WORKING PAPER

EARNINGS INEQUALITY IN GERMANY: A DECOMPOSITION-ANALYSIS

Ulrike Stein[*]

ABSTRACT

Several studies have shown that income inequality has risen in Germany until 2005. Less focus was put on the rise of earnings inequality which continued to rise until 2010. We distinguish different groups in the labour market with respect to working-time, gender and region by exploiting data from the German Socio-Economic panel (GSOEP) for the years 1995 till 2014. Using the decomposition of the $Theil_1$-index we demonstrate that the increase in earnings inequality is primarily the result of diverging average earnings of the various groups in the labour market (between-group inequality) and to some extent due to increasing earnings heterogeneity within groups (within-group inequality). The former effect is larger than the latter. Without the inequality reducing effect on earnings inequality due to the continuous decrease in the share of full-time working employees and the increase in the female labour participation rate (compositional effect) earnings inequality would have actually further increased after 2010. Independent of the policy target, policy measures to reduce inequality need always to be designed in such a way that they take the whole work force into account in order to achieve measurable effects.

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Earnings inequality in Germany: A decomposition-analysis

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Abstract

Several studies have shown that income inequality has risen in Germany until 2005. Less focus was put on the rise of earnings inequality which continued to rise until 2010. We distinguish different groups in the labour market with respect to working-time, gender and region by exploiting data from the German Socio-Economic panel (GSOEP) for the years 1995 till 2014. Using the decomposition of the $Theil_1$-index we demonstrate that the increase in earnings inequality is primarily the result of diverging average earnings of the various groups in the labour market (between-group inequality) and to some extent due to increasing earnings heterogeneity within groups (within-group inequality). The former effect is larger than the latter. Without the inequality reducing effect on earnings inequality due to the continuous decrease in the share of full-time working employees and the increase in the female labour participation rate (compositional effect) earnings inequality would have actually further increased after 2010. Independent of the policy target, policy measures to reduce inequality need always to be designed in such a way that they take the whole work force into account in order to achieve measurable effects.

Keywords

Earnings inequality, Theil decomposition, part-time employment, female participation rate, German Socio-Economic Panel (GSOEP)

JEL Classifications: D31, J21, J39

1   Introduction

The issue of income inequality[1] became a prominent part in the public debate after most countries in the EU experienced growing income inequality prior to and also due to the global economic crisis. However, there are various different concepts of income inequality. It depends crucially on the type of income under consideration. The focus of income inequality is often based on net equivalised household income, which is a conceptional income that comprises various different income components but also two forms of redistribution. The first includes all kind of governmental transfers and taxes and the second consists of a factor that accounts for the redistribution within the family. All this makes it difficult to disentangle the effects of each single income component (see Stein 2014a). Furthermore, in the public perception income inequality often concentrates on only one single key measure, namely the Gini coefficient. The conceptional reduction of income inequality into one single number is a disproportionate shortening of the analysis of income inequality. It is far more diverse than that and hence a broader approach is needed to provide an adequate description of income inequality.

The increase in personal income inequality since the German unification is well documented and evident at all levels of the income distribution (Grabka and Goebel 2013, OECD 2008, OECD 2011, Schmid and Stein 2013). However, depending on the chosen concept, the development of income inequality follows a different pattern over time. On the basis of equivalised net household income, income inequality was constant in the 1990s, before it then increased sharply in the first half of the 2000s. Since then it stagnates on a much higher level. Income inequality of equivalised household market income developed quite differently. It increased considerably after reunification, peaked in 2005 and fell slightly thereafter. The changing impact of public redistribution over time can explain the differences in the development of income inequality of both income concepts. Until the late 1990s, the impact of public redistribution increased, since then it has declined.[2]

Given these various developments and concepts, it is not surprising, that there is considerable room for interpretation when assessing income inequality. Some people argue that income inequality is too high in Germany, for others it is not a problem, since they consider it to be a success that it has not increased further since 2005. However, this controversy over the interpretation of these numbers is secondary. The real issue is something else. Given the good performance of the

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[1] Throughout the article it is net equivalised household income when we talk about income inequality in contrast to earnings or wage inequality which is based on individual earnings from work. Earnings inequality is based on monthly earned income, wage inequality on hourly wages.

[2] Compare Figure 5.1 in Schmid and Stein (2013).

German labour market with declining unemployment and an employment level that hits one record high after the other implies that more and more individuals in households receive labour income, intuitively we would actually expect income inequality to decrease against this background which is surprisingly not the case. Additionally, by focusing on the idealised concept of equivalised income we also tend to mask the persistent increase in inequality of earned income which kept rising after 2005.[3] So far it is less clear, what factors have actually caused the increase in inequality of earned income.

Regardless of whether income inequality is perceived as too high or not, one must understand what factors actually cause inequality and which are responsible for changes in income inequality. Moreover, Grabka and Goebel (2017) find signs that income inequality is rising again. Essentially this can happen through two different channels. Changes in income inequality can be the result of either changes in the distribution of primary incomes or changes in the redistribution mechanism (Atkinson 2015). Biewen and Juashz (2012) found that changes in employment outcomes and changes in the tax system contributed to the increase in income inequality, but that a large part was due to increasing inequality in labour incomes. According to SOEP data, earned income makes up roughly 90 % of market income and is therefore by far the most important source of household income. It is also the income source that people relate directly to their work, in contrast to the purely conceptual equivalised household income. The compensation for work has also something to do with the appreciation of the work. Poor pay, falling real wages with simultaneously increasing management salaries and rising earnings inequality is something that affect people feelings of fairness. The same holds for the increasing share of low-wage and part-time jobs, the gain in marginal employment and the persistently high level of vulnerability (risk of poverty) which is associated with the increase in earnings inequality. Beyond that earnings provide satisfaction and play an important role in society from a fairness point of view.[4]

Furthermore, the composition of the work force has changed significantly over the last two decades. The German economy experienced a strong increase in part-time employment and female participation. According to the IAB Working-Time-Calculations the part-time share increased from 22.9% in 1995 to 38.4% in 2014 and female labour force participation rate increased according to Eurostat from 61.3% to 72.9%. In addition earnings in East Germany are still significantly lower than those in West Germany. From all this it follows that it is important to look more closely at earnings in the analysis. The aim of the following paper is to obtain a better understanding of the development

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[3] See the discussion in Stein (2014b) and Stein (2015).

[4] The relationship between income and wellbeing is complex and there has been research on income and happiness. See for instance the early work by Easterlin (1974) who analysed the relationship between income growth and happiness or the work by Clark et al. (2008) which provides a good overview of the topic.

of earnings inequality in Germany and to identify how changes in the structure of the work-force with respect to full-time and part-time employment and gender in East and West Germany have contributed to its increase. In this way the following decomposition analysis attempts to make a contribution to the understanding of the evolution of earnings inequality. In contrast to the majority of existing studies the following study includes the complete workforce.

The paper is structured as following. After a brief literature review, the data and some descriptive statistics are presented. We then examine the evolution of individual earnings over time, broken down by different groups with respect to gender, in East and West Germany and working-time. Next we use the Theil-index to decompose earnings inequality into its group-specific contributions using the method proposed by Mookherjee and Shorrocks (1982). We analyse how inequality of earnings has evolved over time and identify how structural changes in the workforce have contributed to it. By using the Theil-decomposition, we can also show how much of the rise in inequality can be attributed to the sole changes of the average subgroup earnings (between-group inequality), to changes in earnings inequalities within groups (within-group inequality) or to changes in the employment structure of the workforce (compositional effect). Finally, the paper concludes with a brief discussion and outlook.

2   Why did inequality rise?

There are a number of prominent theories trying to explain why wage inequality has increased in most countries. According to Fitzenberger (2012) who summarises the main theories and provides a good overview about the development of earnings inequality in Germany, wage inequality at the top of the income distribution has already risen in the 1980s. Since the 1990s, wage inequality has risen both at the top and at the bottom of the distribution. In contrast to income inequality based on equivalent household net income, wage inequality did not stop to increase after 2005. Fitzenberger (2012, p. 2-3 and 14-17) presents five main reasons for the continuous rise in wage inequality:[5]

One hypothesis (see for instance Katz and Autor 1999) claims that skill-biased technological change caused the demand for higher skilled workers to increase relatively more than the demand for less skilled workers. According to Dustmann et al. (2009) this hypothesis explains the rise in income inequality at the top end of the wage distribution. However, Giesecke and Verbiebe (2009) find empirical evidence against this hypothesis in favour of the hypothesis that the increase in wage inequality is the result of structural features, such as decreasing collective bargaining coverage, unemployment and changes in labour market policies.

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[5] For a similar summary see also Stein (2014a).

A second hypothesis is summarised as task-based approach and polarisation. It builds on the first, arguing on the basis of a task-based approach that routine tasks can be easily replaced by the use of computers and equipment and therefore the demand both for low-skilled and highly skilled workers increase more than the demand for workers who carry out routine activities. Some evidence supporting the task-based approach is found by Spitz-Oener (2006) as well as Dustmann et al. (2009). Both papers find some polarisation in employment. More recent work by Eichhorst et al. (2015) finds only very limited support for polarisation of the labour market as an explanatory factor for increasing inequality in Germany.

A third hypothesis claims that the decline in collective bargaining coverage caused the rise in wage inequality. Antonczyk et al. (2010) found a positive correlation between decreasing collective bargaining coverage and rising inequality, although this relationship is not very strong because inequality has also increased in areas that are subject to collective agreements.

The fourth hypothesis argues that the labour market reforms and increased labour market flexibility were inequality-enhancing. Biewen and Juhasz (2012) and Fitzenberger (2012) suggest that these reforms contributed to the general increase in inequality, but that the overall contribution from these reforms is rather small given that the increase in inequality began even before the reforms.

In contrast to the more established hypotheses with respect to supply and demand side factors and changes in labour market institutions Card et al. (2013) find empirical evidence for a rather new hypothesis, which claims that the increasing heterogeneity of firms is partly responsible for the increasing wage inequality. The conclusion Fitzenberger (2012) draws from this study can shortly be summarised as: There is a segmentation of the German labour market into good jobs in good firms and less good firms with less good jobs. However, the argument put forward by Card et al. (2013), that increasing firm heterogeneity was an important driver of increasing wage inequality, is not fully understood yet. More research is needed to clarify what the underlying mechanisms are that cause this increasing firm and workplace heterogeneity (see Fitzenberger 2012).

Based on existing evidence so far it is obvious that none of these theories on its own can fully explain the increase in income inequality in Germany. All the evidence found in the literature suggests that there were more possible factors at work that caused income inequality to rise.

Additionally, Fitzenberger (2012, p. 3) points out that the academic literature on the descriptive wage analysis refers mostly to the development of wages of full-time employees who work in West Germany. A comprehensive study of wage inequality for all employees is missing so far. However, the changing employment structure and changes in the shares of the different employment forms make it more important to include the complete workforce into the analysis. The following study includes

the complete workforce and contributes to the clarification to what extend the increasing heterogeneity in the employment structure, e.g. the increasing part-time rate and increasing female participation, and evolution of earnings can explain the increase in earnings inequality.

3   Data and approach

There are several possible data sources to analyse the distribution of labour income in Germany. On the one hand, there are administrative data with respect to social security contributions from the Institute for Employment Research (IAB) such as the SIAB (sample of integrated labour market biographies) and LIAB (linked employer-employee dataset). On the other hand, there are survey data such as the SOEP (socio-economic panel) from the German Institute for Economic Research (DIW). Both data sets have advantages and disadvantages and therefore the choice will finally depend on the research question.

The major advantage of administrative data is that it includes 2 % of all employees paying mandatory social security contributions. Hence, it is not only a large sample, but the data quality is excellent. Unfortunately, only the daily rate of pay is recorded and no information about hours worked per day is available. This is a big disadvantage as no hourly wages can be calculated. For example to analyse the development of wage inequality, only full-time employees can actually be compared with each other. Given the general increasing importance of part-time work and the high proportion of women in part-time work, this procedure will lead to an exclusion of segments of the population which tend to be affected by lower incomes, and therefore should definitely not be excluded from the analysis. Another major drawback is the censoring of the data at the upper earnings limit for social security contributions. As a consequence, wages at the top end of the distribution are not accurately recorded.

Survey data do not suffer from censoring, which is a clear advantage over administrative data, but have to cope with other disadvantages. In surveys, there is generally the problem of non-attendance, missing or wrong answers, and the under-representation of some parts of the population.[6] Generally, information of incomes at the top end of the income distribution is underreported, leading to an underestimation of income inequality at the top end. This issue may be partly resolved by either imputation of missing values or through the use of weighting factors. The major asset of data from the SOEP is the provision of information on working hours which allows the calculation of hourly wage rates. Given the erosion of the so-called normal employment arrangement (e.g. full-time, permanent) and the reasons described earlier makes it more important to include the

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[6] The issue of inaccuracies caused by subjective responses is less of a problem for the analysis when the focus is on the development of hourly wages over time rather than on specific wage levels at a certain point in time.

entire working population in the analysis which requires the use of hourly wages. So far the SOEP is the only data set that provides this information and therefore makes this data in this case superior to any administrative data.

The analysis of income inequality is usually based on equivalised household income. This means that all individual and household incomes from different income sources are summed up. For instance, in the case of equivalised household market income the following four components are added: household labour earnings[7], household asset income[8], household imputed rental value[9] and household private retirement income. Given that labour earnings represent roughly 90 % off all market income, a better understanding of earnings inequality is crucial to improve our knowledge of income inequality. To focus on this link between earnings and income inequality in the following the emphasis of the analysis will be firstly on the evolution and inequality of monthly gross earnings. Since we are not interested in the redistributional effect of households the focus will be on individual labour earnings. In a separate analysis which is closely linked to the one presented here the components of earnings inequality are examined and we focus on hourly wages and discuss the role of changes in working-time in more detail (Stein and Herzog-Stein 2018).

In the following paper data[10] from the German Socio-Economic Panel (SOEP) provided by the DIW are used. The SOEP is a representative longitudinal study of private households conducted via fieldwork, providing information on German households and its members. Each year around 11,000 households and about 30,000 persons are sampled. The questionnaire is repeated annually with the same households (see Wagner et al. 2007). From time to time the SOEP is extended to offset the natural reductions in the number of individuals and households known from survey data and to take account for the fact that the distribution of the society changes over time. In the following the time period between 1995 and 2014 is considered.

For the analysis the sample is restricted to all employed persons with a positive monthly gross income from work. Extra payments are not included because this information refers to the previous year. All persons in vocational training or internships, in workshops for disabled people, near retirement with zero working hours, in military or community service as well and both self-employed and persons helping in the family business are excluded from the sample. Following Grabka et al. (2012, box 1) the first survey wave of individuals is excluded from the sample. Studies have shown

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[7] This is the sum of individual earnings of all household members.

[8] Asset income are besides of interest and dividend incomes also rental income. Any operation and maintenance costs are deducted, but not more than the value of the rental income.

[9] To make income data internationally comparable, it is common practice to include in the market income also a value for imputed rent to take the opportunity costs for owner-occupied housing into account (see Frick et al. 2007 and Frick and Grabka 2009, p. 10f).

[10] Socio-Economic Panel (SOEP), data for years 1984-2014, version 31, SOEP, 2020, doi:10.5684/soep.v31.

that there is a learning effect in the behaviour of respondents after the first wave. Particularly, the answers of first-time respondents with respect to questions about income are more inaccurate than the answers of a person already familiar with the questionnaire.[11]

The categories 'full-time´ and 'part-time work' are determined by using the self-reported answers to the question "Are you currently employed? Which one of the following applies best to your status?". The category full-time work refers to the answer "employed full-time". Part-time work refers either to the answer "employed part-time" or "in marginal or irregular employment". A further distinction between part-time and marginal employment in the following analysis is not possible because some of the chosen groups would obtain too few observations.

4 Descriptive Analysis

In Table 1 the comparative statistics for monthly labour earnings and key inequality measures are summarised. All these measures and indicators show an increase in earnings inequality in Germany in the period 1995-2010 and no big changes thereafter (Figure 1, left-side panel). This is in contrast to the development of income inequality which did not further increase after its peak in 2005.

Comparing different inequality measures reveals that the increase in earnings inequality took place mainly at the lower end of the earnings distribution until 2010. An indication for this is the stronger increase of the Theil_0-index in comparison to the Theil_1-index, because the calculation of the Theil_0-index is such that income deviations to the bottom lead to higher contributions to inequality than the same deviations to the top.[12]

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[11] Compare Frick et al. (2006).

[12] See formula in Table 2.

Table 1: *Comparative statistics and inequality measures*

	Unit	1995	2000	2005	2010	2014	% change 1995-2000	% change 2000-2005	% change 2005-2010	% change 2010-2014	% change 1995-2014
Labour earnings											
Mean	Euro	2.470	2.578	2.502	2.412	2.416	4.3	-2.9	-3.6	0.2	-2.2
Median	Euro	2.287	2.386	2.324	2.200	2.205	4.3	-2.6	-5.3	0.2	-3.6
Inequality measures											
Gini-coefficient	Index	0.291	0.311	0.346	0.360	0.364	7.0	11.0	4.2	0.9	24.9
Theil 0	Index	0.179	0.208	0.265	0.294	0.292	16.2	27.4	11.1	-0.9	63.1
Theil 1	Index	0.150	0.169	0.209	0.228	0.229	12.6	23.7	9.2	0.4	52.7
Theil 2	Index	0.170	0.183	0.232	0.261	0.261	7.3	27.2	12.4	-0.3	52.9
Decile ratios											
Decile ratio 90-50		1.8	1.9	1.9	2.0	2.0	4.1	-0.1	5.1	1.5	10.9
Decile ratio 90-10		4.3	5.1	9.3	10.8	10.4	19.7	81.1	15.6	-3.7	141.2
Decile ratio 50-10		2.4	2.8	5.0	5.5	5.2	15.0	81.2	10.0	-5.1	117.6
Mean earnings by deciles											
1. decile	Euro	519	441	321	279	294	-15.1	-27.2	-13.1	5.5	-43.3
2. decile	Euro	1.240	1.186	886	755	760	-4.4	-25.3	-14.8	0.7	-38.7
3. decile	Euro	1.635	1.621	1.392	1.289	1.271	-0.9	-14.1	-7.4	-1.4	-22.2
4. decile	Euro	1.928	1.952	1.791	1.692	1.662	1.2	-8.2	-5.5	-1.8	-13.8
5. decile	Euro	2.166	2.229	2.158	2.055	2.029	2.9	-3.2	-4.8	-1.3	-6.3
6. decile	Euro	2.407	2.521	2.495	2.390	2.366	4.7	-1.0	-4.2	-1.0	-1.7
7. decile	Euro	2.681	2.851	2.836	2.733	2.725	6.3	-0.5	-3.6	-0.3	1.6
8. decile	Euro	3.058	3.222	3.251	3.148	3.175	5.4	0.9	-3.2	0.9	3.9
9. decile	Euro	3.641	3.853	3.878	3.803	3.857	5.8	0.6	-1.9	1.4	5.9
10. decile	Euro	5.417	5.892	6.001	5.967	6.015	8.8	1.8	-0.6	0.8	11.0
Earning shares by deciles											
1. decile	%	2.1	1.7	1.3	1.2	1.2	-18.7	-24.9	-10.0	5.3	-42.1
2. decile	%	5.0	4.6	3.5	3.1	3.2	-8.2	-23.2	-11.7	0.8	-37.2
3. decile	%	6.6	6.3	5.6	5.4	5.3	-5.2	-11.3	-3.7	-1.8	-20.6
4. decile	%	7.8	7.6	7.2	7.0	6.9	-2.6	-5.5	-2.1	-2.0	-11.6
5. decile	%	8.8	8.7	8.6	8.5	8.4	-1.7	-0.5	-1.6	-1.0	-4.7
6. decile	%	9.7	9.8	10.0	10.0	9.8	0.4	2.2	-0.3	-1.7	0.5
7. decile	%	10.9	11.0	11.3	11.3	11.3	1.4	2.9	-0.1	-0.3	3.9
8. decile	%	12.4	12.5	13.0	13.1	13.1	1.4	3.6	0.6	0.2	5.8
9. decile	%	14.7	14.9	15.5	15.7	16.0	1.6	3.8	1.5	1.7	8.9
10. decile	%	22.0	22.9	24.0	24.8	24.9	4.1	4.9	3.2	0.6	13.3

Note: Analysis is based on individual monthly gross earnings (in prices of 2010).

Source: SOEP 31l, own calculations.

This argument is further supported by the fact that in the same period of time we observe strong increases in the decile ratios 50-10 and 90-10 with a rather constant decile ratio 90-50. Graphically, the argument is confirmed in Figure 1 (right-side panel) where the evolution of the means of different income deciles is presented. The increase in earnings inequality at the lower end of the earnings distribution was particularly pronounced in the period between 1995 and 2005 and less strong in the years 2005 till 2010. Although, from 2010 onwards, the income in the lowest decile experienced the highest percentage increase of all decile groups it was nevertheless small compared to the huge decline those incomes experienced until 2010. This also explains why we cannot observe any reversal in income shares.

Figure 1: *Inequality measures (left) The development of earnings by deciles(right)*
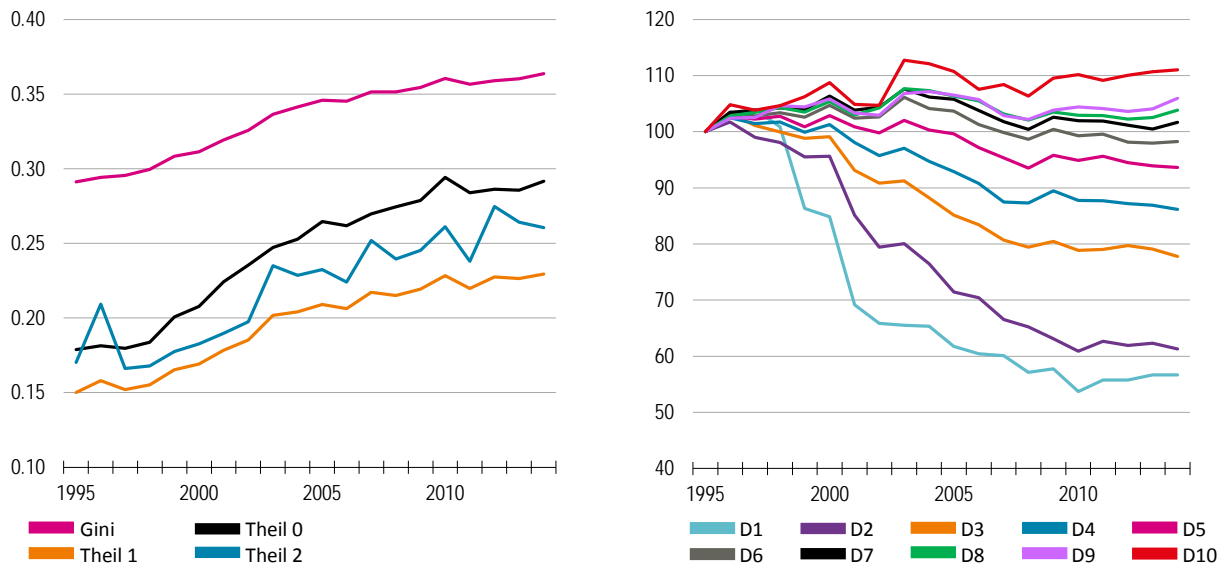
Note: Analysis is based on individual monthly gross earnings (in prices of 2010). In the right hand panel the incomes represent the mean incomes of each decile group. $Theil_0$-index is also called the mean log deviation and the $Theil_2$-index the 'half the squared coefficient of variation'.

Source: SOEP 31l, own calculations.

In 2014 earnings shares of the top deciles are higher than ever (Table 1). In 1995, the earnings share of the employees in the six lowest deciles together was approximately 40 % and hence only slightly higher than that of the two highest deciles which was 36.7 %. Until 2014 the employees in the two top deciles could steadily increase their income share up to 40.9 % whereas the combined income share of those in the six lowest deciles reached an all-time low of only 34.7 % in 2014.

One could argue that these developments are due to a working-time effect. Interestingly, this fact is not only a part-time phenomenon but is also observable when only the sample of full-time employees is analysed on its own.[13] Although earnings inequality among full-time employees is lower than in the full sample, we observe the same increase in earnings inequality at the lower end of the earnings distribution.

As a matter of fact we know that the composition of the work-force constantly changes over time and that various groups of the labour market with diverse characteristics have not only different average earnings but also tend to experience varying evolutions of their earnings. Thus, one of the stylised facts is that women earn on average less than men. Furthermore employees in East Germany have lower mean earnings than in West Germany (Figure 2). In addition, there seem to be

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[13] Data is not shown in Table 1.

differences in the remuneration between full-time and part-time employees. Hence, in the following analysis the sample is divided into eight different groups according to the characteristics: full-time/part-time, male/female, East/West.

Figure 2: *Descriptive statistics for the decomposition sample. (Monthly earnings)*
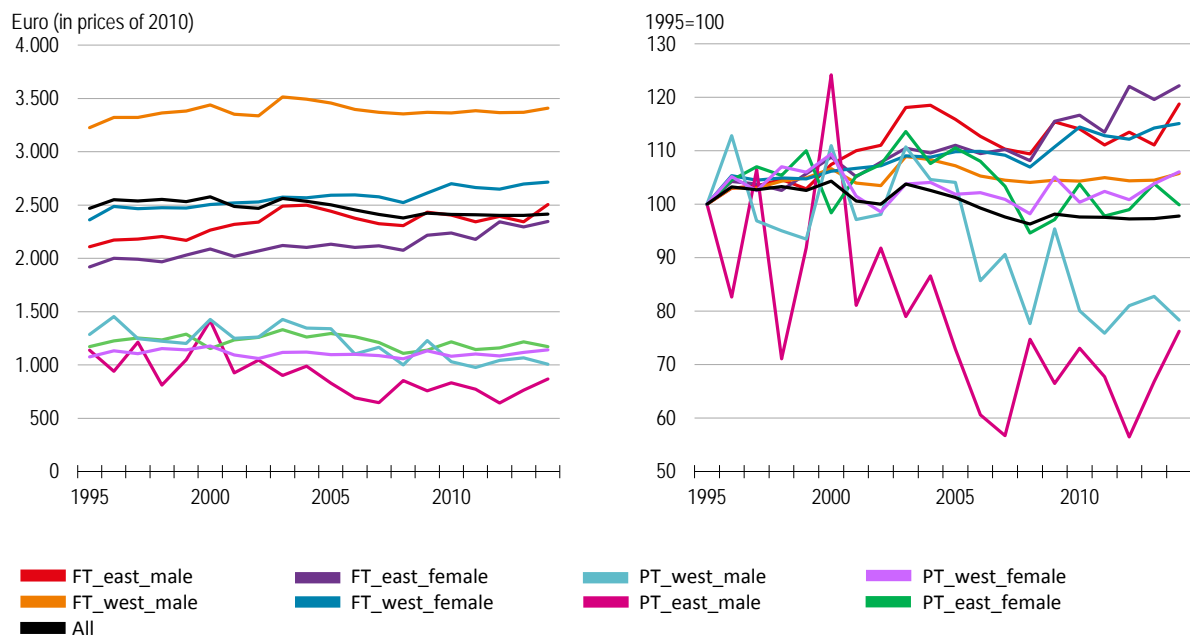
Note: Analysis is based on individual monthly gross earnings (in prices of 2010). FT and PT refer to full-time and part-time, respectively. The sample of part-time male workers in East Germany has less than a 100 observations before 2010 and has to be taken with caution.

Source: SOEP 31l, own calculations.

Differences in monthly earnings of full-time and part-time employees are the trivial consequence of different working hours. At first glance, it seems therefore to be surprising to compare monthly earnings with each other. However, every standard analysis of income inequality is actually based either on monthly or yearly household income. Given that earned income is the most important income source of households in overall income it is also vital to understand changes in the distribution of monthly earnings. Only then can we understand its impact on the overall income inequality - based on equivalised household net incomes - in Germany over time.

Figure 2 shows average earnings (left-hand panel) and contrasts the evolution of these earnings by various groups (right-hand panel). There are quite substantial differences in average earnings for full-time employees. Earnings range between about €2300 for females in East Germany and €3400 for males in West Germany in 2014. Part-time employees earn on average less than half of the full-time equivalent, although differences among the four different part-time groups are not as huge as

the differences for full-time employees. Furthermore, Figure 2 reveals that mean earnings developed very differently over time. Whereas full-time employees obtained earning gains between 5.8 % and 22.2 % between 1995 and 2014, part-time workers experienced on average either a decline or only a moderate increase in earnings.

The compositional changes of the work-force over the time are presented in Figure 3 where the shares of full-time employees among different subgroups of the population like female and male workers in East and West Germany are plotted. In each subgroup the share of full-time employees decreased over time. During the period under consideration, the overall full-time share fell from 81.5 % to 67.5 %.[14] With almost 20 percentage points the decline in the full-time rate was especially strong for East German women, who had a far higher full-time rate in 1995, whereas the full-time rate for women in West Germany fell only by about 12 percentage points. Thus both groups have a high proportion of part-time employees with a full-time rate of about 56 % and 45 % respectively. The development for East and West German men was much more equal and the decline in full-time rates was much less pronounced than in the female subgroups. Both full-time rates are around 88 % in 2014. The increasing share of part-time employees and the different developments in the various subgroups suggest that working hours had an impact on mean earnings of each group. The role of the unequal distribution of hours worked with respect to inequality is discussed in Bosch and Kalina (2015). They show that changes in the employment pattern can cause changes in income inequality. In the case of Germany there is a positive correlation between the number of hours worked and the income class. Due to the decreasing full-time rate, this correlation became stronger over time. The lower the income class the higher was the reduction of the full-time rate in the corresponding income class. Therefore, it is important to distinguish between full-time and part-time.

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[14] Comparing the numbers with official data from the IAB Working-Time-Calculations shows that both the part-time rate and the increase of it are underestimated in the SOEP. The full-time rate of the IAB fell by more than 15 percentage points from 77.1 % to 61.4 % in the period under consideration.

Figure 3: *Share of full-time employees by subgroups (Monthly earnings)*
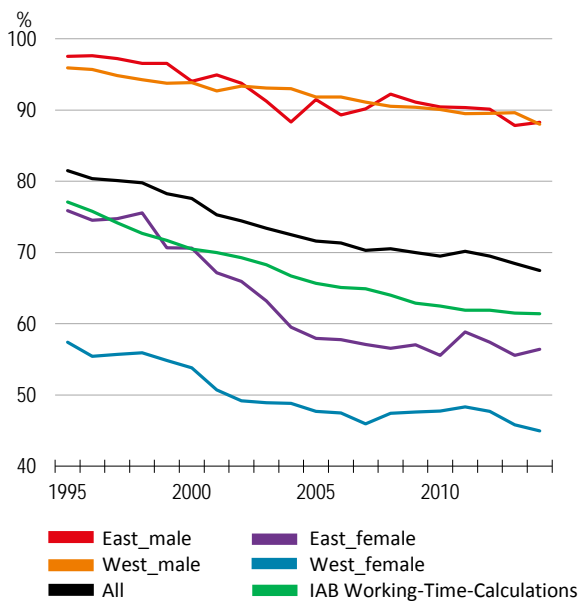
Note: Analysis is based on individual monthly gross earnings (in prices of 2010). For comparison data from the IAB Working-Time-Calculations are included (dotted line).

Source: SOEP 31l, IAB Working-Time-Calculations (data as of January 13, 2017), own calculations.

5   Theil-Index and its decomposition

To analyse the impact of compositional changes of the workforce on earnings inequality in more depth a suitable indicator is required. There are a variety of inequality measures to describe income inequality. However, not each of them possesses the same desirable properties. Litchfield (1999, p. 2-3) summarises five key axioms that inequality measures are often required to meet.[15] These are:

- **Pigou-Dalton transfer principle:** a transfer from the richer to the poorer should at least not increase inequality.
- **Income scale independence or mean independence:** a change of incomes in the same proportions should not change the inequality measure, e.g. only relative income changes matter, absolute income changes are irrelevant.
- **Principle of population:** the population size should not matter for the inequality measure. Simply doubling of the population should leave the inequality measure unchanged.
- **Anonymity:** any characteristic of individuals other than their income should be irrelevant for the inequality measure.
- **Decomposability**: The measure can be decomposed into two components, inequality within subgroups and inequality between subgroups. If inequality of subgroups (population subgroups or different income sources) rises then overall inequality should also increase.

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[15] See also the overview in Schwarze and Elsas (2013, p. 186ff).

Inequality measures that fulfil these characteristics belong to the group of „generalised entropy class of measures". The general formula is[16]:

$$GE(\alpha) = \frac{1}{\alpha^2 - \alpha} \left[\frac{1}{N} \sum_{i=1}^{N} \left(\frac{y_i}{\bar{y}} \right)^{\alpha} - 1 \right],$$

where N is the number of individuals, $\bar{y}$ is average earnings in the population, and α is a sensitivity parameter, which determines how much weight is given to the distance between incomes in different parts of the income distribution. i indicates the parameters of the subpopulation respectively. The higher α the more sensitive is the inequality measure to changes in the upper part of the earnings distribution. Thus, depending on the size of the sensitivity parameter "α" the impact of earnings changes in the inequality measure differs. The three most commonly used inequality measures are represented in Table 2. They take the values for α equal to 0, 1 and 2. Each of them is sensitive to a different income range. First, the $Theil_0$ (also called the mean-log deviation) is more sensitive to changes at the bottom of the earnings distribution. E.g. earnings transfers at the bottom of the distribution have a higher impact on the reduction in inequality than equal transfers at the top of the income distribution. Second, the $Theil_1$ is a neutral measure. Earnings changes, independent of the position in the earnings distribution, lead to the same reduction in inequality. Finally, the $Theil_2$ (also called the half the squared coefficient of variation) is a measure that is more sensitive to income changes at the upper end of the income distribution. The Gini-coefficient is not decomposable but is represented for comparability.

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[16] See Litchfield (1999).

Table 2: *Overview of selected inequality measures*

Name	Alternative name	Inequality measure	Sensitivity Parameter α	Impact	Decomposability
		$$GE(\alpha) = \frac{1}{\alpha^2 - \alpha}\left[\frac{1}{n}\sum_{i=1}^{n}\left(\frac{y_i}{\overline{y}}\right)^{\alpha} - 1\right]$$			
Theil$_0$	*mean-log deviation*	$$GE(0) = \frac{1}{n}\sum_{i=1}^{n} ln\left(\frac{\overline{y}}{y_i}\right)$$	0	**Bottom sensitive**: Sensitive to changes at the bottom of the income distribution.	Subgroup decomposability, within- and between-group inequality sum to total inequality.
Theil$_1$	*Theil T*	$$GE(1) = \frac{1}{n}\sum_{i=1}^{n} \frac{y_i}{\overline{y}} ln\left(\frac{y_i}{\overline{y}}\right)$$	1	**Neutral**: Equal weight is given to income over the entire distribution.	Subgroup decomposability, within- and between-group inequality sum to total inequality.
Theil$_2$	*CV = 1/2 the squared coefficient of variation*	$$GE(2) = \frac{1}{\overline{y}}\left[\frac{1}{n}\sum_{i=1}^{n}(y_i - \overline{y})^2\right]^{1/2}$$	2	**Top sensitive**: Sensitive to changes at the top of the income distribution.	Subgroup decomposability but within- and between-group inequality do not sum to total inequality
Gini		$$Gini = \frac{1}{2n^2\overline{y}}\sum_{i=1}^{n}\sum_{j=1}^{n}|y_i - y_j|$$		**Middle sensitive**: Sensitive to changes at the middle of the income distribution.	No subgroup decomposability

Source: Formulae are from Litchfield (1999).

Given that the focus of the following analysis is on decomposing earnings inequality, a measure is required for which the various components of the decomposition add up to total inequality. However, this is only the case for two members of the general entropy class of measures: Theil$_0$ and Theil$_1$. In the case for α = 0 and α=1 the index $GE(\alpha)$ can then be written as:

$$GE(\alpha) = GE_W(\alpha) + GE_B(\alpha),$$

where $GE_W(\alpha)$ refers to the within-group inequality and $GE_B(\alpha)$ to the between-group inequality. $GE_B(\alpha)$ is derived under the assumption that every person within a subgroup receives the mean income of this subgroup (compare Jenkins, 2008). Assume that there are j = 1, 2, …, g subgroups in the population, then the within-group and between-group component of the decomposition of the two respective Theil indices are those represented in Table 3. The difference between the within-group inequality components is that in case of the Theil$_0$ the group-specific population shares $\left(\frac{N_j}{N}\right)$ are used as a weighing factor whereas in the case of the Theil$_1$ the group-specific income shares $\left(\frac{Y_j}{Y}\right)$ are used.

Table 3: *Decomposition of the inequality measures*

	Within-group inequality $GE_W(\alpha)$	Between-group inequality $GE_B(\alpha)$
Theil$_0$	$\displaystyle\sum_{j=1}^{g}\left(\frac{N_j}{N}\right)GE(0)_j$	$\sum_{j=1}^{g}\left(\frac{N_j}{N}\right)ln\left(\frac{\bar{y}}{\bar{y}_j}\right)=\sum_{j=1}^{g}\left(\frac{N_j}{N}\right)ln\left(\frac{N_j/N}{Y_j/Y}\right)$
Theil$_1$	$\displaystyle\sum_{j=1}^{g}\left(\frac{Y_j}{Y}\right)GE(1)_j$	$\sum_{j=1}^{g}\left(\frac{Y_j}{Y}\right)ln\left(\frac{\bar{y}_j}{\bar{y}}\right)=\sum_{j=1}^{g}\left(\frac{Y_j}{Y}\right)ln\left(\frac{Y_j/Y}{N_j/N}\right)$

Source: Formulae based on Haughton and Khandker (2009).

The two Theil inequality measures can take values between 0 and ∞. If incomes in a society are equal then both indices take the value 0. However, both coefficients differ with respect to their maximum values. These depend on the number of observations; so that only proportionate changes can be meaningfully compared (see Schwarze 2013, p. 192).

6   Inequality decomposition with respect to working-time, gender and region

In the general discussion about earnings inequality, two questions are of importance: What is the impact of part-time and full-time employment and gender controlling for regional differences between East and West Germany on earnings inequality in Germany? And second, what is the impact of the increase in part-time employment and change in female participation rates on the increase in earnings inequality? Given the differences with respect to working-time, gender and region discussed earlier it is reasonable to assume that these factors also affect earnings inequality.

To answer both questions a decomposition analysis of monthly individual earnings in Germany is done in the following according to the specification described in the previous section. Descriptive statistics of the main decomposition components are presented in Table 4. As the basis for the analysis the Theil$_1$ index is selected given that it puts equal weight to earnings levels over the entire distribution. Independent of the chosen inequality measure overall earnings inequality increased during the evaluation period. The Theil$_1$ index of our sample increased from 0.150 to 0.229 between 1995 and 2014.

Table 4: *Components decomposition (monthly individual labour earnings)*

	1995	2000	2005	2010	2014	1995-2000	2000-2005	2005-2010	2010-2014	1995-2014
Mean (in Euro)										**in %**
Overall	2.470	2.578	2.502	2.412	2.416	4.3	-2.9	-3.6	0.2	-2.2
FT_east_male	2.108	2.266	2.443	2.406	2.504	7.5	7.8	-1.5	4.1	18.8
FT_east_female	1.920	2.089	2.132	2.240	2.346	8.8	2.0	5.1	4.7	22.2
FT_west_male	3.225	3.440	3.458	3.365	3.411	6.7	0.5	-2.7	1.4	5.8
FT_west_female	2.360	2.506	2.592	2.701	2.717	6.2	3.4	4.2	0.6	15.1
PT_east_male	1.140	1.416	831	833	869	24.2	-41.3	0.2	4.4	-23.7
PT_east_female	1.172	1.153	1.295	1.216	1.171	-1.6	12.3	-6.1	-3.7	-0.1
PT_west_male	1.287	1.428	1.340	1.031	1.008	11.0	-6.2	-23.0	-2.2	-21.7
PT_west_female	1.077	1.179	1.098	1.081	1.142	9.4	-6.9	-1.5	5.6	6.0
Population Share (in %)										**in percentage points**
FT_east_male	10.3	9.0	7.6	7.6	7.5	-1.3	-1.5	0.1	-0.2	-2.9
FT_east_female	6.2	5.6	4.3	4.6	4.8	-0.5	-1.4	0.4	0.2	-1.3
FT_west_male	45.6	43.5	40.6	37.3	36.5	-2.1	-2.9	-3.4	-0.7	-9.1
FT_west_female	19.4	19.4	19.2	20.0	18.6	0.0	-0.2	0.8	-1.3	-0.7
PT_east_male	0.3	0.6	0.7	0.8	1.0	0.3	0.1	0.1	0.2	0.7
PT_east_female	2.0	2.3	3.1	3.7	3.7	0.4	0.7	0.6	0.1	1.8
PT_west_male	1.9	2.8	3.6	4.1	5.0	0.9	0.8	0.5	0.9	3.0
PT_west_female	14.4	16.6	21.0	21.9	22.8	2.3	4.4	0.9	0.9	8.5
Income share (in %)										**in percentage points**
FT_east_male	8.8	7.9	7.4	7.6	7.7	-0.9	-0.6	0.2	0.1	-1.1
FT_east_female	4.8	4.6	3.6	4.3	4.7	-0.2	-1.0	0.7	0.4	-0.1
FT_west_male	59.6	58.1	56.2	52.0	51.6	-1.5	-1.9	-4.2	-0.4	-8.0
FT_west_female	18.5	18.8	19.9	22.4	21.0	0.3	1.0	2.5	-1.4	2.5
PT_east_male	0.1	0.3	0.2	0.3	0.4	0.2	-0.1	0.0	0.1	0.2
PT_east_female	0.9	1.1	1.6	1.9	1.8	0.1	0.5	0.3	0.0	0.9
PT_west_male	1.0	1.6	1.9	1.8	2.1	0.6	0.4	-0.2	0.3	1.1
PT_west_female	6.3	7.6	9.2	9.8	10.8	1.4	1.6	0.6	1.0	4.5
Relative mean										**in percentage points**
FT_east_male	85.3	87.9	97.7	99.8	103.6	3.0	11.1	2.1	3.9	21.4
FT_east_female	77.7	81.1	85.2	92.8	97.1	4.3	5.1	9.0	4.6	24.9
FT_west_male	130.5	133.5	138.2	139.5	141.2	2.2	3.6	0.9	1.2	8.1
FT_west_female	95.6	97.2	103.6	112.0	112.4	1.7	6.6	8.1	0.4	17.7
PT_east_male	46.2	54.9	33.2	34.5	36.0	19.0	-39.5	4.0	4.2	-22.0
PT_east_female	47.4	44.7	51.8	50.4	48.5	-5.7	15.7	-2.6	-3.9	2.1
PT_west_male	52.1	55.4	53.6	42.7	41.7	6.3	-3.4	-20.2	-2.4	-19.9
PT_west_female	43.6	45.7	43.9	44.8	47.3	4.9	-4.0	2.2	5.4	8.4
Theil 1-Index										**in %**
Overall	0.150	0.169	0.209	0.228	0.229	12.6	23.7	9.2	0.4	52.7
FT_east_male	0.064	0.076	0.103	0.119	0.102	19.9	34.5	15.3	-13.8	60.3
FT_east_female	0.067	0.079	0.121	0.172	0.135	18.5	53.4	42.1	-21.6	102.5
FT_west_male	0.086	0.093	0.104	0.107	0.118	8.1	12.1	2.7	9.9	36.8
FT_west_female	0.074	0.080	0.089	0.125	0.102	7.6	11.5	41.3	-18.6	38.1
PT_east_male	0.187	0.323	0.406	0.539	0.476	73.3	25.5	33.0	-11.8	155.1
PT_east_female	0.120	0.231	0.218	0.273	0.236	92.1	-5.8	25.3	-13.4	96.1
PT_west_male	0.320	0.407	0.606	0.451	0.442	27.2	49.0	-25.6	-2.1	38.1
PT_west_female	0.223	0.228	0.268	0.285	0.277	2.4	17.6	6.4	-2.8	24.4

Note: Analysis is based on individual monthly gross earnings (in prices of 2010). The group of part-time male employees in East Germany has less than 65 observations before 2000 and has to be taken with caution. FT = full-time, PT = part-time.

Source: SOEP 31l, own calculations.

6.1 What factors explain income inequality in Germany?

To answer the first question overall earnings inequality is decomposed into a between-group and a within-group inequality component for selected years (Table 5).

Table 5: *Inequality decomposition by groups for selected years*

Year	Theil 1-index	Between-component	Within-component	FT_east_male	FT_east_female	FT_west_male	FT_west_female	PT_east_male	PT_east_female	PT_west_male	PT_west_female
		all	all								
1995	0.150	0.058	0.092	0.006	0.003	0.051	0.014	0.000	0.001	0.003	0.014
	(100.0)	(38.6)	(61.4)	(3.7)	(2.1)	(34.1)	(9.1)	(0.1)	(0.7)	(2.1)	(9.3)
2000	0.169	0.063	0.106	0.006	0.004	0.054	0.015	0.001	0.002	0.006	0.017
	(100.0)	(37.4)	(62.6)	(3.6)	(2.1)	(31.9)	(8.9)	(0.6)	(1.4)	(3.8)	(10.3)
2005	0.209	0.080	0.129	0.008	0.004	0.059	0.018	0.001	0.003	0.012	0.025
	(100.0)	(38.4)	(61.6)	(3.6)	(2.1)	(28.0)	(8.4)	(0.5)	(1.7)	(5.6)	(11.8)
2010	0.228	0.086	0.143	0.009	0.007	0.056	0.028	0.001	0.005	0.008	0.028
	(100.0)	(37.6)	(62.4)	(4.0)	(3.2)	(24.4)	(12.3)	(0.7)	(2.2)	(3.5)	(12.2)
2014	0.229	0.088	0.141	0.008	0.006	0.061	0.021	0.002	0.004	0.009	0.030
	(100.0)	(38.4)	(61.6)	(3.4)	(2.8)	(26.4)	(9.3)	(0.7)	(1.9)	(4.0)	(13.0)

Note: Analysis is based on individual monthly gross earnings (in prices of 2010). Decomposition refers to the $Theil_1$-index which is divided into the between- and the within-inequality component. Numbers in parentheses refer to the group-specific contribution to overall inequality in percentage.

Source: SOEP 31l, own calculations.

The between-group component is that part of inequality that is explained by differences in average earnings between the various groups. It also takes the composition of the workforce into account. Technically groups with average earnings above the population mean earnings contribute a positive amount to inequality via the between-group component and groups with average earnings below decrease the between-group component. Practically the between group inequality component compares average earnings of a subgroup with average earnings of the total sample. By taking the importance of a subgroup (here measured by the income share) into account, the significance of the earnings dispersion of a group to overall inequality is determined. Roughly 40 % of earnings inequality is the result of earnings differentials between different groups while the remaining 60 % is explained by earnings differentials within these groups. This divide has remained fairly stable over time (see columns 2-3 in Table 5).

The within-group component is that part of inequality that is explained by the dispersion of earnings within each subgroup. As expected, inequality in all groups of part-time working employees is higher than in the full-time working groups ($Theil_1$ indices in Table 4). Inequality within each subgroup was higher in 2014 than in 1995. In Table 5 the within-group inequality is further

decomposed into the eight group-specific contributions. It can be seen that male full-time employees in West Germany are the most important group in the sample. In 1995 more than one third of overall inequality was explained by the inequality within this group. Furthermore, almost 10 % each were explained by the dispersion of earnings of full-time and part-time working females in West Germany. In 2014 still almost half of overall inequality can be explained by the dispersion of earnings in these three groups. The impact of the dispersions of earnings in the group of full-time working men in West Germany goes back over time, but at the same time the impact of the group of part-time working females in West Germany increases.

6.2 What effect had the change in the composition of the workforce on the increase in inequality in Germany?

The composition of earnings inequality is interesting because it shows the main contributors to inequality and therefore provides valuable insights in how inequality can possibly be reduced. However, equally interesting is to find out what has actually driven the increase in inequality. Given that changes in earnings inequality can be caused by earnings changes between groups, by earnings changes within different groups or changes in the composition of the work force, the decomposition analysis for the change in earnings inequality is a bit more complex. Following the decomposition method proposed by Mookherjee and Shorrocks (1982) we can write the change in earnings inequality as the sum of the following three components:

$$
\Delta Theil_1 = \sum_{j=1}^{g} \left[\left(\frac{Y_j}{Y} \right)^{T-1} \left[GE(1)_j^T - GE(1)_j^{T-1} \right] \right] + \sum_{j=1}^{g} \left[\left(\frac{Y_j}{Y} \right)^{T-1} \left[ln \left(\frac{\bar{y}_j}{\bar{y}} \right)_j^T - ln \left(\frac{\bar{y}_j}{\bar{y}} \right)_j^{T-1} \right] \right]
$$
$$
+ \sum_{j=1}^{g} \left[\left[\left(\frac{Y_j}{Y} \right)^T - \left(\frac{Y_j}{Y} \right)^{T-1} \right] \left[ln \left(\frac{\bar{y}_j}{\bar{y}} \right)_j^T + GE(1)_j^T \right] \right],
$$

where the first term refers to the change in inequality that is due to the change of inequality within-groups, the second term reflects the change in inequality due to differences between groups and the third term is that part of the change in inequality that can be explained due to the compositional change of the workforce. T indicates the year.

Figure 4 represents the $Theil_1$ decomposition into the three components for different time intervals. It can be seen that the between-group inequality (blue bars) was the main driver in the increase in inequality between 1995 and 2014. Without any other changes the pure dispersion of mean incomes would actually have increased the $Theil_1$ index by 0.107 points, which is far more than the actual increase of 0.079 points.

The within-group inequality (red bars) also increased overall inequality between 1995 and 2010 but had a small inequality reducing impact after 2010. The sole increase of inequality within the different groups would have increased overall inequality by 0.037 points between 1995 and 2014.

Interestingly, the compositional changes of the workforce (green bars), e.g. the increasing part-time rates, had an inequality reducing impact over the whole time span, but it was by far not strong enough to outweigh the inequality increasing forces.

Half of the increase in inequality happened between 2000 and 2005. The remaining increase in inequality took place equally between 1995 to 2000 and 2005 to 2010. After 2010, inequality stagnated more or less and therefore this period of time plays no significant role in explaining rising inequality.

Figure 4: *Contribution to the change in inequality for different periods of time and different groups Overall inequality*
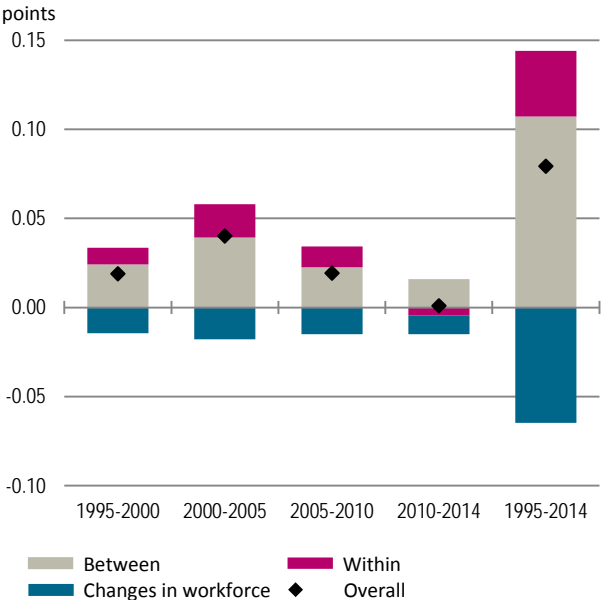
Note: Analysis is based on individual monthly gross earnings (in prices of 2010). Decomposition refers to the change in the Theil$_1$-index which is divided into the change in the between- and within-inequality component and a component capturing the impact due to the change in the composition of the workforce.

Source: SOEP 31l, own calculations.

To understand the underlying forces a closer look at each of the three components separately is necessary. Additionally, given that monthly earnings are the product of hours worked and the wage rate, changes in earnings inequality could also be influenced by changes in the working-time. However, this is not the subject in the following, but will be addressed in a separate paper (see Stein and Herzog-Stein 2018).

6.3 Between-group inequality

Overall, changes in between-group inequality are driven by diverging mean earnings and thus reflect the impact of differences in the development of mean earnings of various subgroups. Looking at the German data in more detail reveals that full-time workers experienced much larger increases in their average earnings than part-time employees which partly even experienced decreasing earnings (Table 4). Given that, it is actually the change in the relative mean that matters for the between-group inequality, all four full-time working groups contributed, therefore, positively to the increase of between-group inequality as can be seen in Figure 5 (left panel). Among them, the two largest groups in the labour market with a stronger than average increase in mean earnings - males and females in West Germany - were the main drivers of between-group inequality. Together they are responsible for more than 70 % of the increase in between-group inequality. The groups of full-time working employees in East Germany drove between-group inequality and surprisingly also the group of part-time working females in West Germany, which experienced over the whole period of time (although small) an above average increase in mean earnings.

Figure 5: *Groups contributions to inequality*

Note: Analysis is based on individual monthly gross earnings (in prices of 2010). Decomposition refers to the change in the $Theil_1$-index which is divided into the change in the between- and within-inequality component and a component capturing the impact due to the change in the composition of the workforce.

Source: SOEP 31l, own calculations.

Furthermore, more insights are obtained when we consider different periods of time. More than one third of the entire between-group effect took place between 2000 and 2005. Here, the overall average income fell and mean incomes of the groups diverged particularly strongly (Table 4).

Part of the change of the between-group inequality can certainly be explained by changes in working hours. However, working-time changes are unlikely to be the main reason for the different developments of earnings among the various groups of full-time working employees.[17]

6.4 Within-group inequality

In Figure 5 (middle panel) the change in within-group inequality is broken down into the eight group specific contributions, illustrating how much of the change in overall inequality is caused by changing earnings dispersion within a particular group. Depending on the importance of a group (here measured by the income share in the base year) the within-group component of each group can have large effects even though the rise in earnings dispersions within a group might have been relatively small.

Earnings dispersion increased within each of the eight groups (see group-specific $Theil_1$-indices in Table 4) and therefore each of them contributed positivity to the overall increase in inequality between 1995 and 2014. In 1995 inequality was lowest in the group of full-time working males and females in East Germany. In 2014, the groups of full-time males in East Germany and full-time females in West Germany had the smallest earnings inequality. Inequality among full-time females and part-time working males in East Germany increased particularly strong.

Interestingly, the increase in within-group inequality is not the result of increasing heterogeneity within the groups of part-time working employees as we might expect. Most of the increase in within-group inequality is the result of the increasing earnings dispersions within the groups of full-time working employees. More than half is caused by the group of full-time working men in West Germany.

Some interesting facts emerge by looking in more detail at changes to within-group inequality over time. Figure 5 (middle panel) reveals that a significant part of the increase in inequality was caused by the groups in West Germany. Furthermore, half of the increase in within-group inequality took place between 2000 and 2005. The other half of the increase happened more or less equally between 1995 and 2000, and 2005 and 2010.

During 2000 and 2005 it was mainly the group of full-time working men in West Germany which drove the increase in within-group inequality, between 2005 and 2010 it was the group of full-time

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[17] The role of hours worked is discussed in Stein and Herzog-Stein (2018).

working females in West Germany. During 2010 and 2014 earnings dispersion declined in all groups except in the group of full-time working men in West Germany. Thus, despite a negative change in overall within-group inequality during this period of time, the increasing earnings dispersion among full-time working men in West Germany, contributed strongly to the overall increase in inequality.

6.5   Compositional changes of the workforce

The third component measures the effect of compositional changes on the change in inequality. Overall, the pure change in the composition of the workforce, ceteris paribus, would have actually reduced inequality by 0.065 points Figure 5 (right panel). Intuitively this makes sense given that the continuously decreasing share of full-time working employees is replaced by an increasing share of part-time working employees with below average earnings. This is also true for each of the four subgroups: male_east, male_west, female_east, female_west (Figure 3).

However, the pure decrease in earnings inequality due to the increasing part-time rates implies also that average earnings in the population decrease. This reveals that in the case of this part-time effect there is a trade-off between the reduction of earnings inequality and the economic well-being (measured by average earnings) of the population.

The inequality reducing impact of the compositional component was a continuous process and observable in all of the four sub-periods. Thereby, the reduction in employment of full-time working men in West Germany and the employment gains of part-time working females in West Germany had the highest inequality reducing impact on the compositional inequality component.

Full-time female employment in West Germany developed differently. In contrast to the general trend of falling full-time rates, there was no fall in the population share of the group of full-time working females in West Germany between 1995 and 2010 and due to above average earnings, the earnings share of this group increased significantly by almost 4 percentage points. Additionally, since 2001 the mean income of the group of full-time working females in West Germany is above the population mean earnings. Altogether this worked out inequality-enhancing from 1995 until 2010, particularly strong between 2005 and 2010.

7   Summary

The on-going debate about income inequality in Germany and first signs that income inequality could be on the rise again (Grabka and Goebel 2017) are the starting point to deal more intensively with the evolution of earnings inequality over time. As earnings account for about 90 percent of total

market income they are crucial for obtaining a better understanding of the development of overall inequality. This paper contributes to the literature on inequality by decomposing the Theil-index with respect to different groups of employees according to working time, gender and region. The analysis quantifies how much of the of the overall increase in earnings inequality is due to changes in earnings differentials between different groups, changes in earnings inequality within groups and changes in the compositional structure of the work force caused by an increasing share of part-time work and a higher female participation rate effected earnings inequality.

The decomposition analysis showed that there were a variety of different forces at work causing earnings inequality in Germany to change in both directions over the last 20 years. The principal reasons for the overall increase in inequality between 1995 and 2014 were a mixture between the diverging spread of average earnings of various groups (between-group inequality) and increasing wage dispersions within groups (within-group inequality) which outweighed the inequality-reducing impact due to the changing employment structure (compositional effect).

The increasing share of part-time workers without any other effects would have led actually to a decrease in inequality. However, despite the inequality-reducing impact of the compositional inequality component, overall inequality increased between 1995 and 2010 due to increasing wage dispersions between and within groups. The first effect was about twice as large as the latter. Although earnings dispersion between groups kept increasing further after 2010 there is no further increase in overall earnings inequality because besides the inequality reducing impact of the compositional change of the workforce also earnings dispersions within groups slightly decreased (Figure 5).

Between-group inequality kept increasing over the whole period of time due to the fact that mean earnings of the various groups developed so differently. While the mean earnings of the total population actually fell in the period under consideration, mean earnings of the groups with full-time workers increased and mean earnings of the groups with part-time workers fell or increased only moderately. As a consequence relative earnings[18] of full-time working men in West Germany are higher than ever. That means that their earnings are more than 40 % higher than the average earning in the population in 2014. The gap used to be 30 % in 1995. In contrast part-time workers earn on average less than half of the population mean. Thus interestingly, it is not predominantly the part-time effect (which indirectly might be influenced by hours worked) which caused the increase in earnings inequality.

Overall, the increase in inequality in individual earnings is driven by the groups of full-time working employees due to above average increases in earnings and also increasing wage dispersions

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[18] The relative mean is the average group earnings divided by population average earnings.

within these groups (Table 6). Part-time employment actually had overall an inequality decreasing impact mainly due to the compositional effect. Despite the highest increase of inequality within the employment groups in East Germany, the overall impact on inequality in Germany is limited because workers in East Germany have together an income share of less than 15 %. Therefore, not surprisingly, developments with respect to the groups of employees in West Germany can explain a large part of the overall increase in inequality. Gender differences did not play a significant role.

Table 6: Overall contribution of groups to the change in inequality for selected periods of time

	Overall contribution by group								
	FT_east_ male	FT_east_ female	FT_west_ male	FT_west_ female	PT_east_ male	PT_east_ female	PT_west_ male	PT_west_ female	all
1995-2000	5.3	3.7	14.7	5.6	-0.2	-0.3	0.6	-5.3	24.0
2000-2005	12.6	5.8	23.6	18.9	-1.0	-1.3	3.2	-11.4	50.5
2005-2010	3.8	7.1	-14.5	36.3	0.2	-0.8	-8.4	0.6	24.3
2010-2014	2.3	1.0	12.1	-9.4	-0.6	-1.5	-2.5	-0.2	1.2
1995-2014	24.0	17.5	35.9	51.5	-1.6	-3.8	-7.1	-16.3	100.0

Note: Analysis is based on individual monthly gross earnings (in prices of 2010). Decomposition refers to the change of the $Theil_1$-index. Numbers refer to the overall group-contributions to the change in inequality in percentage, which is the sum of the group-specific contributions to the between-group and within-group inequality component and the component capturing the impact due to the change in the composition of the workforce

Source: SOEP 31l, own calculations.

Noticeable are two inequality enhancing effects still observable after 2010. First, the gap between mean earnings of the various groups continued to rise with the consequence that between-group inequality increased further. Second, earnings dispersion within the group of full-time working males in West Germany kept increasing. Due to its size, it had a measureable inequality enhancing effect via the within-group inequality component.

8   What have we learned about earnings inequality?

From the decomposition analysis we have learned some lessons. Without changes in the composition of the workforce, i.e. the continuous trend towards more part-time work, earnings inequality would actually have continued to rise after 2010. Therefore, in order to stabilise or to reduce earnings inequality we need to diminish both between- and within-group inequality.

The compositional effect did not only have an inequality reducing impact but it also reduced average earnings in the population. Therefore, we have to be aware that in the case of an increasing share of part-time work there is a trade-off between the reduction of earnings inequality and the economic well-being in terms of average incomes of the population.

The between-group inequality, the spread of mean earnings of the different groups in the labour market, is higher than ever. While average earnings of full-time working men in West Germany are now more than 40 % higher than average earnings of the population, average earnings of part-time working men in East Germany are only 36 % of average earnings. So, for instance, for a decrease in between-group inequality, mean incomes of part-time employees need to increase relatively more than those of full-time employees.

Given that earnings are the product of hours worked and the hourly wage rate, there are two ways this could be achieved, either if part-time working employees increase their number of hours worked or if their hourly wages would rise quicker. In Stein and Herzog-Stein (2018) it is shown that in fact both factors were responsible for the rise in earnings inequality in Germany.

A change in within-group inequality can only be achieved if the heterogeneity of earnings within groups changes. Earnings dispersions within all groups in the labour market have increased over time. For a reduction in earnings dispersions, earnings at the bottom of the distribution would need to rise quicker or earnings at the top of the distribution need to be compressed.

Overall, looking at the group-specific contributions to the increase in within-group inequality of earnings reveals that more than 80 % of this increase was caused by the groups of full-time working employees, in particular males in West Germany. The fact that within-group inequality of full-time working males in West Germany kept rising after 2010 shows that it is not enough to focus only on the groups of employees in precarious work or non-standard employment. In fact it is necessary to deal with the evolution of earnings inequality within the group of employees in core employment. In our case, measurable effects could already be achieved by concentrating on the largest group in the labour market, e.g. the group of full-time working men in West Germany. Therefore, independent of the policy aim, policy measures to reduce inequality need always to be designed in such a way that they take the whole work force into account in order to achieve measurable effects.

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