Why a Labour Market Boom Does Not Necessarily Bring Down Inequality: Putting Together Germany's Inequality Puzzle

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ABSTRACT

Why a Labour Market Boom Does Not Necessarily Bring Down Inequality: Putting Together Germany's Inequality Puzzle[*]

After an economically tough start into the new millennium, Germany experienced an unprecedented employment boom after 2005 only stopped by the COVID-19 pandemic. Persistently high levels of inequality despite a booming labour market and drastically falling unemployment rates constituted a puzzle, suggesting either that the German job miracle mainly benefitted individuals in the mid- or high-income range or that other developments offset the effects of the drastically improved labour market conditions. The present paper solves this puzzle by breaking down the observed changes in the distribution of disposable incomes between 2005/06 and 2015/16 into the contributions of eight different factors, one of them being the employment boom. Our results suggest that, while the latter did have an equalising impact, it was partially offset by the disequalising impact of other factors and substantially dampened by the tax and transfer system. Our results point to a strong role of the German tax and transfer system as a distributional stabilizer implying that, if the COVID-19 shock were to persistently reverse all the employment gains that occurred during the boom, this would only have a moderately disequalising effect on the distribution of net incomes.

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1 Introduction

Following the reunification in 1990, Germany had to face difficult economic conditions throughout the 1990's and the early 2000's: low economic growth, a high fiscal deficit and increasing unemployment. In the mid 2000's, however, the so-called "sick man of Europe" took off to experience an unprecedented employment boom that was chasing its own records in recent years (Dustmann et al., 2014). Not even challenging events such as the global financial crisis in 2008/09 or the drastically increased immigration since 2014 (often referred to as the "refugee crisis") interrupted Germany's economic upsurge, which was only stopped by the global COVID-19 crisis starting in 2020.

The "German labour market miracle" (Burda, 2016) has drawn much attention not only in politics, but also among economic researchers trying to trace back its roots and possibilities of replication. Particular focus has thereby been put on a number of labour market reforms – the so-called Hartz reforms –, which were the answer to Germany's economic struggles after the millennium. While Hochmuth et al. (2019) and Burda and Seele (2020) attest a central role to the Hartz reforms, Dustmann et al. (2014) and Kügler et al. (2018) find that the increasing flexibilisation of the German labour market institutions themselves and the prevailing trend of decentralised wage setting were the main drivers of the employment boom. Hartung et al. (2018) and Hutter et al. (2019) further identify improved matching, low separation rates and increased job search intensity – presumably due to the more restrictive unemployment benefit receipt after the Hartz reforms – as important factors contributing to the economic upswing.[1]

In light of the flourishing labour market, one would expect substantial effects on the distribution of incomes and income inequality, which had been steeply rising before the upswing. With over 5 million individuals unemployed, the official unemployment rate reached its all-time peak in the year 2005, right before the onset of the employment boom (see figure 1). However, although inequality in disposable incomes stagnated from 2005 onwards (Peichl et al., 2018; Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung, 2019), previous contributions have struggled to establish a clear effect of both the massive expansion and the compositional changes in employment after 2005 on the resulting distribution of household disposable incomes (Biewen et al., 2019).

Given the magnitude of the employment boom, these findings constitute somewhat of a puzzle. In view of the drastic reduction in unemployment and the increasing participation in part-time and marginal employment, the labour market boom should have massively benefitted those at the bottom of the income distribution. But to what extent was this really the case? Rothe and Wälde (2017), for instance, claim that a large part of

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[1]The discussion of the effects of the Hartz reforms has not been uncontroversial, e.g., Akyol et al. (2013), Launov and Wälde (2013), Launov and Wälde (2016), Bradley and Kügler (2019) and Carrillo-Tudela et al. (2019).

the unemployed who found a job within the last decade did not go into full-time work. Rather they observe a substantial increase in part-time employment and non-standard work (e.g., minijobs). Burda (2016) makes a similar point by arguing that total work hours remained rather constant, but were distributed among more individuals, where new jobs seem to have been predominantly created in the low-income sector. Ehrich et al. (2018) and Carrillo-Tudela et al. (2019) emphasize that the employment boom also increased participation in general, drawing individuals into the labour market that would not have participated otherwise. This was particularly true of women who often entered part-time or marginal employment out of non-participation.
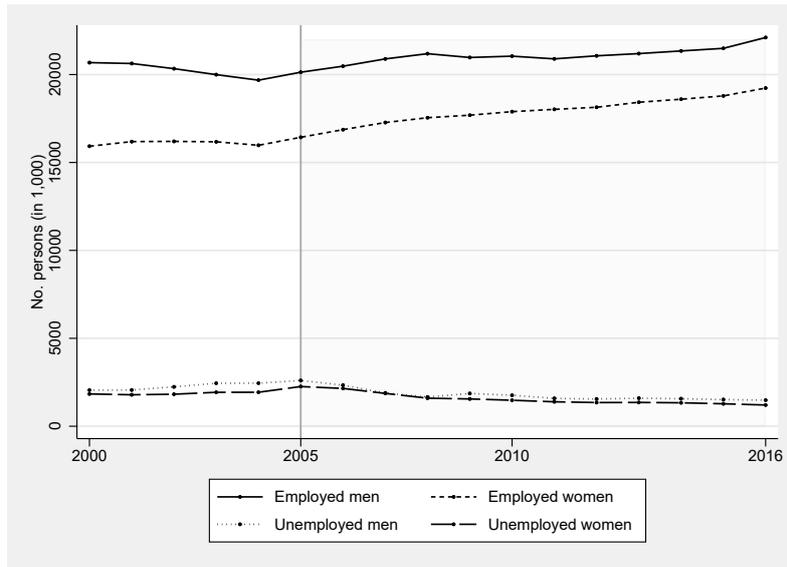
Figure 1: Aggregate employment and unemployment (Source: Federal Statistical Office)

All of the above contributions concentrated on the effects of the boom on different aspects of the level and the composition of employment. Analysis of the pass-through of these changes to the distribution of household incomes is challenging, however, because their effects depend on who exactly gained from the boom, how employment structures changed within households, and how the tax and transfer system transformed income gains into net incomes. The aim of the present paper is to provide a detailed empirical analysis of how gains and changes in the structure of employment altered the German income distribution after 2005. Based on rich household data, we model changes in different employment forms (full-time, part-time, marginal part-time) as well as in employment quantities (number of months worked per year) for individual household members to trace their consequences for household gross and net incomes. We explicitly consider heterogeneous effects of the boom on households by modelling in detail changes in labour market participation conditional on a rich set of individual and household characteristics. It is only in this way that we can assess the effects of boom on the distribution of incomes as these will depend on how exactly employment gains were allocated to households.

As employment trends are not the only source of changes in the distribution of net incomes, and as their effect may be masked by the contributions of other factors, we explicitly consider the effects of confounding factors such as changes in pay structures, changes in the composition of the population, changes due to immigration, changes in other income sources such as capital income, and changes in the tax and transfer system.

Our paper adds to the literature that studies the consequences of the "German labour market miracle", which was possibly the result of the major labour market reforms undertaken in the early 2000's ("Hartz reforms"). These reforms are often seen as a potential role model for countries whose institutional settings and industrial relations are more rigid than they have been in Germany after these reforms (Burda, 2016; Bradley and Kügler, 2019; Carrillo-Tudela et al., 2019; Hochmuth et al., 2019; Burda and Seele, 2020). Our results are therefore potentially relevant for other countries in which similar reforms may be carried out in the future. We also add to a suprisingly small literature that analyses possible causes for changes in the distribution of *net incomes* – which is the income distribution relevant for welfare analysis and policy – but which is the complex result of a large number of elements such as employment, pay structures, household arrangements and institutional circumstances (Hyslop and Maré, 2005; Daly and Valletta, 2006; Biewen and Juhasz, 2012; Jessen, 2019; Blundell et al., 2018; Sologon et al., 2019). Much of the literature deals with *gross incomes* (often derived from tax records, e.g., Armour et al., 2013) or individual income components such as wages, which makes it difficult to assess the consequences for the final distribution of *net incomes* in a population (see Armour et al., 2013, for a related point).

We reach the following conclusions. First, despite the apparent constancy of the German income distribution after 2005, the employment boom did have a significantly equalising effect. This effect, however, was substantially dampened by the progressive tax system and the generous social security system (including unemployment insurance). One of the main purposes of this system is to insure income losses due to job loss or other unforeseen causes. On the positive side, this substantially alleviates the effect of economic downturns. On the negative side, however, this may also dampen the effects of economic upturns. The impact of the German tax and social security system appears particularly strong in this respect. Our results suggest that even if the economic consequences of the COVID-19 shock were to reverse all the employment gains that occurred during the boom, this would only have modest effects on the distribution of net incomes. Second, our results indicate that the liberalisation of labour market institutions as implemented in the German Hartz reforms does not have to come with adverse distributional effects, while potentially increasing employment and output. If anything, the impact of the boom was equalising, while raising employment levels across the whole distribution. Third, we show that distributional effects of employment changes may be masked by other developments, making it hard

to determine their exact magnitude. In our case, we show that the equalising impact of the boom was partly offset by immigration of individuals with low disposable incomes and by compositional changes in the population (educational upgrading and population aging).

The remainder of this paper is structured as follows. In section 2, we describe the data underlying our study. Section 3 provides an overview of recent trends in the German income distribution. In section 4, we present and discuss our empirical results. Section 5 concludes. Our appendix contains a more detailed outline of our methods whose description in the main text is kept brief.

2 Data

Our study is based on the German Socio-Economic Panel (SOEP), a representative study of households living in Germany collected and maintained by the German Institute for Economic Research (DIW), see Wagner et al. (2007). In spite of the general limitations of survey data, the SOEP constitutes the only data source containing sufficient information for a study covering all relevant aspects of the distribution of net household incomes such as different income components, employment outcomes and socio-economic characteristics of all household members. Besides the SOEP core survey, we exploit the information in the SOEP migration samples as well as in the IAB-SOEP refugee sample to assess potential effects of immigration (see details below).

The focal point of our analysis is the distribution of annual net equivalised incomes between the years 2005/06 (when the employment boom set in) and 2015/16 (the most recent survey years with available income information at the time our study was carried out).[2] Our measure of net equivalised income is based on annual household net income

$$y = y_{Market} + y_{Pens} + y_{Trans} - ssc(y_{Labour}, y_{Pens}) - tax(y_{Tax}), \qquad (1)$$

where y_{Market} denotes the sum of all household members' annual market incomes (labour income and capital incomes such as income from interest, dividends, rents[3]), y_{Pens} the sum of all pension incomes (private and public), and y_{Trans} the sum of public transfers received. Household public transfers include the full range of government transfers such as unemployment benefits, child benefits, student grants and substistence allowances (among others). The terms $ssc(y_{Labour}, y_{Pens})$ and $tax(y_{Tax})$ represent deductions of social security contributions (pensions, health, unemployment and old age care insurance) as well as

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[2]We pool years in order to increase statistical precision and to make our analysis less dependent on individual years as in Hyslop and Maré (2005) or Blundell et al. (2007)

[3]Following common practice, we also include imputed rental values for owner-occupied housing and imputed social security contributions for civil servants in household market income.

income taxes paid by the household. We compute both of these components for each household using our own income tax and social security contributions module described in the appendix. In order to focus only on real income changes, we inflate nominal income measures to prices of our most recent year 2016 (in the case of taxes and social security contributions we do this after the respective calculations). Finally, we equivalise annual net household income using the commonly used modified OECD equivalence scale and attribute the resulting equivalised income measure to each household member.

A big strength of a survey data set like the SOEP is the availability of individual income components, mostly at the individual level, see Grabka (2017). This is crucial for our purpose as we aim to counterfactually alter individual components such as labour incomes in order to determine their effect on the resulting distribution of household net incomes. Another crucial ingredient to our analysis is the availability of detailed calendar information on monthly employment activities in different categories. Based on the information in the monthly income and employment calendars of our survey participants, we construct for each individual the annual number of months worked in different employment categories (full-time, part-time, marginal part-time) along with the average monthly wage received in the respective category. We include in our definition of employment both dependent and self employment. Our construction is such that multiplying and adding up individuals' months worked and monthly wages yields the annual labour income of each individual as reported in the SOEP.[4]

Our analysis makes use of a large number of further characteristics at the individual and at the household level. In general, we distinguish between the following six different household types: (i) single pensioner households (65 years or older), (ii) multiple pensioner households (at least one household member 65 years or older and no household member under 55 years), (iii) single adults without children, (iv) multiple adults without children, (v) single adults with children, and (vi) multiple adults with children. Within households we consider detailed individual information on the household head and (if present) the partner or the second oldest adult in the household (gender, age, nationality, educational qualification in three categories, work experience in years, see table 2). For certain purposes, we also use information on individual employment histories (such as the number of months worked in different employment categories in the past three years, see below for more details). In addition to the characteristics of individual household members, we consider information

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[4]The full use of employment information from the annual activity calendars of household members is an important difference to our previous study Biewen et al. (2019) which only used crude information on employment at the household level and only from the survey month (rather than over a full calendar year) along with descriptive information about different income measures over time. This turns out to be a crucial difference, as Biewen et al. (2019) failed to establish a clear relationship between employment changes and changes in the distribution of net incomes. Another important difference is that our earlier paper considered only the short time period 2005/06 to 2010/11, whereas the current paper covers the whole period of the economic upturn 2005/06 to 2015/16.

on the number of children in the household in different age categories (0-3, 4-6, 7-17 years), the number of further adults in the household, and whether the household resides in East or in West Germany.

All our computations make full use of the SOEP sampling weights provided by the DIW. For statistical inference, we use bootstrapping taking account of the repeated observation of the same households in different years and the clustering of individuals within households when computing bootstrap confidence intervals (Biewen, 2002).

3   General trends

Figure 2 displays inequality trends in equivalised net incomes since the year 2000. Consistent with previous contributions, the graph shows that income inequality first stagnated after the onset of the labour market boom in 2005 but then followed a slight upward trend from 2010 onwards. The upward trend after 2010 is present both in the upper half of the distribtion (percentile ratio P90/P50), but is even more pronounced in the lower half (percentile ratio P50/P10).
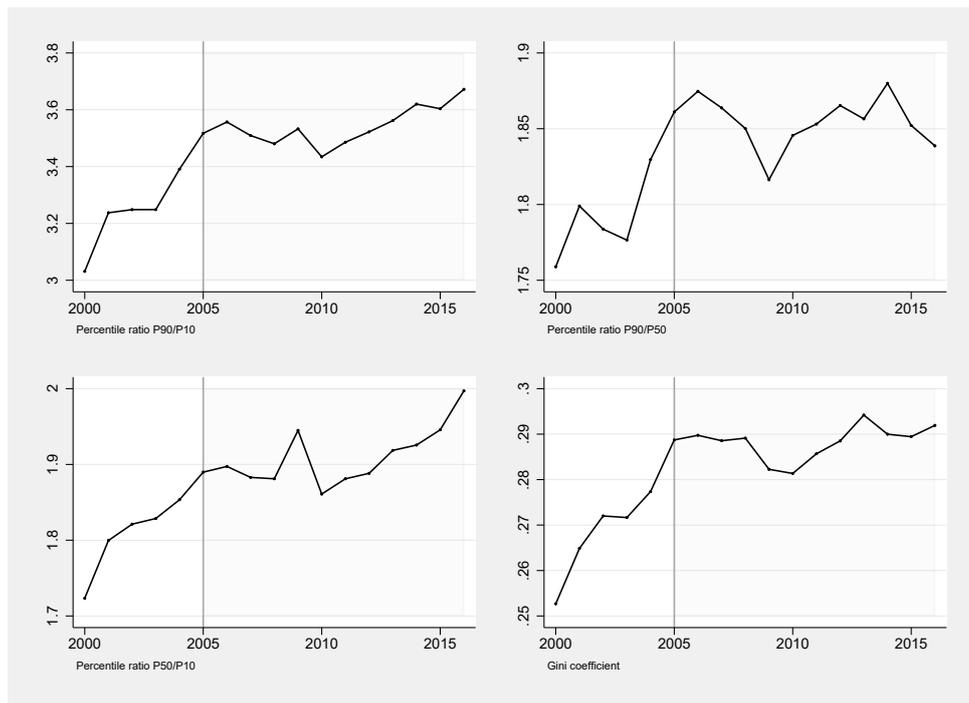
Figure 2: Inequality in equivalised net incomes (Source: Socio-Economic Panel)

The development of mean and median equivalised income is shown in figure 3a. After years of stagnation between 2000 and 2005, the average living standard started to grow again in the same year as the employment boom began. Figure 3b shows the development of the semi-official "at-risk-of-poverty rate" (the proportion of individuals with incomes below the relative poverty line of 60 percent of the median), suggesting further strong

increases in poverty risk after 2010.
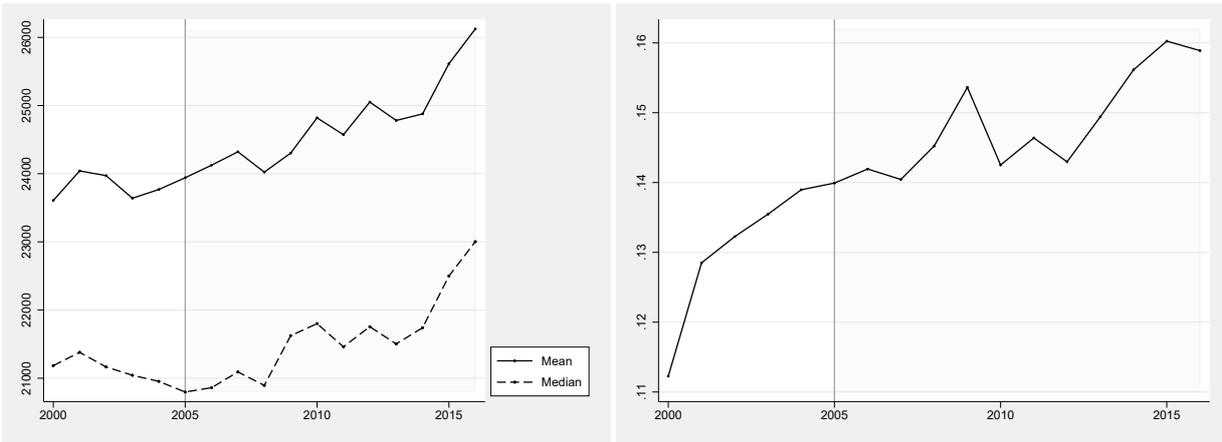
(a) Mean/median equivalised income (Euros/year)

(b) Relative poverty rate

Figure 3: Development of mean/median income and relative poverty rate
(Source: Socio-Economic Panel)

Finally, figure 4 presents a more detailed description of distributional change for our
period under investigation. The figure displays the relative change of the percentiles of
the distribution of net eqivalised incomes between 2005/06 and 2015/16, indicating in
which parts of the distribution (real) income growth was largest. It turns out that all
parts of the distribution were shifted upwards, but that growth was relatively modest in
the lower part (2.5 to 7.5 percent), larger at the very top (around 7.5 percent), and largest
in the upper middle part (7.5 to 10 percent).[5]
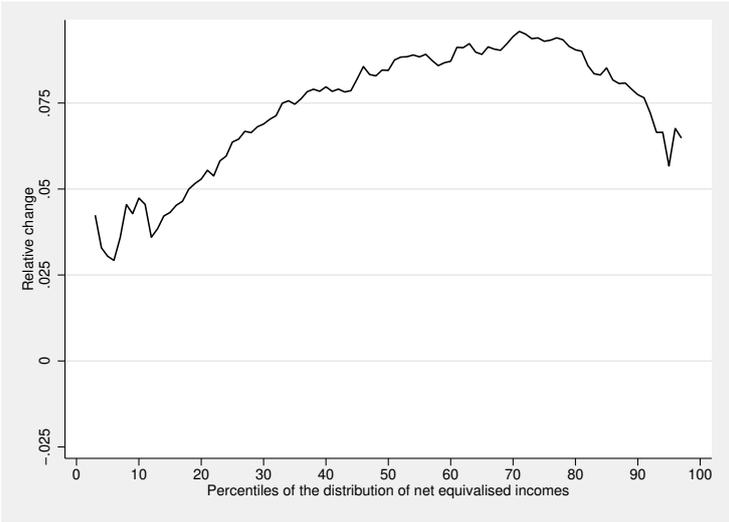
Figure 4: Relative changes of income percentiles 2005/06 to 2015/16
before and after taxes and transfers (Source: Socio-Economic Panel)

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[5]Note that this graph must not be misinterpreted in the way that the incomes of individuals who
belonged to a certain income percentile in 2005/06 grew by the percentages shown in the graph. It is
only that *income positions* (percentiles) grew in the described way. For example, the 40th percentile of
the distribution of equivalised incomes was 7.5 percent higher in 2015/16 compared to 2005/06.

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4 Empirical analysis

The goal of the following analysis is to determine the contribution of the substantial changes in the level and composition of employment between 2005/06 and 2015/16 to the observed changes in the income distribution as shown in figure 4. In order to assess the role of potential confounders, we also describe the contribution of factors other than employment to the pattern shown in figure 4. Our general method will be to compute *counterfactual distributions* of net equivalised incomes in which we change only one factor (e.g., employment) while keeping all other factors constant. The comparison of counterfactual vs. factual change will then yield an estimate of the isolated effect of the given factor on the development of the distribution over the period of interest.[6]

4.1 Distributional effects of the employment boom

We now turn to our analysis of the effects of the employment boom on the distribution of incomes. In order to see how the employment boom affected different forms of employment, we plot in figure 5 the evolution of the average number of months worked per year in different employment categories, separately for men and women. The figure suggests that the boom led to increases in male and female full-time employment mainly up to 2010. While female part-time employment also grew in the period 2005 to 2010, its growth accelerated dramatically after 2005. Male part-time employment also grew continuously but on a much lower level. Marginal part-time employment tended to grow after 2005 for both men and women, but growth rates were lower than in 2003 when this form of employment was liberalised. To sum up, the employment boom that started in 2005 led to substantial gains in male and female full-time employment, and to even more pronounced gains in female part-time employment. This evidence is consistent with that from administrative data sources, see, e.g., Carrillo-Tudela et al. (2019).

Before we turn to our detailed micro-analysis of the effect of employment changes on the income distribution, we present a suggestive preliminary analysis aimed at describing the incidence of employment growth across the deciles of the distribution. Figure 6a plots the average yearly gains in the number of months worked in the different employment categories per household across different positions of the distribution of equivalised incomes.[7]

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[6]This is commonly accepted methodology in econometric decomposition analysis, see Fortin et al. (2011). It is important to note that this approach does not address general equilbrium effects. On the positive side, it avoids the large number of potentially controversial assumptions that are necessary to model such effects. Policy-makers often prefer this approach over equilibrium models for transparency. We view both methods as complementary. The advantage of the method used here is that the potential quantitative importance of different channels of distributional change can be determined in a transparent way with minimal assumptions. It provides an "anatomy" of observed changes that allows one to assess which factors were important and which factors played a negligible role, not claiming their role as final causal determinants. See appendix for additional discussion.

[7]More precisely, we compute for each household from a particular income decile the change in months
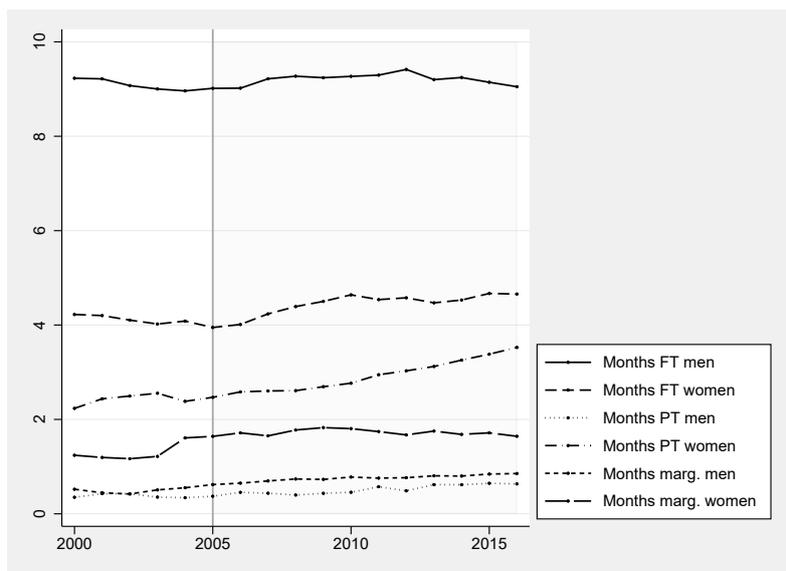
Figure 5: Annual number of months worked in different employment categories of individuals aged 18-64 years, not in education (Source: Socio-Economic Panel)

The figure suggests that households in the lower part of the distribution substantially gained full-time employment months, while households in the upper part substantially lost. This would be a misleading interpretation, however, because it is likely that households in the lower part always tend to gain employment (even in the absence of an employment boom because low income is associated with low employment), while households in the upper part tend to lose employment (because high income is typcially associated with a high degree of employment that often cannot be increased further, i.e. a ceiling effect).

In order to determine the effect of the employment boom compared to the situation before, it therefore makes sense to subtract from picture 6a the corresponding picture 6b for the period before the boom, i.e. 2000 to 2004. The differential effect shown in figure 6c suggests that households at the bottom of the distribution indeed benefitted substantially from full-time employment gains due to the boom and that there were also gains in the middle of the distribution, albeit to a lesser extent. The pattern for part-time employment is similar but not as pronounced. Note that the general level of part-time employment is lower so that relative gains are still substantial. The growth of marginal part-time employment tends to be negative relative to the period 2000 to 2004. This can be explained by the fact that this type of employment experienced idiosyncrated gains in the year of its liberalisation 2003. Summing up, our preliminary analysis suggests that the employment boom led to employment gains for most parts of the distribution, whereas the lower part gained more than the upper part.

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worked in the different categories from year t to year $t+1$ and average these changes over years and over households from the respective decile.
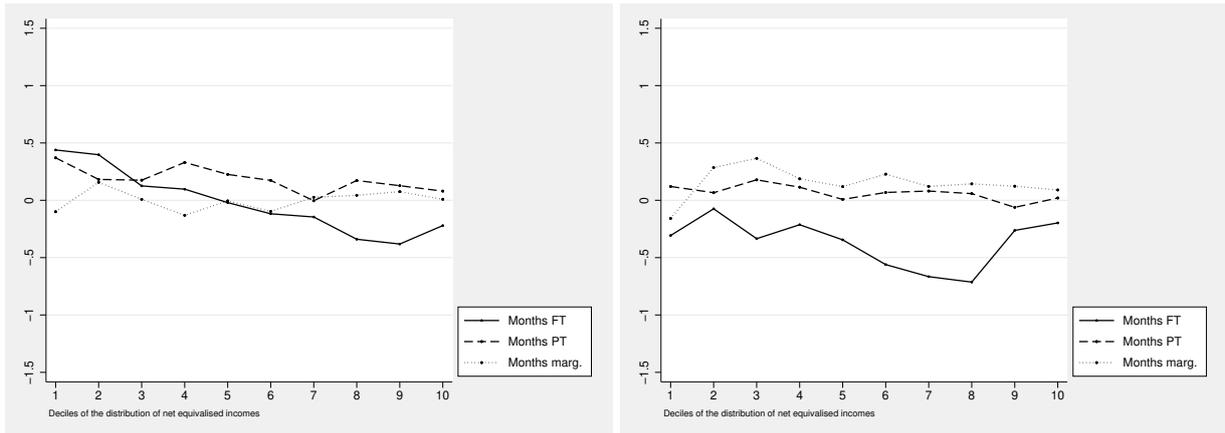
(a) Average annual employment growth, 2005-2016 (b) Average annual employment growth, 2000-2004
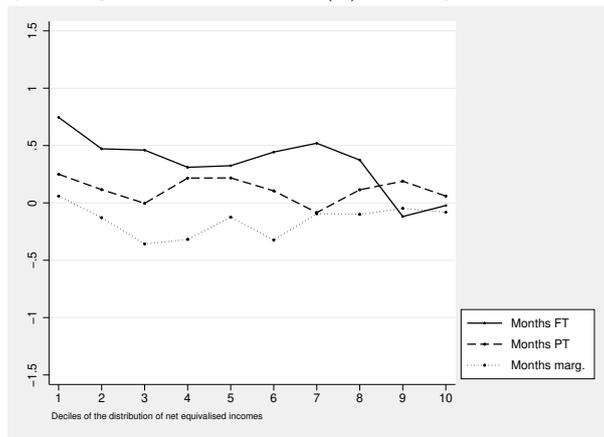
(c) Differential effect (growth incidence
2005-2016 relative to 2000-2004)

Figure 6: Growth of the number of months worked per household across
the deciles of the income distribution (Source: Socio-Economic Panel)

We now turn to our more dataíled analysis of the effects of the employment boom on the distribution of net incomes. Our goal is to model for each individual aged 18 to 64 years and not in education counterfactual employment quantities for 2015/16 that would have prevailed if the boom had not taken place, i.e. if the labour market situation in 2015/16 had been as unfavourable as in 2005/06. In order to do this, we describe the number of months worked per year in the different employment categories (full-time, part-time, marginal part-time) conditional on individual characteristics using logit models. We estimate separate models for each gender and each employment category conditional on the following covariates: nationality, East German residence, disability status, age, age squared, educational qualifications in three categories, work experience, work experience squared and the number of children in different age categories. To account for state dependence in labour market participation, we also include the number of months unemployed/employed in the different employment categories (full-time, part-time, marginal part-time) in the past three years.

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We estimate such models both for the labour market situation in 2005/06 and in 2015/16. Comparing the predictions from these models for a given individual yields a correction term, reflecting how much less/more this individual would have worked in 2015/16 if the labour market situation had still been as in 2005/06. We use this correction term to adjust the factual number of months of each individual observed in 2015/16 into the direction of a counterfactual representing the number of months this individual would have worked in 2015/16 if the employment boom had not taken place.[8]

In order to trace the consequences of these counterfactual changes for equivalised household incomes, we multiply the counterfactual employment months with the monthly wage of the individual in the respective employment category (if observed), or with a monthly wage that we predict using the same set of individual characteristics as in the models for employment in cases in which we do not observe the individual's wage in the respective category (because the individual did not have positive employment months in this category in the factual state).

In cases in which individuals counterfactually *lose* employment (because they would have been unemployed or inactive in the labour market absent the employment boom), we check whether these individuals would be entitled to unemployment benefit I ($ALG\ I$), which depends on the individual labour market history. In order to account for the fact that labour market histories would have been much less favourable in 2015/16 if the employment boom had not taken place, we counterfactually correct each individual's labour market history to reflect how it would have looked under the labour market conditions of 2005/06 (see appendix for more details). We then calculate the amount of unemployment benefit I based on the corrected labour market histories and impute this income source to all individuals eligible.

In a next step, we sum up all counterfactual income changes per household and recalculate income tax and social security contributions. If the resulting household net income lies below the household minimum income threshold (*"Hartz IV Regelsatz"*) plus housing costs, the household is entitled to the so-called unemployment benefit II ($ALG\ II$). In these cases, we compute the exact amount of unemployment benefit II (plus housing costs) and replace the net income of the household with this amount. Finally, we equivalise the resulting household net incomes using our equivalence scale.

The comparison of the counterfactual income distribution for 2015/16 obtained in this way with the factual distribution of 2015/16 reveals which parts of the distribution gained from the boom in terms of net income and to what extent. This result is shown in figure 7 (dashed line). The figure suggests that the lower part of the distribution gained more from the boom (up to 5 percent) than the upper part (around 2.5 percent). These are

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[8]This is an abbreviated description of our calculations, see appendix for more details.

substantial effects.

An important reason why the effects of the boom are not larger is that the consequences of changing back employment quantities to the level of 2005/06 are considerably alleviated by the social security system. If the labour market situation in 2015/16 had been as bad as in 2005/06, not all the individuals affected would have been without income. Many of them would have been entitled to unemployment benefit I/II. In order to assess this aspect, the dotted line in figure 7 shows the *gross effect* of the boom, i.e. without assigning unemployment benefits to individuals who counterfactually lost employment in our calculations. As expected, this effect is very substantial.
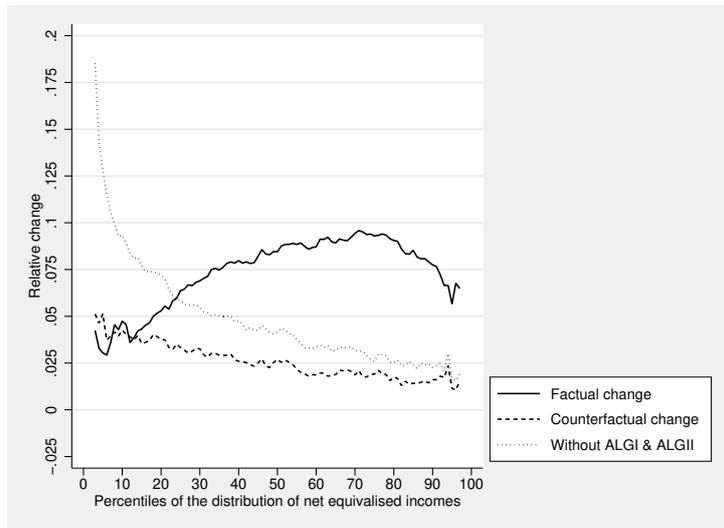

Figure 7: Relative change of income percentiles due to the employment boom
(Source: Socio-Economic Panel, own calculations)
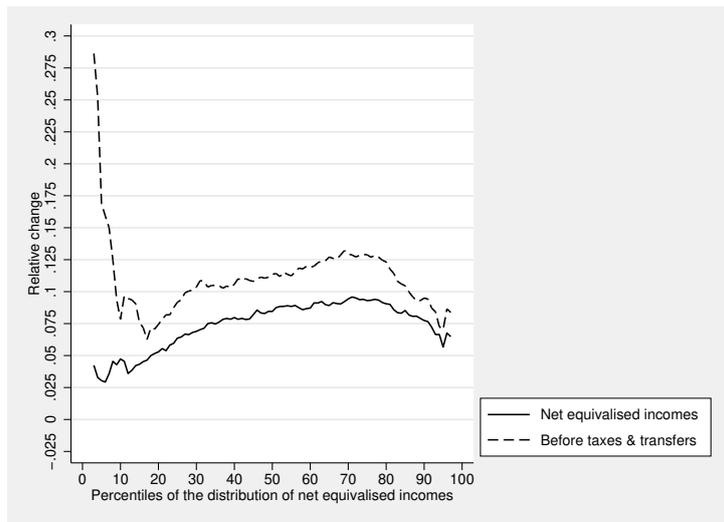
Figure 8: Relative changes of income percentiles 2005/06 to 2015/16
before and after taxes and transfers (Source: Socio-Economic Panel)

Our counterfactual calculations are supported by figure 8 displaying the *factual* changes

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in the distribution of equivalised incomes *before* and *after* taxes and transfers. Similar to figure 7, we observe large relative gains in incomes before taxes and transfers at the bottom of the distribution, which are not translated into corresponding income gains after taxes and transfers. Note, however, that figure 8 includes the effect of all other factors (apart from employment) and does not disentangle the effects of individual aspects as we do in our counterfactual analyses (also see below).

We draw the following tentative conclusions about the impact of the employment boom on the German income distribution. First, the employment boom led to substantial income gains across the whole distribution. Second, the lower part of the distribution benefitted more than the upper part, most likely because the boom prevented many individuals from being unemployed in 2015/16 (this is implicitly revealed by the difference of the dotted and the dashed line in figure 7). Third, the boom also benefitted households in the middle and upper part of the distribution, presumably through additional female labour market participation (e.g., wives who take up part-time work or who upgrade part-time to full-time employment). Fourth, the effects of the boom were substantially dampened by the generous social security system as many of the individuals who gained employment through the boom would have been eligible for unemployment benefits without it. To a lesser extent, they were also dampened by the progressive tax system which in part taxes away additional income. Fifth, the boom had an equalising effect on the distribution of net incomes, albeit a moderate one. This follows from column 1 of table 3 in which we compute the effect of the counterfactual changes on different inequality measures. And sixth, while the boom produced a substantial contribution to overall distributional change (solid line in figure 7), there must be other factors that also contributed.

4.2 Other factors

Given that the employment boom cannot fully account for the changes in the distribution between 2005/06 and 2015/16, we look at a number of other potential explanations: i) immigration, ii) changes in household types, iii) changes in individual and household characteristics, iv) changes in the level and structure of pay, v) changes in capital incomes, vi) changes in the tax and transfer system. Considering the effect of other factors is important for our understanding of the effects of the boom because its impact may have been wiped out or masked by the countervailing effects of other developments.

4.2.1 Immigration

As many other countries, Germany experienced substantial immigration during the period under investigation, in particular in the context of the so-called "refugee crisis" of 2014/15, in the course of which a large number of individuals from the Middle East found refuge in the country. Our data base contains information on immigration through a number of

refreshment samples (SOEP samples M1 Migration 1995-2010, M2 Migration 2009-2013, M3/4 Refugees 2013-2015). In order to assess the potential effect of immigration on the distribution of net incomes, we carry out the following counterfactual exercise. We omit all individuals (as well as their children) who immigrated to the country after 2005 from our sample. As in our other computations, this will ignore potential general equlibrium effects of immigration. Such effects are expected to be small however, as many of the individuals who immigrated after 2005 were refugees who were not allowed to participate in the labour market in the first years after their arrival. Unfortunately, income information on individuals who immigrated as refugees is available for the first time for the year 2016, so that the following results compare 2005/06 to 2016 (rather than to 2015/16).

Table 1 gives an overview of the number of individuals in our sample counted as having immigrated into the country after 2005 (grossed up to population figures using the sample weights). The total figure of around 3.6 million corresponds well to that reported by the Federal Government (Bundesamt für Migration und Flüchtlinge, 2017). Apart from *Aussiedler* (ethnic Germans) and Germans returning from abroad, EU foreigners and refugees constitute the largest groups among the individuals who immigrated after 2005. Our data also contain a large number of immigrants without information on their exact status (the "Other/no information" group in table 1). Judged from their observable characteristics, most of these individuals are likely to also belong to the "Asylum seekers/refugees" group.

Migration group	Number of individuals
Aussiedler, Germans living abroad	132,574
EU foreigners	924,646
Asylum seekers/refugees	792,356
Other/no information	1,748,241
Sum	3,598,817

Data: SOEP v34

Table 1: Grossed-up number of individuals who immigrated to Germany between 2005 and 2016 (Source: Socio-Economic Panel)

The effect of omitting individuals who immigrated since 2005 from the distribution of incomes in 2016 is shown in figure 9. The lower dashed line demonstrates that the overall effect of immigration was such that lower parts of the distribution were pulled downwards by up to 4 percent. The other lines show that this was mainly due to the group of refugees and the "no information" group, while the group of EU foreigners and ethnic Germans did not differ much in their composition of incomes compared to the native population. The effect at the lower end is substantial and suggests that the mere fact that a large number of individuals with very low incomes joined the population may account for some of the

poor income growth at the bottom of the distribution of net incomes (and neutralise some of the positive effects of the employment boom). In table 3, we show that this had an inequality increasing effect.
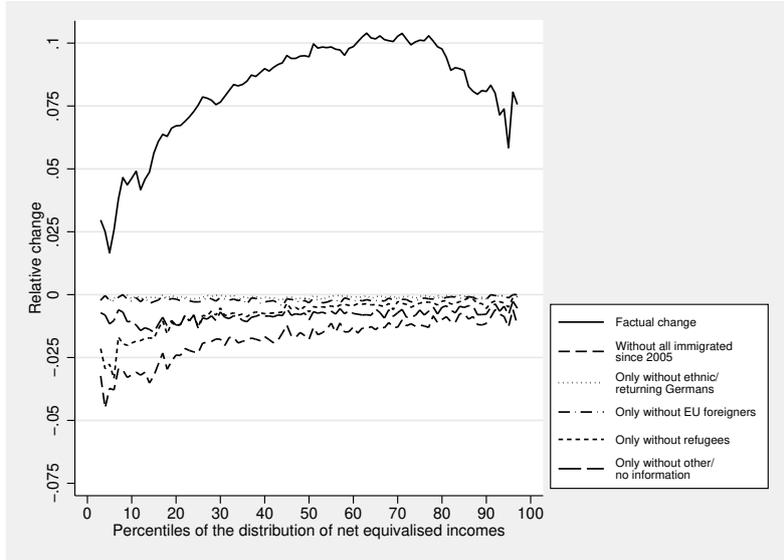
Figure 9: Relative change of income percentiles due to immigration
between 2005 and 2016 (Source: Socio-Economic Panel)

4.2.2 Changes in household types

Changes in the composition of the population with respect to household types constitute another factor that potentially masks effects of the employment boom on the income distribution. If the share of household types with low equivalent income secularly increases (e.g., lone parents, pensioners), this will lead to increasing inequality independent of employment gains for low-income households.

Figure 10 shows that changes in household types over the period under investigation were substantial. In particular, multiple adult households without children and pensioner households increased their shares at the expense of multiple adult households with children. In order to assess the effect of this development on the income distribution, we counterfactually change the population weights of the different households types in the income distribution of 2015/16 to those in 2005/06 (see appendix for more details). Figure 11a shows that, despite the substantial changes, the effect of doing this is negligible, i.e. changes in household types do not help to account for changes in the distribution between 2005/06 and 2015/16.

4.2.3 Changes in individual and household characteristics

Next, we consider finer compositional changes in the structure of the population. For example, it may be the case that educational upgrading and population aging induced more

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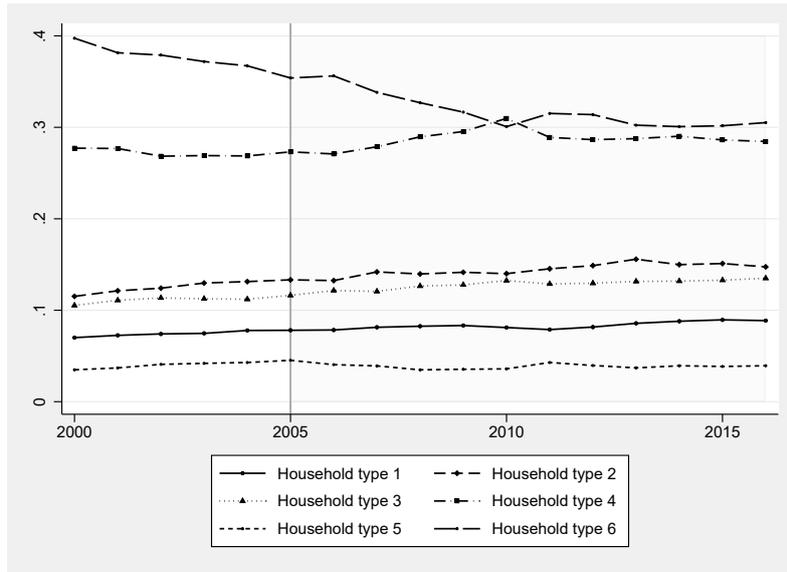
Figure 10: Development of household types over time: 1) single pensioners, 2) multiple pensioners, 3) single adults without children, 4) multiple adults without children, 5) single adults with children, 6) multiple adults with children (Source: Socio-Economic Panel)

(a) Household types

(b) Individual and household characteristics

(c) Level and structure of pay

(d) Capital income
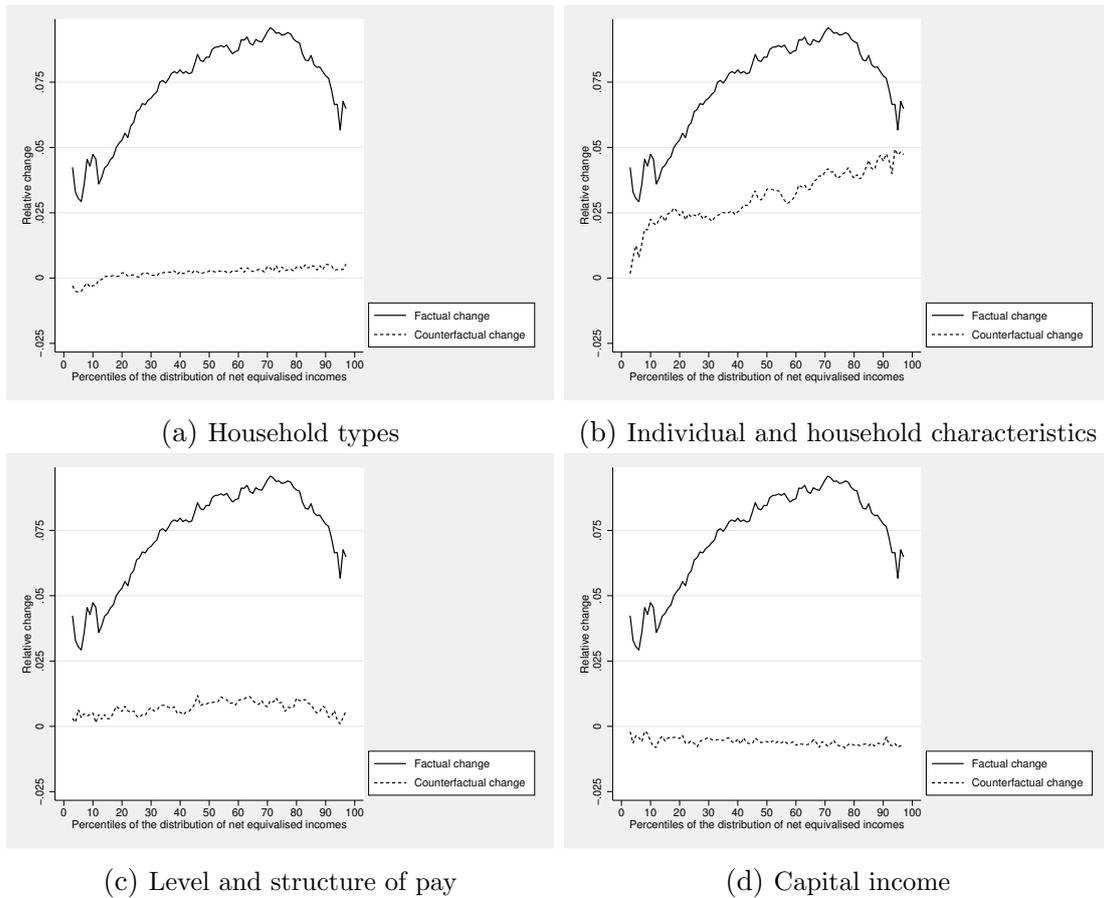
Figure 11: Relative changes of income percentiles due to other factors (Source: Socio-Economic Panel, own calculations)

income inequality because a shift towards higher educational qualifications and older age groups raised the share of population subgroups with high income disperson (increasing within-group inequality), or increased the divide between eduation or age groups (increasing between-group inequality). The changes in the individual and household characteristics considered by us are summarised in table 2. As expected, there is a trend towards higher age, work experience and education as well as towards more households with female heads and fewer children.

| Variable	Average 2005/06	Average 2015/16	Difference
Household head			
Female	0.37	0.43	+0.06
Foreign nationality	0.08	0.10	+0.02
Age	50.18	52.47	+2.29
University degree	0.19	0.25	+0.06
Vocational training	0.63	0.59	-0.04
Less than vocational training	0.18	0.15	-0.02
Work experience (years)	12.22	13.35	+1.13
Partner or second oldest person (if any)			
Female	0.72	0.63	-0.09
Foreign nationality	0.11	0.10	-0.01
Age	46.97	49.28	+2.31
University degree	0.14	0.17	+0.03
Vocational training	0.59	0.51	-0.08
Less than vocational training	0.27	0.32	+0.04
Work experience (years)	9.95	10.40	+0.45
Other household characteristics			
East Germany	0.21	0.20	-0.01
Number of children in household	0.70	0.61	-0.08
Number of children 0-3 years	0.11	0.11	0.00
Number of children 4-6 years	0.12	0.10	-0.02
Number of children 7-17 years	0.47	0.41	-0.07
More than two adults	0.18	0.17	0.00

Table 2: Individual and household characteristics in 2005/06 and in 2015/16
(Source: Socio-Economic Panel)

We compute the effect of these changes on the income distribution in 2015/16 by reweighting the distribution of these characteristics back to the one observed in 2005/06, leaving everything else constant. We do this separately by household type using the semi-parametric reweighting procedure proposed by DiNardo et al. (1996) (see appendix for more details). Figure 11b shows that the impact of changes in these characteristics on the distribution of incomes was considerable. The shift towards higher age and education groups implied higher income levels, especially in the middle and at the top of the distribution. This contributed to increasing inequality counteracting the pro-poor income growth induced by the employment boom (column 4 of table 3). The compositional effects of changing income-relevant characteristics is consistent with findings in the literature showing that this factor can account for a large part of changes in the distribution of *wages* (Dustmann

et al., 2009; Biewen and Seckler, 2019).

4.2.4 Changes in the level and structure of pay

Apart from quantities, prices for employment may have changed over the period under consideration. In order to describe the potential effect of this factor on the distribution of net incomes, we form for each individual observed in 2015/16 a counterfactual wage that mimics the wage this person would have earned under the pay structures of 2005/06. To this end, we regress monthly (log) wages on the following characteristics: nationality, East German residence, disability status, age, age squared, three education categories, work experience and work experience squared. We do this separately for the three employment categories, the two genders, and the two situations 2005/06 and 2015/16, the latter representing the pay structures in 2005/06 and in 2015/16, respectively. We then compute for each individual observed working in 2015/16 a correction term based on the difference in wage predictions under the pay structures of 2005/06 and 2015/16, reflecting how much higher/lower the person's wage would have been under the pay structure of 2005/06. We also consider changes in pay for unobservables (i.e. wage residuals) assuming that the individual would have had the same rank in the distribution of residual wages in 2005/06 as she had in 2015/16 (see appendix for more details). The resulting counterfactual wages are then multiplied by the observed number of months worked in the different employment categories yielding changes in individual and household market income. Finally, we compute taxes and social security contributions for the changed sum of incomes and carry out the equivalisation.

Note that this procedure captures both changes in the *level* and in the *structure* of wages.[9] The results of this exercise are shown in figure 11c. It turns out that changes in pay played only a minor role for the development of the income distribution between 2005/06 and 2015/16. There were small real wage gains which were slightly higher for the middle of the distribution. This did not significantly impact income inequality (see lower panel of table 3). The (missing) effect of changes in pay structures for the period under investigation found in our analysis is consistent with evidence from administrative data showing that, after increasing inequality before 2005, the quantiles of the wage distribution mostly developed in a horizontal way, implying stagnating real incomes and no increasing inequality after 2005 (see Baumgarten et al., 2018, p. 7, figure 1b).

4.2.5 Changes in capital incomes

Changes in capital incomes may also have influenced the income distribution in the period considered by us. We investigate this by constructing a counterfactual distribution of net

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[9]Recall that we only consider changes in real wages as all of our wage information is expressed in prices of 2016.

incomes that results if one changes back the distribution of capital incomes to its state in 2005/06, leaving everything else constant. We do this by transforming each household's rental income and each household's other capital incomes by multiplying them by the ratio of the percentiles of these distributions in 2005/06 and 2015/16 based on the corresponding ranks of the household in 2015/16 (see appendix for more details). Again, this reflects both changes in the *level* and the *dispersion* of capital incomes.

The effect of changing rental and other capital incomes is shown in figure 11d. The figure suggests that changes in capital incomes *depressed* the income distribution. This is in line with the fact that real interest rates fell over the period considered. Perhaps surprisingly, these effects occured uniformly across the distribution. Our analysis comes with the caveat that survey data like the SOEP do not cover developments at the very top of the income distribution (Bartels and Jenderny, 2015). Also note that the respondents in our survey may report certain capital incomes as income from self-employment (in our study included in labour income). Drechsel-Grau et al. (2015) have shown on the basis of tax data that, if one excludes incomes from owner-run enterprises, capital incomes are indeed approximately uniform across the German income distribution. Overall, we do not find any evidence for an important role of capital incomes for changes in the distribution of net incomes, but certainly cannot rule out effects at the very top not covered by our data.

4.2.6 Changes in the tax and transfer system

We consider the effect of the following changes in the German tax and transfer system that occurred between 2005/06 and 2015/16.

Changes in transfers:

- Extension of mothers' pensions (two instead of one year of implicit contributions for children born before 1992)

- Abolishment of the temporary supplement to ALG II after receipt of ALG I (transitionary payment for individuals whose unemployment benefit I ran out amounting to 2/3 of the difference between unemployment benefit I and unemployment benefit II in the first year, and 1/3 in the second year)

- Higher child allowances, higher student allowances, higher unemployment benefit II (we only consider the part of the increase since 2005 that was higher than inflation)

Changes in the tax system (including changes in social security contribution rates):

- Introduction of a "rich tax" (marginal tax rate of 45 percent instead of 42 percent starting from 250,000 (500,000) Euros taxable income per annum)

- Withholding tax for capital incomes (flat rate of 25 percent instead of personal tax rate)

- Changes in the tax schedule (changes in a number of tax allowances plus various changes in marginal tax rates)

- Changes in social security contribution rates (mainly reductions, e.g., lower contribution rates to unemployment insurance due to falling unemployment)

We describe the effects of these changes on the distribution of net incomes by counterfactually undoing each of these reforms. We emphasize that, as in our other computations, we ignore potential behavioural reactions to these changes.[10] The results of these operations are shown in figures 12a and 12b. Figure 12a and the numbers in table 3 demonstrate that the changes in the transfer system tended to have an equalising effect, mainly due to the extended mothers' pension and the higher child allowances. On the other hand, the changes in the tax schedule mainly benefitted households in the middle and the top part of the distribution (households at the bottom of the distribution typically do not pay income tax). This had an inequality increasing effect (figure 12b and table 3). The fall in social security contribution rates led to small income gains in the middle of the distribution, but not at the bottom and the top (as households at the bottom are typically not employed and as labour incomes in households at the top tend to exceed the social security contributions ceiling).
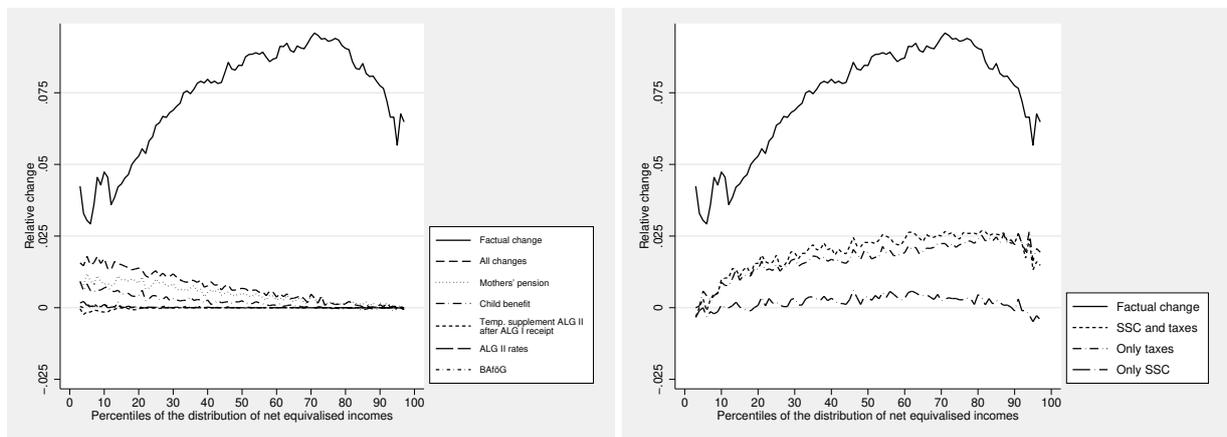

(a) Transfer system

(b) Tax and SSC system

Figure 12: Relative change of income percentiles due to tax and transfer changes
(Source: Socio-Economic Panel, own calculations)

Index	Employment boom	Immigration	HH types	HH characteristics
Mean	+580.072	-362.008	+79.502	+908.138
	[+412.854 ; +755.861]	[-429.526 ; -293.971]	[-49.634 ; +205.381]	[+668.401 ; +1146.968]
Median	+631.493	-366.039	+61.764	+749.205
	[+423.208 ; +837.515]	[-485.849 ; -254.829]	[-62.887 ; +188.914]	[+510.938 ; +972.845]
P90/P10	-0.098	+0.078	+0.025	+0.090
	[-0.161 ; -0.037]	[+0.038 ; +0.121]	[+0.002 ; +0.053]	[+0.021 ; +0.156]
P90/P50	-0.024	+0.011	+0.004	+0.025
	[-0.040 ; -0.004]	[-0.004 ; +0.024]	[-0.004 ; +0.014]	[-0.001 ; +0.051]
P50/P10	-0.028	+0.031	+0.010	+0.023
	[-0.059 ; -0.002]	[+0.010 ; +0.052]	[+0.000 ; +0.021]	[-0.003 ; +0.048]
Gini	-0.004	+0.004	+0.001	+0.005
	[-0.006 ; -0.002]	[+0.003 ; +0.005]	[+0.000 ; +0.002]	[+0.002 ; +0.008]
Poverty rate	-0.003	+0.005	+0.001	+0.004
	[-0.008 ; 0.001]	[+0.002 ; +0.008]	[-0.001 ; +0.003]	[-0.001 ; +0.009]

Index	Pay structures	Capital incomes	Transfers	Tax and SSC
Mean	+160.299	-159.121	+117.167	+526.212
	[-63.717 ; +385.391]	[-210.710 ; -108.257]	[+112.257 ; +121.559]	[+506.540 ; +544.972]
Median	+209.604	-144.170	+154.761	+518.147
	[+26.584 ; +400.229]	[-198.236 ; -87.573]	[+117.870 ; +196.741]	[+452.883 ; +585.615]
P90/P10	+0.001	-0.006	-0.053	+0.050
	[-0.055 ; +0.057]	[-0.026 ; +0.014]	[-0.074 ; -0.030]	[+0.024 ; +0.080]
P90/P50	-0.005	-0.002	-0.012	+0.001
	[-0.030 ; +0.018]	[-0.009 ; 0.006]	[-0.016 ; -0.007]	[-0.012 ; +0.014]
P50/P10	+0.006	-0.001	-0.016	+0.027
	[-0.012 ; +0.025]	[-0.010 ; +0.006]	[-0.027 ; -0.004]	[+0.016 ; +0.038]
Gini	-0.001	-0.000	-0.003	+0.001
	[-0.004 ; +0.004]	[-0.001 ; +0.000]	[-0.003 ; -0.002]	[+0.001 ; +0.002]
Poverty rate	+0.002	-0.000	-0.003	+0.004
	[-0.001 ; +0.006]	[-0.002 ; +0.001]	[-0.005 ; -0.002]	[+0.002 ; +0.007]

Index	Sum	Factual change
Mean	+1850.261	+1919.746
	[+1428.914 ; +2274.000]	[+1477.581 ; +2344.251]
Median	+1814.765	+1921.334
	[+1328.090 ; +2293.619]	[+1539.278 ; +2312.802]
P90/P10	+0.088	+0.121
	[-0.061 ; +0.241]	[-0.011 ; +0.246]
P90/P50	-0.002	-0.014
	[-0.063 ; +0.059]	[-0.063 ; +0.038]
P50/P10	+ 0.051	+0.080
	[-0.014 ; +0.111]	[+0.027 ; +0.136]
Gini	+0.004	+0.003
	[-0.002 ; +0.010]	[-0.006 ; +0.011]
Poverty rate	+0.010	+0.020
	[-0.002 ; +0.021]	[+0.011 ; 0.030]

95% bootstrap confidence intervals in brackets (1000 replications)

Table 3: Effects on inequality measures (Source: Socio-Economic Panel, own calculations)

4.3 Summary of changes

How successful are our calculations at putting together Germany's inequality puzzle? Figure 13a shows that the sum of all changes modeled by us reconstructs the observed changes in the distribution strikingly well. This is also the case for the inequality calculations in table 3, although these are more affected by the unsmooth form of the sum of changes

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[10]Such reactions are likely to be small and they typically counteract the original effects (Jessen, 2019), rendering our calculations upper bounds.
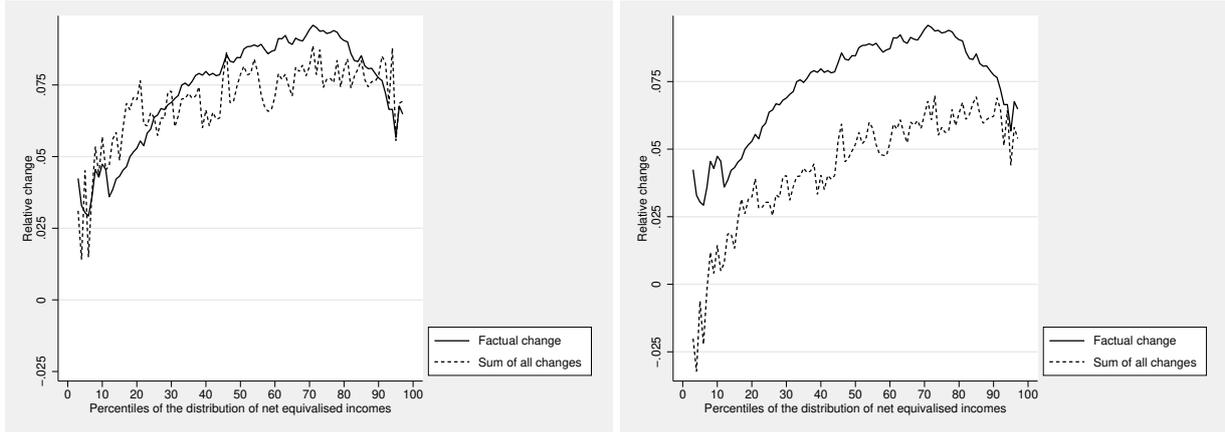
(a) With employment boom   (b) Without employment boom

Figure 13: Factual change vs. sum of counterfactual changes with and without employment boom (Source: Socio-Economic Panel, own calculations)

(figure 13a). Figure 13b showing the sum of all changes *without* the employment boom suggests that the employment boom indeed contributed substantially to distributional change between 2005/06 and 2015/16, but that its impact was masked by a number of other developments which also undid some of its inequality reducing effects.

5 Conclusion

This paper addressed the puzzling question of why income inequality and poverty risk remained persistently high in Germany, despite an unprecedented labour market boom in the period after the implementation of the labour market liberalizing Hartz reforms that drastically reduced unemployment. We reach the following conclusions. First, the boom indeed boosted incomes and reduced inequality. Second, its effects on the distribution of net incomes were substantially dampened by the social security system and the progressive tax system, which reduce the impact of economic downturns, but also that of economic upturns. Third, the effects of the boom on the income distribution were masked by a number of other developments such as immigration of individuals with low incomes and changes in the composition of the population (educational upgrading and population aging), making it difficult to determine their exact magnitude. Altogether, our results suggest that employment growth that is the potential result of a liberalisation of labour market institutions does not have to come with adverse distributional effects, even if it entails growth of non-standard employment forms such as part-time and marginal part-time employment. Of course, this does not rule out that some population subgroups may suffer disadvantage from such reforms. Finally, our results imply that if the COVID-19 shock were to reverse all the employment gains that occurred during the boom, this would only have a moderately disequalising effect on the distribution of net incomes.

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Appendix

A1   Income tax and social security contributions

Our income tax calcuations comprise the following elements:

- Joint taxation of married couples living in the same household

- Deduction of various tax allowances (*Sonderausgabenpauschale, Werbungskostenpauschale, Altersentlastungsbetrag*, contributions to pension and social security system, extra allowances for lone parents)

- Exact computation of income tax burden using tax formula of given year

- Taxes on old age pensions incl. allowances (increasing tax rate across years, *Versorgungsfreibetrag, Versorgungshöchstbetrag, Altersentlastungsbetrag*)

- Progression clause for unemployment benefit I and maternity benefits (*Progressionsvorbehalt*, i.e. these income sources are not taxed but they are added when determining the marginal tax rate)

- Child allowance: households either receive the child allowance as a direct payment, or, if more favourable, deduct child allowances from their taxable income in order to reduce their tax burden *(Günstigerprüfung Kindergeld)*

- Withholding tax on income from interest, dividends and similar income sources introduced 1st January 2009 (*Abgeltungssteuer*, flat rate of 25 percent)

- Solidarity surcharge (5.5 percent on income tax burden)

The calculation of contributions to the social security system include the following elements:

- The exact value of the social security contribution ceiling in the pension, unemployment, health and old age care insurance in each year

- The exact contribution rates in the pension, unemployment, health and old age care insurance in each year (only contributions by employees, not by employers)

- The exact contribution rates in the health and old age care insurance in each year for the income sources of pensioners that are subject to social security contributions

A2 Counterfactual analysis

This section documents more details of our counterfactual analyses.

A2.1 Employment boom

The distribution of months worked per year in the different employment categories turns out to be very bipolar with little mass on the intermediate outcomes 1 to 11 months. Preliminary experiments with different ordinal models suggested that it is practically impossible to predict the exact number of months outside 0 or 12 months, or even whether this number lies between 0 and 12. In our preliminary investigations, we obtained the best fit and most robust results with models which combined the values 0 to 5 months and 6 to 12 months into a binomial outcome 0 vs. 12 months modeled by a logit model. In order to eventually also obtain intermediate values 1 to 11, we then added to logit predictions for the value 0 the difference between the observed value for months worked and 0, and subtracted from predictions 12 the difference between 12 and the observed value (rounding to 0 and 12 if this prediction lay outside the interval 0 to 12).

For our counterfactual predictions, we estimate logit models for the months worked (separately for full-time, part-time, marginal part-time) in the two labour market situations 2005/06 (period 0) and 2015/16 (period 1), conditional on the following individual characteristics: nationality, East German residence, disability status, age, age squared, three education categories, work experience, work experience squared, the number of children in different age categories as well as the number of months unemployed and employed in the last three years in the three employment categories. We estimate these models separately by gender and employment category. We use the difference in predictions (as described in the first paragraph of this section) for 2005/06 vs. 2015/16 per individual to correct the actual number of months worked for individuals observed in 2015/16 into the direction of the labour market situation of 2005/06 (i.e. before the boom):

$$MonthsFT_i^{1,cf} = MonthsFT_i^1 + (\widehat{MonthsFT}_i^0 - \widehat{MonthsFT}_i^1) \tag{A1}$$

$$MonthsPT_i^{1,cf} = MonthsPT_i^1 + (\widehat{MonthsPT}_i^0 - \widehat{MonthsPT}_i^1) \tag{A2}$$

$$MonthsMarg_i^{1,cf} = MonthsMarg_i^1 + (\widehat{MonthsMarg}_i^0 - \widehat{MonthsMarg}_i^1). \tag{A3}$$

The correction terms reflect how much lower/higher the number of months worked by the individual would have been if the labour market situation in 2015/16 had still been as in 2005/06, given her observed characteristics. To account for the connectedness of decisions in the three employment categories, we include the number of full-time months as a regressor in the models for part-time months and the number of full-time/part-time months in the models for marginal part time. For our counterfactual predictions,

these values are replaced by the predicted number of full-time and part-time months, respectively.

For our employment models, we only consider individuals aged between 18 and 64 years who are not in education. Our logit models are specified such that the counterfactual distribution of months worked in the different categories resembles the factual distribution of 2005/06. In order to take account of the fact that labour market histories in the situation of 2005/06 would generally have been much less favourable than in the situation of 2015/16, we also correct the observed number of months unemployed/worked in the past three years (separately by full-time, part-time, marginal part-time status) for each individual before we compute counterfactual predictions using a similar procedure as for the number of months worked (i.e. we estimate regressions for these quantities both for 2005/06 and 2015/16 and use the difference in predictions to correct the values observed for 2015/16 into the direction of 2005/06).

The counterfactual annual labour income of inviduals observed in 2015/16 reflecting the labour market situation of 2005/06 is then computed as

$$MonthsFT_i^{1,cf} \cdot \overline{WageFT}_i^1 + MonthsPT_i^{1,cf} \cdot \overline{WagePT}_i^1 + MonthsMarg_i^{1,cf} \cdot \overline{WageMarg}_i^1 \tag{A4}$$

where $\overline{WageFT}_i^1$, $\overline{WagePT}_i^1$ and $\overline{WageMarg}_i^1$ denote the monthly wages of the individual in the respective employment category. If the monthly wage of the individual in an employment category with non-zero counterfactual months is not observed, we predict it based on wage regressions conditional on the following individual characteristics (separately by gender): nationality, East German residence, disability status, age, age squared, three education categories, experience and experience squared.

If an individual is hit by a counterfactual loss of at least six full-time months (relative to the observed number of months worked in 2015/16), we check whether this individual would be entitled to unemployment benefits I (ALG I). For this, we use the employment history of the individual in the past three years which was corrected earlier for the fact that employment histories in 2005/06 were less favourable than 2015/16 (see above). If the individual is entitled to unemployment benefits I in the counterfactual state, we compute the exact entitlement per individual and month and assign it to the individual for the number of counterfactually lost employment months.

In the next step, we sum up all income sources per household (including the counterfactually changed labour incomes) and recompute taxes and social security contributions. The resulting counterfactual household net income is given by (in simplified notation):

$$
\begin{aligned}
y_{cf} = {}& y_{Market} + \hat{\Delta} y_{Labour} + y_{Pens} + y_{Trans} + \hat{\Delta} y_{Trans} \\
& - ssc_1(y_{Labour} + \hat{\Delta} y_{Labour}, y_{Pens}) - tax_1(y_{Tax} + \hat{\Delta} y_{Labour}),
\end{aligned} \tag{A5}
$$

where y_{Market}, y_{Labour}, y_{Pens}, y_{Trans} and y_{Tax} denote household market income, household labour income, household pension income, transfers received by the household and the household's taxable income, respectively. The terms $\hat{\Delta} y_{Labour}$ and $\hat{\Delta} y_{Trans}$ incorporate the counterfactual changes in household labour incomes and the counterfactual addition/subtraction of ALG I due to losses/gains in employment. The changes in labour incomes further feed into social security contributions and taxes, as reflected by the last two components in equation (A5).

In a last step, we check whether the above net household income falls below the subsistence level of unemployment benefit II (ALG II or *Hartz IV*) plus costs for accommodation and heating. If this is the case, y_{cf} is replaced by the latter.

A2.2   Immigration

To assess the impact of immigration on the distribution of net incomes between 2005/06 and 2016, we omit for the year 2016 all individuals who immigrated into the country between 2005 and 2016 as well as children below 16 years of age living in their households (see main text for more details). In the SOEP, individuals under 16 years do not complete their own questionnaire but are only described by the household head. Our results do not change in any substantial way if do not omit children living in the households of recent immigrants.

A2.3   Changes in household types

To establish a counterfactual income distribution in which everything is as in 2015/16 (period 1) but the distribution of household types is as in 2005/06 (period 0), we replace in the situation of 2015/16 the population shares of the different household types by those of 2005/06. Formally,

$$f_{cf}(y) = \sum_{j=1}^{6} w_{0j} f_{1j}(y), \tag{A6}$$

where w_{0j} denote the population shares of household types $j = 1, \ldots, 6$ in period 0, and f_{1j} the distribution of net equivalent incomes of individuals living in household type $j = 1, \ldots, 6$ in period 1.

A2.4   Changes in individual and household characteristics

In a similar fashion, we construct an income distribution that would have prevailed in 2015/16 if the joint distribution of individual and household characteristics x had still

been as in 2005/06. To this end, we compute, separately by household type j,

$$f_{cf,j}(y) = \int_x f_{1j}(y|x) \left[\frac{dF_{0j}(x)}{dF_{1j}(x)} \right] dF_{1j}(x), \tag{A7}$$

with reweighting factors

$$\frac{dF_{0j}(x)}{dF_{1j}(x)} = \frac{P_j(x|t=0)}{P_j(x|t=1)} = \frac{P_j(t=0|x)}{P_j(t=1|x)} \cdot \frac{P_j(t=1)}{P_j(1=0)} \tag{A8}$$

obtained from predictions based on logit models $P_j(t=1|x)$, $P_j(t=0|x)$. We include into the logit models all the individual and household characteristics listed in table 2. The reweighting factors are computed by household type and we include for each household type only the characteristics that are present in the respective type (e.g., we do not include information on children in household types without children). The terms $P_j(t=1), P_j(1=0)$ are the weighted sample fractions of period 1 and 0, respectively, in the combined sample of periods 1 and 0. The final counterfactual distribution is obtained by aggregating across all household types,

$$f_{cf}(y) = \sum_{j=1}^{6} w_{1j} f_{cf,j}(y). \tag{A9}$$

A2.5   Changes in the level and structure of pay

In order to assess the effects of changes in the level and structure of the returns to labour market characteristics, we estimate wage regressions for the labour market situations in 2005/06 (period 0) and 2015/16 (period 1), separately by gender and the three employment categories (full time, part time, marginal part time).

The regressions for monthly wages take the form

$$log(wage) = z\beta + u, \tag{A10}$$

where the vector of individual characteristics z includes nationality, East German residence, disability status, age, age squared, educational qualification in three categories, work experience and work experience squared. We include in our regressions only individuals aged between 18 and 64 years who are not in education.

Our counterfactual wage computations capture three aspects: i) general wage gains (reflected in the changing regression intercepts), ii) changes in wage differentials (reflected in the changes of the estimated regression coefficients $\hat{\beta}$), and iii) changes in the dispersion of unobserved (i.e. residual) wage components u.

More concretely, we carry out the following calculations:

$$\widehat{wage}_1(z, rank_1) = exp(z\hat{\beta}_1 + \hat{u}_1(rank_1)) \tag{A11}$$

$$\widehat{wage}_0(z, rank_1) = exp(z\hat{\beta}_0 + \hat{u}_0(rank_1)) \tag{A12}$$

$$wage_1^{cf} = wage_1 + (\widehat{wage}_0(z, rank_1) - \widehat{wage}_1(z, rank_1)). \tag{A13}$$

As evident from the last line, the factual wages in 2015/16 are corrected upward/downward by a correction term reflecting how much more/less a person with characteristics z and $rank_1$ in the residual wage distribution of period 1 would have earned in period 1 if the pay structure in period 1 had still been as in period 0. Note that all wage changes are in real terms (all wage information is expressed in prices of 2016, except for tax calculations for which we termporarily convert incomes back to nominal values).

We then multiply the counterfactual wages of each person by the actual number of months worked in the respective employment category to obtain the counterfactual annual labour income under the assumptions that the level and structure of pay in 2015/16 had been as in 2005/06. Summing within households and recomputing taxes and social security contributions yields the counterfactual annual household net income

$$y_{cf} = y_{Market} + \hat{\Delta}y_{Labour} + y_{Pens} + y_{Trans}$$
$$- ssc_1(y_{Labour} + \hat{\Delta}y_{Labour}, y_{Pens}) - tax_1(y_{Tax} + \hat{\Delta}y_{Labour}). \tag{A14}$$

A2.6 Changes in capital incomes

For the computation of counterfactual capital incomes, we first determine the rank of the household in period 1 (2015/16) in the distribution of rental incomes, $RentRank_1$, and the rank in the distribution of other capital incomes, $CapRank_1$. We then compute the ratio of the percentiles belonging to this rank in the two distributions of period 0 and period 1 to rescale the observed value of rental and other capital incomes of period 1. This leads to the correction terms

$$\hat{\Delta}y_{Rent} = PercRent_0(RentRank_1)\frac{y_{Rent}}{PercRent_1(RentRank_1)} - y_{Rent} \tag{A15}$$

$$\hat{\Delta}y_{Cap} = PercCap_0(CapRank_1)\frac{y_{Cap}}{PercCap_1(CapRank_1)} - y_{Cap}, \tag{A16}$$

which we use to correct household capital incomes in order to arrive at counterfactual household net income reflecting the level and structure of capital incomes of period 0 (2005/06)

$$y_{cf} = y_{Market} + \hat{\Delta}y_{Rent} + \hat{\Delta}y_{Cap} + y_{Pens} + y_{Trans}$$
$$- ssc_1(y_{Labour}, y_{Pens}) - tax_1(y_{Tax} + \hat{\Delta}y_{Rent} + \hat{\Delta}y_{Cap}). \tag{A17}$$

A2.7 Changes in the transfer system

For our counterfactual simulations, we reverse the reforms listed in the main text (extension of mothers' pension, the abolition of the temporary supplement to ALG II after receipt of ALG I, the changes in child/student allowances and in unemployment benefits II) by changing the respective income component at the level of the individual in period 1 (2015/16) and by aggregating at the household level. This yields our counterfactual annual household income

$$
\begin{aligned}
y_{cf} = {}& y_{Market} + y_{Pens} + \hat{\Delta} y_{Pens} + y_{Trans} + \hat{\Delta} y_{Trans} \\
& - ssc_1(y_{Labour}, y_{Pens} + \hat{\Delta} y_{Pens}) - tax_1(y_{Tax} + \hat{\Delta} y_{Pens}).
\end{aligned}
\tag{A18}
$$

A2.8 Changes in taxes and social security contributions

To assess the effects of changes in the tax and social security system, we replace in the calculations for period 1 (2015/16) the tax and social security contributions system with that of period 0 (2005/06):

$$
y_{cf} = y_{Market} + y_{Pens} + y_{Trans} - ssc_0(y_{Labour}, y_{Pens}) - tax_0(y_{Tax})
\tag{A19}
$$

A2.9 Limitations of our methodology

As pointed out in the main text, our counterfactual calculations ignore behavioural reactions and equilibrium effects. Note that such effects have often been found to be small, see Jessen (2019). Modelling such effects would necessarily rely on a large number of potentially controversial and often arbitrary assumptions. This represents a trade-off. Ignoring equilibrium effects certainly also presents a limitation, but the effects calculated by us present transparent counterfactual operations allowing us to assess the quantitative importance of different channels of distributional change irrespective of whether we attach a causal interpretation to them.

On a related note, we point out that the validity of our results is generally *not* affected by the presence of endogenous explanatory variables in our models for employment and wages. The reason is that our task is counterfactual *prediction* rather than causal modelling. The only assumption we have to maintain is that the degree of endogeneity of our regressors does not change substantially between periods 0 and 1. For example, if the correlation between education and unobservables in 2015/16 is the same as in 2005/06, we can realistically predict the wage of a person with a certain level of education in 2015/16 using the counterfactual wage schedule of 2005/06 because regression coefficients incorporate the effect of correlated unobserved components (such as ability) whose correlation with observables is, by assumption, constant over time.