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The Diverging Trends of Male and Female Bottom Earnings in Germany

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DISCUSSION PAPER SERIES

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ABSTRACT

The Diverging Trends of Male and Female Bottom Earnings in Germany*

Men at the bottom quintile of the German male earnings distribution had lower average earnings in 2019 than in 2001. In contrast, female earnings have increased throughout the distribution. What explains these diverging trends and how did they translate into changes in net income? Data from the Socio-Economic Panel (SOEP) reveal that the drop in bottom male earnings is mostly due to a decrease in work hours, while hours worked of females with low earnings have increased. Changes in socio-demographic characteristics explain little of the evolution of income inequality. Households and the welfare state have cushioned much of low-earning men's income drop, while disposable incomes of women have increased by less than their earnings. Finally, earnings poverty is persistent: About half of individuals in the bottom quintile are still in the bottom quintile after five years.

JEL Classification: D31, I38, J3

Keywords: income inequality, earnings inequality, working hours, decomposition

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1 Introduction

In recent decades earnings inequality has increased in much of the rich world (Hoffmann et al., 2020). While in the US most of the increase in earnings inequality happened in the 1980s and the 1990s (Autor et al., 2008), the most robust increase since the year 2000 can be observed for Germany and Italy (Guvenen et al., 2022). In this paper, we focus on the years 2001 to 2019 in Germany, a period that saw a particularly marked increase in earnings inequality. We start with a striking observation: Male earnings at the bottom quintile of the German earnings distribution were lower in 2019 than in 2001. We then ask what explains these diverging trends and study how changes in earnings inequality translate into changes in disposable income.

As a starting point, we document trends in earnings inequality from 2001 to 2019. For men, real earnings at the top of the distribution have increased, while earnings in the lower half have stagnated at best. In 2019, earnings for the bottom 20 percent were about 20 percent lower than they were in the year 2001. In contrast, the bottom 40 percent of women have experienced the strongest earnings growth in our observational period. These results are qualitatively in line with recent findings in Drechsel-Grau et al. (2022), who combine income tax and social security data to describe the evolution of income inequality in Germany from 2001 to 2016.

We then leverage three key advantages of our data base, the Socio-Economic Panel (SOEP), a widely used representative household survey. First, it contains detailed information on individual and household characteristics, allowing us to study the drivers behind the trends in the earnings distribution. Second, it enables us to examine how households and the welfare state mitigate changes in income inequality by analysing pre- and post-government household incomes in addition to earnings. Third, the panel dimensions allows us to study income mobility in various income concepts.

Our analysis of the drivers behind the diverging trends in earnings starts with a simple observation: Earnings are the product of annual hours worked and the average hourly wage. This insight allows for a straight-forward decomposition of the change in log earnings into changes of hours worked and wages. For males in the bottom quintile, the earnings drop in 2010 was driven equally by decreases in wages and hours worked. However, hourly wages recovered by 2019, and by then, the lower hours worked compared to 2001 entirely explained the earnings drop. In contrast, the rise in female earnings at the bottom quintile is primarily due to an increase in hourly wages. To further validate

these findings, we use reweighting method based on DiNardo et al. (1996), which helps us understand how much of the observed changes in earnings can be attributed to changes in the distributions of specific variables, such as hours worked or nationality, while holding other factors constant. This approach constructs a counterfactual scenario where the distribution of a key variable—in this case, hours worked—remains fixed at its baseline level (2001), allowing us to assess its contribution to the observed trends.

Applying this method, we find that holding the distribution of hours worked constant at 2001 levels, the decline in male earnings would have been significantly smaller. This result underscores the importance of reduced hours worked in explaining the earnings drop for males in the bottom quintile. Other compositional changes, such as regarding nationalities or levels of education do not explain much of the changes in earnings as the counterfactual earnings distributions in our observational period with the distribution of socio-demographic characteristics held fixed at the 2001 level are close to the actual ones.

From a policy perspective, it is important to understand to what extent the drop in bottom earnings translates into a decline in disposable incomes for affected individuals and if the earnings-poor, defined here as those in the bottom quintile of the earnings distribution, typically stay poor for longer periods. In principle, both households and the welfare state can cushion income changes. We find that the drop in pre-government household income is less pronounced than that in male earnings, while post-government household incomes at the bottom have stagnated in the past two decades. Thus, both the family and the welfare state have cushioned—but not reversed—the negative trend in bottom quintile male earnings. Another natural question to ask is if people at the bottom of the distribution tend to stay there. If income mobility was very high, then the negative trend at the bottom of the distribution might be less worrisome. However, an analysis of income mobility reveals that income poverty is persistent: About half of people at the bottom quintile are still in that quintile after five years.

Our study adds to the literature on German wage and income inequality in several ways. First, we document trends in labour earning and additionally show to what extent the rise in earnings inequality translates into changes in disposable income, which is more relevant for welfare.¹ Instead, many papers focus on earnings inequality alone and typically find increases in wage inequality from the 1990s onwards (e.g. Card et al., 2013; Dustmann et al., 2009; Fuchs-Schündeln et al., 2010). In a recent paper, Drechsel-Grau

¹A related literature analyses how households and the welfare state mitigate earnings *instability*, see e.g., Blundell et al. (2015) for Norway, De Nardi et al. (2021) for the Netherlands and Bartels and Bönke (2013) for Germany.

et al. (2022) use high-quality registry data to show that earnings inequality for males has increased from 2001 to 2016 and, notably, earnings at the bottom of the distribution have declined, while low-earning women have caught up.

The increase in male earnings inequality in Germany has been attributed to various factors including technological change and changes in unionization rates (Dustmann et al., 2009) as well as changes in employment, in particular hours worked and days in employment (Drechsel-Grau et al., 2022). Biewen and Plötze (2019) study the increase in earnings inequality from 2001 to 2010. They find that for men about one third of the increase in the variance of earnings can be attributed to increases in the variance of hours worked and for women one half of the increase. A reweighting analysis yields similar results for various inequality measures. Using the SOEP, Beckmannshagen and Schröder (2022) show that hours mismatch can also explain part of the increase in earnings inequality. Most of the increase in earnings inequality happened between 2001 and 2009. Various studies attribute the stop in the rise in earnings inequality to sectoral minimum wages or the general minimum wage, respectively (Brüll and Gathmann, 2020; Bossler and Schank, 2023). The findings in our paper corroborate the idea that increasing male earnings inequality can to a large extent be explained with a drop in hours worked at the bottom.

Another strand of the literature focuses on post-government incomes. This literature typically uses survey data because the available administrative data do not cover the non-working population and contain only incomplete information on cohabiting and government transfers. Like earnings inequality, inequality in disposable incomes increased from the beginning of the 2000s, but then stagnated from the mid-2000s onward (Biewen and Juhasz, 2012; Biewen et al., 2019; Blömer et al., 2023). The increase can, at least partly, be attributed to changes in employment behaviour and labour incomes conditional on employment outcomes (Biewen and Juhasz, 2012) as well as changes in household compositions (Biewen and Juhasz, 2012; Peichl et al., 2012). While tax reforms in the early 2000s have contributed to an increase in income inequality Biewen and Juhasz (2012), overall, changes to the tax- and transfer system have, if anything, dampened the rise in income inequality (Jessen, 2019; Mühlhan, 2022).

The next section describes the data, income concepts, a simple decomposition method, and the reweighting method. Section 3 documents trends in the German income distribution and the results of the decomposition, while section 4 analyses the role of the welfare state and households in attenuating changes in the income distribution. Section 5 de-

scribes possible drivers of changes in earnings inequality and contains the results of the reweighting exercise. Section 6 presents the results for income mobility and section 7 concludes.

2 Data and Methodology

2.1 Data and income concepts

We utilize wave 38 of the Socio-Economic Panel (SOEP), which stands as one of the largest and longest-standing multidisciplinary household surveys worldwide. The SOEP annually engages with approximately 30,000 individuals across 15,000 households, providing a robust foundation for our analysis (Goebel et al., 2019). We restrict our sample to individuals with positive labour earnings aged 25-55 years.

Our analysis covers the period from 2001 to 2019. These years saw a particularly strong increase in earnings inequality. Starting our analysis with the year 2001 offers the added advantage that we can compare our findings with a recent study that uses administrative data to describe the evolution of earnings inequality, namely Drechsel-Grau et al. (2022). We do not analyse the year 2020 as the 2021 sample of the SOEP, which contains retrospective questions about the year 2020, is considerably smaller than in previous years due to the COVID-19 pandemic. This structural break makes comparisons with previous years difficult. The key income measures considered in our study include labour income, net income and pre-government income as calculated by the SOEP. Specifically, labour income is constructed to incorporate wages and salaries from all employment, including training, primary and secondary jobs, along with additional components such as bonuses, overtime, and profit-sharing income. Self-employed individuals are excluded from the analysis.

Pre-government household income is the sum of total family income from labour earnings, asset flows, private retirement income, and private transfers. Post-government household income, on the other hand, is calculated as the sum of pre-government income plus public transfers and social security pensions minus income taxes and social security contributions. For household income concepts, pre- and post-government income, we always report equivalized income according to the modified OECD scale, i.e., we divide income through $1 + 0.5 \times (\text{number of adults} - 1) + 0.3 \times \text{number of children under 14}$.

Table 1: Summary statistics

	Female		Male	
	Mean	SD	Mean	SD
Earnings (labour income) (€)	23,491.80	20,604.53	37,643.99	30,284.79
Gross Income (€)	35,911.29	28,015.07	38,054.54	41,455.38
Post-Government Income (€)	26,245.18	16,085.82	27,321.73	24,405.86
Hourly Wage (€)	14.37	14.59	17.19	13.31
Hours worked	1,623	763.61	2,196	645
Observations	110,626		108,062	

Note: All values are annual, with monetary amounts in 2018 prices.

All figures presented in our analysis have been inflation-adjusted with reference to 2018 prices. Table 1 provides summary statistics for our analytic sample, separately for women and men. On average, men have substantially considerably higher earnings and wages and work 35 percent more hours than women. In contrast—since many people in the sample live in heterosexual couple households—average male post-government household incomes are only slightly higher than those of women.

2.2 Decomposition of Earnings

We decompose average earnings changes for specific quintiles into changes in average hours and changes in average hourly wages. For an individual j earnings Y_j are the product of working hours H_j and the hourly wage W_j ,

$$Y_j = W_j H_j. \quad (1)$$

In logs, we can write this additively, where we use lower case letters to indicate logs, e.g., $\ln(Y_j) = y_j$,

$$y_j = h_j + w_j. \quad (2)$$

It follows that one can easily calculate for every quintile the contribution of changes in hours and the hourly wage to the overall change in earnings relative to a base period. The average change in log earnings from base period 0 to period 1 for individuals in a earnings quintile i is

$$\bar{y}_1^i - \bar{y}_0^i = \underbrace{\bar{h}_1^i - \bar{h}_0^i}_{\text{effect of hours changes}} + \underbrace{\bar{w}_1^i - \bar{w}_0^i}_{\text{effect of wage changes}}, \quad (3)$$

where $\bar{\zeta}_t^i$ with $\zeta = y, h, w$ and $t = 0, 1$ are average log earnings, log hours or log hourly wages, respectively, of individuals in earnings quintile i in period t . In this paper, we apply this decomposition with the year 2001 as base period.

2.3 Reweighting

We also apply a widely used reweighting procedure to construct counterfactual income distributions. The idea, first introduced by DiNardo et al. (1996) and later further developed, involves reweighting observations based on whether they are over- or underrepresented in a hypothetical scenario compared to the status quo.² In our case, we make comparisons over time and consider the counterfactual situation were the distribution of some covariates, such as nationalities, remains fixed at the 2001 level (period 0). The difference between this counterfactual and the actual distribution in a given year is then due to the change in the marginal distribution of income in the periods 0 and 1.

As described in Fortin et al. (2011), the counterfactual cumulative distribution of outcome Y in period 1 is given by

$$F_{Y_1^C}(y) = \int F_{Y_1|X_1}(y|X) \cdot \Psi(X) dF_{X_1}(X), \quad (4)$$

where $F_{Y_1|X_1}(y|X)$ is the conditional distribution of Y given X in period 1, $F_{X_0}(X)$ is the marginal distribution of X in period 0, and $F_{Y_1^C}(y)$ is the counterfactual distribution of Y , which is simply a reweighted version of the actual distribution $F_{Y_1}(y)$. Finally,

$$\Psi(X) = \frac{dF_{X_0}(X)}{dF_{X_1}(X)} \quad (5)$$

is a reweighing factor. Consider, for example, the year 2019. The reweighing factor is

$$\Psi(X) = \frac{dF_{X_{2001}}(X)}{dF_{X_{2019}}(X)}. \quad (6)$$

Using $dF_{X_{2019}}(X) = \Pr(X|D_0 = 0)$ and $dF_{X_{2001}}(X) = \Pr(X|D_0 = 1)$ and applying Bayes' rule, the reweighting factor can be rewritten in terms of conditional probabilities,

$$\Pr(X|D_{2001} = 1) = \frac{\Pr(D_{2001} = 1)}{\int_x \Pr(D_{2001} = 1|X)} \cdot \frac{dF(X)}{dF(X)} = \frac{\Pr(D_{2001} = 1|X)}{\Pr(D_{2001} = 1)}, \quad (7)$$

²This procedure has been adopted in several papers to learn about the drivers of changes in German income inequality (e.g., Biewen and Juhasz, 2012; Peichl et al., 2012; Drechsel-Grau et al., 2022).

where $D_{2001} = 1$ for observations in period 0. In our example, the reweighting factor that fixes the covariates as in 2001 is:

$$\Psi(X) = \frac{\Pr(X|D_{2001} = 1)}{\Pr(X|D_{2001} = 0)} = \frac{\Pr(D_{2001} = 1|X)/\Pr(D_{2001} = 1)}{\Pr(D_{2001} = 0|X)/\Pr(D_{2001} = 0)} \quad (8)$$

Equation (8) can easily be computed by estimating a probability model such as a Probit or a Logit model for $\Pr(D_{2001} = 1|X)$ on the pooled sample of observations in periods 0 and 1, and using the predicted probabilities to compute a value $\hat{\Psi}(X)$ for each observation. In this paper, we use discrete variables for X and thus our reweighting approach is non-parametric. In other words, results from Probit, Logit or Linear Probability model are exactly identical. Note that the counterfactual distribution changes the distribution of X under the assumption that the marginal distributions are not affected by this.

3 Trends in Earnings and Decomposition

As a starting point, we plot the evolutions of average individual labour earnings across quintiles for both males and females in Figure 1. Note that the quintiles are defined separately for each gender, such that average earnings differ between genders. In Figure A.1 in the appendix, we show the equivalent figure, but earnings are not normalized to zero in 2001. This makes it possible to compare the earnings distributions for men and women. The figure documents that average earnings in each quintile are lower for women than for men. For instance, the third quintile for women was even below the second quintile of men in our observation period.

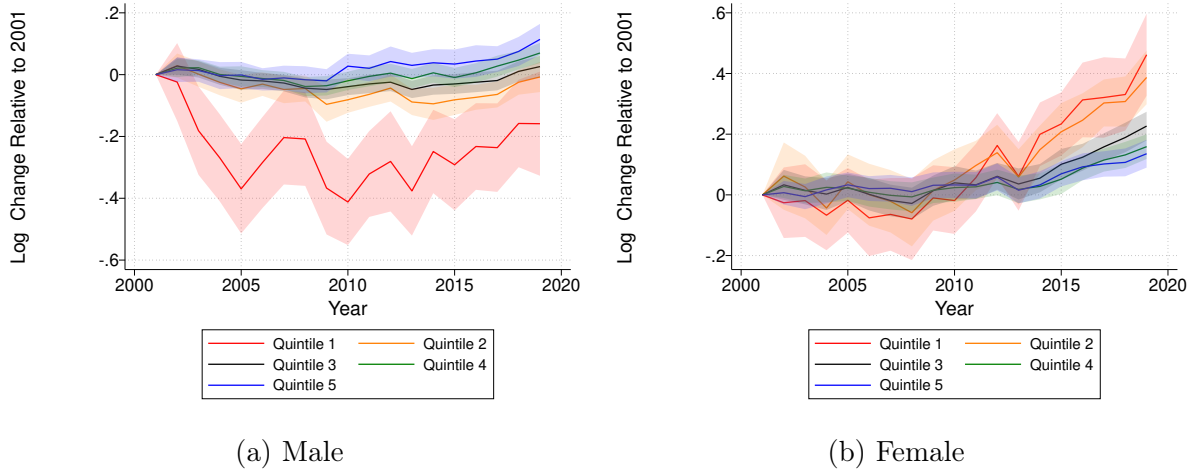


Figure 1: Evolution of log annual earnings quintiles

Note: Evolution of quintiles of log real annual earnings relative to 2001 in the SOEP. Individuals aged 25-55 with positive earnings. The graphs for males and females represent their marginal distributions rather than a joint distribution. 95 percent confidence intervals are derived from bootstrap with 100 replications.

Male earnings declined at the bottom of the distribution and stagnated for the upper half from 2001 to 2010. From 2010 onward, there was some real wage growth for the upper two quintiles. The most salient observation is the trend at the bottom of the distribution, specifically the first quintile. The bottom 20 percent of the distribution experienced a sharp and significant decline in earnings since the benchmark year of 2001, and never fully recovered to the 2001 values. This trend is also noticeable for some years for the second quintile, although here the loss was not as sizable. In 2010, the bottom quintile had lost almost 0.4 log points relative to 2001, implying a decline by roughly 40 percent. Earnings then recovered to some extent, but in 2019 remained almost 20 percent below the 2001 level. A modest decline can also be observed for the second quintile, although it has caught up again as of 2019. The top quintile experienced limited earnings growth until 2010, just after the Great Recession, and then witnessed a small but steady increase thereafter. These findings align with the conclusions drawn by Drechsel-Grau et al. (2022) regarding the evolution of labour income inequality in Germany.

For women, the picture is notably different. Earnings increased steadily for all quintiles after a minor downturn at the beginning, especially following the 2008 crisis. The two bottom quintiles saw the the most rapid increase in our observation period.

In the appendix, we show equivalent figures, but with different measures of income. While Figure 1 is based on annual labour earnings, Figures A.2 and A.3 are based on

current monthly individual gross and net earnings, respectively. The patterns are very similar. Finally, Figure A.4 is based on annual labour earnings, but the sample is restricted to those with earnings of at least 2,300 Euro, following Drechsel-Grau et al. (2022). The idea is to exclude workers with weak labour force attachment. Again, the pattern is very similar, but the drop in bottom quintile earnings is less extreme, going only slightly beyond 0.2 log points, which is still sizeable. Throughout the paper, we show the evolution of average earnings in quintiles of the distribution. A key advantage is that changes in average earnings of quintiles can easily be decomposed into contributions of hours and wage changes. However, for comparison we also show the evolution of *percentiles* of the male and female earnings distributions in Figure A.5 in the appendix. The pattern is similar to that of quintiles with a particularly pronounced decrease of male earnings at the 10th percentile, while low-earning women have outperformed women with higher earnings.

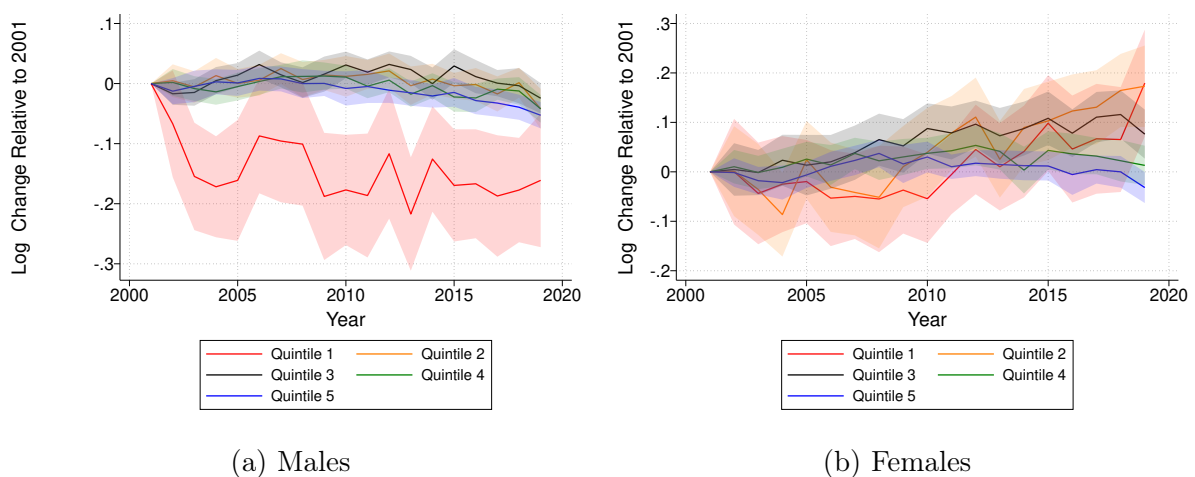


Figure 2: Evolution of Log Hours Worked along the Earnings Distribution

Note: Evolution of log actual annual hours of work at the quintiles of the earnings distribution the SOEP. Individuals aged 25-55 with positive earnings. The graphs for males and females represent their marginal distributions rather than a joint distribution. 95 percent confidence intervals are derived from bootstrap with 100 replications.

We now turn to the components of log earnings, log hours of work and log hourly wages of the quintiles of the earnings distribution. Figure 2 shows the evolution of average log annual hours worked of the quintiles of the *earnings* distribution. Importantly, we are not looking at quintiles of the hours worked distribution, but we are rather interested in how hours of work evolved for the quintiles of the earnings distribution. Given that log earnings are the sum of log hours and log hourly wages, one way to interpret the figure

is that it shows by how much average log earnings for individuals in different quintiles would have changed if hourly wages had remained at the 2001 levels. For men, average hours worked at the bottom quintile have declined by about 20 percent in our observation period. For the other quintiles, the changes are not significant throughout most of the 18 years, though a slight decline is apparent toward the end of the observation period. For women, we see a significant increase in hours worked for the bottom 60 percent of the earnings distribution.

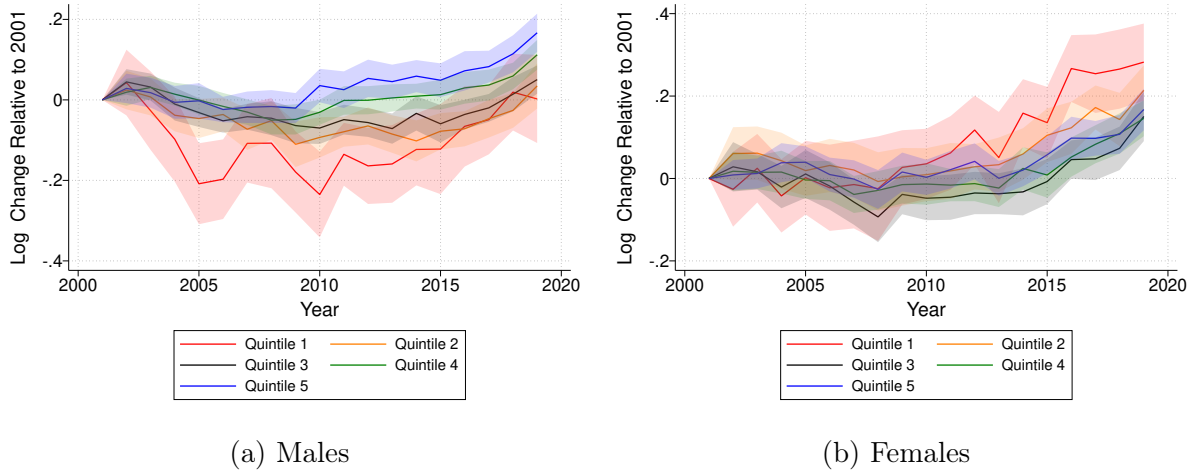


Figure 3: Evolution of Log Hourly Wages along the Earnings Distribution

Note: Evolution of log hourly real wages relative to 2001 along the earnings distribution in the SOEP. Individuals aged 25-55 with positive earnings. The graphs for males and females represent their marginal distributions rather than a joint distribution. 95 percent confidence intervals are derived from bootstrap with 100 replications.

Turning to changes in hourly wages at various quintiles of the earnings distributions in Figure 3, we observe that the bottom three quintiles of the male earnings distribution suffered significant declines in hourly wages. Thus, had hours of work stayed constant, earnings of the bottom 60 percent would still have declined. However, hourly wages recovered toward the end of our observation period and in 2019 were at or above the 2001 level throughout the earnings distribution. Hourly wages for the top 40 percent stagnated from 2001 to 2009 and increased thereafter. In 2019, they were more than 10 percent above the 2001 level. For women, hourly wages in 2019 are above their 2001 levels throughout the distribution. In stark contrast to males, the highest increases occurred at the bottom of the earnings distribution with hourly wages for the bottom two quintiles increasing by more than 20 percent.

Figure 4 shows the significance of changes in hourly wages and hours for the overall change in earnings at the bottom quintiles of the male and female earnings distributions based on the decomposition described in subsection 2.2. Note that the contributions of the components of earnings have exactly the same value as shown in Figures 2 and 3. For instance, in 2010, where male bottom earnings reached their lowest value, hours worked were approximately 20 percent lower than in 2001 (Figure 2), contributing to about half of the decline in earnings (Figure 4). In later years, wages recovered, but hours worked—and consequently earnings—remained significantly below the 2001 level. For women (panel (b) of Figure 4), most of the increase in earnings at the bottom was driven by higher hourly wages.



Figure 4: Decomposition of Change in Average Log Earnings for Quintile 1

Note: The figure illustrates changes in average log hourly wages and average log hours worked relative to 2001 for quintile 1 of the earnings distribution for each gender. Individuals aged 25-55 with positive earnings.

In Figures A.6 and A.7 in the appendix, we additionally display the evolutions of average log months worked and log hours worked per month for the quintiles of the earnings distribution. While months worked increased somewhat for the bottom quintile of the male earnings distribution, they remained constant across all other quintiles and for the entire female earnings distribution. Figure A.8 shows the decomposition of log earnings changes into contributions of log hourly wages, log hours worked per month and log hourly wages. Compared to wage and hours changes, the contribution of months worked is negligible.

4 Attenuation of Earnings Changes Through the Role of Households and the Welfare State

To what extent did the household and the tax-transfer system attenuate the earnings losses suffered by the bottom quintile of men? And did the gains for low-earning women result in increases in disposable income? To answer these questions, we investigate how pre-government and post-government household incomes evolved for the quintiles of the earnings distribution. We equivalize these income concepts, in order to make them comparable between households of different sizes.

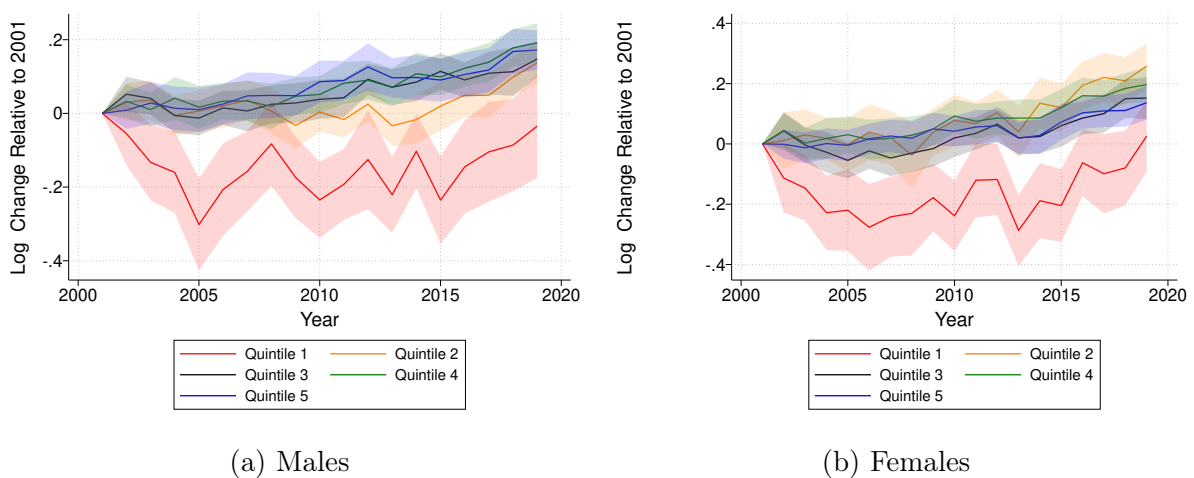


Figure 5: Evolution of Log Equivalized Pre-Government Income along the Earnings Distribution

Note: Evolution of percentiles of equivalized pre-government income relative to 2001 in the SOEP (equivalized income is calculated based on the adapted OECD scale). Individuals aged 25-55 with positive earnings. The graphs for males and females represent their marginal distributions rather than a joint distribution. 95 percent confidence intervals are derived from bootstrap with 100 replications.

Figure 5 displays the evolution of equivalized pre-government household income. This income concept contains incomes of all household members. In the extreme case of perfect correlation of the earnings ranks of spouses and if all individuals lived in heterosexual couple households, subfigures (a) and (b) would be the same. For the male bottom quintile, we see that pre-government household incomes decreased significantly, but less than annual earnings. For instance, average pre-government household incomes in 2010 are about 20 percent below the 2001 level, while in that year average earnings were about 40 percent below their 2001 level. The implication is that income pooling with other household members and relying on other sources of market income halved the income loss

suffered by low-earning men. In contrast, pre-government household incomes for the upper 80 percent of the male earnings distribution were, if anything, larger than the earnings gains. These observations can be explained with the fact that women throughout the distribution experienced earnings gains and thereby compensated the earnings losses of their low-earning partners, or further boosted the gains of higher-earning men. Conversely, low-earning women were, in a sense, held back by their partners. While female bottom earnings increased significantly in our observation period, pre-government household incomes of low-earning females decreased substantially. For the top 80 percent in the female earnings distribution, pre-government household incomes increased significantly, but less than female earnings alone.

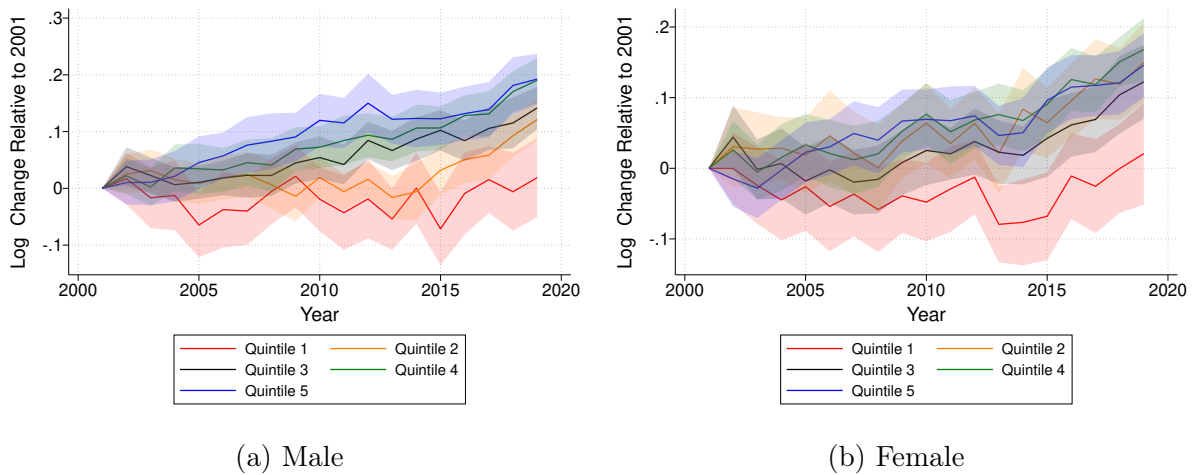


Figure 6: Evolution of Log Equivalized Post-Government Income along the Earnings Distribution

Note: Evolution of percentiles of equivalized post-government income relative to 2001 in the SOEP (equivalized income is calculated based on the adapted OECD scale). Individuals aged 25-55 with positive earnings. The graphs for males and females represent their marginal distributions rather than a joint distribution. 95 percent confidence intervals are derived from bootstrap with 100 replications.

Turning to equivalized post-government incomes in Figure 6, we see that the welfare state nullified the remaining income losses for low-earning men and women. It also dampened the income gains at the upper part of the earnings distribution to some degree. The likely reason for the stronger dampening effect at the bottom than for higher-income earners is that the German transfer system results in very high implicit marginal tax rates

at the bottom. Thus, for transfer recipients a decrease in earnings leads to a much smaller decrease in disposable income.³

5 Compositional Changes and their Impact on Earnings

5.1 Who are the Earnings-Poor?

What are the characteristics of the earnings-poor, i.e., those in the bottom quintile of the distribution, compared to the rest of the population? And has the composition of the earnings-poor changed over time? In this subsection we document the most important compositional changes of variables that might impact the earnings distribution. In the ensuing subsection we then quantify the impact of these compositional changes on the earnings distribution.

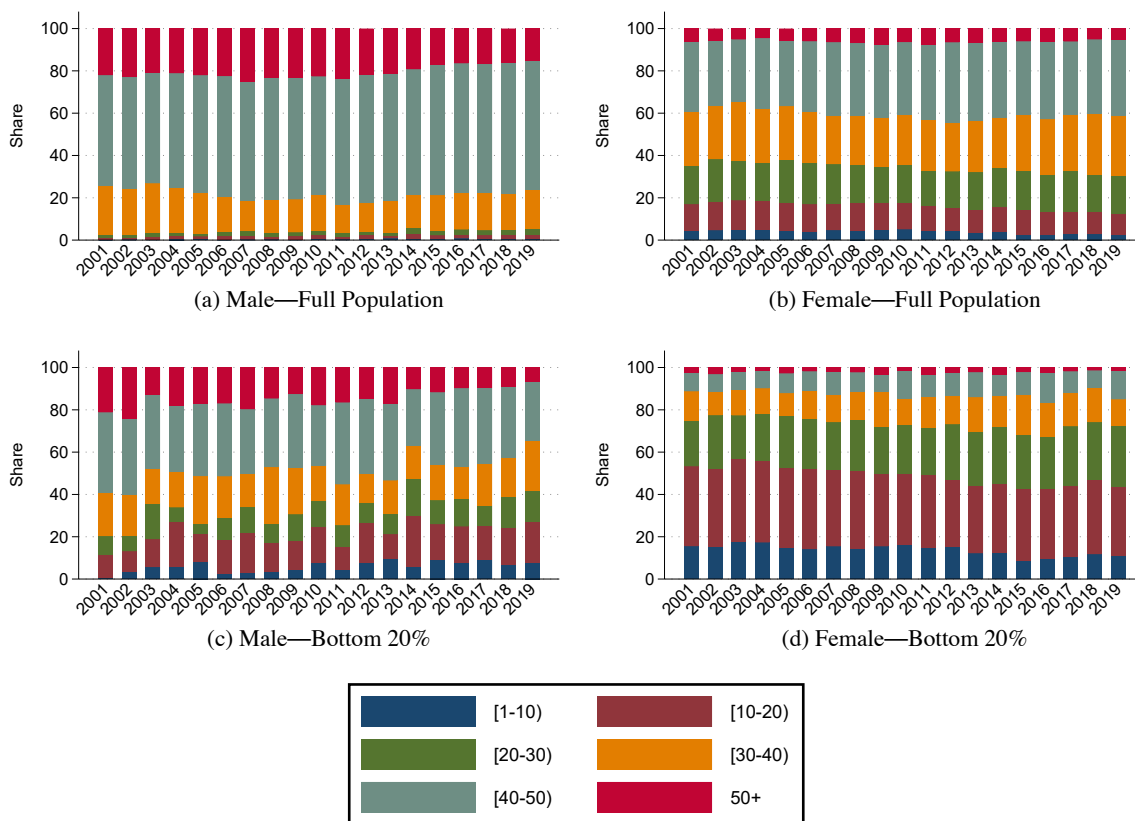


Figure 7: Weekly Hours Worked by Gender and Income Group

Note: Individuals aged 25-55 with positive earnings, based on data from the SOEP.

³Relatedly, De Nardi et al. (2021, Figure 10) show for the Netherlands that earnings changes in the first decile of the earnings distribution result in much smaller post-government household income changes than earnings changes in the ninth decile.

We first turn to the distributions of categories of weekly hours worked (Figure 7). The upper two panels show the distributions of hours worked in the male and female working population. The share of men working at least 40 hours per week is much larger than that of women working full time. Notably, the share of men working at least 50 hours decreased somewhat in our observation period. At the same time, the share of women working at least 40 hours has increased. The lower two panels show the distributions of hours worked at the bottom quintile of the earnings distribution. Little surprisingly, the share of part-time workers is much higher than for the full working population. For men, the share of workers working fewer than 40 hours increased considerably in our observation period, from 40 percent in 2001 to over 60 percent in 2019.⁴ The pattern is less striking for low-earning women, where the share working fewer than 20 hours has decreased. In Figure A.9 in the appendix we also plot the evolution of annual hours worked with qualitatively similar results.

Figure 8 displays the compositional changes in education levels. We make two observations. First, the share of individuals with more than high-school attainment has increased for men and women in the full working population as well as in the respective bottom quintiles. Second, the share of individuals with less than high-school attainment has increased in the bottom quintiles of both the male and female earnings distributions.

⁴Biewen and Sturm (2022) also document an increase in male part time work from 2000 to 2016.

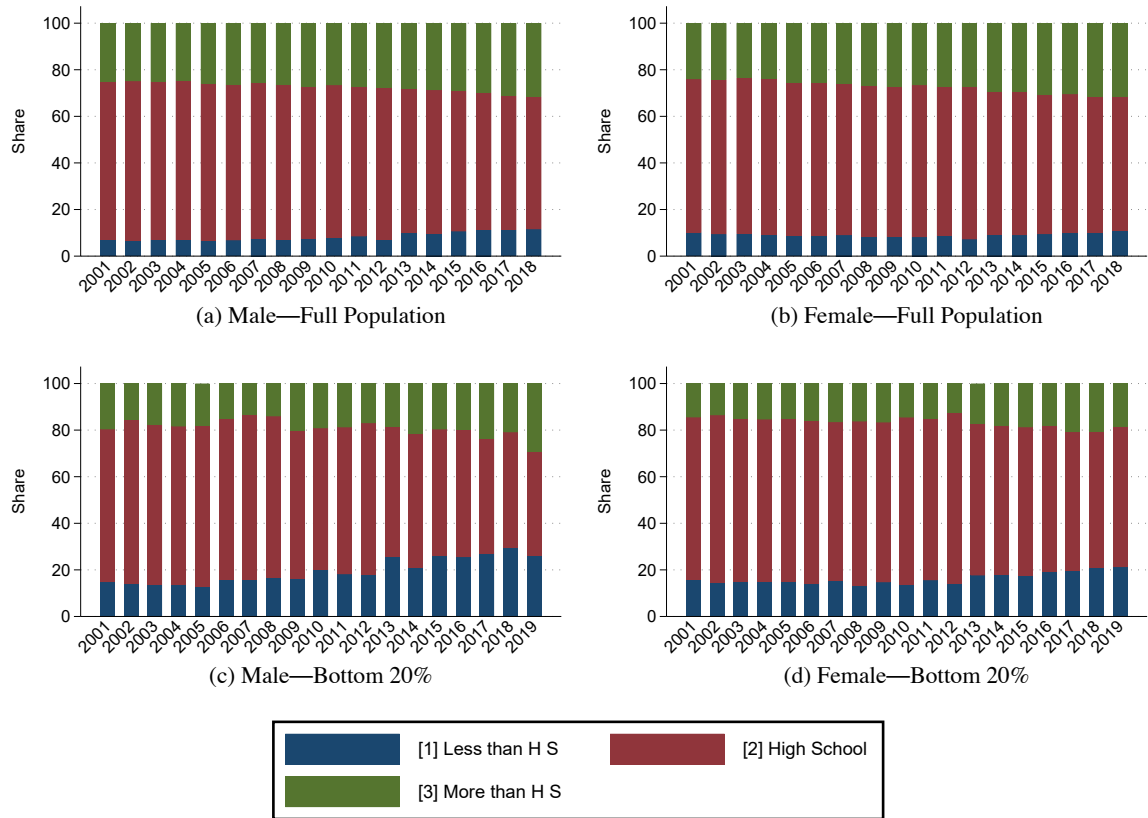


Figure 8: Education levels by Gender and Income Group

Note: Individuals aged 25-55 with positive earnings, based on data from the SOEP.

Figure 9 shows changes in nationalities. The data indicate a rise in the proportion of non-German individuals, especially after 2015, coinciding with the known big influx of migrants to Germany. Particularly, the share of individuals from non-EU and asylum-origin countries has increased for both females and males. The share of individuals with non-EU nationalities is higher in the bottom quintile than in the full working population.

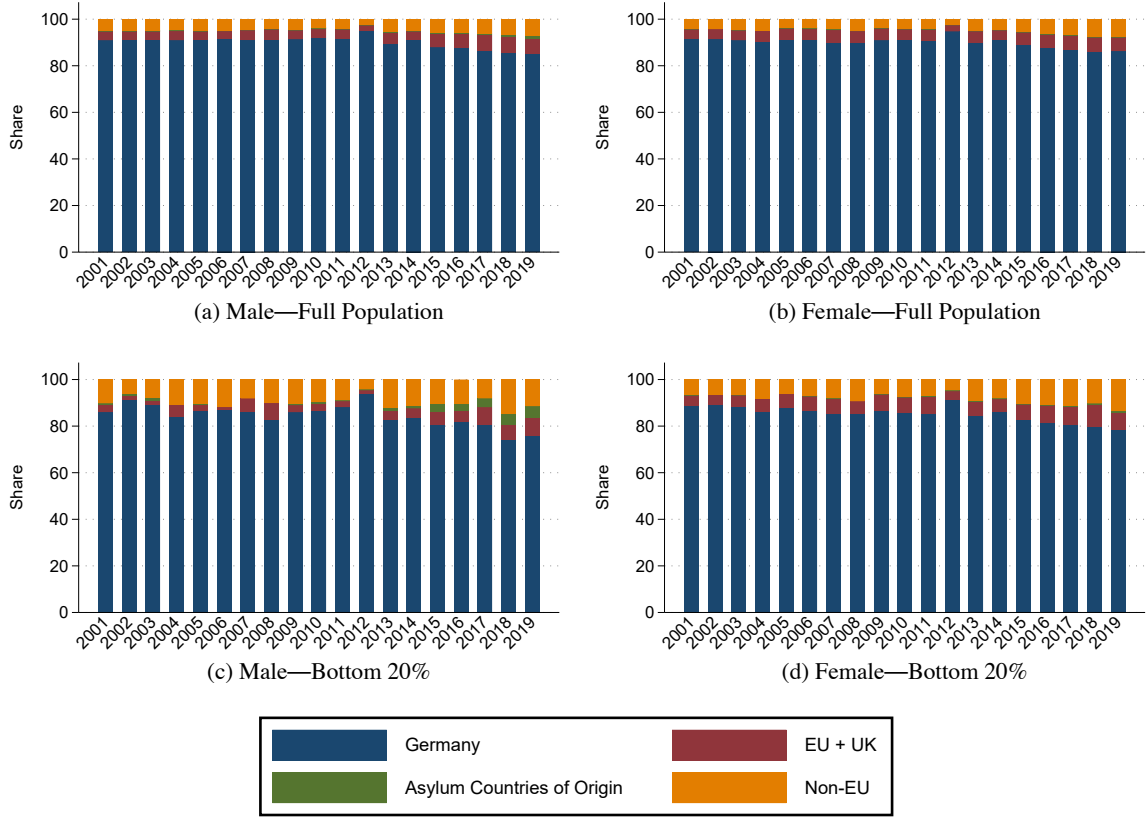


Figure 9: Nationality by Gender and Income Group

Note: Individuals aged 25-55 with positive earnings, based on data from the SOEP.

Figure 10 shows the evolution of the age distribution. Consistent with Germany's ageing population, the share of individuals aged 45-55 within the working population increased from 2001 to 2019. Strikingly, about half of men in the bottom 20 percent of the earnings distribution are under 35 years old. In contrast, for women the age distribution within the bottom quintile is very similar to that of the full working population. For both women and men, the share of young individuals in the bottom quintile increased somewhat in our observation period.

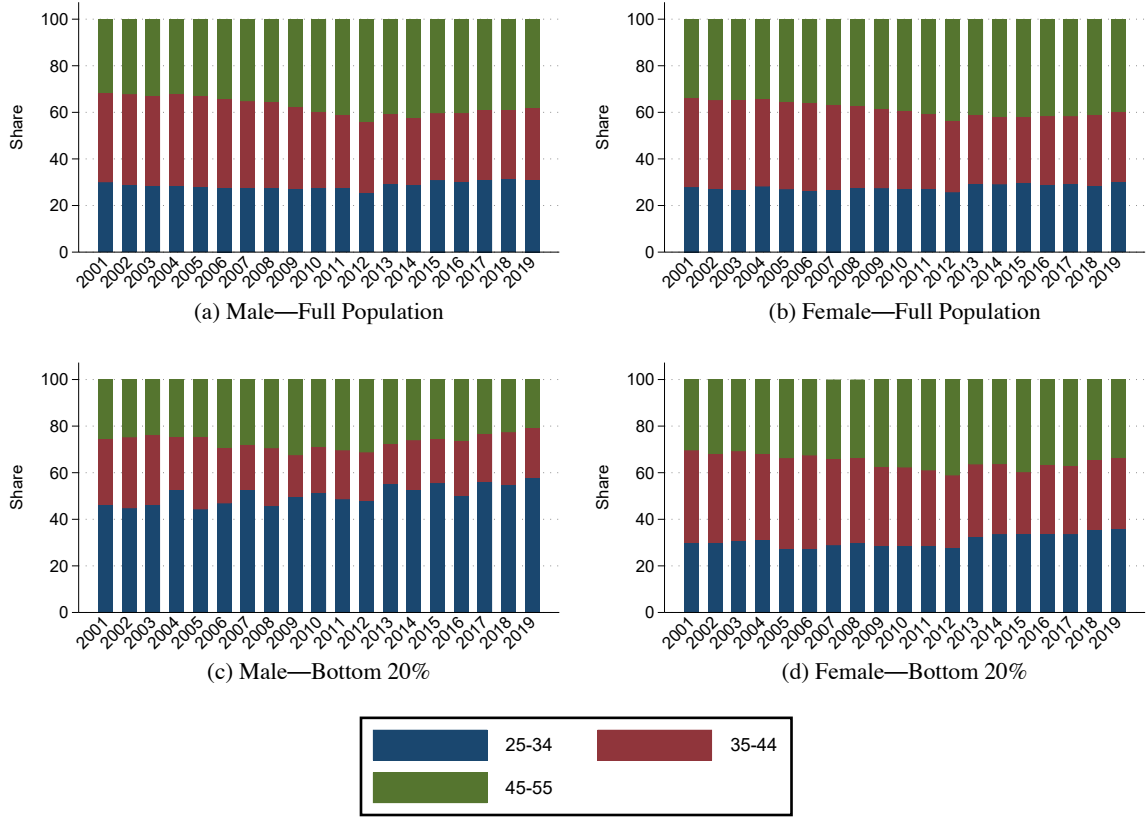
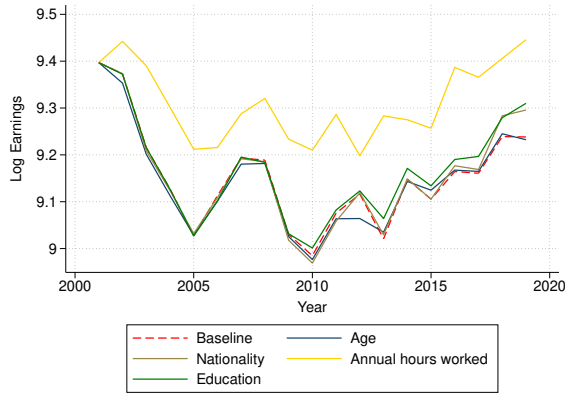


Figure 10: Age groups by Gender and Income Group

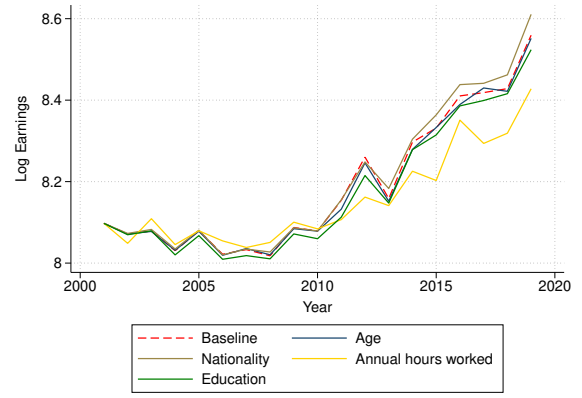
Note: Individuals aged 25-55 with positive earnings, based on data from the SOEP.

5.2 Reweighting analysis

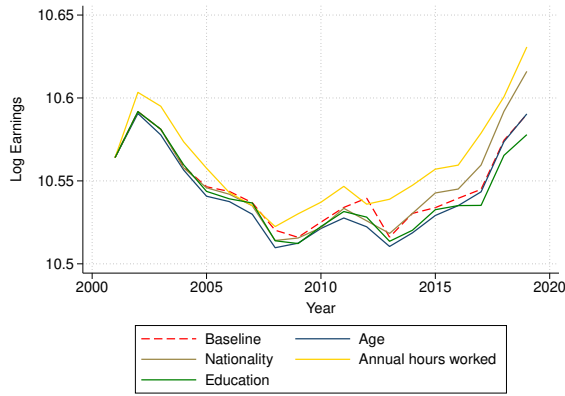
We now employ a counterfactual reweighting analysis following DiNardo et al. (1996) in order to gauge to what extent changes in the characteristics of the population can explain the diverging evolutions of male and female bottom quintile earnings. An important assumption for this method is that the conditional distribution of income does not depend on the distribution of individual characteristics. The interpretation of the exercise is that when counterfactual average earnings in a quintile surpass (fall short of) the baseline value, depicted by dashed lines, it implies that, in the absence of changes to the specific variable, earnings in that quintile would have been higher (lower) than the observed value. Thus, the shift in this particular variable by itself has decreased (increased) earnings.



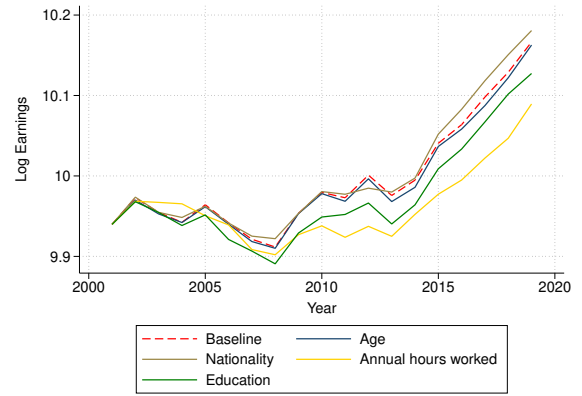
(a) Quintile 1—Male



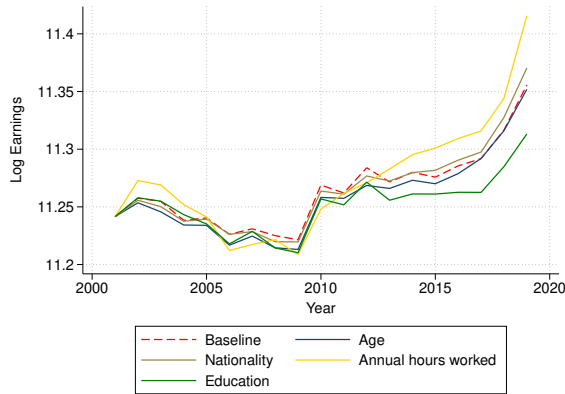
(b) Quintile 1—Female



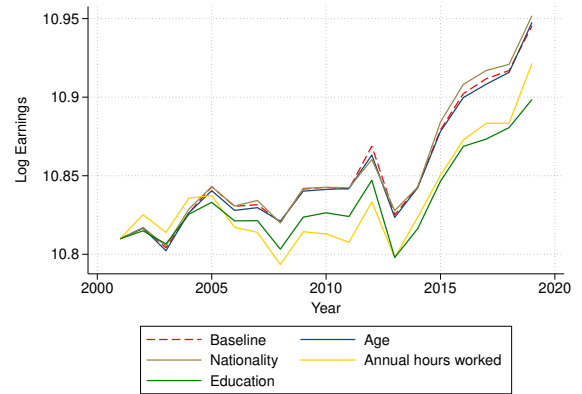
(c) Quintile 3—Male



(d) Quintile 3—Female



(e) Quintile 5—Male



(f) Quintile 5—Female

Figure 11: Counterfactual Evolution of Labour Earnings

Note: Counterfactual evolution of log labour income for several quintiles in the SOEP. The counterfactual quintiles are generated by adjusting the data weights, ensuring that the observable dimensions remain constant at the 2001 levels. The solid lines depict the hypothetical evolution of earnings if the distribution of different variables had remained constant at the 2001 levels. Individuals aged 25-55 with positive earnings.

Figure 11 shows that if the distribution of annual hours worked had stayed constant in the working population, the drop in bottom-quintile male earnings would have been much less pronounced. This is in line with findings reported in Drechsel-Grau et al. (2022), who in their administrative data can only distinguish between full time, part time, and marginal employment. In contrast, for females at the bottom of the distribution, we find that earnings would have increased less if hours worked had remained unchanged. In fact, changes in hours worked had an earnings reducing effect for men and an earnings increasing effect for women throughout their respective distributions.

For males in the bottom quintile, we also see that changes in educational attainment and nationality can explain a small part of the earnings drop in 2019 relative to 2001. For median and high-income earners, quintiles 3 and 5, we see a similar, though less pronounced, pattern. Interestingly, the change in the composition of educational attainment has had a marked positive impact on earnings of the upper 20 percent of men and women, respectively. It is worth noting that much of the changes in earnings are not explained through the compositional changes analysed here. For women, this might not be surprising, as earnings in a growing economy are expected to increase even without changes in population composition.

In the appendix in Figures A.10 and A.11, we show the results of the counterfactual exercise for equivalized pre-government and post-government income. The main take-away is again that, had hours worked remained unchanged, incomes for bottom-quintile males would be higher and incomes for bottom-quintile females would be lower. However, compared to the decomposition based on earnings, changes in hours of work explain much less of the trends.

An important feature of the German labour market institutions is marginal employment, so-called mini jobs, which are almost fully exempted from income tax and social security contributions. In the appendix, we present the changes in the share of mini-jobbers in over the observational period (Figure A.12) and the results of a reweighting exercise using a dummy variable indicating mini-job employment in a given year (Figure A.13). This variable is available only for the years 2004-2019. Therefore, we cannot explain the large drop in male earnings from 2001 to 2004 with a shift in mini jobs. Among men in the bottom quintile, mini jobs became significantly more prevalent during this period. The counterfactual analysis shows that earnings in this quintile would be higher if the share of mini-jobbers had stayed constant. For females, we see an increase in the share of mini-jobbers in the bottom quintile, followed by a decrease in 2019. As is

the case for males, female earnings would have been higher if the share of mini-jobbers had remained constant.

6 Income Mobility

We have documented a drop in earnings and a stagnation in post-government income for bottom-quintile males. However, this trend may be less concerning if these individuals experience upward mobility in the following years. Therefore, we now shift the focus to earnings mobility to assess whether these individuals manage to move up over time. Table 2 shows five-year earnings mobility for males and females, showing the percentage distribution of individuals across income quintiles at time $t + 5$, conditional on their quintile at time t . The rows of the matrices indicate the quintile in $t + 5$, while the columns correspond to the quintile at t . The tables show the average mobility for $t = 2001, \dots, 2014$. Each column in the matrix sums to 100 percent, indicating that all individuals in a given quintile at t are accounted for by their subsequent quintile at $t + 5$. In contrast, row totals do not necessarily sum to 100 percent as the analysis excludes individuals who exit the sample between t and $t + 5$. Diagonal entries in a transition matrix represent persistence within the same quintile over the observed period.

Table 2: Transition Matrix for Labour Earnings by Gender

Quintile in $t+5$	Quintile in t				
	1	2	3	4	5
5	3.66	2.06	5.39	24.43	83.60
4	6.70	8.46	29.57	53.53	12.02
3	11.02	28.80	45.89	16.50	2.53
2	28.73	47.38	15.37	3.86	0.86
1	49.88	13.31	3.79	1.68	1.00

(a) Males

Quintile in $t+5$	Quintile in t				
	1	2	3	4	5
5	3.10	4.15	6.35	21.92	75.00
4	5.67	10.07	22.52	49.99	14.43
3	12.23	24.59	46.69	16.86	4.70
2	26.83	45.86	17.94	7.08	3.78
1	52.16	15.34	6.49	4.14	2.09

(b) Females

Note: The table shows the share of individuals in a given income group in $t + 5$ conditional on their income group in t in percent. Each column in the matrix sums up to 100. Rows might not sum up to 100 as some individuals in the sample are dropped before $t + 5$.

The table documents that 84 percent of males and 75 percent of females in the highest quintile at t remain there at $t+5$, the strongest persistence across all quintiles. Persistence is lower, but still sizeable, for the bottom 20 percent, where, for both genders, about half of individuals remain after five years.

In the appendix, we also present transition matrices for equivalized pre-government income and post-government income in Tables B.1 and B.2. Again, about half of individuals in the bottom quintile remain there for at least five years. Persistence in the upper part of the distribution is somewhat lower than for individual earnings. For instance, for both pre- and post-government household income, 69-70 percent of individuals in the top quintile maintain their position, a lower share than for earnings.

Figure 12 summarizes the transition matrices by showing mean quintiles in $t+5$ for every quintile in t for the three income concepts. The closer one of the quintile-quintile lines is to the 45-degree line, the lower is the average income mobility. For the bottom 40 percent, there is no visible difference in mobility between the income concepts, while—particularly for males—there is less earnings mobility than household-income mobility. Overall it becomes clear that income ranks are quite persistent in Germany.

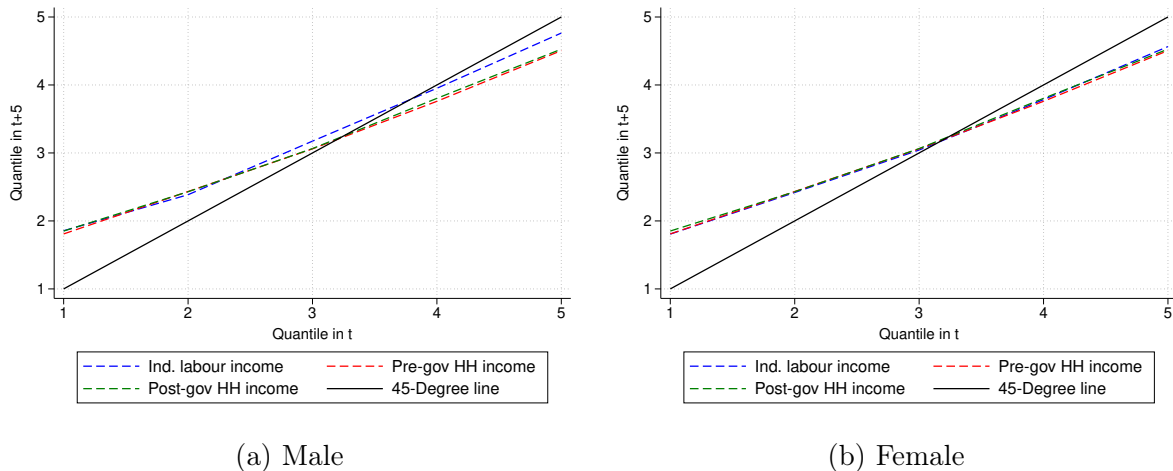


Figure 12: Rank-Rank Analysis, Five-Year Horizon

Note: Mean quintile after five years of individuals in a given quintile for various income concepts. Individuals with positive earnings aged 25-55.

7 Conclusions

We have documented a strong decline in bottom-quintile male earnings from 2001 to 2019, while male earnings at the top have increased. In contrast, by 2019, real earnings for women were higher than in 2001 throughout the distribution. As evidenced by a simple

decomposition as well as a DiNardo et al. (1996)-style reweighting analysis, much of the decline for males is due to a decrease in hours worked, while hours worked of low-earning women have increased. Other factors, such as the increasing share of people from non-EU countries, explain little of the key trends. Our analysis of income mobility highlights the persistence of income poverty. About half of individuals in the bottom quintile of the distribution are still in the bottom quintile after five years.

The diverging evolutions of male and female bottom-quintile earnings imply that household incomes for bottom-quintile males declined less than their earnings. The welfare state further cushioned the earnings drop such that post-government incomes for low-earning males and females stagnated. However, causality might also run in the opposite direction: the welfare state may have contributed to the decline in hours worked by low-earning males by distorting their labour supply decisions.

An avenue for future research is the analysis of the reasons behind the decline in hours worked of low-earning men. One way to approach this question is by using a structural labour supply model as in Bargain (2012) or Jessen (2019). Relatedly, a change in conditional employment outcomes throughout the population might increase earnings inequality (conditional on working) without increasing overall income inequality. In this paper, we have focussed on the sample of working individuals. The analysis of the interaction between changes in employment, earnings inequality, and overall income inequality is another avenue for future research.

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Appendix

A Figures

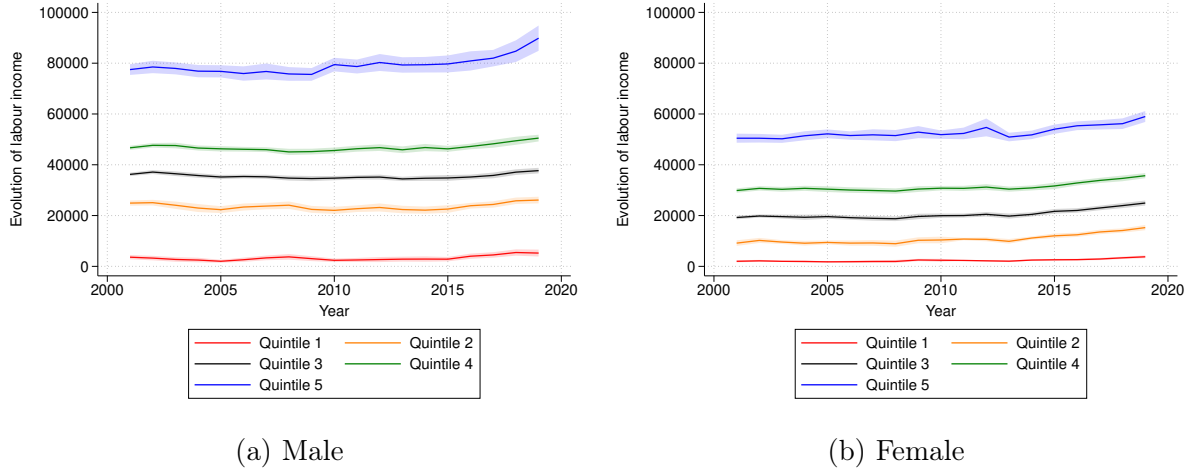


Figure A.1: Labour Income in levels

Note: Evolution of labour income. Individuals aged 25-55 with positive earnings. The graphs for males and females represent their marginal distributions rather than a joint distribution. 95 percent confidence intervals are derived from bootstrap with 100 replications.

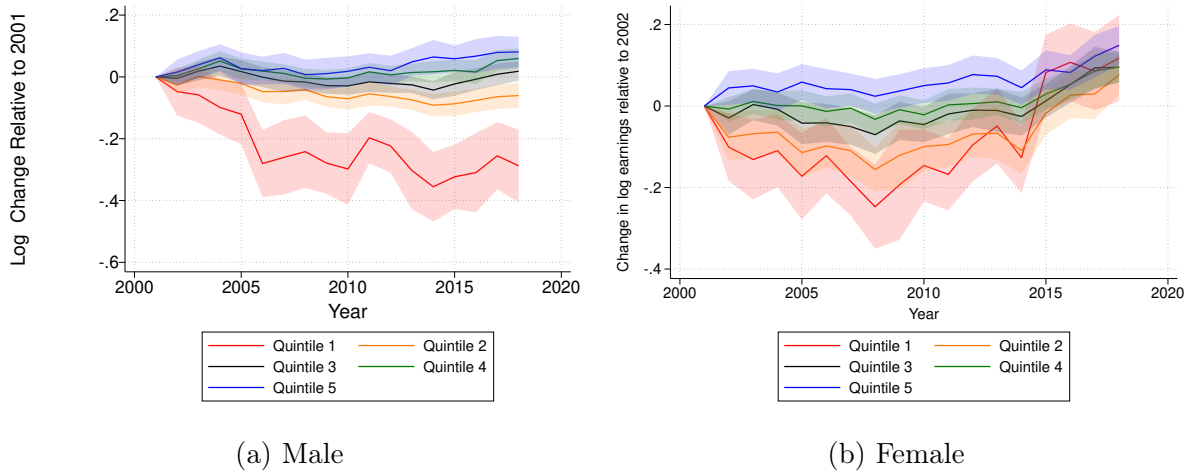
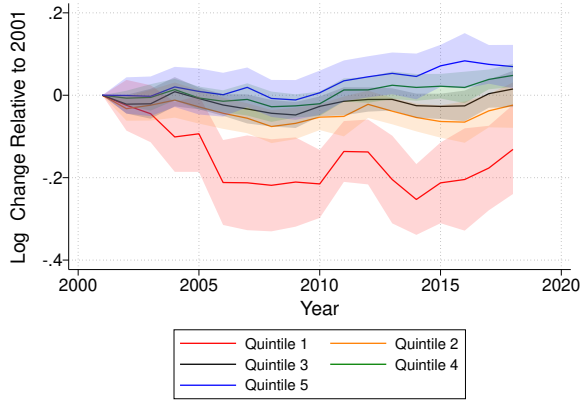
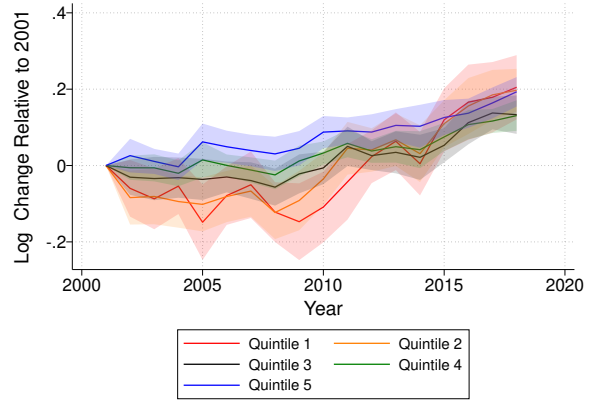


Figure A.2: Current Gross Labour Income in Euros

Note: Evolution of quintiles of current gross labour income relative to 2001 in the SOEP. This variable represents the current gross labour income for the previous month in the main job, corresponding to the survey year rather than the prior year, as is the case with most other income variables used in this paper. Individuals aged 25-55 with positive current gross labour incomes. The graphs for males and females represent their marginal distributions rather than a joint distribution. 95 percent confidence intervals are derived from bootstrap with 100 replications.



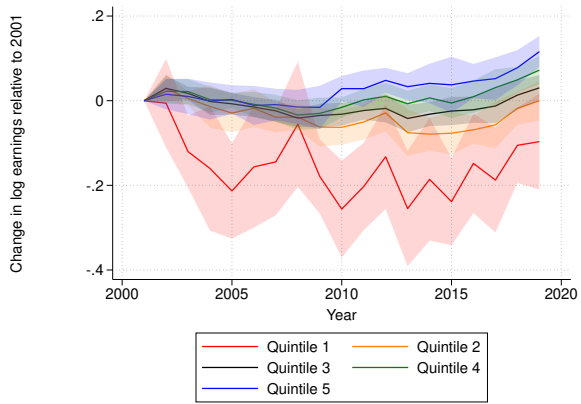
(a) Male



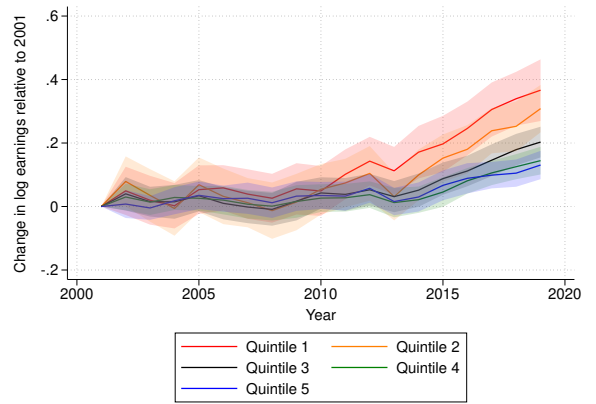
(b) Female

Figure A.3: Current Monthly Net Labour Income in Euros

Note: Evolution of quintiles of Current Net Labour income relative to 2001 in the SOEP. The variable represents net labour income for the prior month in the main job, corresponding to the survey year rather than the prior year, as is the case with most other income variables used in this paper. Individuals aged 25-55 with positive current net labour incomes. The graphs for males and females represent their marginal distributions rather than a joint distribution. 95 percent confidence intervals are derived from bootstrap with 100 replications.



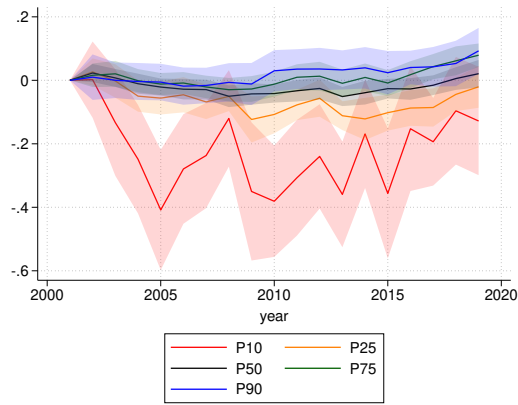
(a) Male



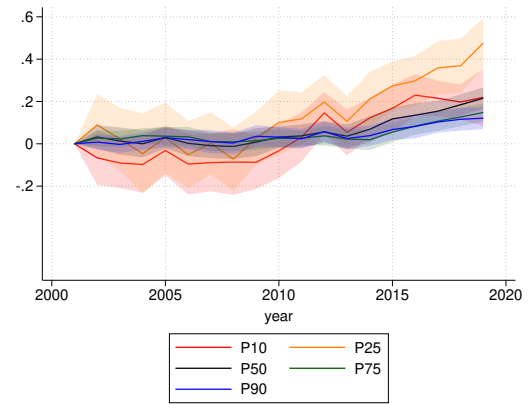
(b) Female

Figure A.4: Annual Labour Income over 2300 Euro

Note: Evolution of quintiles of Current Net Labour income relative to 2001 in the SOEP. Individuals aged 25-55 with positive earnings. The graphs for males and females represent their marginal distributions rather than a joint distribution. 95 percent confidence intervals are derived from bootstrap with 100 replications.



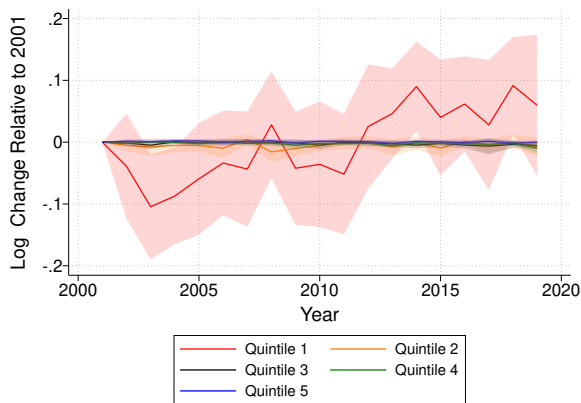
(a) Male



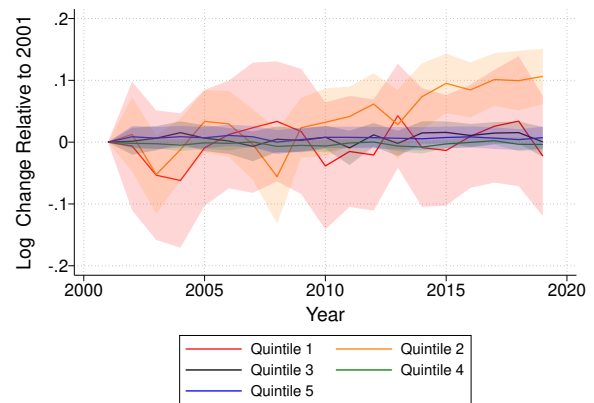
(b) Female

Figure A.5: Evolution of log annual earnings percentiles

Note: Evolution of percentiles of labour income relative to 2001 in the SOEP. Individuals aged 25-55 with positive earnings. The graphs for males and females represent their marginal distributions rather than a joint distribution. 95 percent confidence intervals are derived from bootstrap with 100 replications.



(a) Males



(b) Females

Figure A.6: Months worked of quintiles of the earnings distribution

Note: Evolution of quintiles of months worked relative to 2001 in the SOEP (hourly wages reflects stipulated hourly wage with employer). Individuals aged 25-55 with positive earnings. The graphs for males and females represent their marginal distributions rather than a joint distribution. 95 percent confidence intervals are derived from bootstrap with 100 replications.

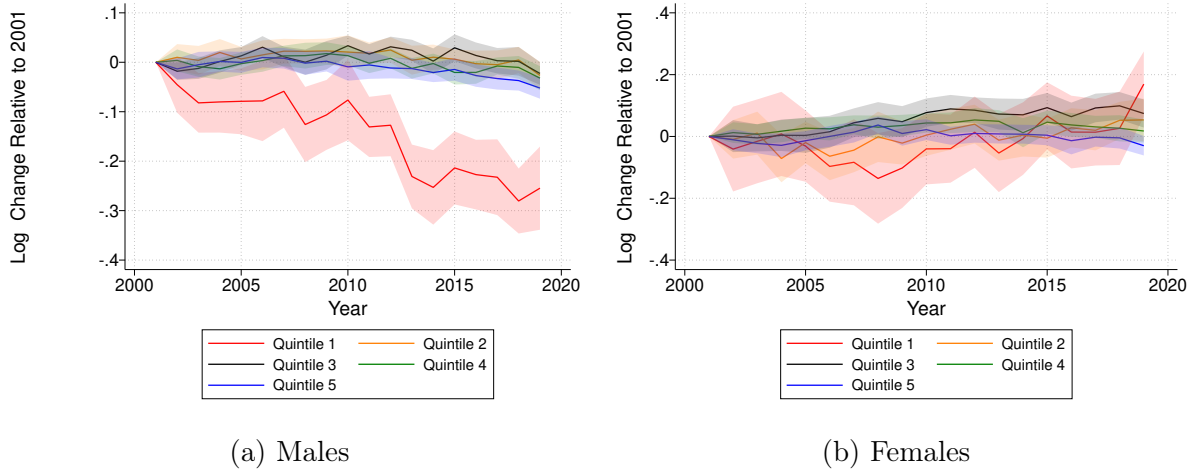


Figure A.7: Hours worked per month of quintiles of the earnings distribution

Note: Evolution of quintiles of months worked relative to 2001 in the SOEP (hourly wages reflects stipulated hourly wage with employer). Individuals aged 25-55 with positive earnings. The graphs for males and females represent their marginal distributions rather than a joint distribution. 95 percent confidence intervals are derived from bootstrap with 100 replications.



Figure A.8: Decomposition of Change in Average Log Earnings for Quintile 1 by Gender

Note: The figure illustrates changes in average log hourly wages and average log hours worked relative to 2001 for quintile 1 of the earnings distribution for each gender. Individuals aged 25-55 with positive earnings.

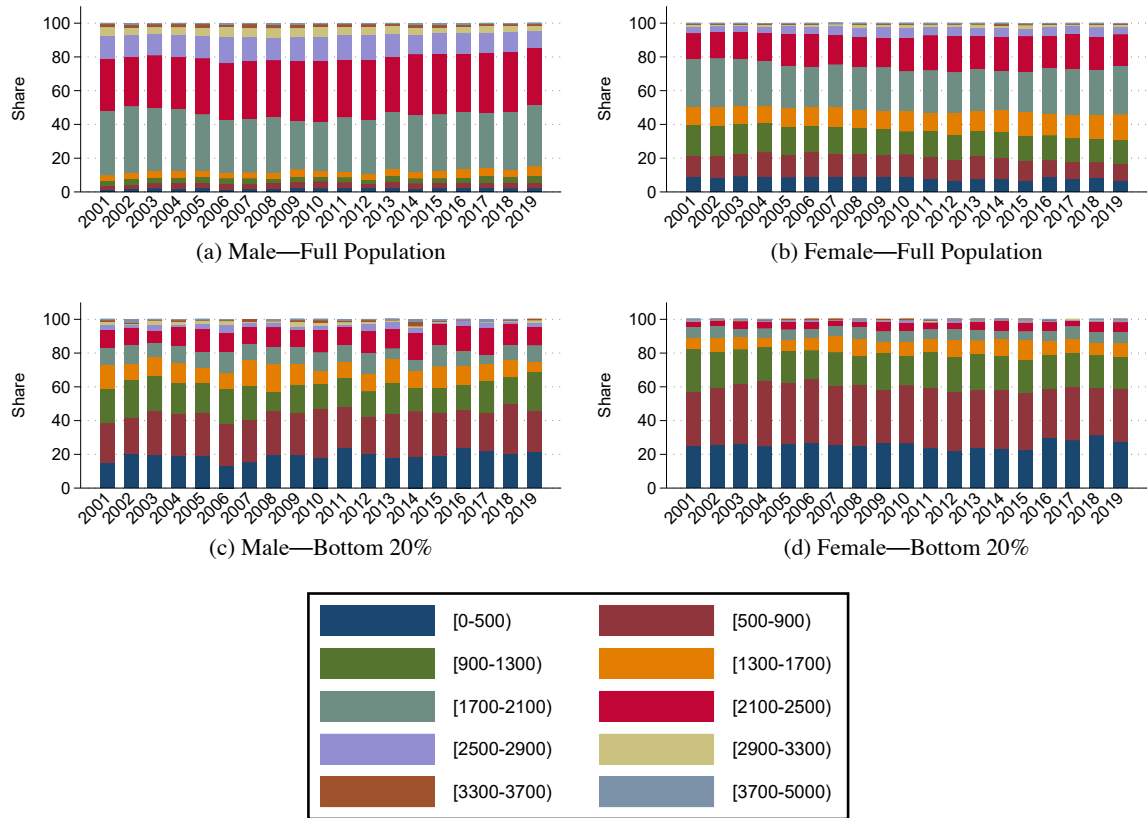
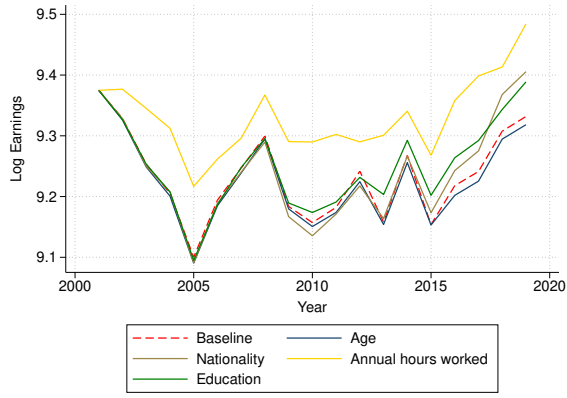
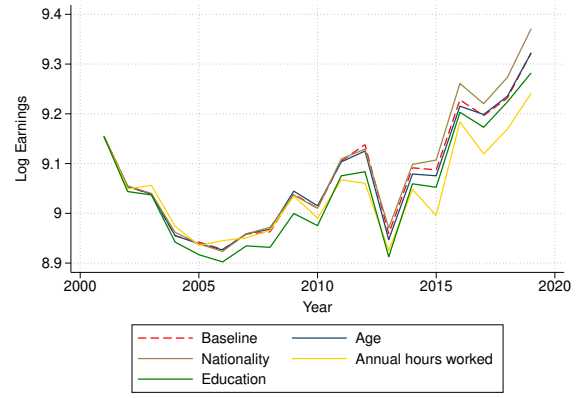


Figure A.9: Annual Hours Worked by Gender and Income Group

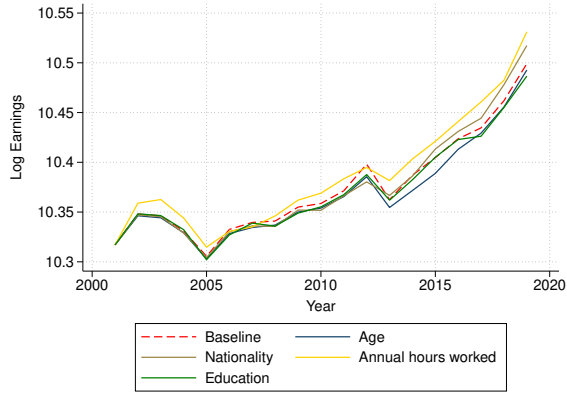
Note: Individuals aged 25-55 with positive earnings, based on data from the SOEP.



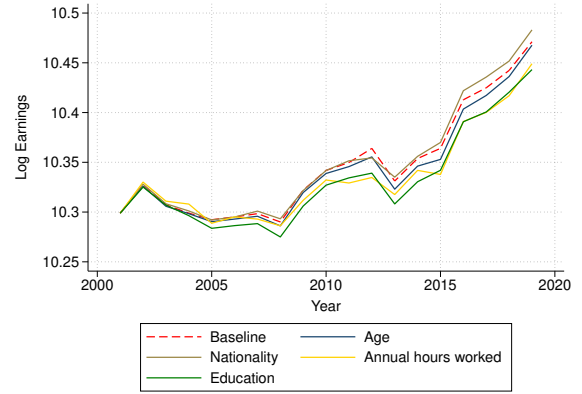
(a) Quintile 1—Male



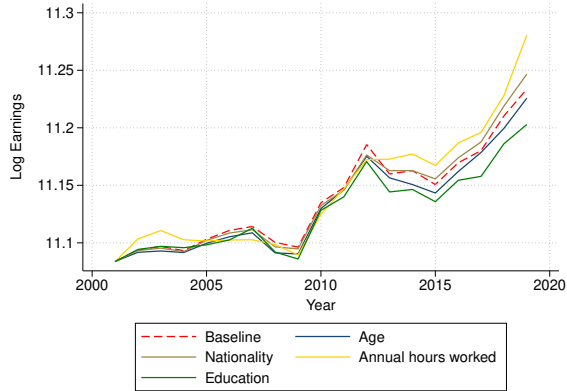
(b) Quintile 1—Female



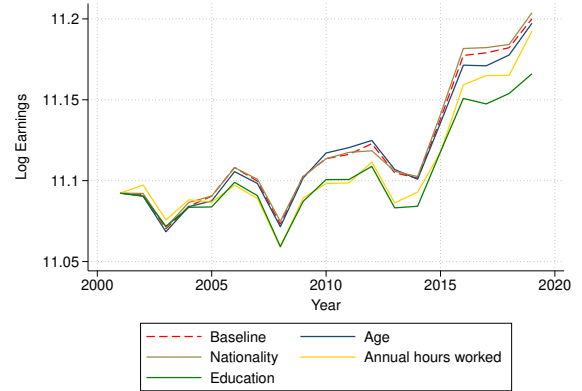
(c) Quintile 3—Male



(d) Quintile 3—Female



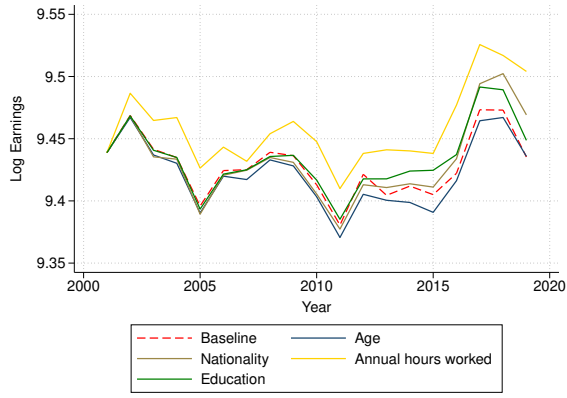
(e) Quintile 5—Male



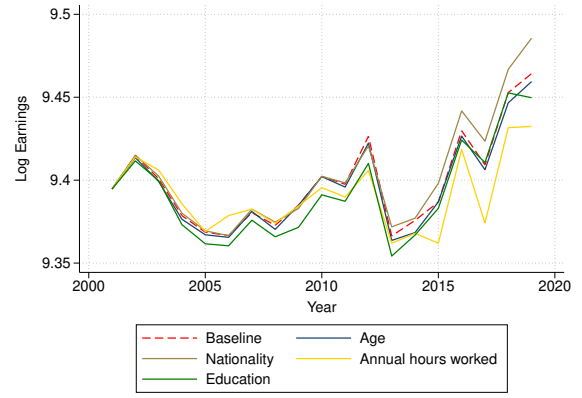
(f) Quintile 5—Female

Figure A.10: Counterfactual Evolution of Pre-Government Income

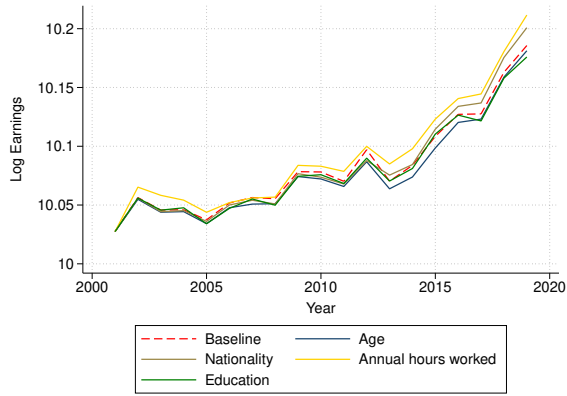
Note: Counterfactual evolution of equivalized pre-government income for several quintiles of the earnings distribution in the SOEP. The counterfactual quintiles are generated by adjusting the data weights, ensuring that the observable dimensions remain constant at the 2001 levels. The solid lines depict the hypothetical evolution of pre-government income if the distribution of different variables had remained constant at the 2001 levels. Individuals aged 25-55 with positive earnings.



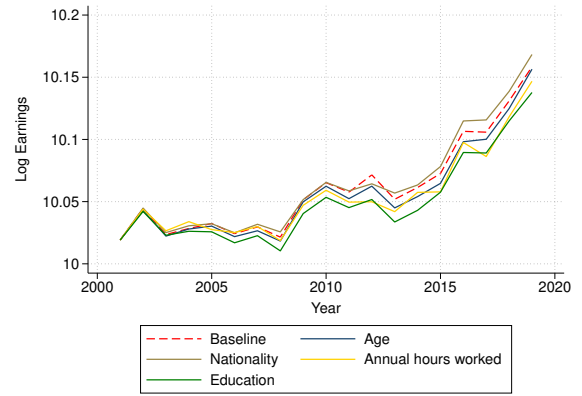
(a) Quintile 1—Male



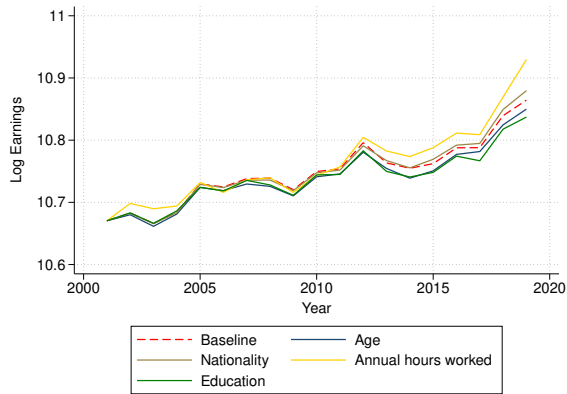
(b) Quintile 1—Female



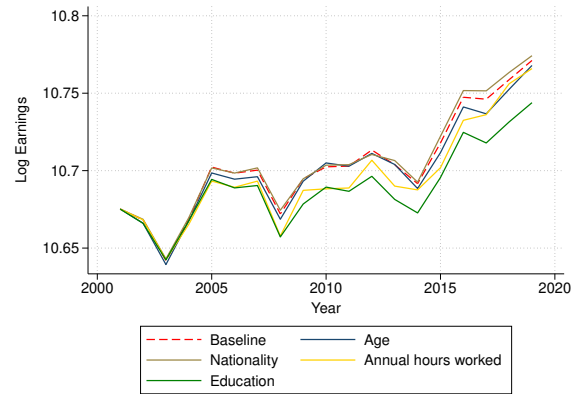
(c) Quintile 3—Male



(d) Quintile 3—Female



(e) Quintile 5—Male



(f) Quintile 5—Female

Figure A.11: Counterfactual Evolution of Post-Government Household Income

Note: Counterfactual evolution of equivalized post-government income for several quintiles of the earnings distribution in the SOEP. The counterfactual quintiles are generated by adjusting the data weights, ensuring that the observable dimensions remain constant at the 2001 levels. The solid lines depict the hypothetical evolution of post-government income if the distribution of different variables had remained constant at the 2001 levels. Individuals aged 25-55 with positive earnings.

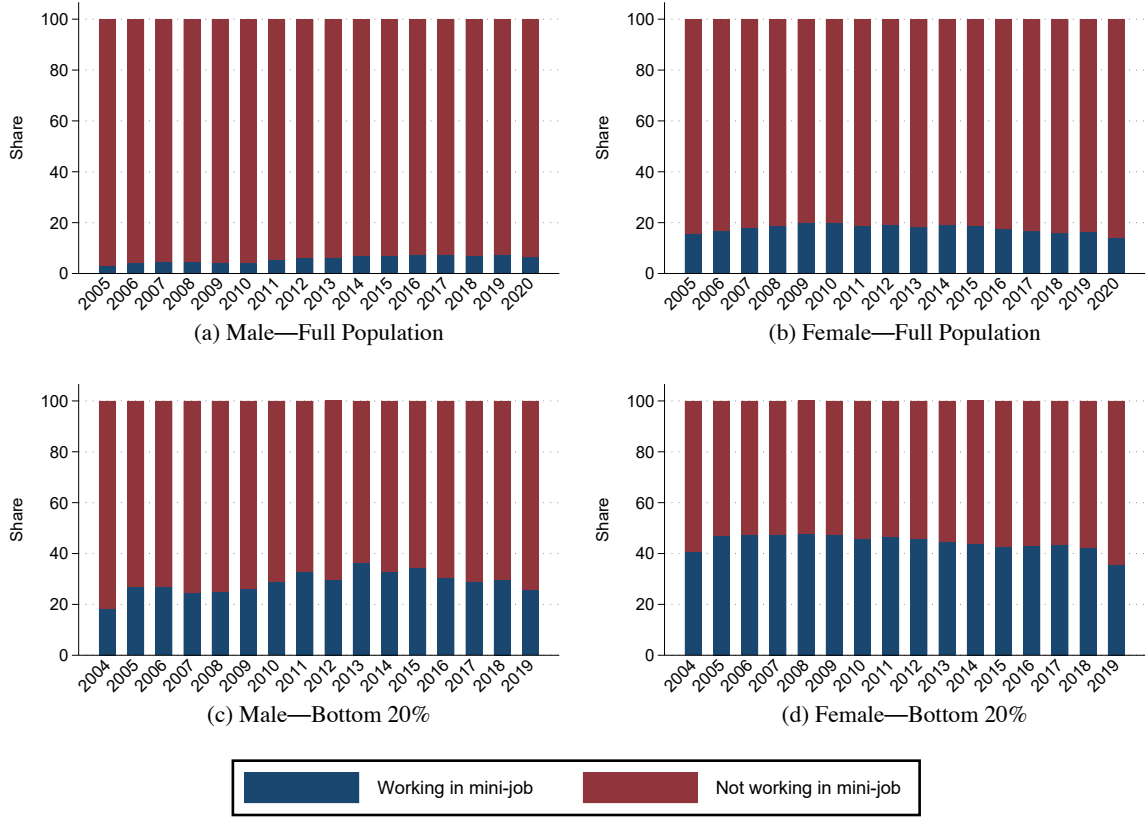


Figure A.12: Mini-Job Employment by Gender and Income Group

Note: Individuals aged 25-55 with positive earnings, based on data from the SOEP.

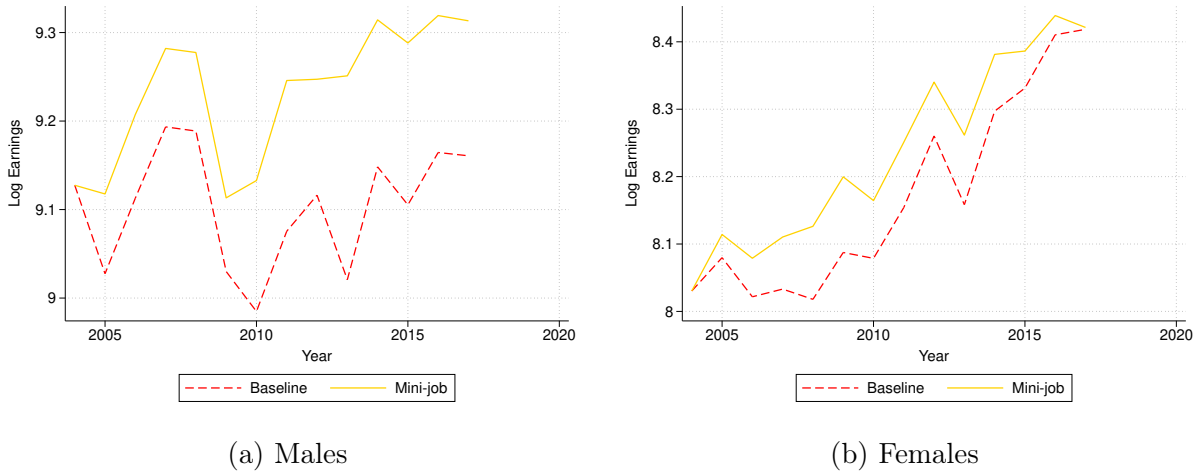


Figure A.13: Counterfactual Evolution of Earnings in the Bottom Quintile—Mini-Jobs

Note: Counterfactual evolution of average log labour earnings for the first quintile of the earnings distribution in the SOEP. The counterfactual quintile is generated by adjusting the data weights, ensuring that the share of mini-jobbers remains constant at the 2004 levels. The solid lines depict the hypothetical evolution of average log earnings if the share of mini-jobbers had remained constant at the 2004 levels. Individuals aged 25-55 with positive earnings.

B Tables

Table B.1: Transition Matrix for Equivalized Pre-Government Income by Gender

Quintile in $t+5$	Quintile in t				
	1	2	3	4	5
5	3.02	2.83	7.77	24.23	68.60
4	5.71	10.76	25.89	42.86	19.41
3	12.17	26.37	38.65	20.95	7.07
2	27.59	43.03	20.56	8.28	3.92
1	51.51	17.00	7.12	3.67	1.00

(a) Males

Quintile in $t+5$	Quintile in t				
	1	2	3	4	5
5	3.03	3.53	7.78	25.96	68.92
4	6.06	13.46	26.25	41.53	18.21
3	11.86	26.78	37.70	19.87	7.61
2	27.08	39.15	20.28	8.95	3.79
1	51.96	17.09	7.98	3.68	1.47

(b) Females

Note: The table shows the share of individuals in a given income group in $t + 5$ conditional on their income group in t in percent. Each column in the matrix sums up to 100. Rows might not sum up to 100 as some individuals in the sample are dropped before $t + 5$.

Table B.2: Transition Matrix for Equivalized Post-Government Income by Gender

Quintile in $t+5$	Quintile in t				
	1	2	3	4	5
5	2.91	2.86	7.72	24.95	69.60
4	6.02	12.25	25.66	42.45	19.61
3	11.91	26.81	38.55	21.97	6.99
2	27.96	37.83	20.75	7.76	2.55
1	51.20	20.26	7.32	2.87	1.25

(a) Males

Quintile in $t+5$	Quintile in t				
	1	2	3	4	5
5	3.41	4.38	8.56	26.23	69.42
4	7.02	13.23	25.99	42.63	18.75
3	12.44	27.08	36.08	19.94	7.28
2	28.95	36.31	21.44	8.45	2.54
1	48.17	19.00	7.92	2.75	2.00

(b) Females

Note: The table shows the share of individuals in a given income group in $t + 5$ conditional on their income group in t in percent. Each column in the matrix sums up to 100. Rows might not sum up to 100 as some individuals in the sample are dropped before $t + 5$.