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Gender Differences in German Wage Mobility

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ABSTRACT

Gender Differences in German Wage Mobility*

This paper analyzes the evolution of wage inequality and wage mobility separately for men and women in West and East Germany over the last four decades. Using a large administrative data set which covers the years 1975 to 2008, I find that wage inequality increased and wage mobility decreased for male and female workers in East and West Germany. Women faced a higher level of wage inequality and a lower level of wage mobility than men in both parts of the country throughout the entire observation period. The mobility decline was sharper in East Germany so that the level of wage mobility has fallen below that of West Germany over time. Looking at long-term mobility, a slowly closing gap between men and women is observed.

JEL Classification: J31, D63

Keywords: wage mobility, wage inequality, administrative data

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NON-TECHNICAL SUMMARY

Studying wage dynamics has been a key element of labor economics for a long time. One major finding is the widening of the wage distribution in most developed countries that started in the 1970s in several countries. In Germany, rising wage inequality was mainly driven by the disproportional wage increases in the upper-tail of the wage distribution in the 1970s before the lower-tail wage inequality started to increase since the 1990s as well. However, as long as individuals are able to move up the earnings distribution, a high degree of cross-sectional wage inequality is likely to exaggerate the extent of wage inequality over a working life.

Thus, for any analysis of the evolution of lifetime wage inequality it is important to also take individual wage mobility over time into account. Wage mobility is de fined as the change of an individual's relative position in the wage distribution between two periods. To this end, I make use of the regional file of the employment subsample of the Research Institute of the German Federal Employment Agency (SIAB data), which contains a 2% random sample of all social security records between 1975 and 2008 that cover approximately 80% of the overall German workforce.

This paper gives a descriptive overview of the evolution of wage inequality and wage mobility separately for men and women in West and East Germany over the last four decades. The results show that the increase in wage inequality was accompanied by a decrease in wage mobility for both sexes in West and East Germany. Women face a higher level of wage inequality and a lower level of wage mobility than men in West and East Germany throughout the entire observation period. The mobility decline was sharper in East Germany so that the level of wage mobility has fallen below that of West Germany. Overall, the impact of wage mobility on reducing wage inequality has become smaller over time.

The long time span of the data additionally allows for an analysis of long-term mobility, which is of particular interest as it gives insights on the chances of moving up the wage distribution over an individual's life cycle. Covering up to 24 years of a West German working life, I find that long-term wage mobility was higher for male than for female workers in all years. However, the wage mobility gender gap has been slowly closing over time as long-term wage mobility has slightly increased for women whereas it slightly decreased for men.

1 Introduction

According to Saez (2012), the top one percent of the earnings distribution in the US earned 10% of all income in 1980, but this share increased to 23% in 2007. This rise in wage inequality has lately fostered public attention (and tension) throughout the developed world. An additional prevailing concern is that those who are rich stay rich and those who are poor stay poor, i.e. wage mobility is perceived to be low.

Although the actual public debate prefers to concentrate on this extreme case of wage inequality at the very top of the earnings distribution, several studies have documented for a number of countries that wage inequality has been rising during the last decades also at lower percentiles (e.g. Autor et al. 2008, Acemoglu 2003, Levy and Murnane 1992).[1] While the upper-tail inequality, measured as 90/50 percentile ratio, for example in the US, has been increasing steadily since the 1980s, the lower-tail inequality (50/10 percentile ratio) rose sharply during the 1980s and flattened thereafter, see e.g. Goldin and Katz (2009).

One reason for the growing upper-tail wage inequality is due to the change in relative supply of skills that was not able to keep up with the change in relative demand that occurred due to rapid skill-biased technological change (Katz and Murphy 1992, Goldin and Katz 2008, Acemoglu and Autor 2012). The erosion of labor market institutions including labor unions as well as rising international trade, immigration, and outsourcing is often viewed to have contributed to rising wage inequality in the lower tail of the wage distribution, see e.g. Burtless (1995), Acemoglu (2003) and Goldin and Katz (2009). The job polarization in the highest- and lowest-wage occupations that is modeled by Autor et al. (2003) and documented, e.g., by Goos and Manning (2007) for the UK may serve as a further explanation for the diverging trends in upper-tail and lower-tail inequality. As a consequence of the technological progress - and in particular the implementation of

[1] In the US and in the UK, wage inequality began to rise in the 1970s whereas the continental European countries experienced the start of the increase in wage inequality about one decade later.

computer technology - machines substitute medium-paid routine tasks conducted by, e.g., craft manual workers and bookkeepers, see Spitz-Oener (2006) for evidence on Germany.[2] Furthermore, Card et al. (2012) find that rising wage inequality has been fostered by rising heterogeneity between workers, rising variability in the wage premiums at different establishments, and increasing assortativeness in the matching of workers to plants.

A full picture of the changing wage structure is, however, only adequately drawn if not only changes in wage inequality, but also changes in wage mobility are taken into account. If, for example, perfect mobility of wages were observed, low-wage earners in one period would have the same probability as high-wage earners to earn a high wage in the next period. In this case, rising wage inequality might be acceptable as a low-wage position would not be of permanent nature. In the other extreme case of perfect immobility of wages, all individuals would be bound to their wage position over time. Thus, a more unequal wage distribution would deteriorate the chances of low-wage workers to move up the wage ladder over the life cycle. In general, wage mobility can thus reduce cross-sectional wage inequality as was shown by, e.g., Gottschalk (1997) for the US and Hofer and Weber (2002) for several European countries. However, international studies suggest that for a large number of countries rising wage inequality was accompanied by declining wage mobility, which gives rise to rising persistence in low-wage employment, see e.g. Buchinsky and Hunt (1999) for the US and Dickens (2000) for the UK.[3]

The wage structure has also been changing in Germany over time, which is particularly interesting for two reasons: first, the German wage structure has long been considered relatively stable at the lower tail of the earnings distribution (Prasad 2004). This was likely due to labor market institutions, such as unions, and was consistent with the hypothesis of skill-biased technological change especially in the upper part of the wage distribution

[2]Antonczyk et al. (2009), however, find that the task-based approach can not explain the recent increase in wage inequality among male employees in Germany.

[3]Burkhauser et al. (1997) denote that a comparable development of US and German earnings mobility is achieved during the 1980s despite major differences in labor market institutions and a greater increase of inequality in the US.

(Fitzenberger, 1999). Since the mid 1990s, the lower-tail wage inequality has distinctly risen (Dustmann et al. 2009, Fuchs-Schündeln et al. 2010, Gernandt and Pfeiffer 2007) to which labor supply shocks, such as the slowdown of skill-upgrading, and strong deunionization are likely to have contributed (Antonczyk et al. 2010, Dustmann et al. 2009). Second, Gernandt (2009) shows in one of the very few studies on wage mobility in Germany that earnings mobility declined over the last decades using household panel data from the German Socio-Economic Panel (GSOEP). This finding is confirmed by Riphahn and Schnitzlein (2011), which is to the best of my knowledge the only study that analyzes both the evolution of wage inequality and wage mobility using German administrative data. Their evidence is based on the change in wage mobility for the overall working population in West and East Germany.

The aim of this paper is to investigate whether certain sub-groups of the population are especially prone to being immobile in their wages in the short and in the long run. I particularly concentrate on gender differences in West and East Germany when analyzing different wage inequality and wage mobility measures. For this purpose, I use administrative data from a 2% subsample of the German Employment Statistics Register (*SIAB* data). In contrast to survey data like the German Socio-Economic Panel (GSOEP), the *SIAB* offer much more individual observations and span (for West Germany) a longer time period from 1975 to 2008. Moreover, less attrition and less measurement errors can be expected as the sample is based on reports from employers in compliance with the notifying procedure for the German social security system.

That differences in wage mobility levels may exist between men and women might stem from various developments. On the one hand, the rising share of well-educated women might have contributed to rising wage mobility across women. On the other hand, there is evidence that men profit from higher wage increases when changing jobs (Gottschalk 2001, Weber 2002). Moreover women are more likely to stick to a low-paid job, which is of particular concern as the share of women in the low-wage sector is much greater than

the share of men (Aretz and Gürtzgen 2012). Thus, women's wage mobility is lower than men's at the low-wage threshold of 2/3 of the median wage. This result, however, gives only an imprecise picture of the development of wage mobility since it does not allow for any conclusion on the development of the rest of the wage distribution.

In international studies, the development of wage mobility by gender has been investigated along the entire wage distribution for various countries. Hofer and Weber (2002), for example, find that, except for Austria and the UK, women are more mobile in their wages than men in a number of OECD countries. The study also includes Germany, but uses the GSOEP for the analysis. The result for the UK is confirmed by Dickens (2000). Moving up the wage distribution being the main determinant of wage mobility, Kopczuk et al. (2010) find for the US that men have a much higher level of long-term upward mobility than women, but this upward mobility gender gap has been closing over time.[4]

The outline of this paper is as follows. Section 2 introduces the data set I use for my analysis and gives an overview on the inequality and mobility measures. The results on the evolution of wage inequality and short-term and long-term wage mobility are displayed in Section 3. Section 4 concludes.

2 Data and Measures

2.1 The SIAB data

The data set that I use for my analysis is taken from the regional file of the IAB employment subsample 1975-2008 (*SIAB*); for detailed information see Dorner et al. (2011). This administrative data set contains a 2% random sample of all social security records from 1975 to 2008 for West Germany and from 1992 to 2008 for East Germany. It includes employment records subject to social security contributions as well as unemployment records

[4]Regarding different developments of wage mobility for different individual groups, Raferzeder and Winter-Ebmer (2007), among others, suggest that young and well educated workers, workers who work for big companies and workers working in the service sector have higher probabilities of upward mobility, ceteris paribus.

with transfer receipt. The data contain the employment history of 1.6 million individuals and provide individual information on daily wages, workers' employment histories and a number of individual characteristics, such as age, education, nationality and occupational status. Approximately 80% of the German workforce are covered, but self-employed workers, civil servants, and individuals currently doing their military service are not included in the data set.

Although the *SIAB* covers a large time span and is subject to much less panel attrition compared to household surveys like the GSOEP, the data set has some disadvantages as well. First, as I only observe whether an individual works full-time or part-time (defined as working less than 30 hours per week), the data lack explicit information on the actual number of hours worked. For this reason, I restrict the sample to full-time workers. Second, the wage information is censored since retirement insurance contributions are only paid up to a fixed social contribution taxation threshold. Appendix C gives an exercise on why it might be advisable to use only the uncensored observations for my analysis rather than imputing wages for censored observations as suggested by Gartner (2005). Third, the wage information contains one-time payments, such as bonus payments, only since 1984. As Steiner and Wagner (1998) point out, ignoring this structural break between 1983 and 1984 leads to an increase in wage inequality. Hence, the method based on Fitzenberger (1999) is used to correct for this. For the analysis, I further restrict the sample to individuals aged between 20 and 55 years. Moreover, only those employment spells are used which overlap June 30th, thereby ensuring that each individual is not observed more than once per year.[5]

[5]If a worker worked for more than one employer in a year, a weighted average is computed where the weights represent the shares worked for each employer. To improve the education variable, I use the imputation rules derived by Fitzenberger et al. (2006). Due to the introduction of the Euro in 1999, all wages before 1999 are transformed from Deutschmark into Euros at a rate of 1 € = 1.95583 Deutschmark. Since the wage variable delivers unrealistic daily wages at the lower end of the wage distribution, all observations with earnings of less than 16 € per day (in prices of 1995) are excluded.

2.2 Wage inequality measures

To shed light on the development of the earnings inequality in Germany over time, different measures of wage inequality can be used. Given that the wage information is censored in the *SIAB*, the comparison of particular wage percentiles over time helps to overcome this limitation. Following Dustmann et al. (2009), I will use the 15th and 50th (50th and 85th) percentile for highlighting the development at the lower (upper) part of the earnings distribution. Moreover, the evolution of the spread between the 85th and the 15th percentile of the annual wage distribution is a first crude measure of overall wage inequality over time.

In order to use more information of the wage distribution, I also apply wage inequality measures that take into account the entire wage distribution (up to the censoring limit). The widely used Gini coefficient, for example, which fulfills desirable properties like mean independence, population size independence, and symmetry displays the level of wage inequality on a scale from 0 (no inequality meaning everyone earns the same income) to 1 (perfect inequality meaning the richest person earns all the income). More formally, it measures the average difference between all possible pairs of incomes in the population, expressed as a proportion of total income (see also Cowell 2011):

$$Gini = \frac{1}{2N^2\bar{y}} \sum_{i=1}^{N} \sum_{j=1}^{N} \mid y_i - y_j \mid, \tag{1}$$

where y_i (y_j) is the income of individual i (j), $\bar{y}$ is the average income of the population and N is the number of individuals in the population.

A third class of inequality measures stems from the family of generalized entropy inequality measures. In contrast to the Gini coefficient, which is particularly sensitive to the middle of the distribution, the Theil index is particularly sensitive to the top of the earnings distribution and is defined as follows:

$$Theil = \frac{1}{N}\sum_{i=1}^{N}\frac{y_i}{\bar{y}}log\left(\frac{y_i}{\bar{y}}\right). \tag{2}$$

The measure of mean log deviation (MLD), also known as Theil's L measure, is particularly sensitive to the lower part of the earnings distribution:

$$MLD = \frac{1}{N}\sum_{i=1}^{N}log\left(\frac{\bar{y}}{y_i}\right) \tag{3}$$

As before, y_i denotes the income of individual i, $\bar{y}$ is the average income, and N is the number of individuals. In contrast to the Gini coefficient, the Theil index as well as the MLD measure allow for additive decomposition between different groups. This is particular interesting in my case as I investigate wage inequality patterns across different subgroups of the population. If Y is the total income of the population, Y_j the income of the subgroup, N the total population and N_j the population of the subgroup, the decomposition of the Theil index is as follows:

$$\begin{aligned} Theil &= \sum_{i=1}^{N}\frac{y_i}{N\bar{y}}log\left(\frac{y_iN}{\bar{y}N}\right) = \sum_{i=1}^{N}\frac{y_i}{Y}log\left(\frac{y_iN}{Y}\right) \\ &= \sum_{j}\frac{Y_j}{Y}Theil_j + \sum_{j}\frac{Y_j}{Y}log\left(\frac{Y_j/Y}{N_j/N}\right) \end{aligned} \tag{4}$$

The first term in equation (4) displays the within-group inequality while the second term represents the between-group inequality. Similarly, the decomposition for the MLD measure is given by:

$$MLD = \sum_{i=1}^{N}\frac{1}{N}log\left(\frac{Y}{Y_iN}\right) = \sum_{j}\frac{N_j}{N}MLD_j + \sum_{j}\frac{N_j}{N}log\left(\frac{N_j/N}{Y_j/Y}\right). \tag{5}$$

Hence, the use of these measures allows to draw conclusions on inter- as well as intra-group inequality of the overall wage inequality observed.

2.3 Wage mobility measures

The wage inequality measures give insights into how the shape of the wage distribution has changed over time. However, movements within the wage distribution cannot be detected by these measures. A series of papers demand to consider wage mobility when dealing with changes in the wage distribution (e.g. Buchinsky and Hunt (1999), Dickens (2000), Cardoso (2006)).

A widely used mobility measure is the rank correlation coefficient, which measures the degree of similarity of, e.g., individual wages between two periods, thus enabling mobility analyses in the short and in the long run. The higher the rank correlation is, the lower will be wage mobility between the two periods. In order to specify whether different parts of the wage distribution differ with respect to the level of wage mobility, I furthermore look at quintile transition matrices. This allows to investigate whether and how many quintiles individuals have moved between two periods. Since such transition matrix approaches fail to capture the movement within each quintile so that mobility is likely to be underestimated, I additionally make use of the measure by Dickens (2000). This mobility measure is based on the degree of change in ranking from one year to the next and is derived in the following way:

$$M_D = \frac{2 \sum_{i=1}^{N} \mid F(w_{i,t+1}) - F(w_{i,t}) \mid}{N}, \tag{6}$$

where $F(w_{i,t})$ and $F(w_{i,t+1})$ are the cumulative distribution functions for earnings in year t and $t+1$, respectively, and N is the number of individuals. As the measure is twice the average absolute change in percentile ranking between year t and year $t+1$, it takes the minimum value 0 when there is no mobility, i.e. when each individual remains in the same percentile. Assuming independence of earnings in the two years would result in a value of 2/3 while the maximum value of 1 would correspond to the situation where the earnings in the two years are perfectly negatively correlated.

Moreover, in order to formalize the relationship between wage mobility and wage inequality, i.e. to measure the extent to which wage mobility reduces short-run wage inequality in the longer run, the Shorrocks index is applied (Shorrocks, 1978). If we consider a population of $i = 1, ..., N$ individuals observed in t consecutive periods and $y_{i,t}$ is the (short-term) earning of individual i in period t, then $\bar{y}_i = \sum_t y_{i,t}$ denotes the average (long-term) earnings of an individual i across T periods. If $Z = (y_1, ..., y_N)$ is a vector of individual earnings and an inequality measure $G()$ is defined that is a convex function of earnings relative to the mean, Shorrocks (1978) shows that it must hold that

$$G\left(\bar{Z}\right) \leq \sum_{t=1}^{T} G\left(Z_t\right)/T, \tag{7}$$

where Z_t is a vector of earnings in period t and $\bar{Z}$ is a vector of average individual earnings across T periods. The Shorrocks index M_S is then defined as

$$M_S = 1 - \frac{G\left(\bar{Z}\right)}{\sum_{t=1}^{T} G\left(Z_t\right)/T}. \tag{8}$$

The index thus compares the average of t period-specific inequality measures with inequality averaged over t periods. If the latter is smaller than the former, intertemporal mobility reduces short-run inequality. The smaller the ratio in equation (8) is, the greater will be the mobility, and the closer to 1 will be the Shorrocks Index. If both components are of the same size, no mobility is observed and the Shorrocks Index takes the value 0. As inequality measure G(), I will present the results using the Gini index to estimate the Shorrocks index and using a horizon of $T = 5$ years.

Furthermore, the long time dimension of the data set allows an analysis of long-term mobility in West Germany. This is of particular interest as it gives insights on the chances of moving up the wage ladder over an individual's life cycle. Therefore, I calculate the rank correlation of individual average earnings of a five-year period centered around period t and a five-year period centered around $t + k$, where $k = 10, 15, 20$ years, thus covering up

to 24 years of an individual working life.

3 Results

3.1 Development of wage inequality

Before studying the developments of wage mobility, it is worth to describe the overall development of wage inequality over time. Figure 1 plots the evolution of real wage growth at three different percentiles of the wage distribution (15th, 50th and 85th percentile) separately for men (Panel A) and women (Panel B).[6] The upper graphs (Panel 1) display the real wage growth for West Germany from 1975 to 1992 with 1975 as the base year. The middle and lower graphs show the real wage growth for West (Panel 2) and East Germany (Panel 3) from 1992 to 2008 with 1992 being the base year.

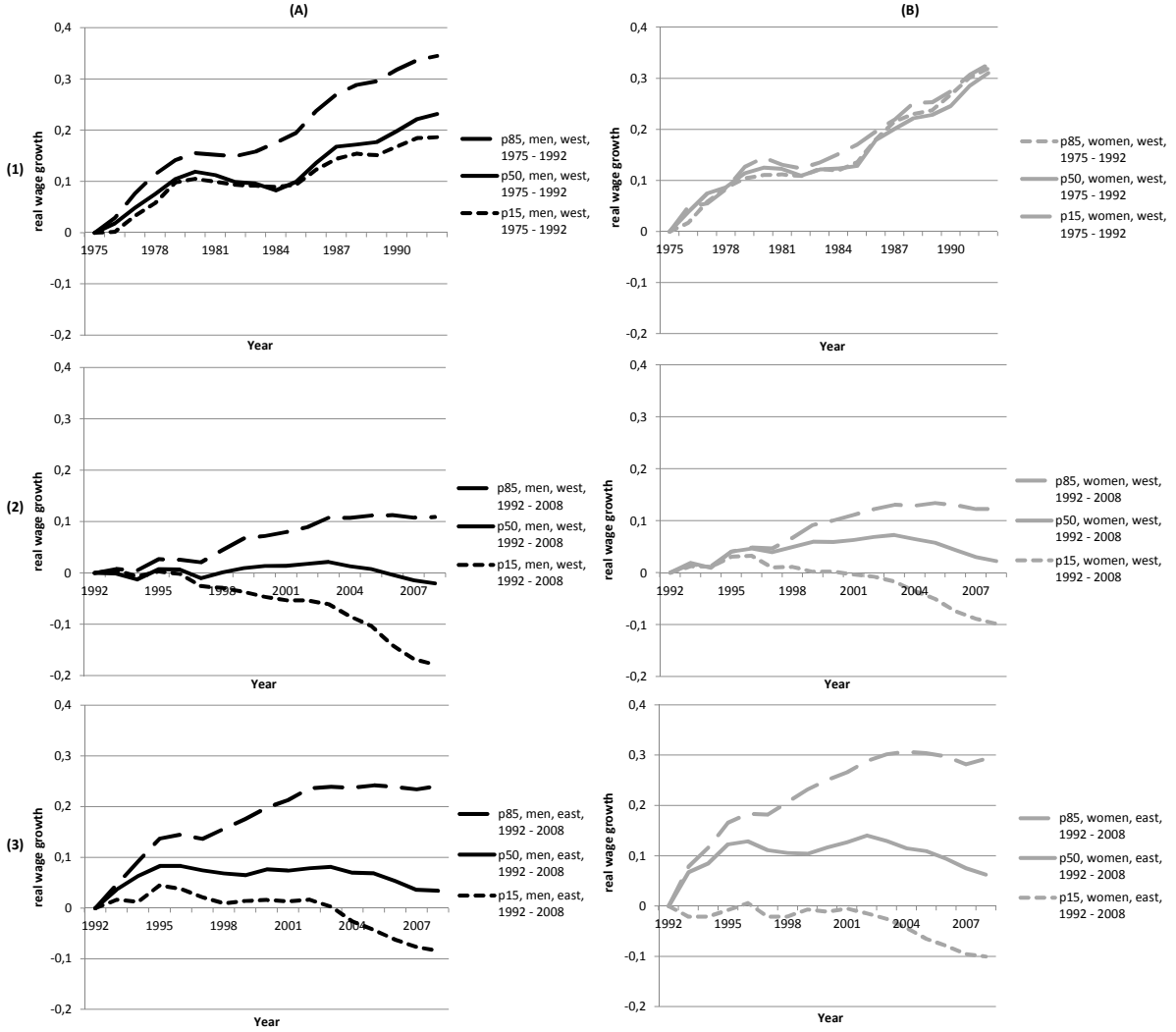
As can be seen from Panel 1A, male individuals at the 85th percentile experienced a distinct rise in real wages between 1975 and 1992 compared to individuals at the 15th and 50th percentile, whose real wages developed similarly over the observation period. For female workers, the real wages for all three wage groups increased similarly as for the men's 85th percentile (see Panel 1B). Since the beginning of the 1990s, the pattern of real wage growth has evolved quite differently for the lower, middle and upper part of the wage distribution for both sexes. While the growth of real wages continued for men and women at the 85th percentile before it attenuated at the beginning of the 2000s, the median male and female worker had about zero real wage growth between 1993 and 2008 in West Germany (Panel 2). During the same period, especially the male individuals at the 15th percentile experienced dramatic real wage losses that amounted to almost 20% while female's wages decreased by around 10% between 1992 and 2008.

A similar decrease in real wages of around 10% was observed for both men and women at the 15th percentile in East Germany (Panel 3). While the median workers' real wage

[6]The wages have been deflated by the German Consumer Price Index from the Federal Statistical Office.

growth stagnated for both men and women similarly as in West Germany, the wage growth of individuals at the 85th percentile in the East was much less pronounced between 1992 and 2008 than for their West German counterparts. All in all, Figure 1 confirms the findings of Dustmann et al. (2009) and Riphahn and Schnitzlein (2011).

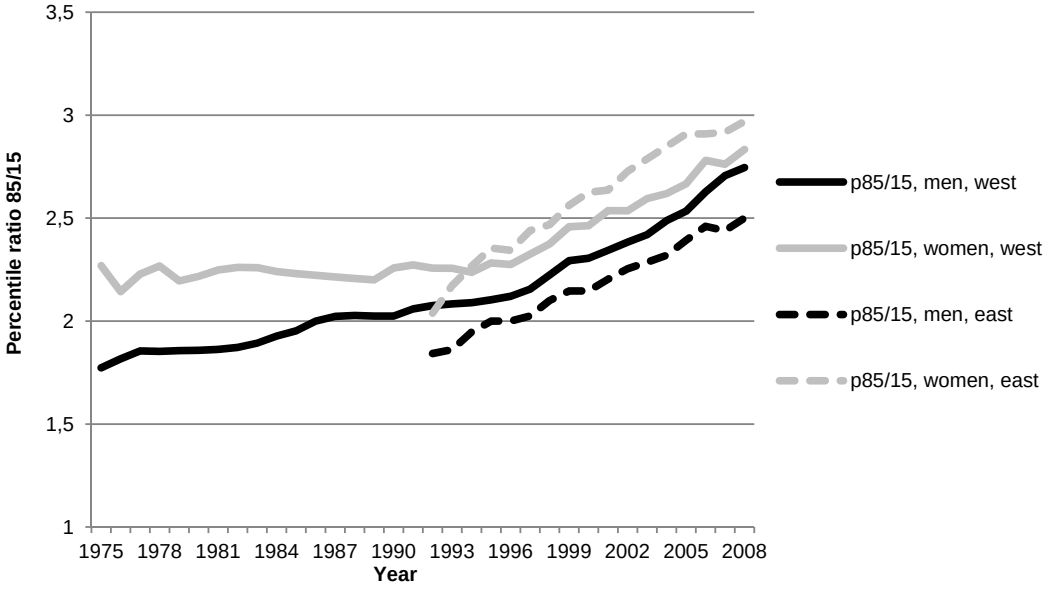
Figure 1: Real wage growth by gender and region, 1975 = 0, 1975 - 1992 and 1992 - 2008



While Figure 1 depicts relative values of the development of wages, Figure A1 in the Appendix displays the development of real gross daily wages by gender and region over time. The absolute difference in daily wages between West German male and female workers amounted to around 20€ per calendar day for individuals at the 15th and 50th percentile in 2008. At the 85th percentile, male workers earned 160€ per calendar day,

which is about 40€ more than their female counterparts. In East Germany, the absolute difference in the average real gross daily wage between men and women is much smaller. It is highest for individuals in the lower part of the wage distribution, where male workers at the 15th percentile earned about 40€ per calendar day in 2008, around 5€ more than their female counterparts.

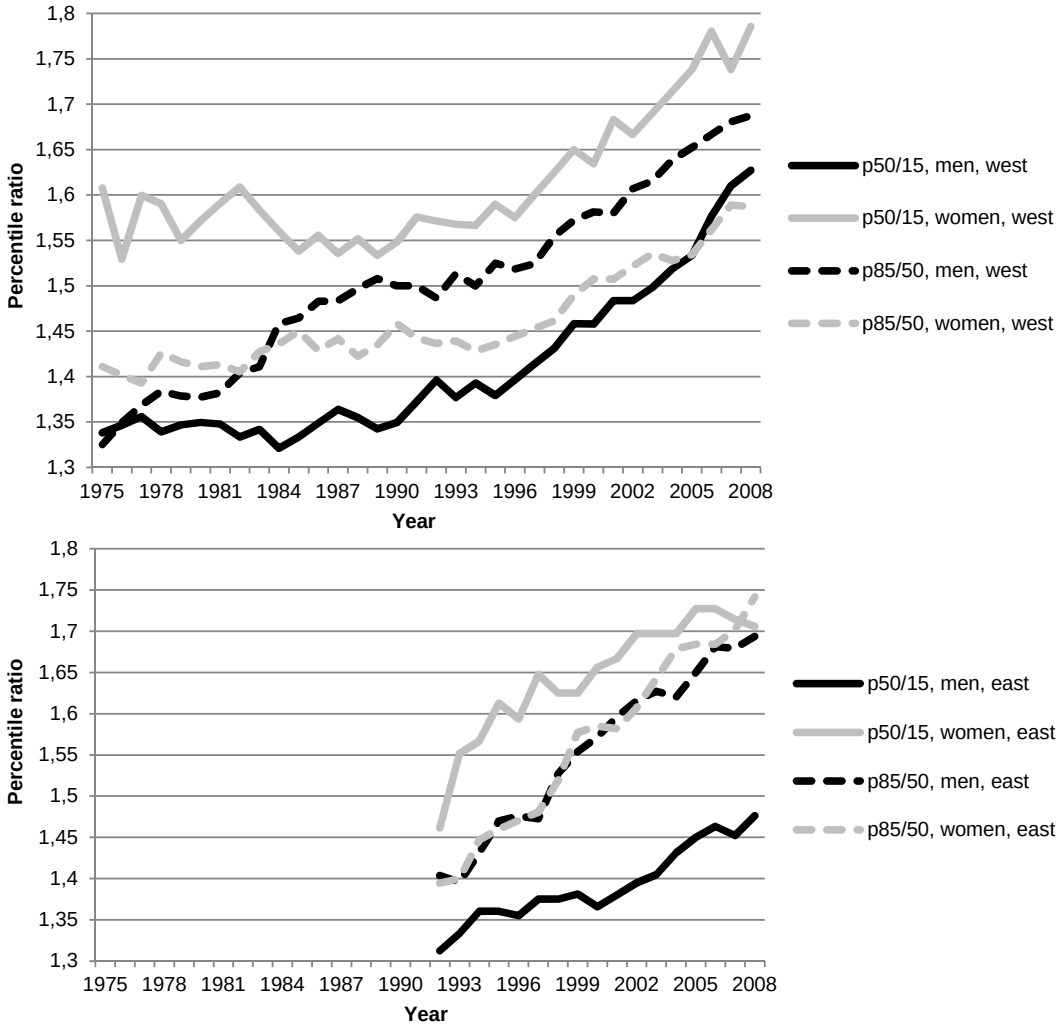
Figure 2: Evolution of the 85/15 percentile ratio, 1975 - 2008, by gender and region



As the different developments of wages at different percentiles in Figure 1 already suggest, wage inequality has been rising over the last decades. This is illustrated by the ratio of the 85th and 15th percentile in Figure 2, shown separately for East and West Germany and men and women. While West German men at the 85th percentile earned about 1.8 times the amount of male workers at the 15th percentile in 1975, the 85/15 percentile ratio increased slightly year by year until the mid 1990s to a ratio of 2.1 before it markedly grew to 2.7 in 2008. Due to the fact that wages are more evenly distributed along the wage distribution for men than for women, women's wage inequality has always been higher than men's throughout the entire observation period. For women, the 85/15 percentile ratio was 2.2 in 1975 and remained constant until the mid 1990s before it rose

to 2.8 in 2008. Hence, by now men's wage inequality has almost converged to the level of women's wage inequality in West Germany. A similar pattern holds for East Germany, where wages are also more unequal for women than for men, a finding consistent with Franz and Steiner (2000). For both sexes, there has been a distinct increase in wage inequality since the start of the observation period in 1992. For men (women), the 85/15 percentile ratio increased from about 1.8 (2.0) in 1992 to 2.5 (3.0) in 2008. Hence, in contrast to West Germany, the difference of the 85/15 percentile ratio between men and women has become slightly larger over time.

Figure 3: Evolution of upper- and lower-tail inequality by gender, 1975 - 2008, West Germany (top) and East Germany (bottom)



In order to shed light on the development of lower and upper-tail wage inequality, Figure 3 illustrates the evolution of the 85/50 and 50/15 percentile ratio by gender and region. Figure 3 reveals a pattern which is consistent for both regions and is in line with the results of, e.g., Kohn and Antonczyk (2011): while the upper-tail wage inequality surmounts the lower-tail inequality for men, the opposite is true for women. Thus, the fact that women's wage inequality is greater than that for men, as seen in Figure 2, results from the high level of women's lower-tail wage inequality. This observation is especially true for East Germany, where the level of upper-tail wage inequality has evolved very similarly for men and women over time, see the bottom part of Figure 3. The upper part of Figure 3 further demonstrates for West Germany that the slight increase in the male's 85/15 percentile ratio until the mid 1990s, as observed in Figure 2, is driven by upper-tail wage inequality as the 50/15 percentile ratio started to increase only at the beginning of the 1990s. This is in line with the findings of, e.g., Fitzenberger (1999) and Dustmann et al. (2009).

As the percentile ratios do not account for the full wage information of the wage distribution, it can only be seen as a first crude wage inequality measure. One measure which takes the whole wage distribution into account is the Gini coefficient. However, the results would be biased if one ignored the fact that the data set is censored at the social contribution threshold. Therefore, one can either decide to rely only on the uncensored observations and to disregard the wage information at the highest percentiles of the wage distribution. An alternative is to use the method by Gartner (2005) and to impute wages of individuals who earn at the social contribution threshold or above, which is the case for up to 14% (6%) of all male observations in West (East) Germany in each year, see Table A1 in the Appendix. Even when using the imputed wages, one still needs to be cautious with the interpretation of the Gini coefficient as the share of imputed observations is not constant over time. Appendix C gives an empirical exercise on the advantages and disadvantages of using either alternative. It turns out that the development of wage

inequality is rather insensitive with respect to the use of imputed wages for censored observations. As the analysis of wage mobility seems to be more sensitive with respect to using imputed wages - see Appendix C for more details - I rely only on observations with uncensored wages throughout my analysis. This has to be kept in mind when analyzing the results as, e.g., the wage inequality results will be rather underestimated.

Figure 4: Evolution of the Gini coefficient by gender and region, 1975 - 2008

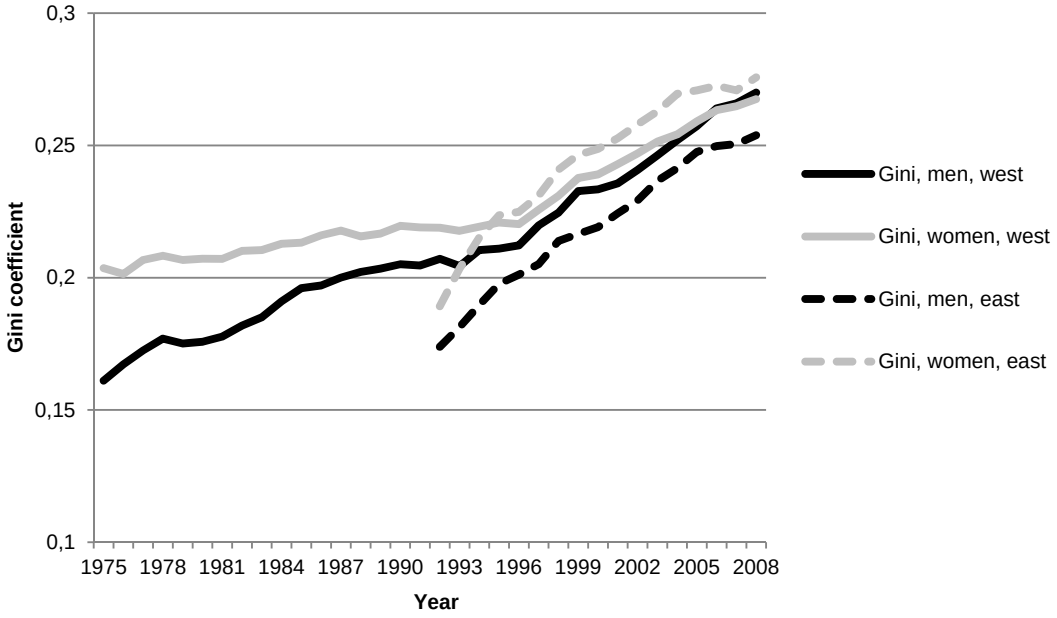


Figure 4 plots the development of the Gini coefficient by gender and region over time. The development of wage inequality using the Gini coefficient is comparable to the development of the 85/15 percentile ratio. The Gini coefficient, which was 0.20 for women and 0.13 for men in 1975, increased only slightly until the mid 1990s for both sexes before a distinct rise was observed for both men and women. In 2008, the Gini coefficient was 0.25 for women and 0.21 for men indicating that men's wage inequality has approached the level of inequality of women over time.[7] The development in wage inequality can

[7]The level of the Gini coefficient is comparable to Riphahn and Schnitzlein (2011) who use the same data set, but do not look at differences across gender. When the entire wage distribution is used, the wage inequality values are larger. According to the OECD (2010), the Gini coefficient increased by 0.04 percentage points for Germany since the mid 1980s to 0.28 in 2007. In international comparison, the Gini coefficient for Germany is rather low as the Gini coefficient across more than 100 countries ranges between 0.26 in Denmark being the most equal country in terms of wages and 0.71 in Namibia (United Nations, 2004).

be confirmed when the mean log deviation or other generalized entropy measures like the Theil index are used for measuring wage inequality, see Figure A2 in the Appendix, which examplarily shows the development of wage inequality using the mean log deviation as wage inequality measure.[8] This emphasizes that the observed wage inequality is not particularly sensitive to either the lower, middle, or upper tail of the wage distribution.

One advantage of using, e.g., the mean log deviation rather than the Gini coefficient as wage inequality measure is that inequality can be decomposed into a within and a between-inequality component. Within-inequality reflects in my case the inequality that exists within the same subgroup of men and women, respectively. Between-inequality catches all inequality that arises from differences across subgroups, i.e. men and women. Thus, if all men earned the same wage and women earned a different wage that were the same for all women, then wage inequality would be covered only by between-inequality. In the other extreme, had men and women the same distribution of earnings, all inequality would be due to within-inequality. As Shorrocks and Wan (2005) point out, the between-group component is usually small relative to the within-group component, especially when using earnings data. This is in fact what I find. While the within-group inequality amounted to 79% of the total wage inequality in 1975, this share gradually increased to explaining around 93% of the total inequality in 2008. The share in East Germany has been even higher throughout the observation period suggesting that the major part of wage inequality is driven by wage differences within one subgroup rather than by differences across subgroups.[9]

To sum up, I have documented a clear upward shift in wage inequality in West and East Germany for both men and women, especially since the mid 1990s. Women have faced a higher wage inequality than men through the entire observation period. While

[8]Further figures illustrating the evolution of wage inequality using other generalized entropy measures are provided by the author upon request.

[9]Using the GSOEP, Becker and Hauser (1994) find a share of within-inequality that is very close to my numbers when using the social status as subgroups for the decomposition of the German wage inequality between 1983 and 1990.

the difference in wage inequality between men and women has been slightly decreasing in the West, it has been slightly increasing in East Germany. In both regions, the upper-tail wage inequality has surmounted the lower-tail inequality for men whereas the opposite was true for women. As set out earlier, it is not only important to look at changes in wage inequality over time, but also to take into account how likely it is for workers to move up the wage ladder. A high degree of cross-sectional wage inequality is likely to exaggerate the extent of inequality over a working life as long as individuals are able to move up the earnings distribution. In the next subsection, I will therefore take a closer look at the development of short-term and long-term wage mobility in West and East Germany.

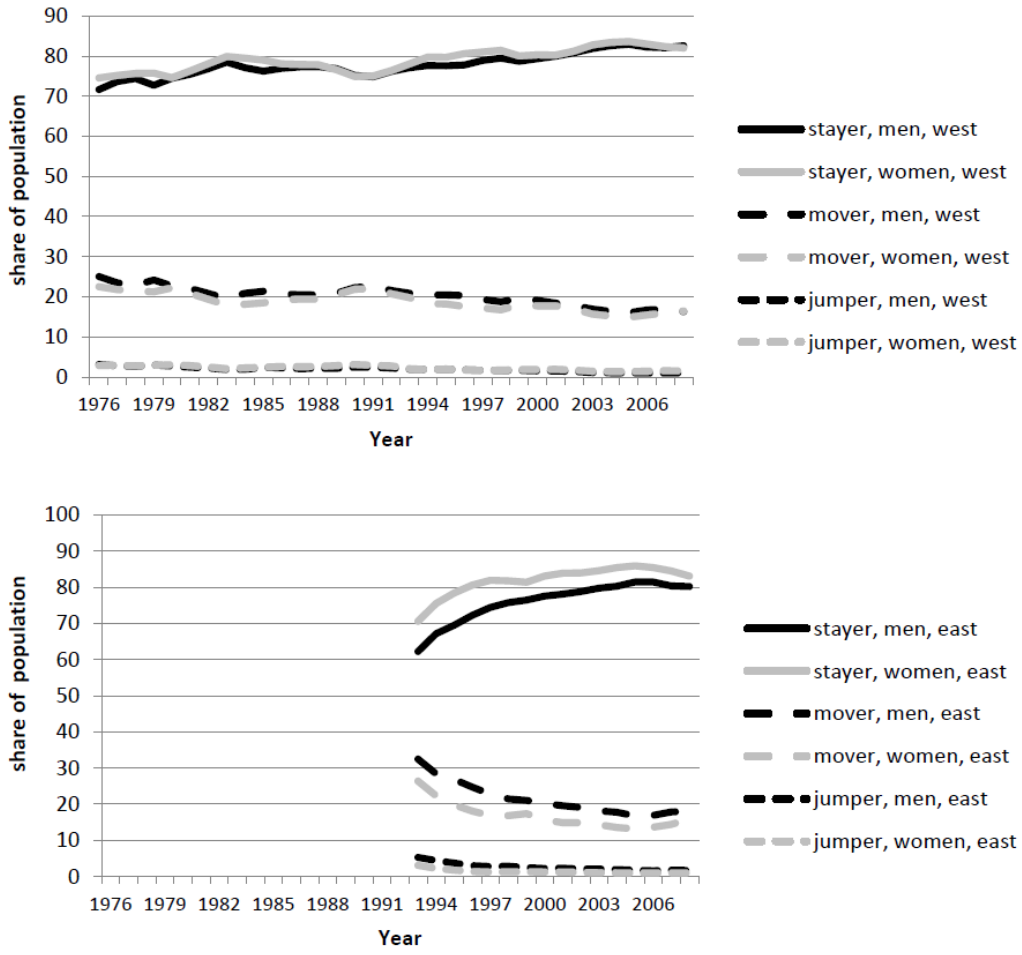
3.2 Development of wage mobility

3.2.1 Short-term mobility patterns

In order to measure wage mobility, the wage distribution is typically split up into different parts of the same size (e.g. percentiles, deciles, or in my case quintiles). In a next step, a matrix is built which reports the movement of individuals across quintiles from one period to another (e.g. $t-1$ and t). Figure 5 plots the evolution of one-year quintile transitions by gender for West (top) and East Germany (bottom). While the "stayers" represent those individuals who have stayed in the same quintile, a "mover" is a person who has moved to a neighbor quintile between $t-1$ and t. "Jumpers" are those individuals who have moved in the wage distribution by more than one quintile within one year.

The upper part of Figure 5 illustrates that the level of quintile transitions was very similar for West German men and women throughout the observation period. While the share of those individuals who stayed in the same quintile increased steadily from around 72% in 1976 to 82% in 2008, the share of individuals who moved by one quintile decreased from 25 to 18% at the same time. The share of individuals who moved by more than one quintile within one year was always below 5% and became even smaller over time.

Figure 5: Evolution of one-year quintile transitions by gender and region, 1976 - 2008



A similar trend towards less movement within the wage distribution can also be observed in East Germany, where the level of mobility was higher for men than for women throughout the observation period, see the lower part of Figure 5. The decreasing trend in wage mobility was especially pronounced during the 1990s when the share of individuals that remained in the same wage quintile one year later increased from 62% (70%) in 1992 to 78% (83%) in 2000 for men (women). In order to shed more light on which part of the wage distribution was particularly prone to wage immobility, Table A2 in the Appendix displays the percentage of quintile stayers for each quintile separately for male and female workers for the years 1993 and 2008. The table shows the typical result, as documented,

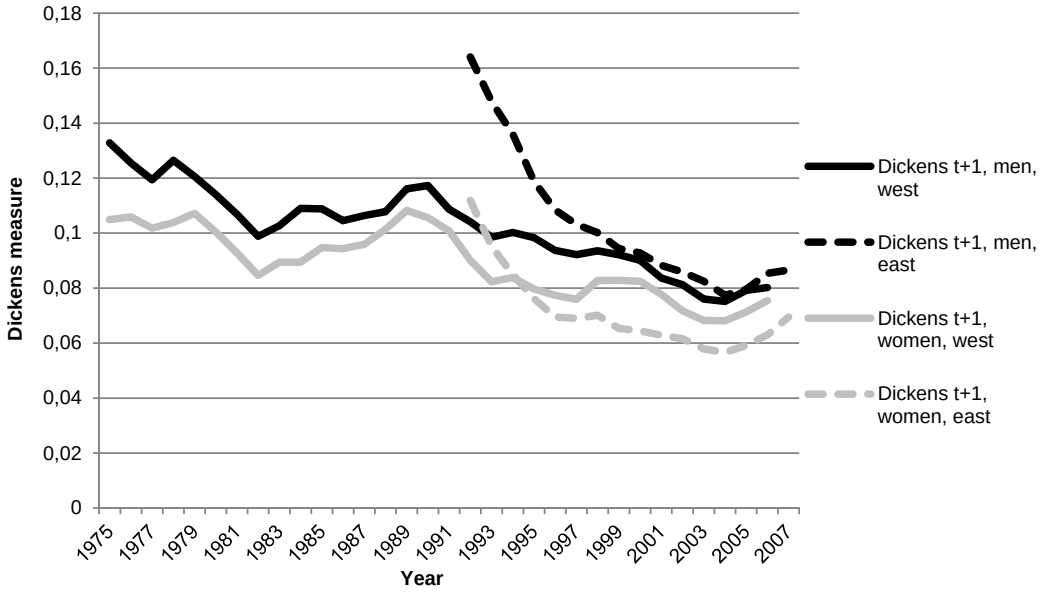
e.g., by Dickens (2000) or Cardoso (2006), that individuals at the top and at the bottom of the wage distribution face less wage mobility than those individuals in the middle of the wage distribution. Moreover, it can be observed that these middle quintiles experienced a more pronounced decrease in wage mobility over time compared to the individuals at the top or the bottom of the wage distribution, especially in East Germany. While the share of stayers in the third quintile increased from 50% in 1993 to 75% in 2008 in East Germany, the share of stayers in the first quintile increased from 70% in 1993 to 80% in 2008.

When looking at wage quintiles, wage mobility can only be observed across but not within quintiles. Therefore, I also make use of the Dickens measure which averages the absolute change in percentile ranking between two periods (t and $t + 1$). The higher these absolute changes are, the higher will be the extent of the Dickens measure and, thus, wage mobility. Figure 6 illustrates the development of wage mobility by gender and region using this measure. The figure reveals that men have been more mobile in their wages than women throughout the entire observation period in both West and East Germany. One reason for this finding might be that men profit from higher wage increases when changing jobs (Gottschalk 2001, Weber 2002). Over time, wage mobility has been decreasing in both regions and for both sexes. The slight decrease in wage mobility in West Germany during the 1970s was followed by an increase during the 1980s for both men and women. Since 1990, wage mobility steadily declined for both men and women until the wage mobility pattern became stationary in 2004.

In East Germany, there was a dramatic decline in wage mobility just after reunification, which is likely to be a consequence of the slowing down of the assimilation of East wages to the wage level of West Germany in the mid 1990s (Steiner and Wagner 1997). While wage mobility was higher than in West Germany in 1992, the Dickens measure had decreased by 50% twelve years later in 2004. Riphahn and Schnitzlein (2011) show that next to structural shifts and unexplained factors a substantial part of around 40% of the

mobility decline in East Germany is associated with changes in observable worker characteristics, particularly those describing job stability and employment characteristics. As a consequence, the level of wage mobility has converged to (and for women fallen below) the level of West Germany. Also with respect to gender, a convergence in wage mobility can be observed. While the absolute difference in the Dickens measure between men and women differed by more than 0.02 index points in 1975 in West Germany and by more than 0.04 index points in 1992 in East Germany, wage mobility was about the same in West Germany across gender by 2007, whereas in East Germany men are still slightly more mobile than women.

Figure 6: Evolution of the Dickens measure of mobility, by gender and region, 1975 - 2007



What we have seen so far is that rising wage inequality was accompanied by decreasing wage mobility in West and East Germany for both men and women. This is a phenomenon also observed in other developed countries, see e.g. Dickens (2000) for the UK and Buchinsky and Hunt (1999) for the US. In order to verify to what extent rising wage inequality is reduced by existing (although decreasing) wage mobility, the Shorrocks index is calculated in a next step. As shown in equation (8), the index compares a longer-term wage

inequality with the weighted sum of single-year wage inequalities. The higher the index is, the higher is the degree to which wage mobility reduces wage inequality in the short run. Figure 7 shows the Shorrocks index separately for gender and region using the Gini coefficient as wage inequality measure for a time horizon of $T = 5$ years.[10]

Figure 7: Evolution of the Shorrocks index, by gender and region, 1975 - 2004

Throughout the entire observation period, the Shorrocks index was higher for men than for women. This is true for West and East Germany. However, the gender difference with respect to the Shorrocks index became smaller over time and had almost disappeared by 2004 for both sexes and in both parts of the country. While in East Germany the decrease in the Shorrocks index evolved more rapidly than in West Germany and monotonously over time, the evolution of the Shorrocks index in West Germany was characterized by ups and downs.[11] The index fell between 1975 to 1981, between 1988 to 1994 and between 1998 to 2003. In between, the Shorrocks index experienced increases which, however, were less pronounced than the decreases in the preceding periods implying an overall downward trend of the Shorrocks index over time. All in all, the evolution of the Shorrocks index

[10] A comparable pattern is observed when using the mean log deviation or the Theil index as wage inequality measure. The corresponding figures are provided by the author upon request.

[11] A similar pattern is observed in Riphahn and Schnitzlein (2011), who, however, do not look at differences across gender.

reflects the earlier reported observed changes in wage mobility and inequality patterns: as wage inequality increases were accompanied by wage mobility decreases, wage mobility has been reducing wage inequality less and less over time.

One explanation for the wavelike pattern in the West German Shorrocks index (and also in the Dickens measure) may be changing business cycle effects over time. In times of economic prosperity, wages grow more rapidly than during recessions, see, e.g., Devereux and Hart (2006), Shin and Shin (2008). This wage procyclicality is stronger for low-wage (and highest-wage earners) compared to median earners as low-wage workers may credibly threaten to quit to unemployment when productivity increases (Robin 2011). Therefore, wage mobility might be positively correlated with the well-being of the economy. In other words, wage mobility might reduce the short-run wage inequality to a higher degree when the unemployment rate, which may serve as a proxy for business cycle effects, is low. Although the underlying correlation coefficients do not provide causal evidence, the negative relationship between the unemployment rate and the Shorrocks index is highly significant for men ($\rho = -0.809, p = 0.000$) as well as for women ($\rho = -0.464, p = 0.007$).[12]

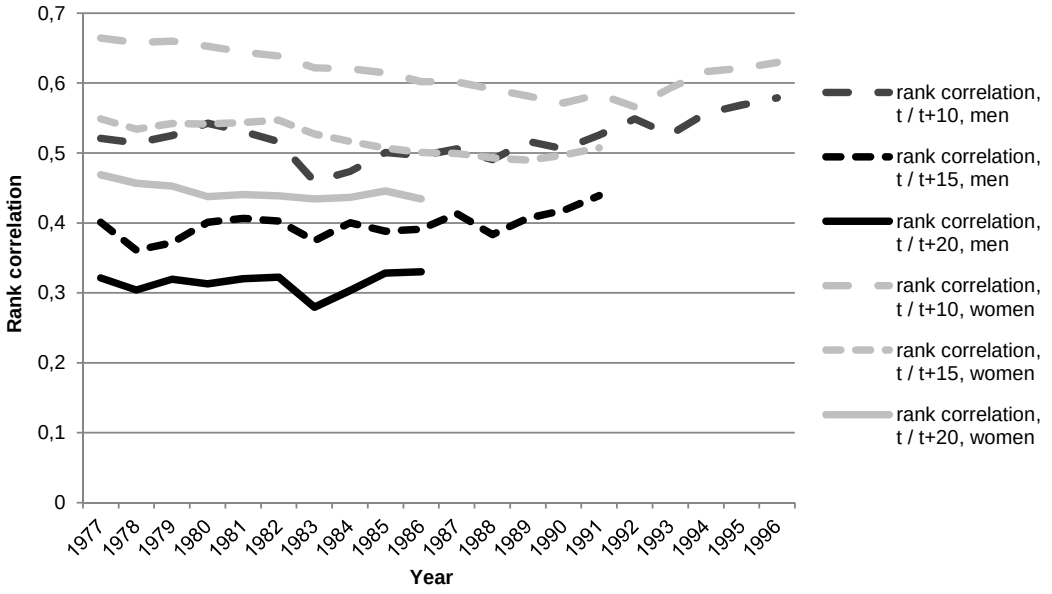
3.2.2 Long-term mobility patterns

The long time span of the data additionally allows for an analysis of long-term mobility, which to the best of my knowledge has not been done so far for Germany. Such an analysis is of particular interest as it gives insights on the chances of moving up the wage ladder over an individual's life cycle. Although the time length of the data is too short to describe mobility across a whole working life, as was done by Kopczuk et al. (2010) for the US

[12]If the GDP is used as proxy for business cycle effects, the positive correlation between the GDP and the Shorrocks index is highly significant for women ($\rho = 0.514, p = 0.002$) and significant for men ($\rho = 0.339, p = 0.054$). Applying the Dickens measure, as illustrated in Figure 6, rather than the Shorrocks index yields similar results: the positive relationship with respect to the GDP is significant for both men ($\rho = 0.419, p = 0.021$) and women ($\rho = 0.522, p = 0.003$), whereas the negative correlation coefficient regarding the unemployment rate is only significant for men ($\rho = -0.677, p = 0.000$, women: $\rho = -0.159, p = 0.400$).

with data that goes back until 1937, it is sufficiently long in West Germany to overcome concerns of transitory changes in earnings impacting wage mobility in the short run. For this, the rank of individual average earnings of a five-year period centered around period t is compared to the rank of individual average earnings of a five-year period centered around period $t+k$, where $k = 10, 15, 20$ years.[13] This allows for covering a time period of up to 24 years and, thus, more than half of a full working life. Periods with zero earnings are included in the analysis as long as the average earnings in a five-year time span lie above the minimum threshold of 4,800 € (in 2008 prices), which is the threshold for being a marginal worker in Germany. To avoid many five-year periods with zero earnings from individuals entering or exiting the labor market early, only those individuals are included in the analysis who are aged between 22 and 38 (43, 48) years in year t when k equals 20 (15, 10).[14]

Figure 8: Rank correlation displaying long-term mobility for three different time horizons, by gender, 1977 - 1996



[13] Yearly average earnings are indexed to 2008 prices.

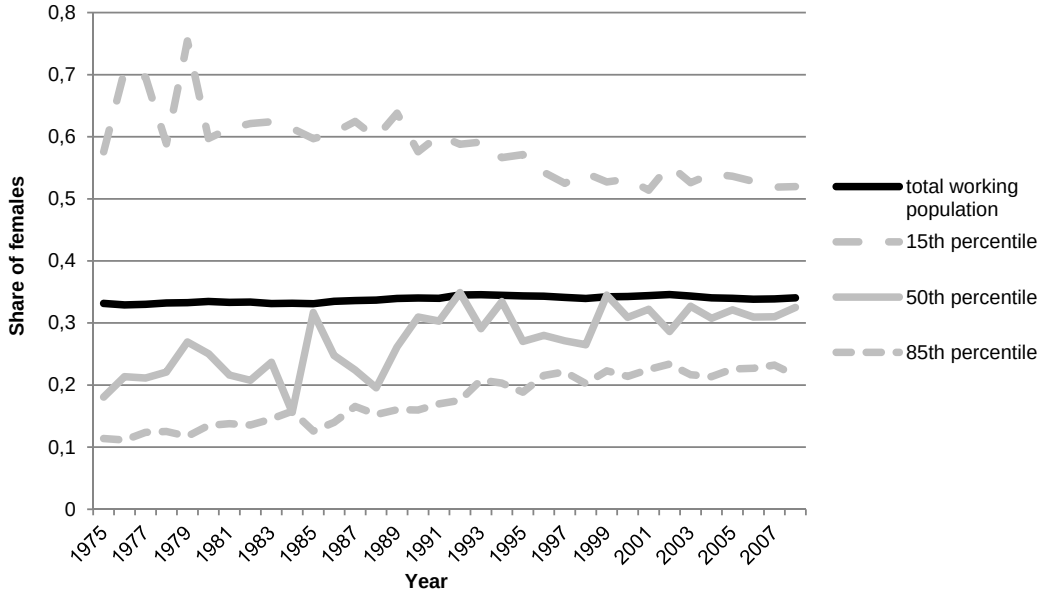
[14] If only those individuals are considered who worked in all periods, i.e., for example, in periods t-2 to t+2 and t-18 to t+22, the evolution of long-term mobility evolves similarly, albeit at a higher level of mobility. Thus, zero earnings do not seem to have a large impact on the trend of long-term mobility.

Figure 8 displays for West German men and women the rank correlation in year t between five-year average earnings centered around t and five-year average earnings centered around year $t+k$, where $k = 10, 15, 20$. Not surprisingly, the degree of mobility is the lower, the longer the considered time horizon.[15] As the rank correlation of individual earnings in year t and $t+k$ is smaller for men than for women, long-term mobility was higher for male than for female workers in all years. The long-term mobility gender gap has, however, been closing over time. While the men's rank correlation slightly increased over time for all three time horizons, the women's rank correlation experienced a slight decline. Thus, the long-term mobility of women slightly increased over time, whereas it slightly decreased for men, a result that is line with the evidence for the US (Kopczuk et al. 2010). This finding is consistent with the observation that the gender wage gap has been decreasing in Germany in the last decades (Fitzenberger and Wunderlich 2002, Black and Spitz-Oener 2010).

One reason for this closing long-term mobility gap might be the increase in the share of women at higher percentiles of the wage distribution. Figure 9 displays the share of females among those individuals earning at the 15th, the 50th, the 85th percentile and among the overall working population in the sample. The figure illustrates that the share of females among the overall working population remained constant at around 33% over time. However, although men are still more likely to be in the upper part of the wage distribution than women, the median wage earners and those individuals earning at the 85th percentile were much more likely to be women in 2008 compared to 1975. The opposite is true for workers at the 15th percentile. Hence, this development suggests that the chances to move up in the earnings distribution have been relatively improving for women compared to men in the last decades.

[15] The long-term mobility level is slightly lower than that observed in Kopczuk et al. (2010) for the US. However, they use an eleven-year rather than a five-year time span, which might be expected to lead to an overall higher rank correlation.

Figure 9: Share of females among the total working population, the 15th, the 50th, and the 85th percentile, 1975 - 2008



4 Conclusion

In this paper, I have analyzed the evolution of wage inequality and wage mobility separately for men and women in West and East Germany over the last four decades. Using a large German administrative data set which covers the years 1975 to 2008, I find that until the 1990s rising wage inequality was mainly observed in the upper tail of the men's wage distribution. Since the mid 1990s, rising wage inequality not only extended to the lower part of the men's wage distribution, but also started to occur for women in the upper and lower part of the wage distribution. In East Germany, lower and upper-tail wage inequality rose since the start of the observation period in 1992 for both men and women. Overall, women faced a higher level of wage inequality than men in West and East Germany. While the wage inequality gender gap has been slightly decreasing in West, it has been slightly increasing in East Germany.

A high degree of cross-sectional wage inequality is, however, likely to exaggerate the extent of inequality over a working life as long as individuals are able to move up the

earnings distribution. Therefore, I have focussed on the evolution of short and long-term wage mobility in this paper. Short-term wage mobility, which has been higher for male than for female workers in West and East Germany throughout the observation period, decreased over time. The decrease was particularly pronounced in East Germany. In West Germany, ups and downs in wage mobility levels were observed over time. One reason for this may be business cycle effects as a strongly negative relationship has been found between the level of wage mobility and the unemployment rate for both men and women. As rising wage inequality is accompanied by decreasing wage mobility, a trend which is also observed, e.g., in the US (Buchinsky and Hunt 1999) and the UK (Dickens 2000), the impact of wage mobility on reducing wage inequality has become smaller.

The long time span of the data additionally allows for investigating long-term wage mobility, which gives insights on the chances of moving up the wage ladder over an individual's life cycle. The results for West Germany show that long-term wage mobility was higher for male than for female workers in all years. However, the wage mobility gender gap has been slowly closing over time as long-term wage mobility has slightly increased for women whereas it slightly decreased for men. One reason for this contrary development across gender might be women's relative earnings improvement as the share of females in the middle and upper part of the wage distribution has distinctly increased over time.

As this study has given a descriptive analysis of the developments in wage mobility and inequality, future research is necessary to identify possible causal effects of what drives the differences in the wage mobility pattern across gender and regions. Moreover, more explanatory variables than those covered by this study may influence the development of wage inequality and mobility, as is suggested by, e.g., Gernandt (2009) and Raferzeder and Winter-Ebmer (2007). Finally, it is important to keep in mind that the results only account for all observations up to the social contribution threshold. This is especially relevant for men in West Germany, for which up to 14% of the observations per year are

censored. Using imputed wages for the censored observation does not appear to be an accurate solution for the censoring problem as the imputed wages artificially drive the wage mobility pattern.

Nevertheless, the simultaneous observation of increasing wage inequality and decreasing wage mobility clearly calls for a closer consideration of workers earning a low wage as this development gives rise to a larger persistence of low-wage employment. However, the determinants underlying the evolution of low-wage mobility are hardly documented in the literature so far. In particular, a decline in wage mobility in the low-wage sector may result from compositional shifts of the low-wage relative to the high-wage sector. Alternatively, increasing genuine state dependence, i.e. low-wage employment today causing low-wage employment in the future for reasons of, e.g., stigmatization or human capital depreciation, might be an explanation for a decline in low-wage mobility. First evidence of Aretz and Gürtzgen (2012) on this topic suggests for West Germany that genuine state dependence among low-paid workers has risen over time and compositional shifts towards more unfavorable observable characteristics among the low-paid also contributed to a rise of low-wage persistence.

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Appendix

A - Tables

Table A1: Total observations and share of females in %, by year and region, and share of censored observations in % by year, region, and gender

	West Germany				East Germany			
	share females	share cens. obs men	share cens. obs women	N	share females	share cens. obs men	share cens. obs women	N
1975	33.1	10.9	1.2	358,335				
1976	32.9	9.7	1.0	355,573				
1977	33.0	9.3	1.0	358,787				
1978	33.2	8.5	0.8	358,887				
1979	33.3	8.1	0.8	369,373				
1980	33.5	9.1	0.9	375,384				
1981	33.3	10.1	1.1	376,242				
1982	33.4	9.8	1.1	369,728				
1983	33.1	9.2	1.0	359,831				
1984	33.2	10.4	1.4	361,562				
1985	33.1	11.0	1.5	358,840				
1986	33.5	10.3	1.4	368,045				
1987	33.6	11.8	1.8	370,807				
1988	33.7	11.0	1.6	373,694				
1989	33.9	11.4	1.8	382,760				
1990	34.0	12.4	2.1	400,488				
1991	34.0	12.4	2.2	411,835				
1992	34.5	13.7	2.6	421,287	43.7	3.8	1.2	99,348
1993	34.6	11.1	2.0	409,127	42.6	4.5	1.6	94,138
1994	34.5	11.4	2.1	396,685	41.7	4.4	1.5	92,346
1995	34.4	10.8	2.1	391,759	41.4	4.4	1.5	91,997
1996	34.3	10.3	1.9	382,912	41.3	4.0	1.2	89,246
1997	34.1	10.8	2.1	376,553	40.9	3.4	1.0	84,666
1998	33.9	10.2	2.1	376,218	41.3	4.6	1.8	82,281
1999	34.2	11.9	2.6	378,397	41.4	4.0	1.6	81,223
2000	34.3	11.5	2.7	384,167	41.4	5.1	2.3	78,395
2001	34.4	11.7	3.0	383,544	41.7	5.7	2.8	75,157
2002	34.6	13.5	3.6	374,043	41.9	6.0	3.3	71,773
2003	34.3	9.5	2.2	363,572	41.6	4.3	1.7	69,401
2004	34.1	10.1	2.4	353,955	41.2	4.2	1.8	66,450
2005	34.0	10.3	2.6	346,295	40.9	4.3	1.8	63,362
2006	33.8	10.1	2.5	348,296	40.5	4.4	1.8	63,059
2007	33.9	10.8	2.9	355,064	40.2	4.4	1.7	63,744
2008	34.0	11.8	3.2	359,704	40.0	4.9	2.3	64,164
Total	33.9	10.8	1.9	12,711,749	41.5	4.5	1.8	1,330,750

Table A2: Share of individuals staying in the same quintile as in previous year in %, by quintile, sex and region, 1993 and 2008

	Q1	Q2	Q3	Q4	Q5	N
West Germany						
Men 1993	80.7	69.2	68.7	75.7	91.4	248,818
Men 2008	82.7	76.9	77.0	82.1	94.1	217,347
Women 1993	83.2	70.9	70.1	75.7	90.6	125,018
Women 2008	83.6	76.1	76.3	80.9	92.8	105,767
East Germany						
Men 1993	69.5	51.6	49.9	58.9	82.6	48,352
Men 2008	80.3	72.5	73.7	80.7	93.4	34,219
Women 1993	78.4	61.4	61.6	67.1	84.2	34,757
Women 2008	83.7	77.8	79.0	82.3	92.4	22,429

B - Figures

Figure A1: Evolution of real gross daily wages, in 2008 prices, 1975 - 2008, by gender, West Germany

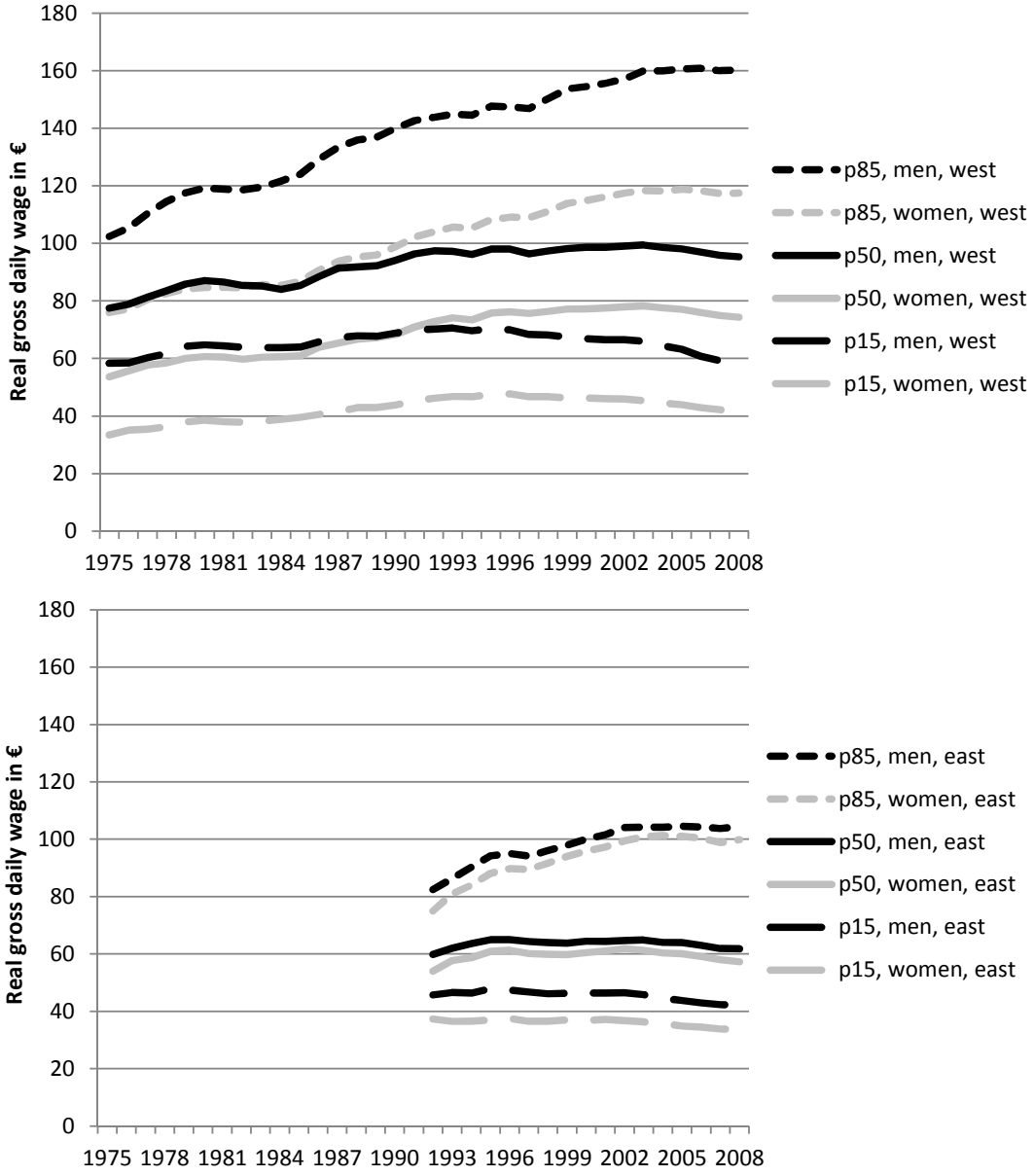
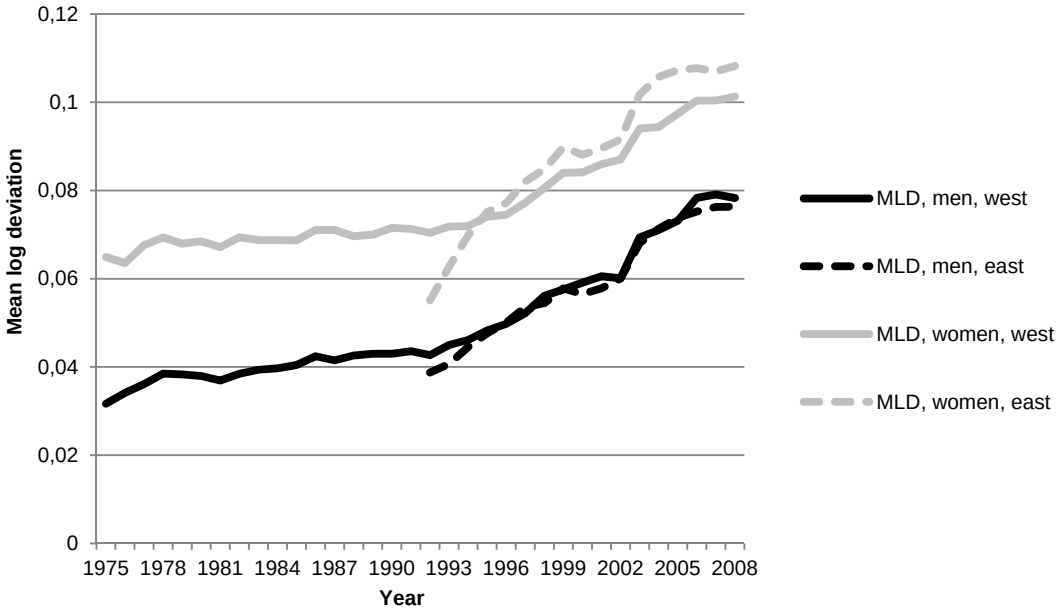


Figure A2: Evolution of the mean log deviation by gender and region, 1975 - 2008



C - How to deal with censored observations

For up to 14% (4%) of West German men's (women's) observations per year, the correct wage is not reported since the wages are censored at the social contribution threshold. Therefore, two different scenarios may be applied to overcome this censoring problem. One might either i) use all the wage information up to the censoring limit and disregard the development of wages at or above the social contribution threshold or ii) impute wages for censored observations using the imputation technique proposed by Gartner (2005). Both alternatives have drawbacks: while the former alternative cannot draw a picture on the entire wage distribution, the latter alternative partly relies on wages that cannot be observed in the data.

In order to get an impression to what extent the Gini coefficient, as a measure for wage inequality, is affected by using either alternative, the upper part of Figure A3 plots the development of the West German Gini coefficient by gender using i) only the observations up to the censoring limit and ii) using all observations including the censored observations

for which the wages are imputed.[16] Figure A3 reveals that a higher level of the Gini coefficient is observed when wages for the censored observations are imputed. This is not surprising as the entire wage distribution is considered in this case. As the share of censored observations has slightly increased over time for men and women - compare Table A1 -, the difference between the two sample alternatives has become slightly larger over time for both men and women. However, I mainly observe a level effect of the Gini coefficient when the imputed observations are used, which is greater for men as their share of censored wages is higher than for women. Thus, the use of the imputed wages seems rather insensitive to the development of wage inequality over time.

With respect to the development of wage mobility, however, the choice of the sample matters to a much higher degree. The lower part of Figure A3 shows for West Germany how the rank correlation of individual wages between year $t-1$ and year t has evolved with and without imputed wages.[17] The rank correlation, which by definition lies between 0 and 1, is the higher, the higher an individual sticks to his wage position, i.e. the lower the wage mobility is. The figure illustrates that the rank correlation is not only smaller when imputed wages are used in the analysis for both men and women, but that it has also developed differently over time compared to the sample with uncensored observations. While the rank correlation increased over time for those individuals earning below the social contribution threshold, the rank correlation remained at the same level over the entire observation period when wages were imputed for the censored observations for both sexes. It is, thus, the mobility of those individuals for which the wages have been imputed and whose share has slightly increased over the years that accounts for most of the wage mobility.

[16]The imputation is conducted separately for men and women, East and West Germany and year. The regression model contains as explanatory variables age, age squared, tenure, tenure squared, degree of education, and occupation.

[17]If only the wage information up to the censoring limit is used, it is important to keep in mind that those individuals who move up to the censoring limit between year $t-1$ and year t are not captured. However, the share of such movers among all workers earning below the censoring limit is on average less than two (one) percent for men (women). Hence, the downward bias of the mobility pattern due to this selection should be small.

Thus, whereas the observations with imputed wages contributed to a fairly constant shift in wage inequality over time, the analysis of wage mobility seems to be more sensitive with respect to using imputed wages. Figure A4 shows that this result is also observed in East Germany, although to a weaker extent as the share of censored observations is smaller than in West Germany. One reason for the sensitivity in wage mobility could be that an imputed wage is attached to some degree of uncertainty. In other words, it is likely that an imputed wage in one period differs from an imputed wage in the consecutive period for the same individual which could artificially increase one's wage mobility. Therefore, using imputed wages needs to be treated with caution especially when the development of wage mobility is analyzed. In order to avoid such inaccuracies, I therefore only focus on those observations that are below the censoring limit.

Figure A3: Evolution of the Gini coefficient (top) and the rank correlation (bottom) by gender, without censored observations and with imputed wages for censored observations, 1975 - 2008, West Germany

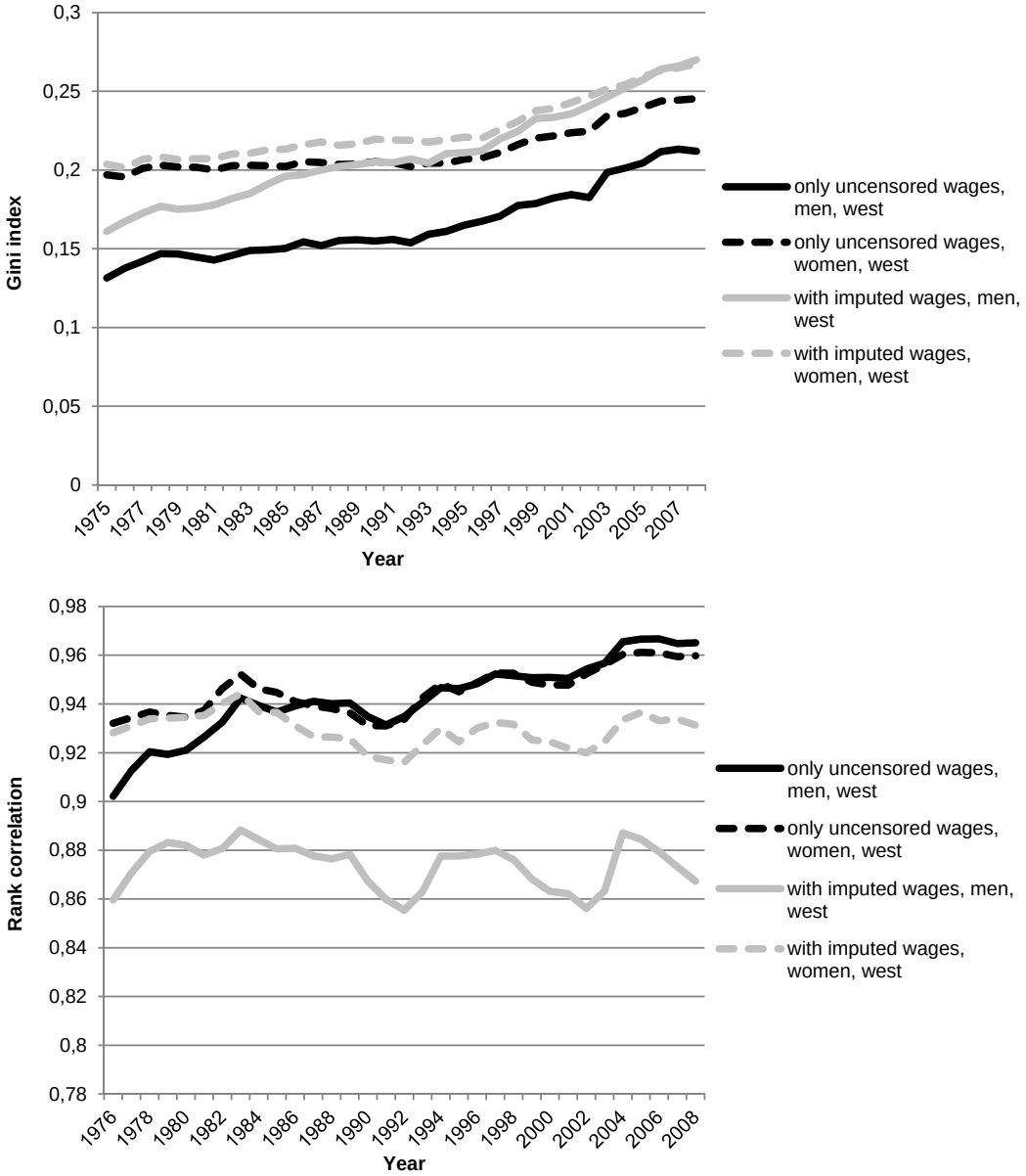


Figure A4: Evolution of the Gini coefficient (top) and the rank correlation (bottom) by gender, without censored observations and with imputed wages for censored observations, 1975 - 2008, East Germany