

Gernandt, Johannes; Pfeiffer, Friedhelm

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## Rising Wage Inequality in Germany

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Discussion Paper No. 06-019

## **Rising Wage Inequality in Germany**

Johannes Gernandt and Friedhelm Pfeiffer

**ZEW**

Zentrum für Europäische  
Wirtschaftsforschung GmbH

Centre for European  
Economic Research

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## **Non technical summary**

This paper contributes to the ongoing debate on rising wage inequality. Based on the GSOEP 1984 to 2005 the evolution of wage inequality is investigated separately for West Germany between 1984 and 2005, and compared to the evolution of inequality in East Germany between 1994 and 2005. Our central measure of wage inequality is the 90<sup>th</sup> to 10<sup>th</sup> percentiles of real gross hourly wages, as well as its two sub-groups, 90<sup>th</sup> to 50<sup>th</sup>, 50<sup>th</sup> to 10<sup>th</sup>. Two samples of workers, one for all workers including the self-employed and one for the group of prime age dependent male workers, have been drawn from the GSOEP. The increase in wage inequality is decomposed into a composition, a price and a residual effect. Not surprisingly, the paper confirms the well known stability of the West German wage distribution for the period 1984 to 1994. Wage inequality started to rise around 1994 in the sample for prime age dependent male workers in both parts of Germany. In the sample for all workers, including the self-employed, the trend towards rising wage inequality started around 1996. The main reason for this lag is that there is no rising inequality for the group of self-employed worker, although the level of inequality is higher compared to wage worker.

The evolution of wage inequality differs in East compared to West Germany. Rising wage inequality in West Germany primarily occurred in the lower part of the wage distribution, and wage inequality in East Germany primarily occurred in the upper part of the wage distribution. These differences presumably are due to the adjustment processes of the two parts of Germany and the induced competition for high wage workers. Surprisingly, the evolution of wage inequality in East Germany seems to have some similarities to the evolution of wage inequality in the United States in the 80s.

There are some more interesting and economically meaningful results from the decomposition analysis. For West German workers residual wage inequality “explains” roughly two thirds of rising inequality, with composition and price effects accounting for one third of the rising inequality. For East German workers residual wage inequality “explains” roughly 40 percent, whereas price effects account for roughly 50 percent of the rising inequality.

Rising wage inequality seems to be a general trend in the sense that it is not restricted to wage workers with specific characteristics, although it is quantitatively more pronounced among low skilled workers and workers with low tenure in West Germany. High rates of unemployment, presumably reinforced by non-neutral technical change, led to wage adjustment primarily through wage decreases for the low skilled and for entrants. Wages for workers with longer years of tenure are more rigid and firm’s adjustment for this group of employees takes place primarily through reduction in employment and hours of work.

# Rising Wage Inequality in Germany

Johannes Gernandt\* and Friedhelm Pfeiffer\*\*

*\*ZEW Mannheim*

*\*\*ZEW Mannheim, University of Mannheim*

This version July 2007

## **Abstract:**

The paper investigates the evolution of wages and wage inequality in Germany based on samples from the German Socio-Economic Panel (GSOEP) 1984 to 2005. Real gross hourly wages for prime age dependent male workers increased on average by 23 percent between 1984 and 1994 in West Germany and the wage distribution was fairly stable. Between 1994 and 2005 average wages increased by 7 percent in West Germany and 18 percent in East Germany. In this period wage inequality, measured by the ratio of the ninetieth to tenth percentile of the wage distribution, increased from 2.5 to 3.1 in West Germany and from 2.4 to 3.2 in East Germany. In West Germany rising wage inequality occurred mainly in the lower part of the wage distribution, whereas in East Germany wage inequality predominantly increased in the upper part of the wage distribution. In West Germany the group of workers with low tenure experienced higher increases in wage inequality compared to the group of workers with high tenure.

**Keywords:** Wage Inequality, Skill Structure, Real Wages, Tenure.

**JEL-classification:** J21, J24, J31

## **Corresponding author:**

Friedhelm Pfeiffer, Centre for European Economic Research, P.O. Box 103443, D-68034 Mannheim. Tel.: +49-621-1235-150, E-mail: [pfeiffer@zew.de](mailto:pfeiffer@zew.de)

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## 1 Introduction

The issue of rising wage inequality has attracted a considerable amount of research in international labour economics.<sup>1</sup> For a long time rising wage inequality in Great Britain and the United States has been contrasted with a stable wage distribution in Europe and especially in Germany.<sup>2</sup> It was suggested that the stability of the German wage distribution might reflect institutional factors such as social transfers, union bargaining power in the German system of central wage bargaining or the public educational expansion of the seventies.

However, as a result of its strong trade orientation, Germany experienced an increase in the demand for high skilled workers and a decrease in the demand for the low skilled, which is a development common to most industrialized countries. Findings by Fitzenberger et al. (2001), Möller (2005), Kohn (2006) and Dustmann et al. (2007) (compare also the summary of studies on wage inequality in Germany in the appendix) suggest that wages in Germany have always been flexible to some degree. More specifically in the recent decade wages below the median experienced a higher dispersion. The studies on wages mentioned above use different samples drawn from the two percent sample of the social security register data (so called IABS).

The IABS is a large representative sample of dependent wage workers starting in 1975. Because information on hours of work is not available in the IABS studies with these data focus on daily wages. Furthermore, data on self-employed workers, civil servants as well as very low wage workers are not collected in the IABS. These limitations may restrict the generality of the findings and the comparability with international studies. For example, compared to Germany, in the United States wage inequality is higher (the ninetieth to tenth percentile of real gross hourly wage was 4.4 in 2004), but remained stable between 1994 and 2004 (Mishel et al., 2006). In Spain inequality is also higher (3.6 in 2002), although it has been decreasing since 1995 (Izquierdo and Lacuesta, 2006).

In this paper we analyse the evolution of wage inequality in Germany based on the German Socio-Economic Panel (GSOEP) 1984 to 2005. The GSOEP includes all groups of workers and information on hours of work is available, although the number of observations is lower compared to the IABS. Our findings indicate that in the past decade wage inequality has been rising in Germany, which is in line with the literature based on the IABS. Our contribution

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<sup>1</sup> See Acemoglu (2002, 2003), Autor et al. (2005a, b), Blau and Kahn (1996), DiNardo et al. (1996), Gottschalk and Smeeding (1997), Juhn et al. (1993) and Katz and Autor (1999), among others.

<sup>2</sup> See for example Prasad (2004). The issue has been highlighted by Krugman (1994) who argued that rising wage inequality and low unemployment rates in the United States and rising unemployment combined with a stable wage distribution in Europe are the two sides of the same coin.

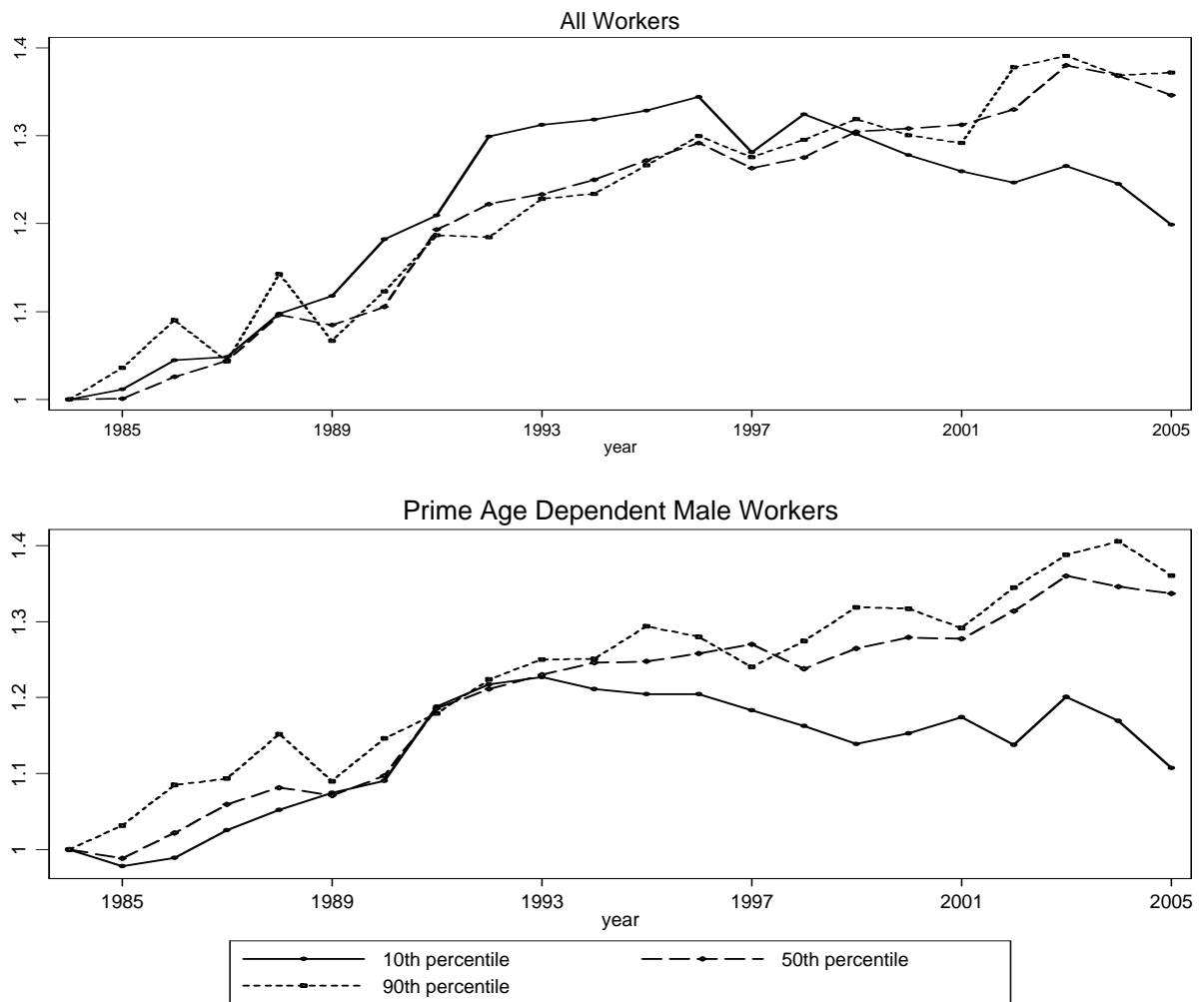
to the analysis of rising wage inequality in Germany is threefold: First, the paper provides evidence for the recent relatively strong increase in wage inequality (the ratio of wages of high wage workers as measured by the ninetieth percentile of the wage distribution and low wage workers as measured by the tenth percentile of the wage distribution for all workers was 2.47 in 1994, 2.76 in 2000 and 3.08 in 2005 in West Germany) and discusses some possible explanations. Second, we separately investigate the evolution of wage inequality both for East and for West Germany in order to account for the different economic transition processes after unification. Third, based on the Juhn et al. (1993) decomposition method, the role of tenure, self-employment, education, nationality and gender for the rise in inequality in each part of Germany is analysed.

Our measures of wage inequality are the ninetieth to tenth percentile of the real gross hourly wage, as well as its two sub-intervals, the ninetieth to fiftieth, and fiftieth to tenth percentile of the wage distribution. Figure 1 and Figure 2 show the evolution of wages between 1984 and 2005 for West Germany and between 1994 and 2005 for East Germany, respectively. Two samples of workers have been drawn from the GSOEP, one comprising all workers including the self-employed, and one only for the group of prime age dependent male workers (age group 25 to 55; for more details see section 2). The findings suggest that wage inequality in Germany started to increase after the economic downturn 1992/93.<sup>3</sup> The significant rise in wage inequality in Germany is a phenomenon that seems not to be exclusive to specific groups of workers as for example the self-employed, women or foreigners. However, the increase in wage inequality was higher for workers with lower tenure compared to workers with higher tenure. Wages therefore seem to react more flexible for entrants and workers with low tenure compared to incumbent workers, which is line with the literature on empirical determinants of wage rigidity in Germany, see Franz and Pfeiffer (2006), among others.

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<sup>3</sup> After the unification boom the German economy experienced a severe recession with employment losses in the private sector of 1.97 percent in 1992/93, 1.56 percent in 1993/94 and 1 percent in 1994/95, (DIW Viertel-jährliche Gesamtrechnung, own calculations).

**Figure 1: The Evolution of Real Wages at the 10<sup>th</sup>- 50<sup>th</sup>- and 90<sup>th</sup>-Percentile, West German Workers 1984-2005**



Source: GSOEP 1984-2005, own calculations based on cross-section weights; all wages for the three percentiles are normalized to 1 in 1984. Real wages at the tenth percentile increased from 5.77 € in 1984 over 7.48 € in 1994 to 6.91 € in 2005 for all workers and from 7.48 € in 1984 over 9.37 € in 1994 to 9.03 € in 2005 for prime age dependent males. At the fiftieth percentile wages grew from 9.36 € in 1984 over 11.74 € in 1994 to 12.86 € in 2005 for all workers and from 10.48 € in 1984 over 13.23 € in 1994 to 14.69 € in 2005 for prime age males. At the ninetieth percentile wages increased from 14.97 € in 1984 over 18.45 € in 1994 to 21.25 € in 2005 for the full sample and from 16.04 € in 1984 over 19.77 € in 1994 to 22.67 € in 2005 for the prime age dependent males.

Between 1994 and 2005 the average hourly wage of prime age dependent male workers increased by 23.4 percent in East Germany and by 9.8 percent in West Germany. For this group, the ratio of the ninetieth to the tenth percentile of the wage distribution increased from 2.3 to 2.9 in East Germany and from 2.1 to 2.5 in West Germany. With respect to West Germany, this implies a strong increase in inequality in a period with only very moderate average wage growth. Between 1984 and 1994 the wage distribution was stable even though average wage growth was 23.7 percent for prime age dependent males.



**Figure 2:** The Evolution of Real Wages at the 10<sup>th</sup>- 50<sup>th</sup>- and 90<sup>th</sup>-Percentile, East German Workers 1994-2005



Source: GSOEP 1994-2005, own calculations based on cross-section weights; all wages for the three percentiles are normalized to 1 in 1994. Real wages at the tenth percentile increased from 5.31 € in 1994 to 5.31 € in 2005 for all workers and from 5.74 € in 1994 to 6.01 € in 2005 for prime age dependent males. At the fiftieth percentile wages grew from 8.38 € in 1994 to 9.56 € in 2005 for all workers and from 8.58 € in 1994 to 9.88 € in 2005 for prime age males. At the ninetieth percentile wages increased from 12.75 € in 1994 to 17.00 € in 2005 for the full sample and from 12.99 € in 1994 to 17.62 € in 2005 for the prime age dependent males.

The evolution of wages and wage inequality in East Germany differs considerably from that in West Germany. During the transition process towards a market economy, mean wages as well as wage dispersion rose faster. In East Germany, rising inequality mainly concerns wages above the median wage, while in West Germany it had a higher impact on low wage workers. This is in line with the theory that rising wage inequality in East Germany primarily results from firm competition for (high) qualified workers who else might migrate to West Germany, and rising wage inequality in West Germany primarily results from an increased supply of low-wage workers.

The rest of the paper is organized as follows: Section 2 describes the data and major changes in the structure of the German workforce. Section 3 discusses

the evolution of wages and wage inequality while section 4 focuses on the findings from the decomposition of wage changes. Section 5 concludes.

## 2 Data and Changes in the Structure of the German Workforce

Two samples were drawn from the 22 waves of the German Socio-Economic Panel (GSOEP<sup>4</sup>) 1984 to 2005, both separately for West and for East Germany. First, a full sample was drawn containing all workers aged 16 to 65 years including the self-employed. All observations with missing information on at least one variable of interest were dropped. The variable real gross hourly wage<sup>5</sup> is obtained for all workers including the self-employed by calculating the ratio of last months' salary and hours worked. Hourly wages are trimmed at the two percent highest and lowest observations to reduce the risk of measurement error from extreme values. Further issues of errors in reported hours for measured wage inequality are discussed in part four below. With this sample the evolution of wage inequality in Germany is analysed based on all individuals participating in the workforce, including women, part-time workers and the self-employed.

Second, a restricted sample was drawn containing only prime age dependent male workers, at the age between 25 and 55 years (about 45 percent of the full sample).<sup>6</sup> This restricted sample is chosen to facilitate comparisons with previous studies which concentrate on the populations of dependent workers who are part of the German system of social security.<sup>7</sup> Furthermore we would like to answer the question whether rising wage inequality is also prevalent in the group of workers with the highest commitment to the labour market which are prime age dependent males.<sup>8</sup> For those (see Table A2), average hourly wages in West Germany were 11.27 € in 1984 (compared to 10.00 € in sample one), 13.94 € in 1994 (12.38 € in sample one) and 15.31 € in 2005 (13.61 € in sample one). Weekly hours worked were 43.45 in 1984 (40.53 in sample one), 42.15 in 1994 (38.80 in sample one) and 43.20 in 2005 (37.41 in sample one).

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<sup>4</sup> See Haisken-DeNew and Frick (2005).

<sup>5</sup> All wages are deflated with the Consumer Price Index for Germany (base year 2000, see Statistisches Bundesamt (2006).

<sup>6</sup> Table A2 in the appendix contains detailed summary statistics on wages, hours and earnings for the chosen samples for West Germany, and Table A3 for East Germany.

<sup>7</sup> For instance Kohn (2006), Möller (2000, 2005).

<sup>8</sup> The GSOEP is a representative survey of the German population. We compared our results with the quarterly wage survey of the German Federal Statistical Office (see Statistisches Bundesamt 1995, 2006) which contains average wages for blue collar unskilled workers and blue collar skilled workers and wages for white collar skilled and unskilled workers from manufacturing. Between 1994 and 2004 the wage gap of male blue collar skilled and unskilled workers increased from 26.5 percent in 1994 to 33.3 percent in 2004 in West Germany and from 19.5 percent to 29.4 percent in East Germany, confirming rising wage inequality. Furthermore, the wage gap of male white collar skilled and unskilled workers increased from 53.5 percent in 1994 to 62.6 percent in 2004 in West Germany and from 40.2 percent to 63.6 percent in East Germany.

In the subsequent econometric analysis it is necessary to estimate wages as a function of educational qualification, tenure, potential experience, sex (female), self-employment and nationality (foreigner) of workers. The evolution of these variables reflects structural changes in the German workforce. In West Germany the share of highly educated workers<sup>9</sup> doubled between 1984 and 2005. Prime age dependent male workers are better educated compared to workers in the full sample. In both samples, the average duration of years of schooling increased by about 1 year (to 12.30 years in sample one and to 12.35 in the sample of prime age dependent males in 2005).

Female participation increased from 37 to 47 percent, while the share of foreigners fluctuates around 8 percent. About 6 percent of the workers in the overall sample are self-employed.<sup>10</sup> Self-employment has been rising continuously since 1994. The share of people whose tenure is seven years (the median) or longer (“high tenure”) decreased in the sample of prime age dependent West German males from 64 percent in 1984 to 58 percent in 2005. In this sample the average years of tenure was 11.46 in 1984 and 11.77 in 2005. For workers with high tenure, average wages increased 42 percent between 1984 and 2005 (1984: 11.57 €, 1994: 14.61 €, 2005: 16.43 €), while for workers with low tenure, average wages increased 28 percent between 1984 and 2005 (1984: 10.73 €, 1994: 12.88 €, 2005: 13.74 €).

In East Germany average wages in 2005 amount to 77 percent (71 percent in 1994) of average wages in West Germany in sample one and to 72 percent (64 percent in 1994) in the sample of prime age dependent male workers.<sup>11</sup> East German prime age dependent males work on average 1.4 hours more than West Germans, while in the sample of all workers the difference is 3.8 hours in 2005. Compared to West Germany there are more workers with high education. Female participation rates are higher, although the West German ones are converging to East German levels. The share of foreigners in East Germany does not exceed one percent.

There was a continuous rise in the share of self-employed workers (3.68 percent in 1994, 7.09 percent in 2005) after the transition to a market economy and the permission of private enterprises. In East Germany, the share of individuals with high tenure increased by about 50 percent in the sample of prime age dependent males (1994: 26 percent, 2005: 37 percent). Not surprisingly the average number of tenure (9.90 for the full sample in 2005) is still lower compared to West Germany. The ratio of the officially registered unem-

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<sup>9</sup> These are people with a degree from a technical college or university.

<sup>10</sup> Shares for weighted data with cross sectional weights.

<sup>11</sup> In sample one, average wages in East Germany (West Germany) amount to 8.82 €(12.38 €) in 1994 and to 10.52 €(13.61 €) in 2005. For prime age dependent males average wages amount to 8.96 €(13.94 €) in 1994 and to 11.06 €(15.31 €) in 2005 in East Germany (West Germany), see Table A2 and A3 in the appendix.

ployed in the workforce<sup>12</sup> increased from 15.7 percent in 1994 to 20.6 percent in 2005 in East Germany and from 9.1 percent in 1984 and 1994 to 11.0 percent in 2005 in West Germany.

### 3 The Evolution of Wage Inequality

#### *West Germany 1984 to 2005*

This section presents the evidence on the development of wage inequality in the GSOEP samples for West Germany. *Table 1* displays the central measure for wage inequality, the ratio of the ninetieth to tenth percentile in the wage distribution. In the sample of all workers the measure of inequality first decreased from 2.59 in 1984 to 2.47 in 1994, indicating a moderate wage compression, and then increased to 3.08 in 2005, indicating rising inequality. According to the 95 percent confidence interval this difference is significant (*Table 1*, in brackets).

Wage inequality is lower in the sample of prime age dependent male workers and for foreigners, although the increase in wage inequality is also present in those subgroups. The ninetieth to tenth percentile in the group of prime age dependent male workers was 2.11 in 1994 and 2.51 in 2005. To compare the basic finding of rising wage inequality in the group of dependent male workers from the GSOEP with results from the IABS the eightieth to twentieth wage percentile was calculated. Between 1992 and 2001 this ratio increased by 5 log points. According to Kohn (2006) in this period the eightieth to twentieth wage percentile of real daily wages based on the IABS increased by 9 log points. This result suggests that our finding based on the GSOEP does not overstate rising wage inequality.

Wage inequality is highest for the self-employed, but the numbers do not indicate a clear trend in the period under investigation. Wage inequality is significantly lower for workers with seven or more years of tenure (see “high tenure” in *Table 1*). For the group of workers with “low tenure” the tendency of rising wage inequality since 1994 is strongest.

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<sup>12</sup> Statistisches Bundesamt (2006), unemployment rate for dependent employed civil workers.

**Table 1: Wage Inequality in West Germany: 90<sup>th</sup> to 10<sup>th</sup> Wage Percentiles**

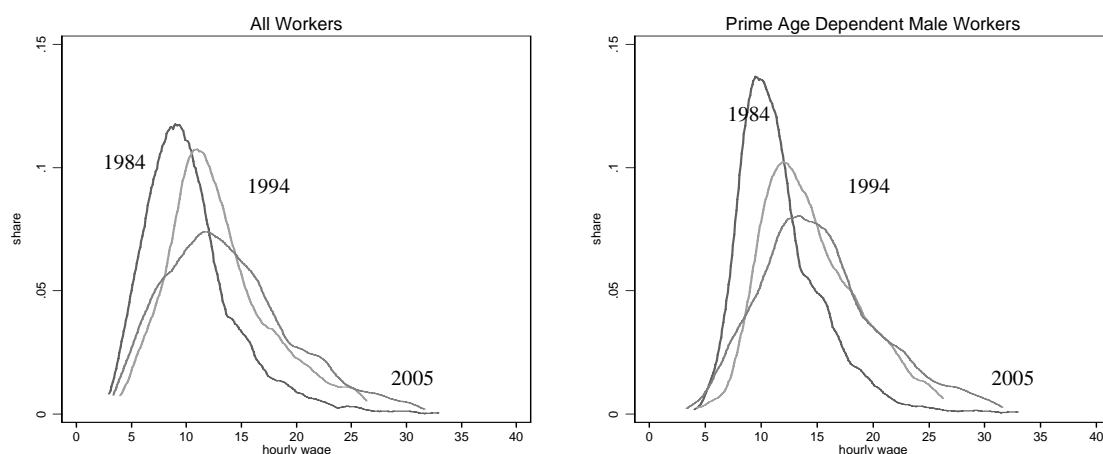
All Worker				Prime Age Dependent Male Worker		
	1984	1994	2005	1984	1994	2005
All	2.59 (2.52 – 2.67) N=4,772	2.47 (2.39 – 2.54) N=3,913	3.08 (3.00 – 3.15) N=5,522	2.14 (2.07 – 2.22) N=2,322	2.11 (2.04 – 2.18) N=1,797	2.51 (2.42 – 2.60) N=2,298
Females	2.46 (2.32 – 2.60) N=1,752	2.37 (2.28 – 2.45) N=1,619	3.16 (3.03 – 3.30) N=2,576	.	.	.
Foreigners	2.13 (2.03 – 2.23) N=1,306	2.07 (1.95 – 2.19) N=860	2.92 (2.60 – 3.23) N=554	1.74 (1.64 – 1.85) N=652	1.83 (1.71 – 1.95) N=399	2.28 (2.20 – 2.95) N=253
Self-employed	5.25 (4.51 – 5.99) N=223	3.63 (3.21 – 4.06) N=182	4.28 (3.65 – 4.92) N=338	.	.	.
High tenure	2.39 (2.29 – 2.48) N=2,625	2.26 (2.16 – 2.36) N=2,051	2.60 (2.50 – 2.71) N=3,009	2.07 (2.00 – 2.14) N=1,506	1.99 (1.92 – 2.05) N=1,099	2.25 (2.15 – 2.35) N=1,344
Low tenure	2.57 (2.48 – 2.66) N=2,147	2.46 (2.33 – 2.58) N=1,862	3.32 (3.16 – 3.47) N=2,513	2.13 (2.02 – 2.25) N=816	2.18 (2.06 – 2.29) N=698	2.86 (2.69 – 3.03) N=954

Source: Samples from GSOEP 1984-2005, see text; in brackets: 95% bootstrapped confidence interval with 1,000 replications, N= number of observations, own calculations.

*Figure 3* illustrates the wage distributions for workers in the overall and in the restricted samples for the years 1984, 1994 and 2005. For 1984 and, to some degree, for 1994 the figures indicate the well-known compressed distribution of German wages which is skewed to the right and shaped like a log-normal distribution. The 2005 figure, however, shows more dispersion and more symmetry. Apparently, compared to 1994, more workers earn both very low and also relatively high wages.

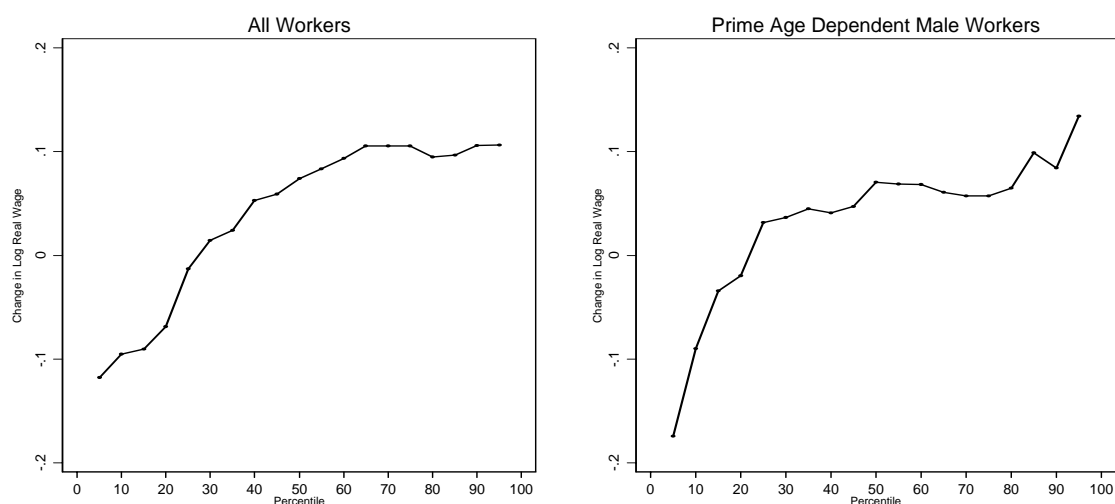
A comparison between twenty percentiles of the wage distribution for 1994 and 2005 in the full sample (*Figure 4*) reveals that real wages below the twenty-fifth percentile decreased, and that wages above the median grew at roughly similar rates. This suggests that the rise in inequality has been stronger below the median, which is in line with findings from Kohn (2006) and Möller (2005). In the group of prime age dependent male workers real wages below the twentieth percentile decreased (see *Figure 4*). For self-employed workers wage growth was more diverse at all percentiles. Foreigners experienced a significant rise in inequality which confirms the findings of Riphahn (2003).

**Figure 3: The Distribution of Wages in West Germany 1984, 1994, 2005**



Source: GSOEP 1984-2005 (for the samples see Chapter 2), weighted data; own calculation.

**Figure 4: Wage Growth in 20 Percentiles, West Germany 1994-2005**



Source: GSOEP 1994-2005 (for the samples see Chapter 2); weighted data; own calculation.

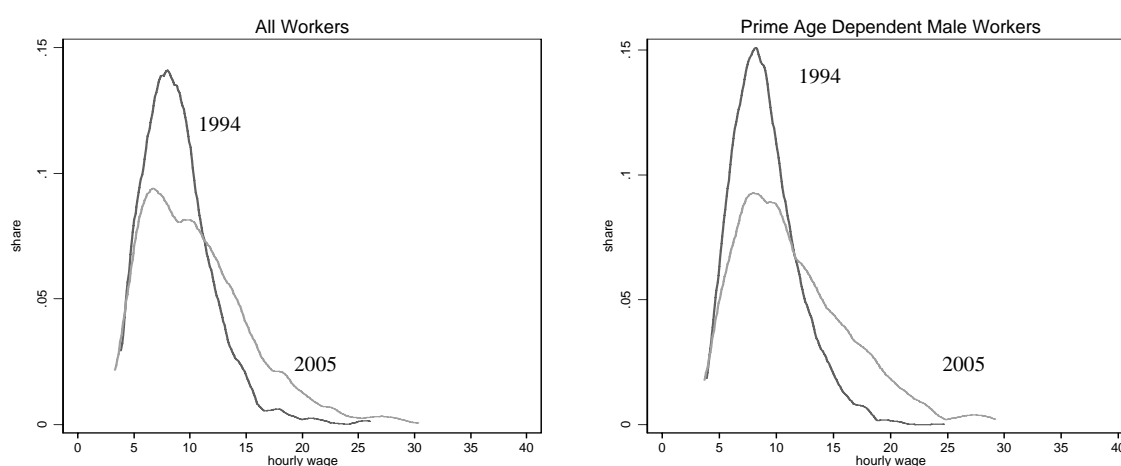
Interestingly, however, wage growth for workers with low and high tenure differs to a higher degree. Between 1994 and 2005 wage growth for the “high tenure” group of workers exceeds growth rates for the “low tenure” group in all percentiles below the seventieth percentile of the wage distribution and in the subgroup for prime age dependent males in all percentiles (see Figure A1 in the appendix). The differences are significant. There is no percentile with a wage decrease for the high tenure group of prime age dependent males. In comparison, real wages of workers with low tenure decreased below the fortieth percentile of the wage distribution. According to these results tenure seems to be an important dimension of wage inequality and wage flexibility. Wage growth in the group of workers with low tenure shows more inequality and dispersion compared to the “high tenure” group. These results suggest that the

adjustment of wages to labour market conditions primarily takes place among entrants to the labour market. In the group of workers with high tenure, adjustment to market conditions for labour mainly takes place through reduction of employment or hours of work, not primarily through wage cuts.

### *East Germany 1994, 2005*

This section reports our results on the evolution of wages and wage inequality in East Germany. To allow a direct comparison with the findings on West Germany, the period of observation is 1994 to 2005. *Figure 5* illustrates the evolution of wages in East Germany for the whole wage distributions and *Figure 6* shows the wage growth for twenty percentiles. Rising wage inequality is present and concentrated to some extent in the upper tail of the wage distribution.

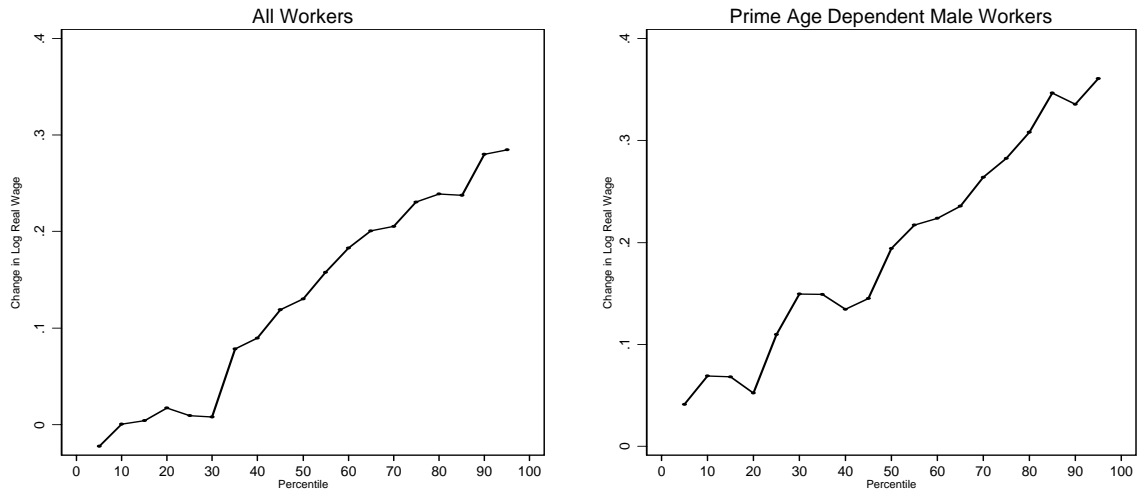
**Figure 5:** The Distribution of Wages in East Germany, 1994, 2005



Source: GSOEP 1994-2005 (for the samples see Chapter 2), weighted data; own calculation.

*Table 2* reports wage inequality as measured by the ninetieth to tenth percentile for the different samples and subgroups of workers (females, self-employed, low and high tenure), including 95 percent confidence intervals. In the first sample, the ninetieth to tenth percentile was 2.40 in 1994 and 3.20 in 2005. The 95 percent confidence intervals do not overlap, indicating rising wage inequality.

**Figure 6: Wage Growth in 20 Percentiles, East Germany**



Source: GSOEP 1994-2005 (for the samples see Chapter 2); weighted data; own calculation.

**Table 2: Wage Inequality in East Germany: 90<sup>th</sup> to 10<sup>th</sup> Wage Percentiles**

	All Workers			Prime Age Dependent Male Workers		
	1984	1994	2005	1984	1994	2005
<b>All</b>	.	2.40 (2.32 – 2.48) N=1,710	3.20 (3.07 – 3.34) N=1,820	.	2.26 (2.15 – 2.38) N=797	2.93 (2.73 – 3.14) N=698
<b>Females</b>	.	2.42 (2.30 – 2.53) N=769	3.04 (2.83 – 3.26) N=886	.	.	.
<b>Self-employed</b>	.	4.79 (n.a.) N=63	4.42 (3.78 – 5.06) N=129	.	.	.
<b>High tenure</b>	.	2.24 (2.10 – 2.37) N=596	3.10 (2.90 – 3.29) N=1,025	.	2.21 (2.02 – 2.40) N=285	2.90 (2.64 – 3.16) N=386
<b>Low tenure</b>	.	2.40 (2.29 – 2.52) N=1,114	2.91 (2.74 – 3.08) N=795	.	2.27 (2.12 – 2.43) N=512	2.70 (2.45- 2.96) N=312

Source: Samples from GSOEP 1984-2005, see text; in brackets: 95% confidence interval, calculated by bootstrapping (1,000 replications), N= number of observations, own calculations. Since the share of foreigners is very low in this sample, they are excluded in the table.

For males and females the increase in wage inequality is rather similar. As in West Germany, wage inequality is highest among the self-employed. Along the tenure dimension results differ in East and West Germany. In East Ger-



many inequality is similar in the high and low tenure groups. Tenure is still lower in East Germany, since firm foundation emerged after unification, only 14 years ago. Firms are smaller in East Germany and smaller firms show a higher degree of employment volatility and a lower inclination in central wage bargaining (for instance Franz and Pfeiffer, 2006). This may explain why the tenure differences found for West Germany are not yet visible in the East German samples.

#### **4 Findings from Decomposition**

This section presents the findings from a decomposition analysis based on the method introduced by Juhn et al. (1993). Changes in wage inequality are decomposed into changes in prices for observable characteristics (in our study: age, tenure, educational qualification, sex, self-employment and foreigner), changes in the composition of the workforce concerning these variables over time and unobserved or residual wage inequality. For this purpose, linear wage equations are estimated with the GSOEP. The estimated coefficients are interpreted as returns to the observable variables, and changes in the observables over time are interpreted as changes in the composition of the workforce. In real data the counterfactual decomposition results do not need to add up to one. Therefore the residual component is calculated as the difference between the observed percentage change in wage inequality and the estimated price and quantity components from the wage equation.

Growing residual wage inequality might result from increasing inequality in the distribution of unobserved skills. For instance in the United States a rise in the variances of wages occurred primarily for high educated workers (Lemieux, 2006). Unlike the United States, in the West German sample from GSOEP the variance of real wages increased in all education groups, from 10.15 in 1994 to 20.82 in 2004 for individuals with the lowest educational degree and from 25.92 to 35.53 for individuals with a degree from a (technical) university.

Increasing residual wage inequality might also result from growing measurement errors in the hours of work available in the data. For instance, recent studies by Autor et al. (2005b) and Lemieux (2006) indicate a different quality of hours and wage information in different US surveys. Since the IABS contains no information on hours worked daily earnings is an incomplete indicator of wages that is wages are measured with an error. Between 1975 and 1995 the estimated variance of the measurement error stayed roughly constant (Pfeiffer, 2003). In the GSOEP data wages are calculated as the ratio of self-reported monthly earnings and hours worked. Self-reported hours of work may also contain some error.

The standard deviation of hours of work in the sample of West German prime age dependent male workers increased slightly from 7.4 in 1984 to 7.7 in 2005 (see Table A2 in the Appendix), while the standard deviation of monthly earning strongly increased. The findings from official wage statistics, from the IABS and from this study indicate that the rise in wage inequality is not just the result of a rise in the error of reported hours of work. We try to confirm this argument with a simulation exercise. In this exercise a normal error with a continuously rising standard deviation was added to the reported hours of work in the sample from 1984 and the corresponding wage inequality was calculated. To increase the ratio of the ninetieth to the tenth wage percentile from 2 in 1994 to 2.5 (the level in 2005) the standard deviation of the hours (actual plus simulated error) has to increase to 11. Compared to this huge increase in the variation of hours, a rise to 7.7 (the value from the sample 2005) had no impact on the ratio of ninetieth to tenth wage percentile.

In order to get a reasonable empirical wage equation, wages have been trimmed and non-linearities are allowed for. Tenure is divided into thirteen<sup>13</sup>, potential experience into seventeen categories<sup>14</sup>. All wage equations have been estimated separately for East and West Germany, for the full sample and the restricted sample of prime age dependent male workers as well as for various subgroups, for example workers with low and high tenure.<sup>15</sup> The following discussion of the empirical findings concentrates on the ninetieth to tenth wage differentials as well as its two sub-groups, the ninetieth to fiftieth and the fiftieth to tenth differentials.

#### *West Germany 1984, 1994, 2005*

The decomposition confirms findings on wage inequality from section 3 and may be helpful in clarifying the role of some explanatory factors for rising wage inequality. *Table 3* summarizes the findings for the full sample and the restricted sample of prime age dependent male workers. To read table 3, look, for example, at its first row: The wage dispersion between the ninetieth and the tenth percentile (column one) decreased in total (column two) by 0.050 log points or 4.88 percent ( $(e^{-0.05} - 1) * 100 = -4.88$ ). The total wage growth is decomposed into a quantity effect (column 3), a price effect (column 4) and a residual effect (column 5).

Detailed findings can be summarized as follows:

- The estimated composition effects seem to have only a minor impact on the evolution of wages in each decade.

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<sup>13</sup> The groups range from 0-3 years over 3-6 years to 33-36 years, the group with highest duration are those employees who stayed with the same employer for more than 36 years.

<sup>14</sup> The groups range from 0-3 years over 3-6 years to 45-48 years, the highest group is “more than 48 years”.

<sup>15</sup> All wage equations are available from the authors upon request.

- There is some evidence of price effects in the period from 1994 to 2005. Price changes for observed characteristics seem to be responsible for one quarter to one third of overall rising inequality.
- Even though wage inequality increased significantly over the whole period, the increase was concentrated on the period between 1994 and 2005. For the period between 1984 and 1994 our findings confirm the stability of the German wage distribution.
- In the full sample of workers there is an asymmetry in the increase of wage inequality between 1994 and 2005: Wage inequality increased somewhat in the upper part of the wage distribution (the total increase in the ninetieth to fiftieth percentile, that is in the upper part of the wage distribution, was 0.050 log points), but the increase is quantitatively more pronounced in the lower part of the wage distribution (the total increase in the fiftieth to tenth percentile, that is in the lower part of the wage distribution, was 0.171 log points).
- The findings differ between the full sample of all workers, including women, and the restricted sample of prime age dependent male workers. However, these differences appear to be relatively small. There was slightly less wage dispersion in the period between 1994 and 2005 in the sample of prime age dependent male workers. Again, rising inequality is quantitatively more pronounced in the lower part of the wage distribution, confirming earlier findings of Möller (2005) for West Germany (1984 to 2001).
- According to Kohn (2006) the increase in wage inequality below the median (between 1992 and 2001) is predominantly concentrated among women. In our analysis this is not the case. Even if we restrict our observation period from 1992 to 2001 and estimate the wage equation separately for women and men, increasing wage inequality is concentrated below the median for males and females (results available upon request).

**Table 3: Decomposition Results for West Germany**

<b>All Workers</b>				
<b>Differential</b>	<b>Total</b>	<b>Composition</b>	<b>Prices</b>	<b>Unobserved</b>
<b>1984-1994 (base year 1984)</b>				
<b>90-10</b>	-0.050	0.020	-0.043	-0.027
<b>90-50</b>	-0.018	0.037	-0.033	-0.022
<b>50-10</b>	-0.032	-0.017	-0.010	-0.005
<b>1994-2005 (base year 1994)</b>				
<b>90-10</b>	0.221	0.018	0.060	0.143
<b>90-50</b>	0.050	-0.025	0.017	0.058
<b>50-10</b>	0.171	0.043	0.043	0.085
<b>1994-2005 (base year 1994), only females</b>				
<b>90-10</b>	0.286	0.053	0.066	0.167
<b>90-50</b>	0.098	0.014	0.026	0.058
<b>50-10</b>	0.188	0.038	0.040	0.109
<b>1994-2005 (base year 1994), only foreigners</b>				
<b>90-10</b>	0.342	0.036	0.150	0.156
<b>90-50</b>	0.132	0.030	0.045	0.057
<b>50-10</b>	0.210	0.006	0.105	0.099
<b>Prime Age Dependent Male Workers</b>				
<b>Differential</b>	<b>Total</b>	<b>Composition</b>	<b>Prices</b>	<b>Unobserved</b>
<b>1984-1994 (base year 1984)</b>				
<b>90-10</b>	-0.016	0.030	-0.022	-0.024
<b>90-50</b>	-0.025	0.015	-0.021	-0.019
<b>50-10</b>	0.009	0.015	-0.001	-0.005
<b>1994-2005 (base year 1994)</b>				
<b>90-10</b>	0.173	-0.014	0.080	0.107
<b>90-50</b>	0.031	-0.016	0.016	0.031
<b>50-10</b>	0.142	0.002	0.064	0.076
<b>1994-2005 (base year 1994), only “low tenure”</b>				
<b>90-10</b>	0.273	0.038	0.118	0.117
<b>90-50</b>	0.074	-0.003	0.056	0.021
<b>50-10</b>	0.199	0.041	0.063	0.095

Source: GSOEP 1984-2005 (for the samples see chapter 2; Juhn et al. (1993) decomposition method, own calculations.

Based on the GSOEP our study confirms the diagnosis of rising wage inequality found by other studies, thus adding to the evidence that the increased dispersion is more than a spurious empirical effect. The findings are in line with evidence from recent studies based on larger samples of German register data for dependent workers for the period between 1975 and 2001, although there are some differences. Increasing wage inequality in West Germany seems to be neither the result of rising participation of women or self-employment workers nor of changes in the share of foreigners. Some of the findings are in line with the international evidence. For instance we find that a larger part of the rise in inequality occurred in the group of workers with low tenure which has not been reported so far for Germany, confirming however findings from Spain (Izquierdo and Lacuesta, 2006).

#### *East Germany 1994, 2005*

Which factors account for rising wage inequality in East Germany? Are there differences between East and West Germany? The results of the decomposition (see *Table 4*) can be summarized as follows:

- The overall measure (ninetieth to tenth differential) indicates a slightly stronger rise in wage inequality in the sample of East compared to West German workers, *Table 4*, which is in line with Kohn (2006). This is presumably a consequence of the transition from a socialist to a market economy after unification. The process of adjustment and convergence to the West German wage distribution is still not complete, and its consequences for the evolution of wage inequality are still unfolding (see also Franz and Steiner, 2000).
- In contrast to West Germany a large part of rising inequality occurred in the upper tail of the wage distribution, 54 in comparison to 23 percent in West Germany (for the full sample). The total increase in the ninetieth to fiftieth percentile of the wage distribution for prime age dependent males was 0.165 log points, the total increase in the fiftieth to tenth percentile of the wage distribution was 0.094 log points (*Table 4*).
- Composition effects seem to be of minor importance in the East German samples. However, price effects are significant especially in the upper part of the wage distribution. For prime age dependent male workers decomposition results suggest that price effects are quantitatively more important than residual effects (*Table 4*).
- The differences in wage inequality between educational groups are less pronounced in East compared to West Germany and there is no tenure effect in wage inequality in the East German sample.

**Table 4: Decomposition Results East Germany 1994-2005**

<b>All Workers</b>				
<b>Differential</b>	<b>Total</b>	<b>Composition</b>	<b>Prices</b>	<b>Unobserved</b>
<b>1994-2005 (base year 1994)</b>				
<b>90-10</b>	0.288	0.016	0.105	0.167
<b>90-50</b>	0.155	0.006	0.079	0.071
<b>50-10</b>	0.132	0.010	0.027	0.096
<b>1994-2005 (base year 1994), only females</b>				
<b>90-10</b>	0.230	0.017	0.084	0.129
<b>90-50</b>	0.107	0.032	0.043	0.031
<b>50-10</b>	0.123	-0.015	0.040	0.095
<b>Prime Age Dependent Male Workers</b>				
<b>Differential</b>	<b>Total</b>	<b>Composition</b>	<b>Prices</b>	<b>Unobserved</b>
<b>1994-2005 (base year 1994)</b>				
<b>90-10</b>	0.259	-0.010	0.189	0.080
<b>90-50</b>	0.165	-0.023	0.158	0.030
<b>50-10</b>	0.094	0.014	0.031	0.050
<b>1994-2005 (base year 1994), only “low tenure”</b>				
<b>90-10</b>	0.174	0.004	0.149	0.021
<b>90-50</b>	0.103	-0.038	0.136	0.005
<b>50-10</b>	0.071	0.042	0.013	0.016

Source: GSOEP 1994-2005, for the selection of samples see chapter 2; own calculations. Since the share of foreigners is very low in this sample, they are excluded in the table.

One economic explanation for the finding that there is no tenure difference in East and a strong tenure difference in West Germany is the competition for high wage workers between both German regions. This competition together with the well known mobility of high wage workers (especially from East to West Germany) contributed to wage dynamics and inequality in the upper part of the wage distribution in East Germany. The relatively higher degree of ris-

ing wage inequality in East compared to West Germany is due to a higher extent of wage inequality for high wage workers in East Germany. Interestingly the pattern of wage inequality in East Germany has some similarities with the period of rising wage inequality in the United States that started in the seventieth (see Juhn et al., 1993).

## **5 Conclusions**

This paper contributes to the ongoing debate on international trends in wage inequality. Based on the GSOEP 1984 to 2005 the evolution of wage inequality is investigated separately for East and West Germany. Despite the strong trade orientation of the German economy and rising wage inequality abroad, the German wage distribution was fairly stable for a long time. However, our findings, based on the rich GSOEP data, hint at rising wage inequality which started after the economic downturn 1992/93 in both parts of Germany.

The recent strong increase in wage inequality in Germany is a robust phenomenon that seems to be unrelated to specific groups of workers, for example the self-employed, women or foreigners, although there is a need for differentiation. Rising wage inequality in East Germany is quantitatively more pronounced among high wage workers and in West Germany among workers with low tenure. In times of high unemployment firms' adjustment takes place primarily through reductions of employment and hours of work while wage competition in West Germany seems to have been stronger among entrants and workers with low tenure. In East Germany rising inequality is due to a higher extent of wage inequality for high wage workers, which presumably is a result of competition for (highly) qualified workers who otherwise migrate to West Germany. The decomposition results indicate that price effects are more important for East compared to West German workers.

Prominent additional explanations in the literature on rising wage inequality refer to the non-neutral nature of technical change, a rising demand for cognitive, non-routine abilities, to world-wide factor competition, decreasing social transfers and union power (German unions lost 2.8 million of their members between 1994 and 2004), changes in unobserved abilities and rising inequality in abilities resulting from the German educational system of early tracking. The computer revolution fostered general education and analytical and cognitive non-routine skills while vocational education and non-cognitive manual and routine skills lost ground. Yet another specific factor for Germany might be the rise in active labour market policies in the observation period that might have influenced wage setting behaviour and the inequality of wages.

Future research could be directed more specifically to these different explana-

tions and reasons for the evolution of wages and inequality in Germany. Since residual wage changes account for two thirds of the rise in wage inequality in West Germany, future research is needed with improved information on hitherto not observed skills. For instance, the content of the chosen categories of education might differ over time as well as the economic value of tenure in an employee-employer relationship. Furthermore the consequences of rising wage inequality for individual well-being, for employment as well as for the evolution of unemployment need to be investigated in greater detail.

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## Appendix

Table A1: Selected Studies on Wage Inequality in Germany

Study	Time	Data	Results
<b>Bellmann and Gartner (2003)</b>	1975-2000	IABS, BLH	Increasing wage dispersion in the 1990s in West Germany, especially within high wage sectors.
<b>Dustmann, Ludsteck, Schönberg (2007)</b>	1975-2004	IABS, LIAB	Increasing Wage Inequality in the 1980s, but only at the top of the wage distribution, in the early 1990s wage inequality also started to increase below the median.
<b>Fitzenberger (1999)</b>	1975-1990	IABS	The wage dispersion within skill groups is stable over time for low skilled workers but increases for medium and high skilled workers. After controlling for age and cohort effects there is increasing wage inequality within the group of low skilled workers.
<b>Fitzenberger, Hujer, MaCurdy and Schnabel (2001)</b>	1976-1984	IABS	Wage compression at the lower part of the wage distribution which seems constant over the surveyed time. The main findings are that wages of workers with intermediate education levels, among them especially those of young workers, deteriorated slightly relative to high and low education levels.
<b>Franz and Steiner (2000)</b>	1990-1997	GSOEP	In East Germany wage distribution was compressed under socialism. After unification there is rising wage inequality in East Germany, strongest in the first years.
<b>Kohn (2006)</b>	1975-2001	IABS	Rising wage inequality, especially in East Germany, starting in the mid 1990s.
<b>Möller (2005)</b>	1975-2001	IABS	Rising wage inequality, especially below the median, starting in the mid 1990s.
<b>Pfeiffer (2003)</b>	1975-1995	IABS	Wage rigidity is present due to central wage bargaining; for 50 percent of workers wages would have been lower without rigidity; the wage sweep-up is higher for German workers in large firms, rises with tenure and is higher in the middle part of the wage distribution.
<b>Prasad (2004)</b>	1984-1997	GSOEP	Relatively stable wage distribution in Germany. Returns to education and experience remained stable. Some evidence for a modest increase in wage inequality at mid 1990s.
<b>Steiner and Hölzle (2000)</b>	1990-1997	GSOEP	Relatively stable wage distribution in Germany. Earnings and wage inequality in East Germany increased after reunification.
<b>Steiner and Wagner (1998)</b>	1984-1990	GSOEP, IABS	Modest increase in earnings inequality when calculated on the basis of the IABS, while earnings remained constant or slightly decreased on the basis of the GSOEP.

**Table A2: Means of Real Wages and Hours (Std.-dev. in Brackets),  
West Germany**

All Workers					Prime Age Dependent Male Workers			
	Obser- vations	Real gross monthly salary	Weekly hours worked	Real gross hourly wage	Obser- vations	Real gross monthly salary	Weekly hours worked	Real gross hourly wage
<b>2005</b>	5,522	2,285.65 (1,275.54)	37.41 (12.77)	13.61 (5.56)	2,298	2,867.47 (1,107.58)	43.20 (7.71)	15.31 (5.32)
<b>2004</b>	5,799	2,337.45 (1,309.48)	37.55 (12.65)	13.88 (5.64)	2,467	2,926.00 (1,136.93)	43.09 (7.64)	15.66 (5.40)
<b>2003</b>	5,994	2,346.46 (1,312.35)	37.49 (12.64)	13.93 (5.61)	2,560	2,945.67 (1,134.20)	42.89 (7.75)	15.80 (5.30)
<b>2002</b>	6,266	2,301.85 (1,269.00)	37.83 (12.65)	13.58 (5.42)	2,698	2,861.53 (1,088.89)	43.16 (7.42)	15.27 (5.12)
<b>2001</b>	6,773	2,244.55 (1,196.82)	38.08 (12.57)	13.19 (5.03)	2,981	2,774.87 (1,023.93)	43.17 (7.71)	14.83 (4.76)
<b>2000</b>	7,490	2,257.83 (1,194.23)	38.31 (12.44)	13.22 (5.06)	3,333	2,765.09 (1,031.04)	43.24 (7.55)	14.75 (4.79)
<b>1999</b>	4,123	2,239.72 (1,138.00)	38.52 (11.79)	13.08 (4.94)	1,857	2,683.38 (986.05)	42.69 (7.32)	14.49 (4.74)
<b>1998</b>	3,946	2,237.40 (1,089.29)	38.97 (11.42)	12.99 (4.75)	1,814	2,674.92 (966.30)	42.97 (7.65)	14.39 (4.59)
<b>1997</b>	3,732	2,187.06 (1,046.01)	38.95 (11.41)	12.71 (4.54)	1,686	2,626.61 (899.89)	42.74 (7.51)	14.22 (4.25)
<b>1996</b>	3,801	2,197.03 (1,054.24)	38.68 (10.99)	12.85 (4.63)	1,720	2,626.61 (930.44)	42.36 (7.52)	14.33 (4.45)
<b>1995</b>	3,880	2,179.26 (1,024.08)	39.03 (10.98)	12.68 (4.67)	1,790	2,606.06 (919.42)	42.57 (7.54)	14.17 (4.45)
<b>1994</b>	3,913	2,120.33 (983.24)	38.80 (10.71)	12.38 (4.27)	1,797	2,540.88 (829.60)	42.15 (7.00)	13.94 (4.07)
<b>1993</b>	4,017	2,107.15 (982.96)	38.82 (10.71)	12.33 (4.39)	1,810	2,549.52 (858.18)	42.22 (7.20)	13.97 (4.16)
<b>1992</b>	4,002	2,094.90 (954.47)	39.01 (10.58)	12.22 (4.35)	1,825	2,546.29 (813.98)	42.58 (7.19)	13.85 (4.02)
<b>1991</b>	4,124	2,048.40 (941.38)	39.21 (10.78)	11.88 (4.26)	1,892	2,493.01 (800.44)	42.65 (7.33)	13.55 (3.97)
<b>1990</b>	4,072	1,955.06 (911.89)	39.47 (10.00)	11.27 (4.14)	1,943	2,345.79 (818.53)	42.60 (6.94)	12.72 (4.00)
<b>1989</b>	4,160	1,920.93 (884.29)	40.20 (10.11)	10.88 (3.95)	1,956	2,312.31 (794.47)	43.36 (6.95)	12.33 (3.78)
<b>1988</b>	4,147	1,938.64 (995.41)	39.86 (10.67)	11.19 (4.92)	1,947	2,332.27 (883.92)	43.08 (7.01)	12.60 (4.66)
<b>1987</b>	4,371	1,854.53 (897.42)	40.04 (10.44)	10.54 (3.98)	2,011	2,242.45 (811.94)	43.27 (6.98)	11.98 (3.86)
<b>1986</b>	4,240	1,854.13 (929.45)	40.55 (10.58)	10.58 (4.81)	2,004	2,222.76 (850.81)	43.60 (7.47)	11.91 (4.60)
<b>1985</b>	4,347	1,800.09 (912.00)	40.61 (10.97)	10.32 (5.02)	2,061	2,139.69 (808.08)	43.59 (7.71)	11.58 (4.89)
<b>1984</b>	4,772	1,766.44 (846.17)	40.53 (10.55)	10.00 (3.96)	2,322	2,109.10 (726.22)	43.45 (7.35)	11.27 (3.65)

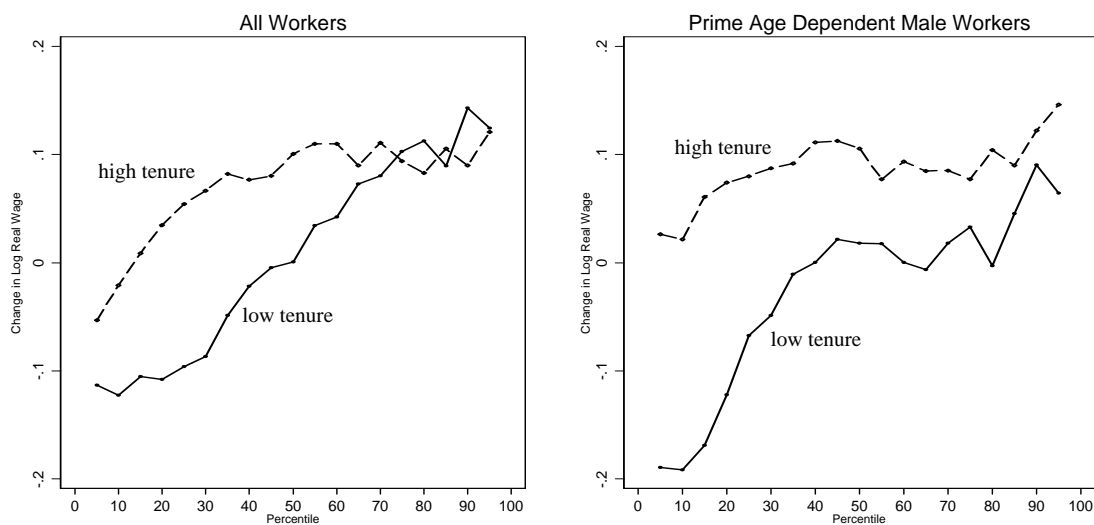
Source: Samples from GSOEP 1984-2005, see text; own calculations.

**Table A3: Means of Real Wages and Hours (Std.-dev. in Brackets),  
East Germany**

All Workers					Prime Age Dependent Male Workers			
	Observations	Real gross monthly salary	Weekly hours worked	Real gross hourly wage	Observations	Real gross monthly salary	Weekly hours worked	Real gross hourly wage
<b>2005</b>	1,820	1,878.80 (961.29)	41.25 (10.09)	10.52 (4.78)	698	2,124.25 (925.17)	44.58 (7.39)	11.06 (4.63)
<b>2004</b>	1,923	1,930.98 (979.70)	41.54 (10.16)	10.70 (4.72)	739	2,174.55 (981.13)	44.54 (7.68)	11.30 (4.68)
<b>2003</b>	1,967	1,931.36 (947.14)	41.81 (9.79)	10.64 (4.57)	761	2,167.30 (928.19)	44.78 (7.15)	11.23 (4.56)
<b>2002</b>	2,050	1,882.83 (890.51)	42.15 (9.81)	10.30 (4.29)	802	2,084.13 (876.38)	44.97 (7.71)	10.73 (4.20)
<b>2001</b>	2,220	1,831.92 (856.01)	42.33 (10.12)	10.04 (4.16)	882	2,016.24 (806.59)	45.31 (7.57)	10.38 (4.02)
<b>2000</b>	2,336	1,812.73 (830.79)	42.46 (10.11)	9.90 (4.01)	931	1,984.44 (804.70)	45.43 (7.88)	10.14 (3.80)
<b>1999</b>	1,668	1,792.09 (762.24)	42.80 (9.52)	9.71 (3.78)	691	1,919.96 (715.47)	45.56 (8.16)	9.83 (3.58)
<b>1998</b>	1,632	1,785.58 (738.21)	43.02 (9.38)	9.67 (3.77)	694	1,937.78 (693.97)	45.62 (8.04)	9.93 (3.55)
<b>1997</b>	1,610	1,793.09 (739.08)	43.62 (9.32)	9.56 (3.61)	690	1,922.98 (683.73)	46.15 (7.92)	9.73 (3.32)
<b>1996</b>	1,673	1,762.72 (720.55)	43.16 (9.31)	9.50 (3.53)	728	1,893.92 (648.47)	46.00 (7.72)	9.63 (3.27)
<b>1995</b>	1,749	1,697.36 (699.52)	43.36 (9.63)	9.12 (3.45)	770	1,831.71 (659.33)	46.23 (7.96)	9.24 (3.13)
<b>1994</b>	1,710	1,653.03 (647.18)	43.45 (8.63)	8.82 (3.12)	797	1,762.10 (592.33)	45.71 (7.21)	8.96 (2.85)

Source: Samples from GSOEP 1994-2005, see text; own calculations.

**Figure A1: Wage Growth in 20 Percentiles, West Germany 1994-2005**



Source: GSOEP 1994-2005; weighted data; own calculations.