.*, 2009; Antonczyk *et al.*, 2010).

Figure 5 shows that growing inequality in labor market returns also translated into growing inequality of labor incomes at the household level. The figure displays the evolution of inequality in equivalized household labor income, i.e. in household labor income divided by an equivalent scale and equally distributed among household members. There is a clear trend of growing inequality, especially

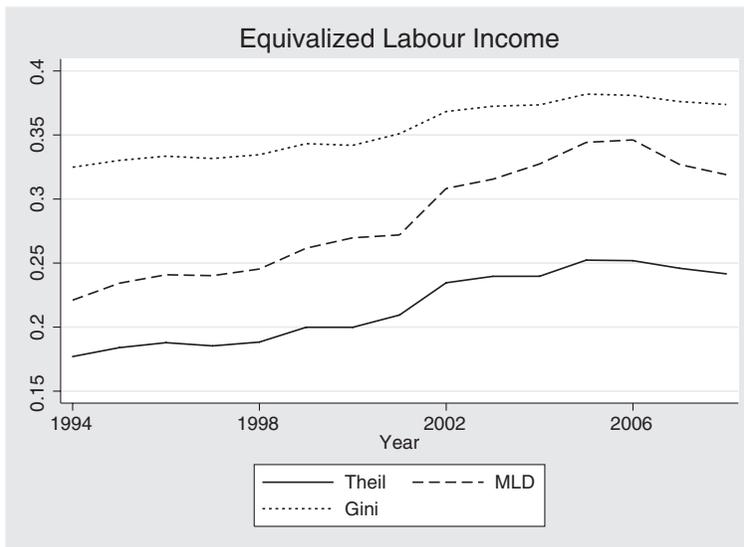


Figure 5. Inequality in Equivalized Labor Income, 1994–2008

Note: See text for the definition of income variables.

Source: SOEP.

between 1999 and 2005. This trend ended in 2006, after which inequality in equivalized household labor income slightly fell.

### *Changes in the Transfer System*

In a highly developed welfare state like Germany, personal disposable incomes in Germany are to a large extent influenced by government transfers, especially at the bottom of the distribution. Changes in the transfer system may therefore directly affect the income distribution. In fact, a major set of labor market reforms, the so-called Hartz-reforms, was enacted in 2005. One of the key elements of the Hartz-reforms was the introduction of the so-called unemployment benefit II which replaced both the former means-tested unemployment assistance for the unemployed and social assistance payments for all other individuals who are (at least in principle) able to take part in the labor market.

The introduction of the unemployment benefit II for former recipients of unemployment assistance had a potentially substantial impact on the income distribution as the old unemployment assistance depended on the former income of the unemployed, while the new unemployment benefit II only provides a basic income independent of any former income.<sup>2</sup> Apart from these income reducing features of the unemployment benefit II, some population subgroups also benefited from its introduction. This was especially true of former recipients of social assistance who benefited from the slightly higher level of the unemployment benefit II, and individuals who, intentionally or unintentionally, failed to claim social assistance under the old system. In fact, contrary to the perception of the Hartz-reforms as being antisocial, the introduction of the unemployment benefit II led to a major increase in government spending.

Another potentially inequality increasing feature of the Hartz-reforms was the reduction of the age-dependent maximum entitlement period for the unemployment benefit I from up to 36 months to generally 12 months (18 months for individuals aged over 55 years). As unemployment benefit I also depends on the former income of the unemployed, this typically leads to a substantial drop in income unless the person in question succeeds in finding a job.

### *Changes in the Tax System*

As in many other countries, the German tax schedule experienced several changes between 1999 and 2008. The main changes are summarized in Table 1. Tax rates were generally reduced, but reductions were somewhat higher at the top of the distribution. In 2007, the so-called “rich tax” took back some of the reductions for tax payers in the upper part of the distribution. Given that some of the changes were considerable, it seems likely that these changes had some impact on the final distribution of disposable income.

<sup>2</sup>However, for former recipients of the ordinary unemployment benefit (i.e., unemployment benefit I), the drop in income to the basic level is cushioned over a period of two years, during which part of the difference between the higher unemployment benefit I and the basic income level is covered by extra payments. For more details on transfer changes in the course of the Hartz-reforms and an analysis of their distributional impacts, see Becker and Hauser (2006) and Arntz *et al.* (2007).

TABLE 1  
CHANGES IN THE GERMAN TAX SCHEDULE

Year	Basic Allowance	Min. Marginal Tax Rate	End of Progression Zone	Max. Marginal Tax Rate
1999	6,681 EUR	23.9%	61,376 EUR	53%
2000	6,902 EUR	22.9%	58,643 EUR	51%
2001	7,206 EUR	19.9%	54,998 EUR	48.5%
2002/2003	7,235 EUR	19.9%	55,008 EUR	48.8%
2004	7,664 EUR	16.0%	52,152 EUR	45%
2005/2006	7,664 EUR	15.0%	52,152 EUR	42%
2007/2008	7,664 EUR	15.0%	52,152 EUR	42% (45%)

*Note:* From 2007 onwards, the marginal tax rate for taxable incomes over 250,000 Euros was 45%.  
*Source:* German Federal Ministry of Finance.

### *Changes in Household Structures*

There are clear trends in the way household structures change in industrialized countries (see OECD, 2008, ch. 2). In particular, there is a trend towards smaller households and towards untypical household forms such as single parents. The effect of the secular decline of household size on the income distribution in Germany is studied in Peichl *et al.* (2012). Not explicitly considering other influences on the income distribution, they find that the effect of declining household sizes is moderate, even over a period of 20 years. Nevertheless, it seems necessary to account for such changes when studying the effect of other factors such as employment or labor market returns.

### *Changes in Other Household Characteristics*

There are, apart from the household form, a number of other characteristics whose change over time may potentially influence the income distribution. These are in particular changes in the age structure of the population (increasing share of the elderly, and the decreasing shares of children and young persons), changes in educational qualifications (secular skill-upgrading), and other changes in the composition of the population, e.g. due to immigration. Again, it seems necessary to account for such changes when studying the effect of other factors such as employment or labor market returns.

### *Other Changes*

We will capture distributional changes induced by factors other than the ones listed above in the “residual” of our decomposition analysis. It turns out that the unexplained “residual” of our analysis is limited so that the factors listed above successfully account for most of the observed distributional changes. One residual factor that is worth mentioning is inequality coming from households’ capital incomes. There is evidence that inequality in household wealth increased over the period 1999 to 2005 (see Frick and Grabka, 2009; German Council of Economic Experts, 2009), implying that capital incomes also grew more unequal. It turns out that inequality in equalized capital incomes displays a similar pattern as inequality in equalized labor incomes, i.e. an increase between 1999 and 2005, and a

slight decrease after 2005 (results are available on request). There is also evidence that capital incomes increased their share in overall equivalized income from about 5 percent in 1994 to about 8 percent in 2007. However, given that the share of capital income in overall income is so small, and given the relative small changes over time, we expect only very moderate influences of capital income.

### 3. ESTIMATION OF COUNTERFACTUAL INCOME DENSITIES

Following DiNardo *et al.* (1996) and Hyslop and Mare (2005), we use a semiparametric decomposition technique to analyze the development of the distribution of equivalized net incomes over the period 1999 to 2008. For sample size reasons and in order to make our results less dependent on individual years, we pool in our analysis two adjacent years.<sup>3</sup> Our main interest lies in the analysis of the change between 1999/2000 (“period 0”) and 2005/2006 (“period 1”) as this marks the period over which the distribution experienced a major inequality increase. In order to check the robustness of our results and to gain further insights, we also analyze the change between 1999/2000 and the more recent period 2007/2008, which also marks the end of our data.

The basic idea of DiNardo *et al.*'s decomposition method is that of a shift-share analysis, in which observations are reweighted according to whether they are over- or under-represented in a counterfactual situation. These are combined with simulated changes of individual income components. Counterfactual situations are obtained by holding some aspects of interest fixed at the period 0 level, while changing others to the period 1 level. The method has its limitations in that it cannot account for interactions between the different factors in the form of behavioral reactions or general equilibrium effects. Despite these limitations, it is generally believed that counterfactual reweighting and simulation exercises convey important information about the main drivers of distributional changes. However, for the reasons mentioned, one must be cautious when interpreting the results in a strict causal way (for a general discussion of the limits of decomposition methods, see Fortin *et al.*, 2010).

#### *Stage 1: Changes in the Distribution of Household Types*

As a first stage, we consider the effect of shifts in the composition of the population with respect to a number of household types (we will distinguish between the six household types, see below). The counterfactual income distribution in which everything is as in period 0, but the distribution of household types is shifted to that of period 1 is given by

$$(1) \quad f_0(y|t_n = 1) = \sum_{j=1}^6 w_{1j} f_{0j}(y),$$

<sup>3</sup>Note that we pool observations not incomes. The pooling is necessary in order to increase the precision of the results which would otherwise be too imprecise to draw valid conclusions. Pooling in order to increase sampling precision is very common, see e.g. Hyslop and Mare (2005) or Blundell *et al.* (2007).

where  $y$  denotes net equivalized personal income,  $w_{1j}$  is the population share of household type  $j$  in period 1, and  $f_{0j}(y)$  the income distribution of individuals from household type  $j$  in period 0. Analogously,  $f_0(y|t_h = 0)$  would be the factual income distribution in period 0, where  $w_{1j}$  is replaced by the factual population shares  $w_{0j}$ .

*Stages 2 and 3: Changes in Household Characteristics and Employment Outcomes*

The second and third stages of our decompositions account for changes in the distribution of household characteristics  $x$  (e.g., the age and educational composition of the household; see below for more details) and changes in household employment outcomes  $e$  conditional on these characteristics  $x$ . For example, the counterfactual income density for individuals living in household type  $j$  in which everything is as in period 0 but the distribution of household characteristics  $x$  and the distribution of household employment outcomes  $e$  conditional on these characteristics are as in period 1, is given by

$$(2) \quad f_{0j}(y|t_x = 1, t_e = 1) = \int_e \int_x f_{0j}(y|x, e) dF_{1j}(e|x) dF_{1j}(x)$$

$$(3) \quad = \int_e \int_x f_{0j}(y|x, e) \left[ \frac{dF_{1j}(e|x)}{dF_{0j}(e|x)} \right] dF_{0j}(e|x) \left[ \frac{dF_{1j}(x)}{dF_{0j}(x)} \right] dF_{0j}(x)$$

$$(4) \quad = \int_e \int_x \Psi_{e|x,j} \cdot \Psi_{x|j} \cdot f_{0j}(y|x, e) dF_{0j}(e|x) dF_{0j}(x).$$

This means the counterfactual distribution  $f_{0j}(y|t_x = 1, t_e = 1)$  is just a reweighted version of the factual distribution  $f_{0j}(y)$  with reweighting factors  $\Psi_{e|x,j}$  and  $\Psi_{x|j}$ . The factual distribution  $f_{0j}(y)$  can be obtained by setting  $\Psi_{e|x,j} = \Psi_{x|j} = 1$ . Analogously,  $f_{0j}(y|t_x = 1, t_e = 0)$  with  $\Psi_{e|x,j} = 1$  is the counterfactual distribution where only the distribution of characteristics  $x$  is shifted to that of period 1 (while the conditional employment and everything else is held fixed at its period 0 level). Finally,  $f_{0j}(y|t_x = 0, t_e = 1)$  with  $\Psi_{x|j} = 1$  would be the distribution where only conditional employment outcomes are changed to the period 1 level, but everything else is held fixed at the period 0 level.

The reweighting factors  $\Psi_{e|x,j}$ ,  $\Psi_{x|j}$  can be rewritten as

$$(5) \quad \Psi_{x,j} = \frac{P_j(x|t=1)}{P_j(x|t=0)} = \frac{P_j(t=1|x)}{P_j(t=0|x)} \cdot \frac{P_j(t=0)}{P_j(t=1)},$$

$$(6) \quad \Psi_{e|x,j} = \frac{dF_{1j}(e|x)}{dF_{0j}(e|x)} = \frac{P_{1j}(e|x)}{P_{0j}(e|x)}.$$

Following Hyslop and Mare (2005), we define household employment outcomes  $e$  as an ordinal variable (see below), so that reweighting factor  $\Psi_{e|x,j}$  can be estimated using predictions from ordinal logit models  $P_{1j}(e|x)$  and  $P_{0j}(e|x)$ . Analogously, reweighting factor  $\Psi_{x|j}$  can be estimated using predictions from logit models  $P_j(t=1|x)$ ,  $P_j(t=0|x)$  and the ratio of observational mass in period 0 and period 1.

*Stages 4, 5, and 6: Changes in Labor Market Returns, Transfers, and Taxes*

In stages 4 to 6 of our decomposition, we consider changes in labor market returns to household characteristics and employment outcomes as summarized in a vector  $z$  (stage 4) as well as selected changes in the transfer system (stage 5) and the tax schedule (stage 6). The vector of characteristics  $z$  is understood to include household characteristics  $x$ , household employment outcomes  $e$ , and suitable interactions between  $x$  and  $e$ . Let  $\hat{\Delta}y_{lab} = z'_0 \hat{\beta}_{1j} - z'_0 \hat{\beta}_{0j}$  be the expected change in household labor income due to changes  $\Delta \hat{\beta}_j = \hat{\beta}_{1j} - \hat{\beta}_{0j}$  in returns to  $z$ . The counterfactual income  $y_0^{cf}$  in period 0 that accounts for the expected change in household labor income due to changes in labor market returns, changes in the transfer system and changes in the tax schedule is then given by

$$(7) \quad y_0^{cf} = y_{gross,0} + \hat{\Delta}y_{lab} + y_{transf,1} - y_{sscontr,0} - tax_1(y_{gross,0} + \hat{\Delta}y_{lab}),$$

where  $y_{gross,0}$  denotes period 0 market incomes from all sources,  $y_{transf,1}$  are government transfers that possibly include counterfactual changes,  $y_{sscontr,0}$  are factual period 0 household social security contributions, and  $tax_1(\cdot)$  is the counterfactual tax schedule of period 1. If changes in labor market returns are not desired in the counterfactual situation, then  $\hat{\Delta}y_{lab}$  is set to zero. Analogously, if changes in the transfer system are not of interest,  $y_{transf,1}$  is replaced by factual transfers  $y_{transf,0}$ . Finally, if changes in the tax schedule are not considered, the counterfactual tax schedule  $tax_1(\cdot)$  is replaced by its factual counterpart  $tax_0(\cdot)$ .

Using (7), we only predict *changes* due to counterfactual variations. Our reference point is always factual household net income  $y_{net,0} = y_{gross,0} + y_{transf,0} - y_{sscontr,0} - tax_0$ . In this way we preserve as much as possible of the information on incomes and their heterogeneity as given in the sample. In short-hand notation, we express the changes to income in period 0 due to counterfactual variations as

$$(8) \quad y_0^{cf} = y_{net,0} + \hat{\Delta}y_{lab} + \hat{\Delta}tr - \hat{\Delta}t,$$

where  $\hat{\Delta}y_{lab}$ ,  $\hat{\Delta}tr$ ,  $\hat{\Delta}t$  represent the shifts due to counterfactual changes in labor market returns, the transfer system, and the tax schedule.

*Counterfactual Densities Incorporating Stages 1 to 6*

Combining equations (1) through (8) one can define counterfactual income densities that combine any desired set of counterfactual variations. For example, the overall income distribution in period 0 that results if household structures, employment outcomes, labor market returns, and government transfers are fixed at their period 0 levels but the distribution of characteristics  $x$  and the tax schedule are counterfactually set to their period 1 levels, is given by

$$(9) \quad f_0(y|t_h = 0, t_x = 1, t_e = 0, t_r = 0, t_{tr} = 0, t_t = 1) = f_0(y|0, 1, 0, 0, 0, 1).$$

Following DiNardo *et al.* (1996), counterfactual densities  $f_0(y|t_h, t_x, t_e, t_r, t_{tr}, t_t)$  can be estimated as

TABLE 2  
INEQUALITY AND POVERTY INDICES

Index	Abbr.	Estimator
Quantile ratio 90/10	Q90/Q10	$\widehat{q90q10}(\hat{f}) = \hat{q}_{90} / \hat{q}_{10}$
Quantile ratio 90/50	Q90/Q50	$\widehat{q90q50}(\hat{f}) = \hat{q}_{90} / \hat{q}_{50}$
Quantile ratio 50/10	Q50/Q10	$\widehat{q50q10}(\hat{f}) = \hat{q}_{50} / \hat{q}_{10}$
Theil's measure	Theil	$\widehat{theil}(\hat{f}) = \int \frac{y}{\mu(\hat{f})} \log\left(\frac{y}{\mu(\hat{f})}\right) \hat{f}(y) dy$
Mean log deviation	MLD	$\widehat{mld}(\hat{f}) = -\int \log\left(\frac{y}{\mu(\hat{f})}\right) \hat{f}(y) dy$
Gini coefficient	Gini	$\widehat{gini}(\hat{f}) = \int y(2\hat{F}(y) - 1) \hat{f}(y) dy$
Forster, Greer, Thorbecke	FGT( $\alpha$ )	$\widehat{FGT}(\hat{f}, \alpha) = \int_{\{y < p(\hat{f})\}} \left(\frac{p(\hat{f}) - y}{p(\hat{f})}\right)^\alpha \hat{f}(y) dy, \alpha \geq 0$

Note:  $FGT(0)$  = poverty headcount,  $FGT(1)$  = poverty gap measure,  $p(\hat{f})$  = poverty line.

(10)

$$\hat{f}(y|t_h, t_x, t_e, t_r, t_w, t_t) = \sum_{j=1}^6 \sum_{i=1}^{n_j} \theta_i \Psi_j \Psi_{x|j}^i \Psi_{e|x,j}^i K\left(\frac{y - (y_{net,0,i} + \hat{\Delta}y_{lab,i} + \hat{\Delta}tr_i - \hat{\Delta}t_i)}{h}\right) \frac{1}{h}$$

where  $\theta_i$  denotes the sample weight of individual  $i$ ,  $n_j$  is the number of individuals in household type  $j$ ,  $K(\cdot)$  a kernel function,  $h$  a bandwidth, and  $\Psi_j = w_{1j}/w_{0j}$ . If a particular counterfactual variation is not desired, the corresponding weighting factor  $\Psi_j, \Psi_{x|j}^i, \Psi_{e|x,j}^i$  is set to 1, or the corresponding shift factors  $\hat{\Delta}y_{lab,i}, \hat{\Delta}tr_i, \hat{\Delta}t_i$  are equal to zero, respectively.

### Estimation of Inequality and Poverty Indices

Given an estimated income density  $\hat{f}(y)$ , we use numerical integration methods to calculate the inequality and poverty indices shown in Table 2 (for the definition and properties of these indices, see Cowell, 2000).

### Statistical Inference

We compute bootstrap standard errors for all our decomposition results. These bootstrap standard errors correctly take into account the serial correlation of individual observations over time as well as their clustering in households. This is achieved by resampling from the universe of longitudinal household observations (see Biewen, 2002 for a discussion of these issues).

## 4. DATA AND SPECIFICATION ISSUES

We base our analysis on data from the German Socio-Economic Panel (SOEP). Our data refers to individuals (including children). We use all available SOEP subsamples and all our calculations are weighted with the appropriate

sample weights. Our main income variable is real annual equivalized personal net income which is calculated from annual net household income. Annual net household income is given by gross income plus transfers minus social security contributions and taxes. Our dataset contains information on each of these components of net income. Taxes were calculated by the data provider, the DIW Berlin, using the official rules. For more details on the definition of the different variables, see Grabka (2009). Our definitions are in general similar to the ones used in the official “Report on Poverty and Richness” (Federal Government of Germany, 2008). There are two important differences, however. We do not consider imputed rental values and modifications to gross income due to differential treatment of population subgroups with respect to social security contributions.

In order to compute the individual income of the members of a given household, household net income is divided by the sum of equivalence weights defined by the OECD equivalence scale (the household head receives a weight of 1, additional household members over 14 years receive a weight of 0.5, and household members aged 14 years or less receive a weight of 0.3). In a robustness analysis, we consider two alternative equivalence scales to see whether our results depend on this particular choice (see below). Following recommendations and practice of the Statistical Office of the European Commission, we set the poverty line to 60 percent of the median of equivalized personal incomes in a given year.

As indicated above, we define six different household types: (i) single pensioner households (65 years or older); (ii) multiple pensioner households (at least one household member is 65 years or older and no household member is under 55); (iii) single adults without children; (iv) multiple adults without children; (v) single adults with children; and (vi) multiple adults with children. Our motivation for this classification is that it combines information on both the principal age composition and the structure of households, thus identifying population subgroups that share a similar economic and social position.

As further household characteristics  $x$  we consider the number of adults in the household, the fraction of female adults in the household, the fraction of adult household members with different educational qualifications (university degree, high school and/or vocational training, no such degree or qualification), the fraction of adult household members with non-German nationality, the fraction of adult household members with disabilities, the fraction of married adults in the household, the fraction of household members in different age groups (0–3 years, 4–11 years, 12–17 years, 18–30 years, 31–50 years, 51–64 years, 65 or older), and a dummy indicating whether the household resided in East Germany (see Table A2 in the Appendix for details).

Employment outcomes  $e$  are defined in an ordinal way: (i) no part-time or full-time workers in the household; (ii) no full-time workers but at least one part-time worker; (iii) one full-time worker but no part-time workers; (iv) one full-time worker and at least one part-time worker; and (v) at least two full-time workers. The category “part-time work” also includes marginal employment (“geringfügige Beschäftigung”). Category (iii) also includes the case where one individual holds a part-time or marginal part-time job in addition to a full-time job. The evolution of the share of individuals living in households with each of the six possible outcomes is given in Figure 4. We estimate the probability for each

household employment outcome  $e$  conditional on household characteristics  $x$  using ordinal logit models. All estimations are carried out for each household type separately (see Table A3 in the Appendix for details).

In order to estimate labor market returns, we regress log household labor income on household characteristics, employment outcome categories, and a full set of interactions. We drop regressors that turn out insignificant. Again, all regressions are carried out separately for each household type (see Table A4 in the Appendix for details).

In order to analyze the effects of the key changes in the transfer system, we simulate unemployment benefits II for former recipients of unemployment assistance and for former recipients of social assistance who are able to take part in the labor market. We also simulate the reduction of the maximum entitlement period for recipients of unemployment benefit I who will fall back to unemployment benefit II payments after the end of unemployment benefit I. We do not consider behavioral reactions to these changes in the transfer system. In this way, we will probably overestimate the distributional effects of these changes as individuals will typically try to take actions in order to make up for income losses incurred (in a related analysis however, Arntz *et al.*, 2007, suggest that taking into account behavioral reactions makes little difference). In the sensitivity analysis involving the years 2007/2008, we in addition take into account the introduction of a new parental leave benefit which was introduced in 2007. More details on the simulation of transfer changes are given in the Appendix.

The tax schedule is estimated using a flexible polynomial of third degree in household gross income along with suitable interactions with variables such as marital status or children (i.e., we regress the household tax variable as given in the data on a polynomial in household taxable income and interactions with other characteristics; results are available on request). The method of calculating taxes using regressions is also used in Frenette *et al.* (2007), and can be seen as a parsimonious variant of micro-simulation.<sup>4</sup> The regressions are only carried out for non-zero tax values. A household pays no tax if its gross income is below the sum of personal tax exemptions. When calculating counterfactual tax values, we first check whether this is the case. We consider different kinds of personal tax exemptions including the rules for the (changing) taxable share of old age pensions as well as standard deductions for labor income, capital income, and insurance contributions. We calculate positive tax values using the estimated tax schedule only if household gross income exceeds the sum of personal tax exemptions and impute a value of zero otherwise. We note that, due to their complexity and due to the nature of our tax variable (which is at the household level) we are not able to replicate all the details of household taxation in Germany. Our regressions fit the tax values given in the data extremely well, making us confident that we use the correct tax schedule. The fit of our tax predictions (including zero predictions) as measured by the squared correlation between predictions and actual values is

<sup>4</sup>For more advanced uses of micro-simulation methods for studying the effect of taxes on the income distribution, see, e.g., Bargain and Callan (2010) and Bargain (2012a, 2012b). These articles also discuss the possibility of decomposing the effect of tax changes into effects due to “fiscal drag,” and other effects. This is an interesting question which we defer to future research.

usually around 95 percent, with the exception of the smaller group of pensioners for which we obtain a fit of around 70 percent.

Finally, note that our analysis refers to inequality in net income between individuals, not households. All data are individual data but individuals are attributed the characteristics and the (equivalized) incomes of the households they live in. Incomes are expressed in year 2000 Euros (except for tax calculations which require nominal incomes). In order to minimize the outlier sensitivity of our regressions we exclude the bottom and top 0.5 percent of observations in our calculations. For expositional reasons we consider log equivalized incomes, which we appropriately transform back when calculating the inequality and poverty indices in Table 2.

## 5. EMPIRICAL RESULTS

### 5.1. Explaining Changes between 1999/2000 and 2005/2006

Figure 6 shows how the overall shape of the (log) income distribution changed from 1999/2000 (period 0) to 2005/2006 (period 1). The picture that emerges is one of increasing spread, i.e. the distribution in 2005/2006 has a lower peak and fatter tails than the one in 1999/2000. However, the widening of the distribution is not symmetric. The changes seem particularly pronounced in the lower tail of the distribution, implying that low incomes were particularly affected by increasing inequality.

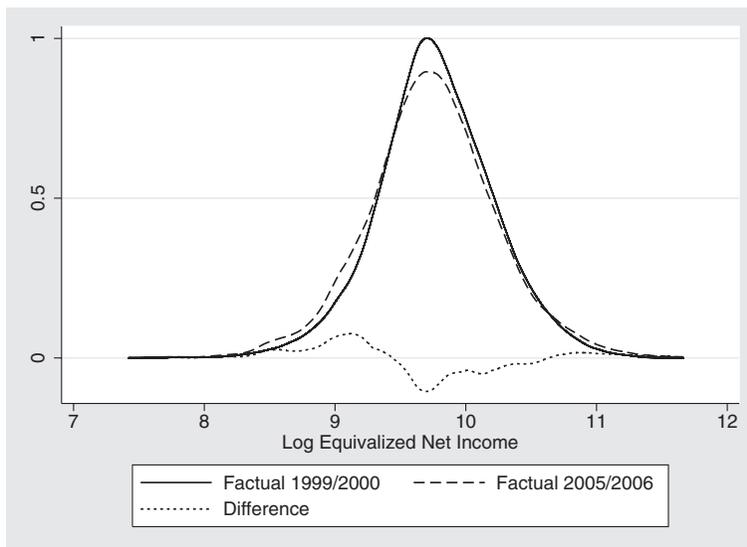


Figure 6. Overall Change in Density from 1999/2000 to 2005/2006

Source: SOEP, own calculations.

### “Ceteris Paribus” Effects of Individual Factors

We now consider “ceteris paribus” effects of the different factors, i.e. we change only one factor at a time to its period 1 level, but hold everything else fixed at the level of the base period 0. We believe that such an exercise comes closest to what one has in mind when asking about the “effect” of a particular factor on the overall change. For example, the bold line in Figure 7 shows the difference between the factual distribution in 1999/2000 and the income distribution that would prevail if the distribution of household types was changed to that of period 1, but everything else was held fixed at its period 0 level. The figure suggests that changes in household structures alone did not contribute much to the overall change in the distribution between 1999/2000 to 2005/2006. The overall density change is of the order of around 0.1 density points (see Figure 6), while the differences due to changes in household types do not exceed 0.01 density points. The fact that changes in the distribution of household types do not contribute much over a period of five to six years is not surprising given that demographic change is slow.

In a similar way, the difference in Figure 7 referring to “stage 2” confirms that changing only the distribution of other household characteristics to its period 1 level had an even smaller effect on the distribution. By contrast, the dotted line shown in Figure 7 relating to “stage 3” demonstrates that a ceteris paribus change

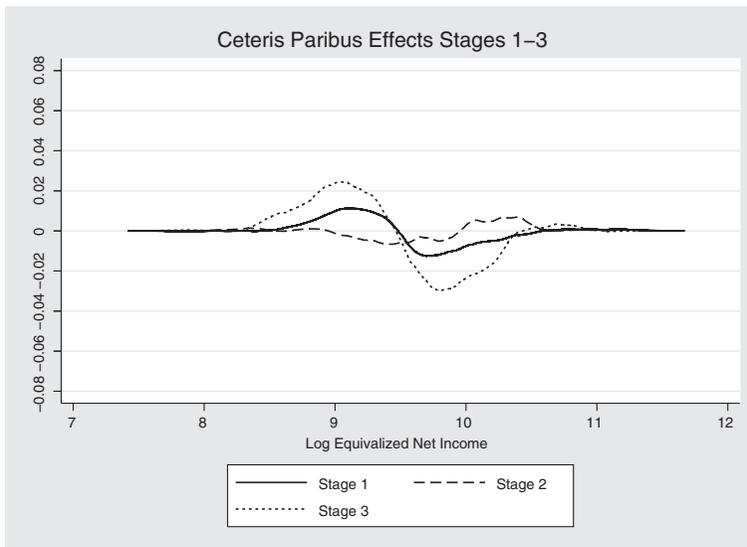


Figure 7. Density Change if Only One Factor is Changed

*Notes:* The graph shows the difference between the factual log-income density 1999/2000 and the counterfactual density that results if only one factor is changed to its 2005/2006 level. Stage 1 = density change if only the distribution of household types is changed. Stage 2 = density change if only the distribution of household characteristics is changed. Stage 3 = density change if only conditional employment outcomes are changed.

*Source:* SOEP, own calculations.

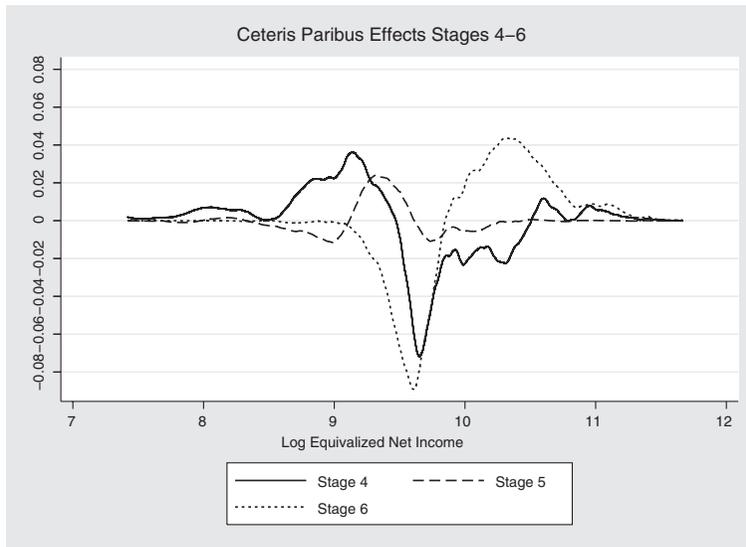


Figure 8. Density Change if Only One Factor is Changed

*Notes:* The graph shows the difference between the factual log-income density 1999/2000 and the counterfactual density that results if only one factor is changed to its 2005/2006 level. Stage 4 = density change if only labor market returns are changed. Stage 5 = density change if only the transfer system is changed. Stage 6 = density change if only the tax schedule is changed.

*Source:* SOEP, own calculations.

in conditional employment outcomes leads to a noticeable redistribution of mass from the middle to the bottom of the distribution. This suggests that changes in unemployment and part-time employment affected particular individuals in the middle and lower part of the distribution. High income households (i.e., over 10.5 log-income points) appeared to be largely unaffected by such changes.

The bold line in Figure 8 shows the considerable effects of a ceteris paribus change in labor market returns on the distribution of incomes. The changes mainly affect the middle and the bottom of the distribution, but in contrast to the case of changing employment outcomes, the very top of the distribution is also slightly affected. The ceteris paribus effect of the transfer changes due to the Hartz-reforms are given by the dashed line in Figure 8. The impact of these changes on the overall distribution seems limited, but as expected, there is a shift from the middle and the very bottom of the distribution to the area between the middle and the bottom. This is consistent with the view that the Hartz-reforms hit middle income earners by replacing income dependent unemployment assistance by the basic income (i.e., unemployment benefit II), and by cutting the maximum entitlement period for unemployment benefit I. On the other hand, households with very low incomes benefited from the introduction of unemployment benefit II as its level was slightly higher than that of the former social assistance, and more households were eligible. Finally, the dotted line in Figure 8 presents the ceteris paribus effect of changes in the tax schedule. These led to a considerable shift of the distribution to the right,

but much more so for middle and especially for high incomes.<sup>5</sup> This suggests that middle and high incomes benefited overproportionally from reduced tax rates, while the density in the very low end of the distribution remained close to constant as these households usually do not pay any tax at all.

Our ultimate goal is to measure what percentage of the inequality increase between 1999/2000 to 2005/2006 can be accounted for by the different factors. Table 3 therefore summarizes what percentage of the overall increase as measured by various inequality and poverty indices can be explained by changing one factor at a time. The numbers largely confirm the findings from the graphical analysis. Only a relatively small percentage of the overall inequality increase can be explained by *ceteris paribus* changes in the distribution of household types (around 9 percent on average) or by changes in socio-economic attributes (around 3 percent on average). *Ceteris paribus* changes in conditional employment outcomes explain on average 29 percent of the total increase (column 3), which is a substantial contribution. Isolated changes in labor market returns account for an even larger share of the overall increase, namely on average 47 percent (column 4).

At -6 percent on average (column 5), changes in the transfer system have a slightly negative net effect on inequality (which is generally not significantly different from zero). At first glance, the finding that the effect of these reforms was inequality reducing rather than inequality increasing may seem surprising. However, as explained above, many individuals at the very bottom of the distribution actually benefited from the reforms (former recipients of social assistance and individuals who were not eligible before the reforms). Moreover, there was a shift of mass from the middle of the distribution to the area below the middle. Together, this resulted in an equalization in the lower half of the distribution (see dashed line in Figure 8). Finally, it is well known that the reforms generally led to a major increase in government spending which exclusively accrued to the lower end of the distribution. Taken together, it is not implausible that the overall effect of the reform was in fact inequality reducing rather than inequality increasing.<sup>6</sup> As to the last factor considered in our analysis, *ceteris paribus* changes in the tax system account for an average 31 percent of the total inequality increase between 1999/2000 and 2005/2006 (column 6). This is also a considerable effect.

The general conclusion is that changes in employment outcomes, changes in the tax schedule, and especially changes in labor market returns explain a major share of the overall inequality increase while changes in household structures, household characteristics, and the transfer system play a smaller role.

<sup>5</sup>Note that, due to the log-transformation, the graphs tend to overstate the importance of changes at the very top of the distribution. In a graph displaying densities of unlogged incomes, differences at the top of the distribution would be spread over fairly wide income intervals.

<sup>6</sup>Using the same data, the related study by Arntz *et al.* (2007) obtains exactly the same result. We have to add one qualification to our and Arntz *et al.*'s result, however. As mentioned, the introduction of unemployment benefit II was accompanied by a slight increase in benefit levels for former recipients of social assistance. However, some of this increase was only meant to compensate for one-time payments that were a part of the old social assistance system but absent in the new unemployment benefits II. To the extent that former social assistance recipients did not report these one-time payments as income in our data, these individuals gained more in our analysis than they did in reality, overstating possible inequality reducing effects of the reforms.

TABLE 3  
CETERIS PARIBUS EFFECTS, 1999/2000–2005/2006

Percentage of the Overall Inequality Increase Explained by Ceteris Paribus Change of					
Household Structure (1)	Household Characteristics (2)	Employment Outcomes (3)	Labor Market Returns (4)	Transfer System (5)	Tax System (6)
Q90/Q10	11.09 (2.95)	34.08 (7.69)	48.55 (10.96)	-6.85 (5.38)	35.52 (5.96)
Q90/Q50	12.02 (5.38)	36.25 (16.03)	41.33 (23.89)	7.01 (11.01)	38.28 (17.41)
Q50/Q10	10.99 (3.75)	33.82 (9.94)	53.62 (13.34)	-14.69 (7.29)	34.94 (6.45)
Theil	9.07 (2.00)	20.07 (4.02)	38.39 (8.25)	-1.20 (4.91)	24.85 (4.07)
MLD	6.39 (2.11)	21.14 (4.72)	41.47 (9.03)	-4.39 (5.99)	24.75 (4.42)
Gini	7.78 (2.33)	22.63 (4.90)	36.37 (9.07)	-2.67 (5.86)	27.11 (4.92)
FGT(0)	11.48 (3.65)	32.75 (8.73)	53.33 (12.52)	-13.71 (7.18)	37.58 (6.62)
FGT(1)	7.25 (3.27)	33.00 (10.23)	62.69 (15.47)	-19.31 (10.29)	31.65 (6.19)

Notes: The numbers in parentheses are bootstrap standard errors taking into account the longitudinal sample design, stratification, and the clustering of individuals in households.

Source: SOEP, own calculations.

TABLE 4  
DECOMPOSITION, 1999/2000–2005/2006

Percentage of the Overall Inequality Increase Explained by Sequential Change of						
Household Structure (1)	Household Characteristics (2)	Employment Outcomes (3)	Labor Market Returns (4)	Transfer System (5)	Tax System (6)	Residual
Q90/Q10	11.09 (2.95)	31.43 (7.67)	54.03 (12.62)	-24.42 (8.73)	18.64 (6.40)	5.40
Q90/Q50	12.02 (5.38)	34.44 (15.57)	39.09 (24.20)	10.39 (14.77)	29.33 (18.53)	-28.29
Q50/Q10	10.99 (3.75)	30.25 (9.70)	61.43 (16.10)	-43.18 (12.75)	12.12 (5.75)	23.97
Theil	9.07 (2.00)	17.56 (3.70)	41.27 (8.62)	-5.55 (6.48)	8.44 (7.82)	27.18
MLD	6.39 (2.11)	21.00 (4.45)	49.45 (10.16)	-11.58 (9.00)	17.39 (9.54)	14.24
Gini	7.78 (2.33)	22.38 (4.66)	40.45 (9.51)	-7.03 (8.73)	17.12 (9.82)	16.56
FGT(0)	11.48 (3.65)	28.56 (8.38)	57.82 (13.92)	-32.05 (10.72)	14.74 (5.36)	15.67
FGT(1)	7.25 (3.27)	28.36 (9.21)	78.62 (19.38)	-46.69 (14.14)	15.64 (6.17)	9.98

Notes: The numbers in parentheses are bootstrap standard errors taking into account the longitudinal sample design, stratification, and the clustering of individuals in households.

Source: SOEP, own calculations.

## Sequential Decomposition of the Increase in Inequality and Poverty

A drawback of the *ceteris paribus* analysis presented so far is that the percentages contributed by each factor do not add up to the complete change and that nothing can be said about the importance of residual factors. We therefore proceed in the usual fashion (DiNardo *et al.*, 1996; Hyslop and Mare, 2005), and decompose the inequality increase 1999/2000 to 2005/2006 into a sequence of incremental changes that result when changes of the individual factors are accumulated. Forcing the sum of contributions to add up to 100 percent comes at the cost that the results may be path-dependent, i.e. they may depend on the particular order in which the different factors are sequentially changed, something which we address in a sensitivity analysis.<sup>7</sup> Given the shortcomings of both the *ceteris paribus* and the sequential decomposition analysis, our final assessment of the importance of the different factors will critically have to take into account all the available evidence from the different approaches.

Using the idea of a sequential decomposition, the change in inequality between 1999/2000 and 2005/2006 can be decomposed as

$$\begin{aligned}
 (11) \quad I(\hat{f}_1(y)) - I(\hat{f}_0(y)) &= [I(\hat{f}_0(y|1, 0, 0, 0, 0)) - I(\hat{f}_0(y|0, 0, 0, 0, 0))] \\
 (12) \quad &+ [I(\hat{f}_0(y|1, 1, 0, 0, 0)) - I(\hat{f}_0(y|1, 0, 0, 0, 0))] \\
 (13) \quad &+ [I(\hat{f}_0(y|1, 1, 1, 0, 0)) - I(\hat{f}_0(y|1, 1, 0, 0, 0))] \\
 (14) \quad &+ [I(\hat{f}_0(y|1, 1, 1, 1, 0, 0)) - I(\hat{f}_0(y|1, 1, 1, 0, 0))] \\
 (15) \quad &+ [I(\hat{f}_0(y|1, 1, 1, 1, 1, 0)) - I(\hat{f}_0(y|1, 1, 1, 1, 0))] \\
 (16) \quad &+ [I(\hat{f}_0(y|1, 1, 1, 1, 1, 1)) - I(\hat{f}_0(y|1, 1, 1, 1, 0))] \\
 (17) \quad &+ [I(\hat{f}_1(y)) - I(\hat{f}_0(y|1, 1, 1, 1, 1))]
 \end{aligned}$$

where  $I(\cdot)$  is one of the inequality or poverty indices in Table 2. The overall inequality change  $I(\hat{f}_1(y)) - I(\hat{f}_0(y))$  is split up into parts contributed by changes in the household structure (11), changes in household characteristics (12), changes in conditional employment outcomes (13), changes in labor market returns (14), changes in the transfer system (15), changes in the tax schedule (16), and an unexplained residual (17).

Table 4 shows the contributions of each of the factors as a percentage of the overall inequality increase. For example, around 7.78 percent of the increase of the Gini coefficient from 1999/2000 to 2005/2006 is attributable to changes in

<sup>7</sup>Biewen (2001) illustrates the problems of possible path dependencies in sequential decompositions such as the one considered here.

household structures. The results largely reproduce the findings from the *ceteris paribus* analysis with the exception of the last two stages (transfer and tax changes). The effect of transfer changes is larger in magnitude, while that of the changes in the tax system is smaller when compared to the *ceteris paribus* analysis. The explanation is that in the sequential decomposition, changes in the transfer system are applied *after* employment outcomes (stage 3) and labor incomes (stage 4) are set to the situation of 2005/2006. As there are more low labor incomes and more unemployment in this situation, this increases the scope for effects of changes in the transfer system. Similarly, the effects of changes in the tax system may become smaller because low incomes are to a large extent exempt from taxes.

The unexplained residuals shown in the last column of Table 4 suggest that the six factors taken together generally explain around 80 percent of the overall inequality increase. Exceptions are the Q90/Q50 ratio for which the residual is negative, and the Theil index for which it amounts to around 27 percent. In the case of the Q90/Q50 ratio, this may be explained by the generally high variability of the results for this index which is also reflected in large standard errors. It is unclear why the standard errors for the Q90/Q50 ratio are larger than for the other indices, but this means that the results for this index are less reliable than for the other indices. The otherwise relatively small size of the residual suggests that most of the inequality increase is successfully accounted for by the factors considered above. The remaining residuals reflect the influence of rising inequality in capital incomes (see above) as well as all other unmodeled influences.

### Sensitivity Analysis

In order to check how sensitive the sequential decomposition is with respect to the decomposition order, we calculated the decomposition for all possible orders. As a simplification, we treated the changes in the tax and transfer system as one stage, i.e. we considered orders in which the tax and transfer system were changed at the same time. This results in  $5! = 120$  different orderings. The results of this exercise are shown in Table A1 in the Appendix. Although the averaged results convey a picture that is qualitatively similar to what we presented above, it turns out that there is quite a lot variability in the contributions of the different factors, depending on the decomposition order chosen. This calls into question the common practice of carrying out such sequential decompositions and makes it necessary to better justify why a particular decomposition order is chosen.

We give the following reasons why the order described in (11) to (16), is more plausible than other orders. First, in decomposition (11) to (16), factors are basically changed in the order of their “pre-determinedness,” i.e. household type and household characteristics are chosen before employment outcomes, labor incomes are the result of household characteristics and employment outcomes, and taxes and transfers are the result of both labor incomes and household characteristics. Second, the order used in (11) to (16) essentially reproduces the contributions that result from the *ceteris paribus* analysis, which is appealing on a-priori grounds, but which has the disadvantage of non-additivity. We go one step further and claim that the *ceteris paribus* analysis is more informative with respect to the “effects” of

the different factors as they directly answer the question of what happens if only one factor is changed in isolation.

We have also carried out further sensitivity checks, in particular we varied the bandwidth used in our density estimations and the equivalence scale used to make incomes comparable across household types. A combination of graphical inspection and Silverman's rule of thumb led us to use a fixed bandwidth of 0.175 throughout our analysis (Hyslop and Mare, 2005 use a similar fixed bandwidth). Our numerical results change only slightly if we vary the bandwidth between 0.1 and 0.3, and qualitative results remain unchanged. The same applies if we use two alternative equivalence scales (we used the so-called Luxembourg scale which deflates household incomes by the square root of household size, and another scale which assigns a weight of 1 to the household head, and weights of 0.7 and 0.5 to additional household members over 14 years, and up to 14 years, respectively).

### *5.2. Explaining Changes between 1999/2000 and 2007/2008*

As another sensitivity test, we also carry out our analysis for the period 1999/2000 to 2007/2008. In view of the considerable changes in employment between 2005/2006 and 2007/2008 (Figures 3 and 4), and the reversing trend in labor income inequality after 2005 (Figure 5), this will allow us to check whether the decomposition results change in the right direction. Moreover, the tax schedule did not change in a major way between 2005/2006 and 2007/2008, so that the contribution of tax changes in the decomposition should essentially remain constant.

The results for the case 1999/2000 to 2007/2008 are given in Tables 5 and 6. The contributions of changes in household structures and household characteristics are slightly higher than those in the decomposition for 1999/2000 to 2005/2006 (columns 1 and 2 of Tables 4 and 5). The likely reason is that the change of these factors is relatively slow so that its effects are stronger over the longer term. As expected, the contribution of employment changes is much reduced when compared to the decomposition 1999/2000 to 2005/2006. However, the fact that there is still a contribution to the trend of rising inequality, although unemployment in 2007/2008 was as low as in 1999/2000, implies that it was not so much rising unemployment but other changes in employment that contributed to the inequality increase between 1999/2000 and 2005/2006. This fits with the fact that those other changes in employment structures—increasing part-time and marginal part-time work—accelerated after 2006 (see Figure 4), probably partly offsetting inequality reducing effects of falling unemployment.

The effects of changes in the transfer system (which now include the introduction of the new parental leave benefit) are still relatively small (slightly above zero in Table 5, and slightly below zero in Table 6). The contribution of tax changes remains about the same as in the decomposition 1999/2000 to 2005/2006, showing that the introduction of the “rich tax” (which only affects a tiny fraction of the population) did not have major distributive effects. Taken together, the results for the comparison 1999/2000 to 2007/2008 are consistent with our previous results, and all changes go in the expected directions.

TABLE 5  
CETERIS PARIBUS EFFECTS, 1999/2000–2007/2008

Percentage of the Overall Inequality Increase Explained by Ceteris Paribus Change of						
Household Structure (1)	Household Characteristics (2)	Employment Outcomes (3)	Labour Market Returns (4)	Transfer System (5)	Tax System (6)	Tax System (6)
Q90/Q10	14.22 (3.81)	5.96 (3.92)	25.62 (7.63)	28.68 (10.23)	7.46 (8.42)	38.32 (7.73)
Q90/Q50	17.39 (12.81)	1.16 (10.22)	29.04 (23.54)	-9.23 (25.35)	19.71 (33.04)	41.91 (33.84)
Q50/Q10	13.11 (4.14)	8.54 (4.34)	24.62 (8.69)	48.51 (13.88)	1.70 (9.60)	37.39 (7.57)
Theil	10.58 (2.30)	1.42 (2.33)	12.20 (3.53)	23.60 (7.21)	7.20 (6.02)	22.76 (4.06)
MLD	8.36 (2.44)	1.05 (2.81)	13.52 (4.44)	30.68 (8.73)	10.16 (7.70)	21.00 (4.65)
Gini	10.00 (2.65)	0.32 (3.05)	13.97 (4.56)	19.13 (8.50)	11.26 (6.78)	22.55 (4.87)
FGT(0)	12.96 (3.76)	8.28 (4.03)	22.76 (7.41)	44.47 (12.17)	4.08 (8.11)	37.52 (6.98)
FGT(1)	9.24 (4.18)	12.86 (5.96)	28.08 (11.21)	78.70 (23.26)	-0.81 (20.11)	38.42 (10.34)

Notes: The numbers in parentheses are bootstrap standard errors taking into account the longitudinal sample design, stratification, and the clustering of individuals in households.

Source: SOEP, own calculations.

TABLE 6  
DECOMPOSITION, 1999/2000–2007/2008

Percentage of the Overall Inequality Increase Explained by Sequential Change of						
Household Structure (1)	Household Characteristics (2)	Employment Outcomes (3)	Labour Market Returns (4)	Transfer System (5)	Tax System (6)	Residual
Q90/Q10	14.22 (3.81)	6.06 (4.03)	24.65 (7.23)	36.63 (12.35)	-5.67 (9.94)	22.46 (8.90)
Q90/Q50	17.39 (12.81)	0.00 (10.95)	28.05 (24.64)	-5.87 (25.89)	18.82 (37.80)	39.22 (32.41)
Q50/Q10	13.11 (4.14)	9.20 (4.45)	23.27 (8.17)	58.09 (16.50)	-18.22 (10.75)	13.34 (6.59)
Theil	10.58 (2.30)	0.65 (2.40)	11.05 (3.28)	28.61 (7.99)	1.48 (10.01)	10.52 (10.67)
MLD	8.36 (2.44)	3.22 (2.78)	15.10 (4.17)	41.88 (9.81)	-2.53 (13.41)	9.83 (14.29)
Gini	10.00 (2.65)	2.36 (2.98)	15.54 (4.29)	24.88 (24.88)	4.14 (13.28)	8.83 (14.32)
FGT(0)	12.96 (3.76)	8.26 (4.01)	21.20 (6.94)	45.32 (13.07)	-3.72 (7.62)	13.85 (13.85)
FGT(1)	9.24 (4.18)	13.95 (6.21)	25.87 (10.24)	97.84 (28.08)	-31.70 (16.49)	20.29 (9.08)

Notes: The numbers in parentheses are bootstrap standard errors taking into account the longitudinal sample design, stratification, and the clustering of individuals in households.

Source: SOEP, own calculations.

## 6. CONCLUSION

This paper analyzed which of different possible factors were behind the recent increase in personal income inequality in Germany. Our contribution lies in the fact that, although possible reasons for rising income inequality in different countries have been discussed and documented many times, little is known about their quantitative importance. Such information is relevant from a policy point of view. For example, it is essential to know whether growing income inequality is a consequence of employment changes, or of inequality in labor market returns. Our results suggest that the conspicuous increase in inequality and poverty over the period 1999/2000 to 2005/2006 was mostly due to increasing dispersion in labor market incomes, which has been attributed to skill-biased technical progress, deunionization, and supply side effects (Dustmann *et al.*, 2009; Antonczyk *et al.*, 2010). Other considerable effects come from changes in employment and changes in the tax system. Together, these three factors explain around 80 percent of the overall increase, where about one half is contributed by increasing inequality in labor incomes, and the other half is equally shared by employment changes and changes of the tax system.

By contrast, changes in household structures, household characteristics, and the transfer system seem to have played a much smaller role. The latter is in sharp contrast to the widespread view that the changes in the transfer system, which were introduced in the year 2005 within a larger set of labor market reforms (“Hartz-reforms”), led to a drastic increase in inequality. In line with the results reported in Arntz *et al.* (2007), our results suggest that the changes in benefits due to the “Hartz-reforms” were slightly inequality reducing rather than inequality increasing. Another interesting and policy-relevant conclusion of our analysis is that although the unprecedented inequality increase between 1999/2000 and 2005/2006 was accompanied by a steep increase in unemployment, this increase was probably only to a small extent responsible for the inequality increase. Our results rather suggest that other changes in employment patterns, especially the growth of part-time and marginal part-time work, have contributed to the overall increase. This fits with the fact that overall inequality remained at its high level after 2005, while unemployment drastically fell but part-time, marginal part-time, and general employment grew at accelerated rates. The fact that we also measure a substantial contribution coming from tax changes shows that tax reforms—which were carried out in many countries—may also have an important effect on the income distribution. Often, the motivation for such tax reforms is to avoid “fiscal drag,” i.e. the automatically rising tax burden under a progressive tax schedule in the presence of inflationary income growth. Our results suggest that the tax reforms carried out in Germany not only fought fiscal drag but changed the progression structure of the tax schedule in a substantial way.

We believe that our results contribute to the understanding of recent changes in the German income distribution and possibly that of other countries. As in many other approaches, our approach has some limitations that should be borne in mind when interpreting the results. Apart from the many simplifying assumptions that have to be made when modeling the complex mechanisms of household arrangements, employment structures, labor market incomes, tax and transfer

rules, the methodological setup used here is not suited to address equilibrium effects and possibly complex interactions between the different factors considered. For example, changes in the tax and transfer system may also influence labor supply decisions and therefore eventually have an impact on the distribution (via changing employment outcomes) that goes beyond the direct effect. Similarly, increasing wage differentials and more wage flexibility may eventually lead to more employment, possibly countering their direct, inequality increasing effects. These aspects should be borne in mind when interpreting our results.<sup>8</sup>

## REFERENCES

- Antonczyk, D., T. DeLeire, and B. Fitzenberger, "Polarization and Rising Wage Inequality: Comparing the U.S. and Germany," IZA Discussion Paper No. 4842, Bonn, 2010.
- Arntz, M., M. Clauss, M. Kraus, R. Schnabel, A. Spermann, and J. Wiemers, "Arbeitsangebotseffekte und Verteilungswirkungen der Hartz-IV-Reform," IAB Forschungsbericht 10/2007, Nürnberg, 2007.
- Bargain, O., "Decomposition Analysis of Distributive Policies using Behavioural Simulations," forthcoming in *International Tax and Public Finance*, 2012a.
- , "The Distributional Effects of Tax-Benefit Policies under New Labour: A Shapley Decomposition," forthcoming in *Oxford Bulletin of Economics and Statistics*, 2012b.
- Bargain, O. and T. Callan, "Effects of Tax-Benefit Changes on Inequality Trends in Europe: A Decomposition Approach," *Journal of Economic Inequality*, 8, 1–22, 2010.
- Becker, I. and R. Hauser, *Verteilungseffekte der Hartz-IV-Reform. Ergebnisse von Simulationsanalysen*, Edition Sigma, Berlin, 2006.
- Biewen, M., "Income Inequality in Germany during the 1980s and 1990s," *Review of Income and Wealth*, 46, 1–20, 2000.
- , "Measuring the Effects of Socio-Economic Variables on the Income Distribution: An Application to the East German Transition Process," *Review of Economics and Statistics*, 8, 185–90, 2001.
- , "Bootstrap Inference for Inequality, Mobility and Poverty Measurement," *Journal of Econometrics*, 108, 317–42, 2002.
- Blundell, R., A. Gosling, H. Ichimura, and C. Meghir, "Changes in the Distribution of Male and Female Wages Accounting for the Employment Composition Using Bounds," *Econometrica*, 75, 323–63, 2007.
- Bound, J. and G. Johnson, "Changes in the Structure of Wages in the 1980s: An Evaluation of Alternative Explanations," *American Economic Review*, 82, 371–92, 1992.
- Cecchi, D. and C. Garcia-Penalosa, "Labour Market Institutions and the Personal Distribution of Income in the OECD," *Economica*, 77, 413–50, 2010.
- Cowell, F. A., "Measurement of Inequality," in A. B. Atkinson and F. Bourguignon (eds), *Handbook of Income Distribution*, Volume 1, Elsevier, Amsterdam, 2000.
- Daly, M. C. and R. G. Valetta, "Inequality and Poverty in the United States: The Effects of Changing Family Behavior and Rising Wage Dispersion," *Economica*, 73, 75–98, 2006.
- DiNardo, J., N. Fortin, and T. Lemieux, "Labor Market Institutions and the Distribution of Wages, 1973–1992: A Semiparametric Approach," *Econometrica*, 64, 1001–44, 1996.
- Dustmann, C., J. Ludsteck, and U. Schönberg, "Revisiting the German Wage Structure," *Quarterly Journal of Economics*, 124, 843–81, 2009.
- Federal Government of Germany, *Lebenslagen in Deutschland. Der 3. Armuts- und Reichtumsbericht der Bundesregierung*, Federal Government of Germany, Berlin, 2008.
- Fortin, N., T. Lemieux, and S. Firpo, "Decomposition Methods in Economics," in O. Ashenfelter and D. Card (eds), *Handbook of Labor Economics*, Vol. 4, Elsevier, Amsterdam, 2010.
- Frenette, M., D. A. Green, and K. Milligan, "The Tale of the Tails: Canadian Income Inequality in the 1980s and 1990s," *Canadian Journal of Economics*, 40, 734–64, 2007.
- Frick, J. and M. M. Grabka, "Gestiegene Vermögensungleichheit in Deutschland," *DIW Wochenbericht* 4/2009, 54–67, 2009.
- Fuchs-Schündeln, N., D. Krüger, and M. Sommer, "Inequality Trends for Germany in the Last Two Decades: A Tale of Two Countries," *Review of Economic Dynamics*, 13, 103–32, 2010.

<sup>8</sup>We thank one of the referees for emphasizing this point.

- German Council of Economic Experts, *Securing the Future through Responsible Economic Policies*, Annual Report, Wiesbaden, 2009.
- Gernandt, J. and F. Pfeiffer, "Rising Wage Inequality in Germany," *Journal of Economics and Statistics*, 227, 358–80, 2007.
- Gosling, A., S. Machin, and C. Meghir, "The Changing Distribution of Male Wages, 1966–1992," *Review of Economic Studies*, 67, 635–66, 2000.
- Grabka, M., "Codebook for the PEQUIV File 1984–2008: CNEF Variables with Extended Income Information for the SOEP," Data Documentation No. 45, DIW Berlin, 2009.
- Grabka, M. M. and J. Frick, "Weiterhin hohes Armutsrisiko in Deutschland," DIW Wochenbericht 7/2010, 1–11, 2010.
- Hauser, R. and I. Becker (eds), *Reporting on Income Distribution and Poverty. Perspectives from a German and a European Point of View*, Springer, Berlin, 2003.
- Hyslop, D. R. and D. C. Mare, "Understanding New Zealand's Changing Income Distribution 1983–98: A Semiparametric Analysis," *Economica*, 72, 469–95, 2005.
- Juhn, C., K. M. Murphy, and B. Peirce, "Wage Inequality and the Rise in Returns to Skill," *Journal of Political Economy*, 101, 410–41, 1993.
- Kohn, K., "Rising Wage Dispersion, After All! The German Wage Structure at the Turn of the Century," IZA Discussion Paper No. 2098, Bonn, 2006.
- Levy, F. and R. J. Murnane, "U.S. Earnings Levels and Earnings Inequality: A Review of Recent Trends and Proposed Explanations," *Journal of Economic Literature*, 30, 1333–81, 1992.
- Murphy, K. M. and F. Welch, "The Structure of Wages," *Quarterly Journal of Economics*, 107, 285–326, 1992.
- OECD, *Growing Unequal? Income Distribution and Poverty in OECD Countries*, OECD, Paris, 2008.
- , *Divided We Stand: Why Inequality Keeps Rising*, OECD, Paris, 2011.
- Peichl, A., N. Pestel, and H. Schneider, "Does Size Matter? The Impact of Changes in Household Structure on Income Distribution in Germany," *Review of Income and Wealth*, 58, 118–41, 2012.
- Prasad, E. S., "The Unbearable Stability of the German Wage Structure: Evidence and Interpretation," IMF Staff Papers No. 51, International Monetary Fund, 2004.
- Steiner, V. and K. Wagner, "Has Earnings Inequality in Germany Changed in the 1980s?" *Zeitschrift für Wirtschafts- und Sozialwissenschaft*, 118, 29–54, 1998.

## SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

**Appendix:** Details on the Simulation of Transfer Changes

**Table A1:** Results from 120 Possible Sequential Decompositions for the Decomposition 1999/2000–2005/2006

**Table A2:** Variable Names

**Table A3:** Ordinal Logit Models

**Table A4:** Regression of Log Labor Incomes on Household Characteristics

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