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# Re-assessing Trends in Wage-Inequality in Germany

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**Abstract**

This paper uses administrative data, combined with firm data, to reassess trends in wage inequality in Germany. Other than the UK or the US, Germany's wage distribution has remained remarkably stable until the early 1990s. We focus on the mid- to late 1990s. For this period, we document a sharp increase in wage inequality: From 1995 to 2000, the standard deviation of log-wages increased by more than 15 %, and the difference between the 85th and 15th percentile of the wage distribution widened by about 10 %. These changes happened both at the lower and upper end of the wage distribution. They were not uniform across skill groups. It is the young and low skilled who suffered the greatest loss and witnessed the sharpest increase in wage dispersion. A decomposition exercise a la Juhn, Murphy and Pierce indicates that changes in the labor force decomposition account only for a small fraction in the increase in inequality. Changes in observed skill prices can explain more than one half of the rise in inequality. The reminder is due to an increase in wage dispersion within narrowly defined skill groups.

**JEL codes: J300, J310, J500, J510**

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# 1 Introduction

A large literature demonstrates a sharp increase in wage- and earnings inequality in the United Kingdom since the late 1970's (see Machin 1996, and Gosling, Machin and Meghir 1980 for evidence). Similarly dramatic increases in the earnings inequality have been documented for the US (see e.g. Bound and Johnson 1992, Katz and Murphy 1992, Levy and Murnane 1992). These rises in wage inequality were both by skill groups, and within demographic and skill groups (residual wage inequality). Other, and in particular European countries experienced much smaller increases in inequality, or no increases at all (see Freeman and Katz 1996 for a summary of inequality in other countries). Germany, in particular, has been singled out as a country characterised by a stable wage distribution during the 1980's (see Steiner and Wagner 1998 and Fitzenberger et al. 2001, among others).

This paper reassess recent trends in wage inequality in Germany. We focus on the mid- 1990s until early 2000's. For this period, we document a sharp increase in wage inequality: From 1995 to 2000, the variance of log-wages increased by more than 20 %, and the difference between the 85th and 15th percentile of the wage distribution widened by more than 16 percentage points. These developments have gone mostly unnoticed in the literature. Although some recent papers based on administrative as well as survey-data sets discuss an increase in inequality since the mid 1990's (see in particular Riphan 2003 or Moeller 2004), these studies concentrate on other issues, and do not investigate these developments in much detail. The main goal of this paper is to carefully document where in the wage distribution these changes took place. Did the changes occur mostly within or between narrowly defined skill groups? Did the changes predominantly happen at the lower or upper end at the wage distribution? Are certain groups -such as the young low skilled- more affected by the change in wage dispersion than other groups, such as the middle aged medium skilled? Is the increase in wage dispersion mostly due to changes in the labor force composition, or due to changes in skill prices? Answering these questions is a necessary first step to evaluate alternative explanations for the recent increase in wage inequality.

The structure of the paper is as follows. The next section describes our data. Section 3 provides descriptive evidence on the overall changes in inequality since the mid 80s, and analyzes whether these changes occrred predominantly within or between narrowly defined skill groups. In Section 4, we use the Juhn-Murphy-Pierce (1993) decomposition as well as Machado and Mata's (2005) quantile decomposition to decompose the overall increase in wage dispersion into two components, labor force composition and skill prices. Price effects are further decomposed into a between and within group component. Both sections distinguish between the upper (i.e. 85th vs 50th percentile) and lower (i.e. 50th vs 15th percentile) end of the wage distribution. Section 5 summarizes our results, and discusses possible explanations for our findings.

# 2 Data Description

# 3 Data Sources

We use two data sources for our analysis. The first data source is a 2 percent random sample of social security records in Germany (the so-called *IABS*). In principle, the data is available from 1975 to 2001. We, however, drop information from 1975 to 1983. We do this because the rules for which type of earnings firms have to report change in 1984 so that the wage data is not directly comparable before and after 1984. Our second data source combines a firm panel with all workers who are employed in one of these firms. As our 2 % random sample, information in workers is based on social security records.

The social security records comprises records of employment and unemployment spells for all workers, employees and trainees with obligations to contribute to the social insurance system. Civil servants, the self-employed and marginal jobs (temporary jobs shorter than 6 weeks and jobs with salaries falling below a certain monthly wage) are not included. Together the employment register (BLH) covers about 80.5% of all employed persons in Western Germany, and 86.2% of all employed persons in Eastern Germany. The dataset contains many personal characteristics relevant for the employment relation and social insurance. A part of the characteristics serves for insurance law purposes and is therefore highly accurate (e.g. monthly gross wages, sex, marital status). Other variables which contain purely statistical information (e.g. education) may be prone to reporting errors.

In both data sets, wages are censored at the so-called *Beitragsbemessungsgrenze*, an upper earnings limit for the social security contribution. More than 10% of all employment spells are censored at this limit; for the highly-qualified, censoring affects more than 40% of all spells. Later, we describe in more detail how we deal with the censoring problem.

**IABS: Sample Selection** From the IABS, we construct the following sample of male workers for the years 1984 to 2001. We ignore multiple jobs and drop all workers with at least one spell in East Germany. We further restrict the analysis to workers who are at least 18 years old, are not currently in apprenticeship training, and are employed full-time on the 1st of July.

**LIAB-Data: Sample Selection** The basis of our second data source in the IAB Establishment Panel, an establishment survey conducted by the IAB (Institute for Employment Research of the German Federal Labour Agency). We use two waves, 1995 and 2001. We restrict the analysis to firms in West Germany. Our sample consists of all male workers who were employed full-time in one of these firms as of 1st of July. We drop workers who are currently in training. After application of the selection rules,

the linked employer-employee dataset contains 1,125,767 employees in 3,526 firms for 1995 and 1,031,489 employees in 8,133 firms for 2001.[1]

The firm panel oversamples large firms. We deal with this problem by using the appropriate cross-sectional weights throughout the analysis.

**Variable Description** The key variables for our analysis are gross daily real wages (computed from monthly wages), indicators for the level of education, age, and an index identifying foreign nationals. The original education variable contains seven raw categories: no degree, vocational training degree, high school degree (abitur), high school degree and vocational training degree, technical college degree, university degree, missing. We reduce that information into three educational categories, no (completed) apprenticeship training (including missing information on education and high school degree without any other degrees)[2], vocational training degree (including workers with vocational training degree and high school degree), and technical college degree (Fachhochschule) and college graduates.

# 4 Trends in Wage Inequality

## 4.1 Overall Trends

**IABS** In Figures 1-3 we display the overall trends in wage inequality for males, and over the period between 1984 and 2001. We have indexed the data series so that they are equal to 100 (or zero) in 1884.

[Figure 1 about here]

Figure 1 displays indexed real wages for the 15th, 50th and 85th quantiles of the wage distribution. The 85th quantile of the wage distribution is observe (i.e. not censored) for every year; hence, for this figure wage censoring poses no problem. The figure suggests a largely parallel rise in real wages for all three groups until about 1992; after 1992, wages continue to increase at a similar pace for the 85th quantile; they are stagnant for the median, and they decrease for the 15th quantile. These figures therefore indicate a substantial increase in wage inequality in Germany over the second part of the 1990's. Moreover, the increase in wage inequality occurred both at the lower and upper end of the wage distribution.

[Figure 2 about here]

[1] The large difference between the number of firms in 1995 and 2001 is explained by the fact that the sample was extended considerably in 2000 and 2001. In the course of the extension, a larger share of small firms was sampled to reduce oversampling of large firms in the earlier waves. Of course, cross section weighting factors are available and used in our investigation to correct this.

[2] We are aware of the bias introduced by coding missings as unskilled (cf. Fitzenberger et al. 2005). This will be improved in later project steps.

In Figure 2, we display the indexed standard deviation of log-wages and log-wage residuals as an alternative measure of dispersion. Here, we deal with censoring using a Tobit approach. We first regress log-wages on a constant only, and report the estimate of the standard deviation of the residual. We then regress log-wages on a constant, foreign status, 3 education groups and 6 age groups[3]. Again, the figure plots the esimate of the standard deviation of the residual. The picture that emerges is similar to that in figure 1: wage dispersion rises slightly during the first part of the 1990's but continues to increase with higher pace over the second part of that decade. There are hardly any differences between residual and wage standard deviations, indicating that much of the increase in wage dispersion occurred within groups.

In figure 3, we display cumulative changes in log-wage differentials by education. As before, we deal with wage censoring by estimating tobit models. We report differentials in log wages between high and low educated, as well as between medium and low educated, and high and medium educated. As before, there is no increase up to 1992; after 1992, the difference in log wages between the highly educated and the low educated increases dramatically. This increase takes place mainly between medium and low educated indivuduals, but also between highly educated and medium educated workers.

[Figure 3 about here]

Overall, these figures suggest a quite dramatic increase in wage inequality, both across quantiles, as well as across education groups, from about 1993 onwards. Importantly, this increase in inequality takes place both at the upper as well as the lower part of the wage distribution. In the next section, we break these changes down to different demographic and age groups,

## 4.2 Changes Between Groups

In table 1 we display changes in median wages for three different periods: 1985-1990 (upper panel), 1990-1995 (intermediate panel), and 1995-2000 (lower panel). To increase the number of observations, observations from the successive years were combined to obtain the median, i.e. the lower period limit relates '1985' relates to years 1984, 1985 and 1986, '1990' to 1989, 1990 and 1991 etc. Notice that some cells are empty - these are cells where top coding affects more than 50 % of the sample population. The table shows a large increase of median wages during the first period: On average, wages have increased nearly 9 percentage points for low and medium skilled workers. Inspection of the different age cells reveals that this increase has been quite evenly distributed across age groups. The increase for the highly skilled is only slightly larger. Also, there seem to be hardly any differences between Germans and foreigners. These results are compatible with our figures above. They are also in line with existing studies for

[3]In the next draft, we will include all possible interactions between foreign status, age, and education.

Germany, which found hardly any development in wage inequality over the 1980's in Germany.

[Table 1 about here]

The next panel reports results between 1990 and 1995. Now overall changes are considerably lower - they are basically zero for the low skilled, and around 2.5 percentage points for the medium skilled. For highly skilled workers, changes are larger at around 6 percentage points, but nevertheless dramatically lower than over the previous 5 years period.

Other than before, changes are now not evenly distributed between demographic groups. Among the low and medium skilled, it is particularly the foreigners who experience dramatic slowdown in growth in median wages. In fact, for foreigners overall wage growth is negative for most age groups. Among the highly skilled, in contrast, there seems to be no difference between foreigners and Germans.

The last panel shows a slight overall reduction in median wages for the period 1995-2000 for low skilled workers. The reduction is quite dramatic for the youngest age groups, who see their wages falling by 10 (younger than 25) and 6 (between 26 and 30) percentage points. Other than for the previous period, there seems to be hardly any difference between foreigners and Germans.

For the medium skilled wage growth is on average practically zero. Other than for the low skilled this seems to be the case for all age groups. For highly skilled workers, wage growth is still positive overall, but only half the size than over the previous period, and only 1/3 of what highly skilled workers experienced over the period 1985-1990.

In line with figure 3, the table reveals a substantial overall increase in educational wage differentials between 1995 and 2000. However, the rise in the return to education is not uniform across age groups. The rise is particularly dramatic for the young, and lowest for the medium-aged.

[Table 2 about here]

Table 2 repeats the analysis using our matched employer-employee data, for the period 1995 to 2000. Results are roughly in line with those from the IABS.

### 4.3 Changes Within Groups

In table 3, we display changes in the 85-15 wage percentile between three periods: 1985-1990 (upper panel), 1991-1995 (intermediate panel), and 1995-2000 (lower panel). As before, we distinguish between foreigners and 6 age groups. Because of wage censoring, we focus on the low and medium skilled. Between 1985 and 1990, the overall quantile wage differential increases only slightly for low and medium educated workers. The increase is almost evenly distributed across education, age and foreign cells. Next, consider the period 1990 to 1995. Our graphs above suggest that towards the end of this 5 year period, wage inequality started to rise. Table 3 reveals that the rise is particularly pronounced among low skilled

young foreigners. For this group, the difference between the 85th and 15th percentile increased by almost 15 percentage points. Most other skill groups show only a slight increase in wage dispersion. The lower panel reports numbers for the period between 1995 and 2000. In line with our figures above, this is the period with a sharp rise in inequality for all skill groups. The rise in inequality is particularly pronounced among the low skilled; among the low skilled, it is most pronounced for the young. Other than over the previous period, the increase in overall inequality is similar for Germans than for foreigners.

[Table 3 about here]

Did these changes mostly occur at the lower or upper end of the wage distribution? Tables 4 and 5 provide an answer. Table 4 reports 85-50 percentile differentials, while table 5 reports 50-15 percentile differentials. Otherwise, the tables have the same structure as table 3.

From 1985 to 1990, there is little change in the 85-50 and 50-15 percentile differentials for any skill group. For the period from 1990 to 1995, young unskilled foreigners witnessed a sharp rise in inequality. It turns out that this increase occured mostly at the bottom of the distribution. For the period from 1995 to 2000, we observe a sharp increase in wage dispersion for all skill groups, but particularly so for the young unskilled. For the medium educated, these changes happened both at the lower and upper end of the wage distribution. For the low educated, in contrasted, changes at the lower end of the distribution are more pronounced than at the upper end.

[Table 4 and 5 about here]

Table 6 repeats the analysis using our matched employer-employee data for the period 1995 to 2000. The results are roughly in line with those from the IABS.

[Table 6 about here]

# 5 Quantile Decompositions

To shed more light on the sources of the rising wage inequality, we next decompose the observed changes in the dispersion measures into three components. The first component is due to changes in labor force composition. Suppose that wage dispersion is higher for a particular group in the labor market, say for university graduates or more experienced workers. Consequently, changes in the distribution of education or experience in the labor force would lead mechanically to increased wage dispersion. Similarly, changes in the labor force composition may lead to changes in wage inequality simply by increasing or decreasing heterogeneity in observed skills. The second component is due to changes in *prices*. Price effects are further decomposed into between group and within group components. We use the techniques developed by Juhn, Murphy and Pierce (1993) to do this. In a future draft of this paper, we intend to also employ

the quantile decomposition technique developed by Machado and Mata (2005) (see also Autor et al. 2005). The next sub-section briefly describes each method. We then discuss our results.

## 5.1 Description of Methods

**Juhn, Murphy and Pierce (1993)** The JMP decomposition is based on a linear wage equation of the form

$$w_{it} = X_{it}\,\beta_t + u_{it}$$

with log-wage $w_{it}$ of individual $i$ in period/wave $t$, a vector $X_{it}$ of observed characteristics, a 'price' vector $\beta_t$, and residual vector $u_{it}$. If $\theta_{it}$ denotes the quantile of individual $i$ in the residual wage distribution then, by definition,

$$u_{it} = F_t^{-1}(\theta_{it}|X_{it})$$

with inverse residual distribution function $F_t^{-1}(\cdot)$. A decomposition of quantile changes into observed characteristics effects, price effects and residual effects can then be obtained after rewriting the wage equation in the form

$$w_{it} = X_{it}\bar{\beta} + X_{it}(\beta_i - \bar{\beta}) + \bar{F}^{-1}(\theta_{it}|X_{it}) + \left[F_t^{-1}(\theta_{it}|X_{it}) - \bar{F}^{-1}(\theta_{it}|X_{it})\right]$$

where $\bar{\beta}$ and $\bar{F}^{-1}(\cdot)$ denote the mean of the coefficient vector and the mean cumulative inverse residual distribution function, respectively. The first term captures the effect of changing quantities $X_i$ at constant (average) prices, the second term the effect of changing prices at constant quantities, and the third term the effect of changes in residual distribution. With the definitions

$$\begin{aligned} w_{it}^1 &= X_{it}\,\bar{\beta} + \bar{F}^{-1}(\theta_{it}|X_{it}) \\ w_{it}^2 &= X_{it}\,\beta_t + \bar{F}^{-1}(\theta_{it}|X_{it}) \\ w_{it}^3 &= Y_{it} \end{aligned}$$

we obtain the decomposition of observed (total) change of quantile $\theta$, $\Delta Q_\theta = Q_\theta(w_\tau^3) - Q_\theta(w_t^3)$ into the contribution of observed quantities $\Delta Q_\theta^x = Q_\theta(w_\tau^1) - Q_\theta(w_t^1)$, the contribution of prices $\Delta Q_\theta^b = \Delta Q_\theta - \Delta Q_\theta^x$ and the contribution of residuals $\Delta Q_\theta^w = \{Q_\theta(w_\tau^2) - Q_\theta(w_t^2)\} - \Delta Q_\theta^b$.

Since our dependent variable is censored, standard regression methods cannot be applied directly to the data. To circumvent this problem, we impute wages above the censoring limit and use the imputed wages in the following steps. Imputation is performed by estimating a maximum likelihood tobit model allowing for heteroscedastic residuals. The latent model has the form $w^* = X\,\beta + u$. $w^*$ is censored at

the social security contribution limit $c$, i.e.

$$w = \begin{cases} w^* & \text{if } w^* < c \\ c & \text{otherwise} \end{cases}$$

To obtain an operational model, we assume that standard deviation of residuals can be approximated by the parametric function $\sigma_u = \exp(z\,\gamma)$.

With estimated coefficients $\hat{\beta}$ and $\hat{\gamma}$ in hand we replace the censored observations by the linear prediction $x_i\,\hat{\beta}$ plus a (pseudorandom) residual noise term $\tilde{u}_i$. If $w_i$ is censored then $u_i > c - x_i\,\beta$. Therefore $\tilde{u}$ is drawn from a truncated normal distribution with standard deviation $\sigma_{ui}$ and (lower) truncation limit $c - x_i\,\hat{\beta}$. Our imputation model contains complete interactions of the regressor variables (education, age, nationality). Additionally we include (log) firm size, 28 sector dummies and 9 region type dummies.

A fundamental problem with the canonical JMP decomposition is that the residual and price components $\Delta Q^w_\theta$ and $\Delta Q^b_\theta$ have to be estimated as remainder terms, and that the components add up to the total change only if the residuals are homoscedastic. Homoscedasticity is, however rejected by the data. Thus the decomposition can only be taken as an approximation.

**Machado and Mata (2005)** The decomposition technique developed by Machado and Mata (2005) and extended by Autor et al. 2005 overcomes this problem. This approach starts with estimating the conditional quantile function

$$Q_\theta(w_{it}|X_{it}) = X_{it}\,\beta(\theta).$$

for a grid of quantiles $\theta \in \{1, 2, \ldots, \theta^{max}\}$ a prerequisite to simulate the distribution of $w_t$ given $X_t$. In our application, $t \in \{1995, 2001\}$. A Monte Carlo simulation is then used to generate various counterfactual distributions of $w_t$. These counterfactual distributions are used to decompose changes of these distribution of $w$ into quantity and price shares.

Quantile regressions are particularly attractive for our application since our wage data are right-censored at the upper earnings limit for social security contribution. As is well known, conditional quantile estimation of the uncensored part of the distribution requires only weak assumptions regarding the distribution of residuals.

Autor et al. (2005) define $\hat{\beta}^b := \hat{\beta}(50)$ as measure of between-group and $\hat{\beta}^w(\theta) := \hat{\beta}(\theta) - \hat{\beta}^b$ as measure of within-group inequality. The observed change of quantile $\theta$,

$$\Delta Q_\theta = Q_\theta\big[f_\tau(w)\big] - Q_\theta\big[f_t(w)\big]$$

is then decomposed into the contribution of observed characteristics (labor force composition)

$$\Delta Q^x_\theta = Q_\theta\big[f(g_\tau(X), \beta^b_t, \beta^w_t(\theta))\big] - Q_\theta\big[f(g_t(X), \beta^b_t, \beta^w_t(\theta))\big],$$

the contribution of between-group prices

$$\Delta Q_\theta^b = Q_\theta\big[f(g_\tau(X), \beta_\tau^b, \beta_t^w(\theta))\big] - Q_\theta\big[f(g_\tau(X), \beta_t^b, \beta_t^w(\theta))\big],$$

and the contribution of within-group prices

$$\Delta Q_\theta^w = Q_\theta\big[f(g_\tau(X), \beta_\tau^b, \beta_\tau^w(\theta))\big] - Q_\theta\big[f(g_\tau(X), \beta_\tau^b, \beta_t^w(\theta))\big].$$

Note that the components sum to the (simulated) total change by construction.

To obtain the marginal distribution of $f(w_t)$ we employ the simulation strategy proposed by Machado and Mata: Draw a random variate $X_t^{(k)}$ of the distribution of worker characteristics $g_t(X)$ at time $t$ by drawing a bootstrap sample from $X_t$. Then draw a random variate $\theta^{(k)}$ from a uniform distribution and apply the probability integral transformation to obtain a random variate $\hat{w_t}^{(k)} \equiv X_t^{(k)}\, \beta_t(\theta^{(k)})$ from the marginal distribution $f_t(w)$. If this procedure is repeated many times, the distribution of the vector of bootstrap samples $\omega = (\hat{w}_t^{(1)}, ..., \hat{w}_t^{(K)})$ converges to the marginal distribution of $w_t$. $\omega$ can be used to decompose changes of the distribution of $w_t$ into quantity and price effects in the vein of the canonical JMP decomposition by combining the appropriate $X_t$ and $b_t(\theta)$ (the details are given below). Autor et al. (2005) show that this approach eliminates some shortcomings of the canonical JMP decomposition and that it nests the nonparametric kernel re-weighting approach proposed by DiNardo et al. (1996).

To make the specification as flexible as possible, our specification of the quantile regression function contains a full set of interactions between three education groups, 4 age groups, and the foreign dummy.

## 5.2 Results

Figure 1: Decomposition of changes in quantile differences into quantities and price effects

| Quantile difference | total | quantities | between prices | within prices |
|---|---|---|---|---|
| 85/50 | 3.3 | 0.1 | 2.0 | 1.1 |
| 50/15 | 3.2 | 0.4 | 1.5 | 1.2 |
| 85/15 | 6.5 | 0.5 | 3.5 | 2.4 |
| 75/25 | 4.5 | -0.2 | 1.7 | 3.0 |

Source: LIAB data. Sample: full-time working males, West-Germany, age 18-65 years.

Table 7 shows the results of the Juhn-Murphy-Pierce decomposition for several quantile differences. Results refer to the change from 1995 to 2001, and are based on the linked employer-employee data. Throughout this period, the difference between the 85th and 15th percentile increased by 6.5 percentage

points. The increase between 50th and 15th percentile is about as large as the increase between the 85th and 50th percentile (3.3 vs 3.2 percentage points). Overall, changes in the labor force composition (column 3) play only a minor role in explaining the increase in wage dispersion ($\leq 10\%$). Changes in observable prices account for more than half of the increase in wage dispersion. The remaining 37 % can be attributed to changes within narrowly defined skill groups.

In a next step, we break down the analysis for the lower and upper end of the wage distribution. It turns out that changes in the labor force composition are more important driving force behind the increase in wage dispersion at the lower end of the wage distribution than at the upper end. Changes in observable prices, in contrast, play a more important role at the upper end than at the lower end of the wage distribution.

In the future draft of the paper,

- We intend to decompose the between-price component into the effect of education, age, and foreign status to answer questions like: Is it only the price for education that changed, or also the price for age or foreign status?
- Furthermore, we plan to repeat the decomposition for the unskilled and apprentices only. For these groups, censoring plays only a limited role; hence, the results for these education groups should be less affected by wage censoring. Moreover, from Tables 3-6, wage dispersion increased most for the group with the lowest education. How much of the wage dispersion for this group is due to changes in labor force composition, and how much is due to changes in prices?
- We also plan to repeat the analysis for young workers (i.e. less than 30), the group for which wage dispersion as well as the return to education increased the most.
- For these groups, we plan to compare the JMP decomposition with that of Machado and Mata (2005).

# 6 Conclusion

This paper analyses recent trends in wage inequality in Germany. We focus on the mid- to late 1990s. For this period, we document a sharp increase in wage inequality: From 1995 to 2000, the variance of log-wages increased by more than 20 %, and the difference between the 85th and 15th percentile of the wage distribution widened by more than 16 percentage points.

The main goal of this paper is to carefully document where in the wage distribution these changes took place. Did the changes occur mostly within or between narrowly defined skill groups? Did the

changes predominantly happen at the lower or upper end at the wage distribution? Are certain groups -such as the young low skilled- more affected by the change in wage dispersion than other groups, such as the middle aged medium skilled? Is the increase in wage dispersion mostly due to changes in the labor force composition, or due to changes in prices? An answer to these questions is a necessary first step to explain the changes in the wage distribution.

Our preliminary answers to these questions are as follows.

- The increase in wage inequality occurred both between and within skill groups. Between 1995 and 2000, the wage differential between workers without post-secondary education and workers with a college degree increased by about 12 percentage points. During this period, the increase in the return to education was substantially higher for the young than for the medium aged.
- The increase in wage dispersion occurred both at the lower and at the upper end of the wage distribution.
- It is the young workers without a post-secondary education who are hit hardest. For this group, average wages declined by 12 % between 1995 and 2000. This is also the group for which within-group inequality increased the most. Moreover, for this group, the bulk of the increase in wage dispersion occurred at the lower end of the wage distribution: the difference between the 50th and 15th percentile rose by 12 percentage points, while the difference between the 85th and 50th percentile increased only by 5 percentage points.
- Results for a quantile decomposition suggests that changes in prices between groups account for most of the increase in wage dispersion. Changes in the labor force composition (Column 3) are an important driving force for the increase in wage dispersion at the lower end of the wage distribution, but not at the upper end.

What are possible explanations for the increase in wage dispersion during the late 90s? Moreover, why has inequality been increasing in the US and the UK since the late 70s, but why did this process start in Germany only about 15 years later?

One possible explanation is related to labor market institutions, in particular unions. There is agreement in the literature that unions lower wage inequality in the economy. In Germany, union coverage has steadily decreased since the early 90s, and could thus be responsible for the rise in wage inequality[4].

[4] According to DiNardo, Fortin und Lemieux (1996), Lee (1999), and Card und DiNardo (2002), the decline in unionization as well as the decline in the minimum wages account for much of the increase in wage inequality in the US during the 80s. This view is largely supported by a more recent study by Lemieux (2005), using more recent data evidence.

However, as Autor et al. (2005a,b) argue, the changes in the wage distribution did not only occur at the bottom, but also at the top of the wage distribution. It thus seems unlikely that the decline in unionization is the only reason for the rise in wage dispersion in Germany. Moreover, if the decline in unionization plays an important role in explaining the rise in wage dispersion, then one would also like to understand what caused this decline. It is possible that the same process that leads to an increase in wage dispersion is also responsible for the erosion of the collective bargaining system[5].

Probably the best known explanation for the rise in inequality in the US and UK is skill-biased technological change. Could this be a possible explanation for the rise in wage dispersion in Germany during the 90s? There is an important problem with this explanation. Did Germany adopt skill-biased technologies only in the 90s, whereas these technologies were adopted by the US and UK already in the 80s? This seems very unlikely, as there is evidence that Germany and the US adopted new technologies at similar rates throughout the 80s and 90s (see e.g. Spitz (2006)). Any model of skill-biased technological change has to explain

- why they increased wage dispersion during the 80s in the US and UK, but not in Germany,
- and why they started to increase wage dispersion in Germany during the 90s.

(Of course, this does not mean that technolgy is not skill-biased!!!)

A further hypotheses for why wage dispersion rose during the 90s is related to the breakdown of the communist regimes in Eastern Europe. The opening of the borders lead to a large increase of migrants, most of them young and low skilled. This is precisely the skill group for which we observe the most dramatic increase in inequality. Moreover, the opening of the borders are likely to have increased trade between Eastern and Western Europe. Maybe more importantly, it offered the chance for German firms to locate their business to Eastern Europe, i.e. to countries with a relatively skilled labor force and wage levels half of those in Germany. All these developments are likely to have hurt the low skilled. Moreover, they may have lowered firms' willingness to recognise union agreements, thus causing a decline in union coverage. Analysing the empirical content of this hypothesis is an important agenda for future research.

# 7 References


- Acemoglu, D., Aghion, P. and Violante, L. (2001): "Deunionization, Technical Change and Inequality," Carnegie-Rochester Conference Series on Public Policy, 55(0), 229–264


[5]See Acemoglu et al. (2001) for a model along these lines.

- Autor, D., Katz, L. and Kearney, M. (2005a): "Trends in U.S Wage Inequality: Re-Assessing the Revisionists", NBER Working Paper no. 11627
- Autor, D., Katz, L. and Kearney, M. (2005b): "Rising Wage Inequality: The Role of Composition and Prices", NBER Working Paper no. 11628
- Bellmann, L., Bender, S. and Kölling, A. 2002: Der Linked Employer-Employee-Datensatz aus IAB-Betriebspanel und Beschäftigtenstatistik der Bundesanstalt für Arbeit, in Kleinhenz, G. (Hg.): IAB-Kompendium Arbeitsmarkt- und Berufsforschung, BeitrAB 250, Nürnberg, S. 21-30.
- Bender, S. Haas, A. and Klose, C.: IAB Employment Subsample 1875-1995. Opportunities for Analysis Provided by the Anonymised Subsample, IZA Discussion Paper, February 2000.
- Bound, J. Johnson, G. (1992): "Changes in the Structure of Wages in the 1980s: An Evaluation of alternative Explanations," American Economic Review, 82, 371–92
- Büttner, T. und B. Fitzenberger (2001) "Central Wage Bargaining and Wage Flexibility: Evidence from the Entire Wage Distribution", Industrial and Labor Relations Review.
- Büttner, T. und B. Fitzenberger (2003) "Integrating Wage Bargaining into an Efficiency Wage Model: The Relationship between Wages and Unemployment Revisited", Diskussionspapier, Universität Mannheim.
- Card, D. (1992): "The Effect of Unions on the Distribution of Wages: Redistribution or Relabelling?" Working paper No 4195. Cambridge, MA: NBER, October.
- Card, D. and DiNardo, J. (2002): "Skill Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles," NBER Working Paper No. 8769
- Dinardo, J., Fortin, N. and T. Lemieux (1996): "Labor Market Institutions and the Distribution of Wages: A Semi-Parametric Approach", Econometrica, 64, pp. 1001-1044.
- Fitzenberger, B. (1999), "Wages and Employment Across Skill Groups: An Analysis for West Germany," Physica Verlag, Heidelberg.
- Lemieux, T. (1998): "Estimating the Effects of Unions on Wage Inequality in a Panel Data Model with Comparative Advantage and Nonrandom Selection" Journal of Labor Economics 16, 261-291.
- Levy, F. and Murnane, R. (1992): "U.S. Earnings Levels and Earnings Inequality: A Review of Recent Trends and Proposed Explanations" Journal of Economic Literature, 30(3), 1333-1381

- Fortin, N. and T. Lemieux (1997): "Institutional Change and Wage Inequality: Is there a Linkage?", Journal of Economic Perspectives, 11, pp. 75-96. Lindbeck, A. and D. Snower (1988): "The Insider-Outsider Theory of Employment and Unemployment", Cambridge, Mass. and London, MIT Press, p. 285.
- Katz, L. and Murphy, K. (1992): "Changes in Relative Wages, 1963-1987: Supply and Demand Factors," Quarterly Journal of Economics, 107(1), 35–78
- Freeman, R. and Katz, L. (1996): Introduction and Summary, in: Differences and Changes in Wage Structures, ed. R. Freeman and L. Katz, 1-22. Chicago: University of Chicago Press
- Gosling, A., Machin, S. and Meghir, C. (2000): "The Changing Distribution of Male Wages in the UK," Review of Economic Studies, 67(4), 635–666
- Herrlinger, D., Müller, D. and Bellmann, L. (2005): "Codebuch zum IAB Betriebspanel Version 1: Längsschnitt 1993-2001", (5. überarbeitete Auflage), FDZ Datenreport Nr. 5/2005 (downloadable from http:fdz.iab.de)
- Juhn, C., Murphy, C. and Pierce, B. (1993): "Wage Inequality and the Rise in Returns to Skill", Journal of Political Economy," 101(3), 410–442
- Machado, J. and Mata, J. (2005): "Counterfactual Decomposition of Changes in Wage Distributions Using Quantile Regression," Journal of Applied Econometrics, 20(4), 445–465
- Machin, S. (1996): "Wage Inequality in the UK," Oxford Review of Economic Policy, 12(1), 47–64
- Riphahn, R. (2005): "Bruttoeinkommensverteilung in Deutschland 1984-1999 und Ungleichheit unter Ausländischen Erwerbstätigen, DIW Discussion Paper
- Spitz, A. (2006): "Technical Change, Job Tasks and Rising Educational Demands: Looking Outside the Wage Structure, Journal of Labor Economics, forthcoming
- Steiner, V. and Wagner, K. (1998): "Has Earnings Inequality in Germany Changed in the 1980's?", Zeitschrift fur Wirtschafts–und Sozialwissenschaften, 118(1), 29–59

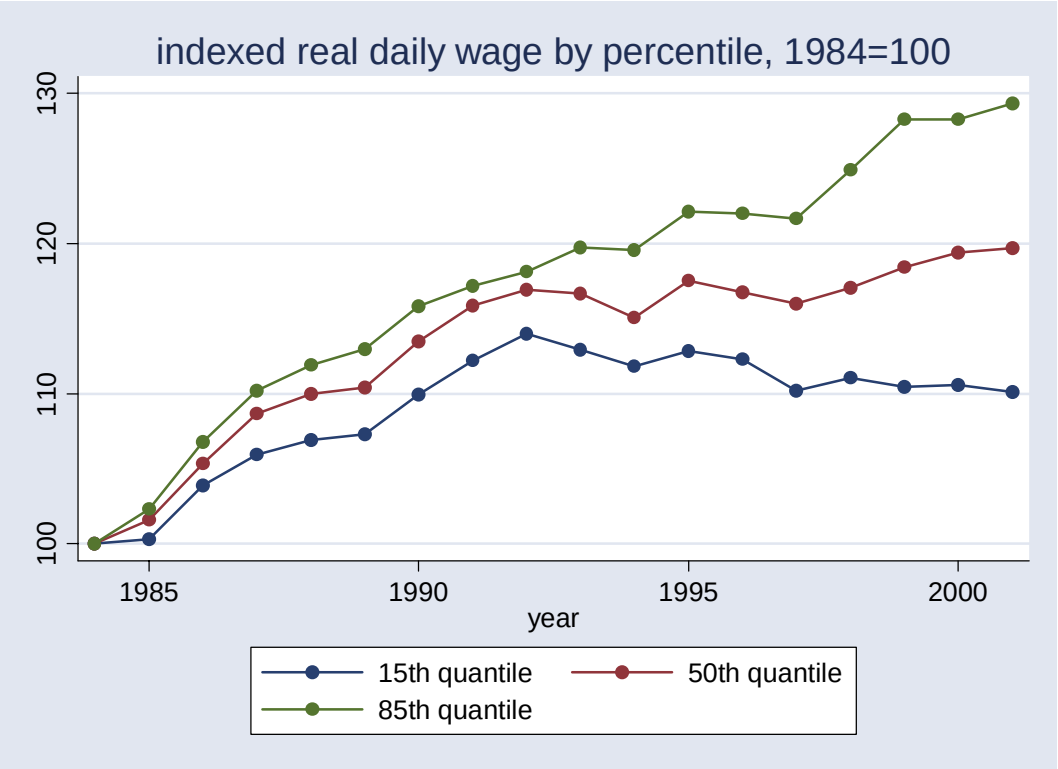


Figure 1: Indexed real daily wages, 1984-2001, different quantiles

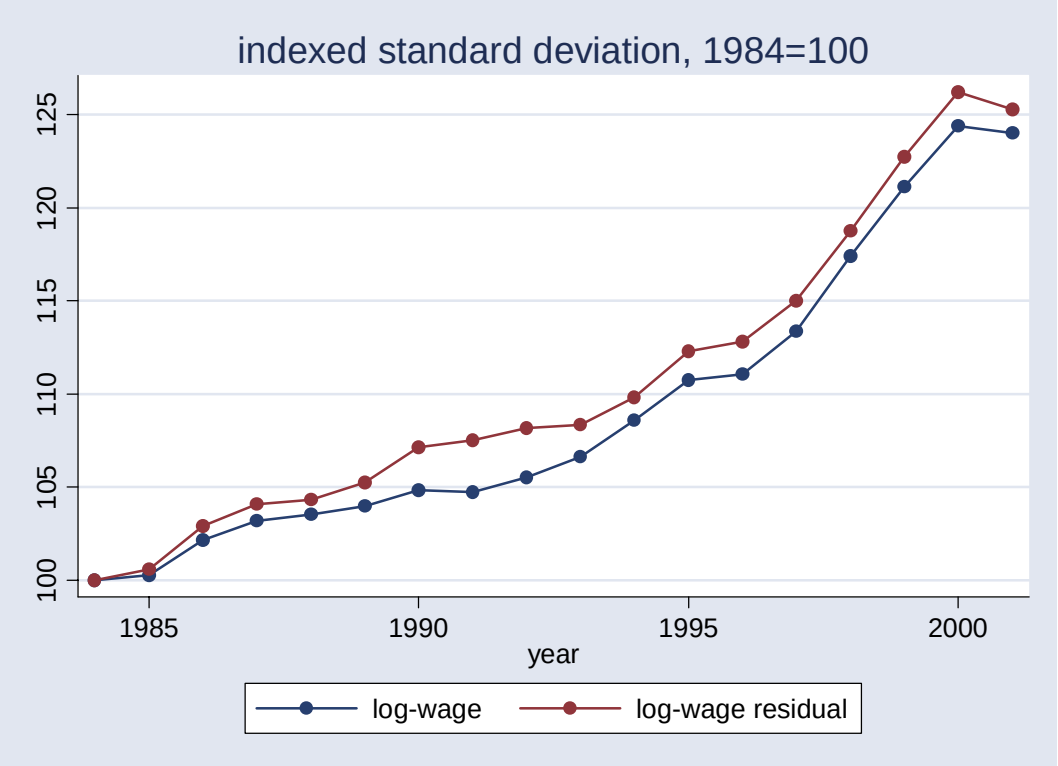


Figure 2: Indexed standard deviation, real daily wages, 1984-2001

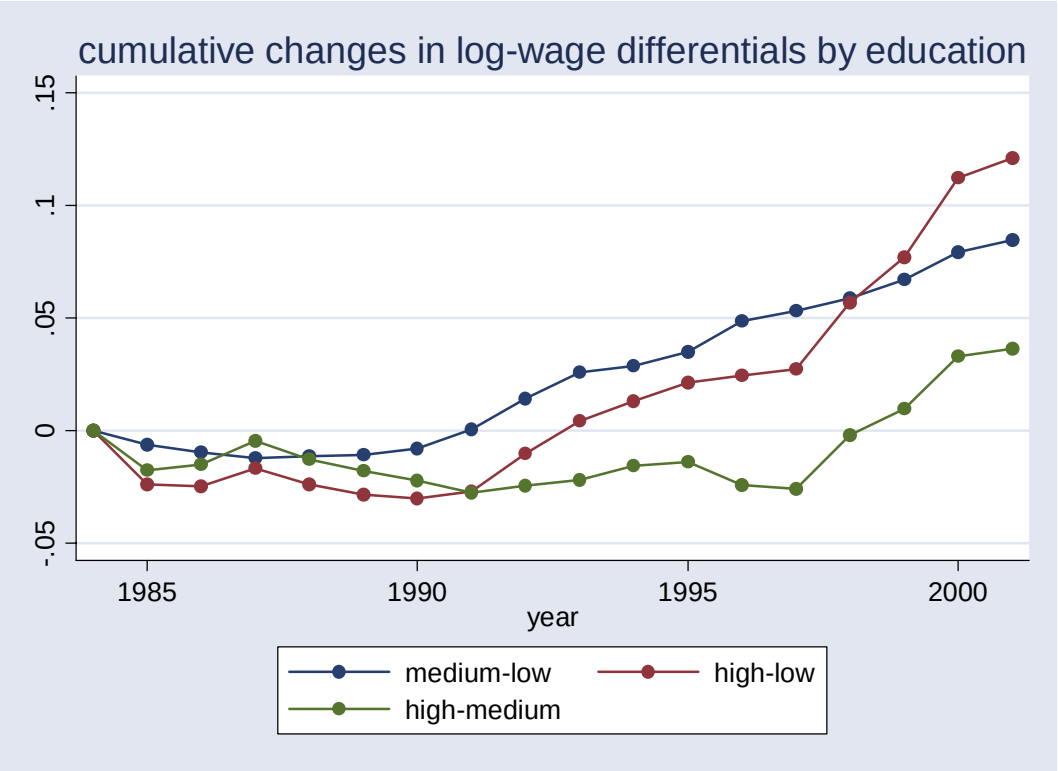


Figure 3: cumulative changes in log-wage differentials by education

**Table 1: Change in Median Log Wages, IABS Data**

**Change in Median: 1985-1990**

| | low | | | medium | | | high | | | all | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| age | German | foreign | all | German | foreign | all | German | foreign | all | German | foreign | all |
| <25 | 0.0987 | 0.1177 | 0.1050 | 0.1190 | 0.1148 | 0.1190 | 0.1575 | 0.0645 | 0.1525 | 0.1209 | 0.1288 | 0.1308 |
| 26-30 | 0.0786 | 0.0852 | 0.0867 | 0.0836 | 0.0708 | 0.0909 | 0.0955 | 0.1204 | 0.0975 | 0.0897 | 0.0809 | 0.0886 |
| 31-35 | 0.0883 | 0.0674 | 0.0835 | 0.0798 | 0.0442 | 0.0842 | 0.0947 | 0.0868 | 0.0947 | 0.0878 | 0.0534 | 0.0832 |
| 36-40 | 0.0750 | 0.0787 | 0.0687 | 0.0736 | 0.0650 | 0.0792 | | 0.1010 | | 0.0835 | 0.0892 | 0.0856 |
| 41-45 | 0.0807 | 0.1153 | 0.1041 | 0.0809 | 0.0974 | 0.0820 | | | | 0.0966 | 0.1088 | 0.0856 |
| >=46 | 0.1003 | 0.1139 | 0.0996 | 0.1108 | 0.1250 | 0.1080 | | | | 0.1271 | 0.1223 | 0.1185 |
| **all** | **0.0870** | **0.0930** | **0.0881** | **0.0917** | **0.0884** | **0.0869** | | **0.1012** | | **0.0990** | **0.0990** | **0.0962** |
| **Change in Median: 1990-1995** | | | | | | | | | | | | |
| <25 | -0.0148 | -0.1004 | -0.0646 | 0.0213 | -0.0360 | 0.0137 | 0.0059 | -0.1019 | 0.0090 | 0.0216 | -0.0630 | |
| 26-30 | 0.0277 | -0.0522 | -0.0210 | 0.0328 | -0.0164 | 0.0271 | -0.0148 | -0.0468 | 0.0249 | 0.0294 | -0.0369 | |
| 31-35 | 0.0135 | -0.0317 | 0.0112 | 0.0193 | -0.0166 | 0.0127 | 0.0214 | 0.0406 | 0.0147 | 0.0247 | -0.0308 | |
| 36-40 | 0.0075 | -0.0608 | 0.0040 | 0.0091 | -0.0499 | 0.0008 | | 0.0513 | | 0.0115 | -0.0585 | |
| 41-45 | -0.0093 | -0.0251 | 0.0076 | -0.0009 | -0.0228 | -0.0004 | | | | 0.0085 | -0.0085 | |
| 46-50 | 0.0088 | 0.0302 | 0.0510 | 0.0114 | 0.0218 | 0.0097 | | | | 0.0186 | 0.0279 | |
| >=51 | 0.0183 | 0.0230 | 0.0439 | 0.0440 | 0.0353 | 0.0438 | | | | 0.0613 | 0.0452 | |
| **all** | **0.0121** | **-0.0298** | **-0.0025** | **0.0277** | **-0.0183** | **0.0251** | **0.0566** | **0.0558** | **0.0566** | **0.0379** | **-0.0180** | **0.0307** |
| **Change in Median: 1995-2000** | | | | | | | | | | | | |
| <25 | -0.1280 | -0.0915 | -0.1037 | -0.0246 | 0.0294 | -0.0172 | 0.0511 | 0.1404 | 0.0614 | -0.0318 | -0.0007 | -0.0306 |
| 26-30 | -0.0517 | -0.0597 | -0.0629 | -0.0104 | 0.0098 | -0.0121 | 0.0632 | 0.0524 | 0.0605 | -0.0002 | 0.0025 | -0.0058 |
| 31-35 | -0.0008 | -0.0255 | -0.0134 | 0.0015 | -0.0083 | 0.0078 | 0.0326 | -0.0243 | 0.0290 | 0.0155 | -0.0019 | 0.0049 |
| 36-40 | 0.0108 | 0.0153 | 0.0110 | 0.0095 | -0.0055 | 0.0014 | | 0.0366 | 0.0293 | 0.0233 | 0.0024 | 0.0158 |
| 41-45 | -0.0053 | -0.0329 | -0.0151 | -0.0020 | -0.0321 | -0.0011 | | 0.0293 | | 0.0091 | -0.0336 | 0.0093 |
| 46-50 | -0.0264 | -0.0259 | -0.0276 | -0.0103 | -0.0475 | -0.0087 | | | | 0.0013 | -0.0157 | 0.0052 |
| 51-55 | 0.0062 | 0.0375 | 0.0187 | -0.0021 | -0.0048 | -0.0021 | | | | 0.0154 | 0.0135 | 0.0073 |
| >=56 | 0.0168 | 0.0237 | 0.0178 | 0.0245 | 0.0296 | 0.0246 | | | | 0.0530 | 0.0379 | 0.0486 |
| **all** | **-0.0089** | **-0.0123** | **-0.0078** | **0.0111** | **-0.0053** | **0.0094** | **0.0293** | **0.0248** | **0.0293** | **0.0278** | **0.0041** | **0.0245** |

Table 2: Change in Median Log Wage, 1995-2001, Linked Employer-Employee Data

**Change in Median: 1995-2001**

| | low | | | medium | | | high | | | all | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| age | German | foreign | all | German | foreign | all | German | foreign | all | German | foreign | all |
| <25 | -0.1271 | -0.0515 | -0.1144 | -0.0267 | 0.0402 | -0.0222 | 0.0097 | 0.0187 | 0.0762 | -0.0429 | -0.0050 | -0.0366 |
| 26-30 | -0.1129 | -0.0293 | -0.0867 | -0.0345 | 0.0716 | -0.0298 | 0.0507 | 0.0269 | 0.0505 | -0.0372 | 0.0247 | -0.0328 |
| 31-35 | -0.0327 | -0.0249 | -0.0345 | -0.0077 | 0.0230 | -0.0066 | 0.0219 | 0.1344 | 0.0267 | 0.0001 | -0.0124 | -0.0028 |
| 36-40 | -0.0321 | -0.0163 | -0.0277 | 0.0063 | 0.0286 | 0.0098 | 0.1557 | -0.1016 | 0.1443 | 0.0011 | -0.0097 | 0.0049 |
| 41-45 | -0.0320 | -0.0328 | -0.0306 | -0.0132 | -0.0194 | -0.0116 | 0.1530 | 0.1122 | 0.1629 | -0.0204 | -0.0305 | -0.0133 |
| 46-50 | -0.0392 | -0.0661 | -0.0496 | -0.0387 | -0.0120 | -0.0334 | -0.0223 | -0.1829 | -0.0286 | -0.0387 | -0.0382 | -0.0274 |
| 51-55 | -0.0669 | -0.0036 | -0.0476 | -0.0156 | 0.0167 | -0.0122 | 0.0191 | 0.0026 | 0.0212 | -0.0157 | -0.0043 | -0.0136 |
| >=56 | -0.0096 | 0.0131 | -0.0047 | 0.0162 | -0.0146 | 0.0141 | 0.2313 | 0.3502 | 0.2411 | 0.0255 | -0.0018 | 0.0219 |
| all | -0.0483 | -0.0135 | -0.0402 | 0.0073 | 0.0252 | 0.0096 | 0.1496 | -0.0072 | 0.1424 | 0.0058 | 0.0035 | 0.0076 |

**Table 3: Change in 85th-15th percentile: 1985-1990**

| | low | | | medium | | | high | | | all | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| age | German | foreign | all | German | foreign | all | German | foreign | all | German | foreign | all |
| <25 | -0.0038 | 0.0015 | 0.0000 | 0.0208 | -0.0188 | 0.0125 | | | | 0.0146 | -0.0042 | 0.0090 |
| 26-30 | 0.0446 | -0.0021 | 0.0241 | 0.0335 | 0.0665 | 0.0336 | | | | 0.0345 | 0.0337 | 0.0364 |
| 31-35 | 0.0364 | 0.0878 | 0.0538 | 0.0202 | 0.0446 | 0.0206 | | | | 0.0284 | 0.0605 | 0.0249 |
| 36-40 | 0.0208 | 0.0839 | 0.0518 | 0.0096 | 0.0907 | 0.0173 | | | | | 0.1220 | 0.0321 |
| 41-45 | 0.0208 | 0.0536 | 0.0373 | 0.0376 | 0.0543 | 0.0319 | | | | | 0.0496 | |
| >=46 | 0.0277 | 0.0402 | 0.0295 | 0.0202 | 0.0383 | 0.0298 | | | | | 0.0638 | |
| **all** | **0.0267** | **0.0405** | **0.0364** | **0.0245** | **0.0494** | **0.0225** | | | | **0.0283** | **0.0615** | **0.0325** |
| **Change in 85th-15th percentile: 1990-1995** | | | | | | | | | | | | |
| <25 | 0.0376 | 0.1486 | 0.0945 | -0.0039 | 0.0748 | 0.0048 | | | | -0.0080 | 0.1163 | |
| 26-30 | 0.0052 | 0.1252 | 0.0604 | -0.0070 | 0.0304 | 0.0003 | | | | -0.0169 | 0.0715 | |
| 31-35 | 0.0003 | 0.0380 | 0.0173 | 0.0125 | 0.0533 | 0.0188 | | | | 0.0173 | 0.0389 | |
| 36-40 | 0.0032 | 0.0808 | 0.0321 | -0.0111 | 0.0501 | -0.0046 | | | | 0.0401 | 0.0566 | |
| 41-45 | 0.0106 | 0.0892 | 0.0347 | 0.0111 | 0.0860 | 0.0130 | | | | | 0.1210 | |
| 46-50 | -0.0059 | 0.0313 | 0.0015 | 0.0385 | 0.0174 | 0.0392 | | | | | 0.0197 | |
| >=51 | 0.0262 | 0.0138 | 0.0228 | 0.0301 | 0.0423 | 0.0314 | | | | | 0.0683 | |
| **all** | **0.0145** | **0.1026** | **0.0474** | **0.0013** | **0.0546** | **0.0028** | | | | **0.0201** | **0.0754** | **0.0295** |
| **Change in 85th-15th percentile: 1995-2000** | | | | | | | | | | | | |
| <25 | 0.2142 | 0.1073 | 0.1534 | 0.0600 | 0.0663 | 0.0686 | | | | 0.0971 | 0.1090 | 0.0968 |
| 26-30 | 0.0899 | 0.0901 | 0.1065 | 0.0632 | 0.0367 | 0.0656 | | | | 0.0802 | 0.0839 | 0.0921 |
| 31-35 | 0.0765 | 0.1073 | 0.1003 | 0.0362 | 0.0382 | 0.0284 | | | | 0.0493 | 0.0675 | 0.0485 |
| 36-40 | 0.0532 | 0.0819 | 0.0682 | 0.0567 | 0.0529 | 0.0526 | | | | | 0.0628 | |
| 41-45 | 0.0373 | 0.0869 | 0.0477 | 0.0249 | 0.0420 | 0.0314 | | | | | 0.0621 | |
| 46-50 | 0.0700 | 0.1687 | 0.0985 | 0.0465 | 0.1240 | 0.0369 | | | | | 0.1841 | |
| 51-55 | 0.0151 | 0.0334 | 0.0197 | 0.0477 | 0.0552 | 0.0566 | | | | | 0.0426 | |
| >=56 | 0.0480 | 0.0624 | 0.0407 | 0.0411 | 0.0670 | 0.0522 | | | | | 0.1212 | |
| **all** | **0.0927** | **0.1074** | **0.1088** | **0.0524** | **0.0617** | **0.0502** | | | | **0.0552** | **0.0883** | **0.0717** |

**Table 4: Change in 85th-50th percentile: 1985-1990**

| | low | | | medium | | | high | | | all | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| age | German | foreign | all | German | foreign | all | German | foreign | all | German | foreign | all |
| <25 | 0.0060 | 0.0044 | 0.0072 | 0.0241 | 0.0053 | 0.0173 | | | | 0.0191 | -0.0002 | 0.0141 |
| 26-30 | 0.0365 | 0.0058 | 0.0199 | 0.0232 | 0.0152 | 0.0179 | | | | 0.0233 | 0.0089 | 0.0166 |
| 31-35 | 0.0187 | 0.0180 | 0.0152 | 0.0069 | 0.0316 | 0.0024 | | | | 0.0152 | 0.0237 | 0.0122 |
| 36-40 | 0.0060 | 0.0504 | 0.0332 | -0.0045 | 0.0348 | -0.0011 | | | | | 0.0666 | 0.0062 |
| 41-45 | 0.0049 | 0.0282 | 0.0095 | 0.0203 | 0.0070 | 0.0146 | | | | | 0.0146 | |
| >=46 | 0.0141 | 0.0206 | 0.0167 | -0.0064 | -0.0018 | -0.0008 | | | | | 0.0348 | |
| **all** | **0.0119** | **0.0178** | **0.0160** | **0.0114** | **0.0114** | **0.0163** | | | | **0.0120** | **0.0265** | **0.0192** |
| **Change in 85th-50th percentile: 1990-1995** | | | | | | | | | | | | |
| <25 | -0.0056 | 0.0579 | 0.0167 | -0.0082 | 0.0065 | -0.0051 | | | | -0.0082 | 0.0295 | |
| 26-30 | -0.0330 | 0.0127 | -0.0110 | -0.0066 | 0.0142 | -0.0055 | | | | -0.0183 | 0.0168 | |
| 31-35 | -0.0051 | -0.0068 | -0.0029 | 0.0095 | -0.0095 | 0.0126 | | | | 0.0120 | -0.0094 | |
| 36-40 | -0.0085 | -0.0006 | -0.0034 | -0.0024 | 0.0179 | 0.0038 | | | | 0.0449 | 0.0071 | |
| 41-45 | 0.0037 | 0.0140 | 0.0087 | 0.0244 | 0.0372 | 0.0197 | | | | | 0.0547 | |
| 46-50 | -0.0122 | 0.0088 | -0.0088 | 0.0438 | -0.0192 | 0.0412 | | | | | -0.0132 | |
| >=51 | 0.0152 | 0.0084 | 0.0093 | 0.0161 | 0.0093 | 0.0176 | | | | | 0.0390 | |
| **all** | **0.0003** | **0.0161** | **0.0045** | **0.0058** | **0.0152** | **0.0014** | | | | **0.0161** | **0.0147** | **0.0165** |
| **Change in 85th-50th percentile: 1995-2000** | | | | | | | | | | | | |
| <25 | 0.0770 | 0.0546 | 0.0597 | 0.0283 | 0.0445 | 0.0337 | | | | 0.0390 | 0.0615 | 0.0439 |
| 26-30 | 0.0254 | 0.0330 | 0.0366 | 0.0280 | 0.0168 | 0.0300 | | | | 0.0475 | 0.0395 | 0.0490 |
| 31-35 | 0.0054 | 0.0324 | 0.0140 | 0.0257 | 0.0270 | 0.0149 | | | | 0.0266 | 0.0260 | 0.0356 |
| 36-40 | 0.0050 | -0.0025 | 0.0009 | 0.0283 | 0.0126 | 0.0310 | | | | | 0.0146 | |
| 41-45 | 0.0116 | 0.0122 | 0.0113 | 0.0109 | 0.0088 | 0.0088 | | | | | 0.0212 | |
| 46-50 | 0.0102 | 0.0326 | 0.0192 | 0.0239 | 0.0646 | 0.0123 | | | | | 0.0871 | |
| 51-55 | -0.0250 | 0.0090 | -0.0111 | 0.0314 | 0.0105 | 0.0314 | | | | | -0.0048 | |
| >=56 | 0.0148 | 0.0077 | 0.0050 | 0.0048 | 0.0172 | 0.0087 | | | | | 0.0632 | |
| **all** | **0.0079** | **0.0281** | **0.0136** | **0.0205** | **0.0257** | **0.0201** | | | | **0.0176** | **0.0378** | **0.0342** |

**Table 5: Change in 50th-15th percentile: 1985-1990**

| | low | | | medium | | | high | | | all | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| age | German | foreign | all | German | foreign | all | German | foreign | all | German | foreign | all |
| <25 | -0.0098 | -0.0029 | -0.0072 | -0.0033 | -0.0241 | -0.0049 | 0.0240 | 0.1772 | 0.0391 | -0.0045 | -0.0040 | -0.0051 |
| 26-30 | 0.0082 | -0.0079 | 0.0043 | 0.0103 | 0.0513 | 0.0157 | -0.0096 | 0.0037 | -0.0076 | 0.0112 | 0.0248 | 0.0198 |
| 31-35 | 0.0176 | 0.0698 | 0.0386 | 0.0133 | 0.0130 | 0.0182 | 0.0184 | 0.0819 | 0.0238 | 0.0132 | 0.0369 | 0.0127 |
| 36-40 | 0.0148 | 0.0335 | 0.0186 | 0.0141 | 0.0559 | 0.0184 | | 0.1392 | | 0.0148 | 0.0554 | 0.0259 |
| 41-45 | 0.0159 | 0.0254 | 0.0278 | 0.0173 | 0.0472 | 0.0173 | | | | 0.0230 | 0.0350 | 0.0182 |
| >=46 | 0.0136 | 0.0197 | 0.0129 | 0.0266 | 0.0401 | 0.0306 | | | | 0.0309 | 0.0290 | 0.0267 |
| **all** | **0.0148** | **0.0227** | **0.0204** | **0.0131** | **0.0381** | **0.0062** | | **0.0760** | | **0.0163** | **0.0350** | **0.0133** |
| **Change in 50th-15th percentile: 1990-1995** | | | | | | | | | | | | |
| <25 | 0.0432 | 0.0908 | 0.0778 | 0.0043 | 0.0683 | 0.0099 | -0.0898 | -0.1794 | -0.0842 | 0.0003 | 0.0868 | |
| 26-30 | 0.0382 | 0.1125 | 0.0714 | -0.0004 | 0.0161 | 0.0057 | 0.0042 | 0.1270 | 0.0119 | 0.0014 | 0.0547 | |
| 31-35 | 0.0054 | 0.0448 | 0.0201 | 0.0031 | 0.0628 | 0.0063 | -0.0105 | 0.0686 | -0.0095 | 0.0053 | 0.0483 | |
| 36-40 | 0.0116 | 0.0814 | 0.0355 | -0.0086 | 0.0322 | -0.0084 | | 0.1060 | | -0.0048 | 0.0495 | |
| 41-45 | 0.0070 | 0.0753 | 0.0260 | -0.0133 | 0.0489 | -0.0067 | | | | -0.0031 | 0.0663 | |
| 46-50 | 0.0064 | 0.0224 | 0.0103 | -0.0052 | 0.0366 | -0.0020 | | | | 0.0007 | 0.0329 | |
| >=51 | 0.0110 | 0.0054 | 0.0135 | 0.0139 | 0.0330 | 0.0138 | | | | 0.0283 | 0.0293 | |
| **all** | **0.0142** | **0.0865** | **0.0429** | **-0.0045** | **0.0394** | **0.0015** | **0.0478** | **0.1115** | **0.0501** | **0.0039** | **0.0607** | **0.0130** |
| **Change in 50th-15th percentile: 1995-2000** | | | | | | | | | | | | |
| <25 | 0.1371 | 0.0527 | 0.0937 | 0.0317 | 0.0218 | 0.0337 | 0.1412 | 0.1946 | 0.1059 | 0.0581 | 0.0475 | 0.0528 |
| 26-30 | 0.0644 | 0.0571 | 0.0699 | 0.0352 | 0.0199 | 0.0300 | 0.0283 | -0.0671 | 0.0296 | 0.0327 | 0.0444 | 0.0431 |
| 31-35 | 0.0711 | 0.0749 | 0.0863 | 0.0105 | 0.0112 | 0.0149 | 0.0188 | -0.0694 | 0.0165 | 0.0227 | 0.0415 | 0.0129 |
| 36-40 | 0.0482 | 0.0844 | 0.0673 | 0.0284 | 0.0403 | 0.0310 | | -0.0075 | 0.0177 | 0.0263 | 0.0482 | 0.0335 |
| 41-45 | 0.0257 | 0.0746 | 0.0364 | 0.0140 | 0.0332 | 0.0088 | | | | 0.0188 | 0.0409 | 0.0194 |
| 46-50 | 0.0597 | 0.1361 | 0.0793 | 0.0226 | 0.0594 | 0.0123 | | | | 0.0214 | 0.0970 | 0.0374 |
| 51-55 | 0.0402 | 0.0244 | 0.0308 | 0.0163 | 0.0447 | 0.0314 | | | | 0.0278 | 0.0475 | 0.0245 |
| >=56 | 0.0332 | 0.0547 | 0.0357 | 0.0363 | 0.0498 | 0.0087 | | | | 0.0484 | 0.0580 | 0.0572 |
| **all** | **0.0848** | **0.0792** | **0.0952** | **0.0319** | **0.0360** | **0.0302** | **0.0030** | **0.0016** | **0.0041** | **0.0376** | **0.0505** | **0.0375** |

**Table 6: Change in different percentiles, 1995-2001, Linked Employer-Employee Data**

**Change in 85th-15th percentile**

| | low | | | medium | | | high | | | all | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| age | German | foreign | all | German | foreign | all | German | foreign | all | German | foreign | all |
| <25 | 0.148 | 0.045 | 0.106 | 0.073 | 0.109 | 0.075 | 0.24 | | 0 | 0.112 | 0.188 | 0.114 |
| **26-30** | 0.189 | 0.05 | 0.147 | 0.044 | -0.121 | 0.039 | | | -0.005 | 0.103 | 0.016 | 0.1 |
| 31-35 | 0.147 | 0.058 | 0.132 | 0.048 | 0.136 | 0.049 | | | 0.058 | 0.066 | 0.093 | 0.062 |
| 36-40 | 0.062 | -0.124 | 0.052 | 0.02 | 0.174 | 0.025 | | | 0.114 | 0.038 | 0.089 | 0.042 |
| 41-45 | 0.147 | 0.065 | 0.14 | 0.026 | 0.099 | 0.029 | | | 0.152 | | 0.114 | 0.062 |
| 46-50 | 0.075 | 0.06 | 0.076 | 0.028 | -0.025 | 0.03 | | | 0.09 | | 0.058 | |
| 51-55 | 0.096 | 0.044 | 0.063 | | 0.061 | 0.01 | | | 0.087 | | 0.045 | |
| >=56 | 0.035 | 0.006 | 0.036 | | 0.028 | 0.088 | | | 0.157 | | 0.001 | |
| **all** | **0.138** | **0.039** | **0.112** | **0.035** | **0.042** | **0.034** | | | | **0.066** | **0.066** | **0.066** |
| **Change in 85th-50th percentile** | | | | | | | | | | | | |
| <25 | 0.046 | 0.002 | 0.035 | 0.023 | 0.012 | 0.024 | 0.061 | | -0.006 | 0.026 | 0.059 | 0.03 |
| 26-30 | 0.076 | -0.014 | 0.059 | 0.031 | -0.021 | 0.03 | | | -0.011 | 0.066 | 0.035 | 0.062 |
| 31-35 | 0.07 | -0.047 | 0.05 | 0.031 | 0.031 | 0.029 | | | 0.055 | 0.037 | 0.025 | 0.04 |
| 36-40 | 0.005 | 0.004 | 0.007 | 0.012 | 0.059 | 0.011 | | | -0.003 | 0.024 | 0.061 | 0.025 |
| 41-45 | 0.029 | -0.015 | 0.022 | 0.019 | 0.019 | 0.017 | | | 0.038 | | 0.032 | 0.036 |
| 46-50 | 0 | 0.04 | 0.016 | 0.02 | 0.013 | 0.019 | | | 0.083 | | 0.045 | |
| 51-55 | 0.043 | -0.001 | 0.028 | | 0.045 | 0.013 | | | 0.031 | | 0.023 | |
| >=56 | 0.028 | 0.021 | 0.024 | | -0.001 | 0.036 | | | 0.037 | | 0.018 | |
| **all** | **0.043** | **0** | **0.033** | **0.016** | **0.025** | **0.014** | | | | **0.033** | **0.031** | **0.033** |
| **Change in 50th-15th percentile** | | | | | | | | | | | | |
| <25 | 0.102 | 0.044 | 0.072 | 0.05 | 0.097 | 0.051 | 0.18 | -0.373 | 0.006 | 0.086 | 0.129 | 0.084 |
| 26-30 | 0.113 | 0.064 | 0.088 | 0.012 | -0.1 | 0.01 | 0.005 | 0.015 | 0.007 | 0.038 | -0.019 | 0.038 |
| 31-35 | 0.077 | 0.105 | 0.082 | 0.017 | 0.105 | 0.02 | 0.004 | -0.446 | 0.003 | 0.03 | 0.068 | 0.022 |
| 36-40 | 0.057 | -0.128 | 0.045 | 0.009 | 0.115 | 0.013 | | -0.016 | 0.117 | 0.013 | 0.028 | 0.017 |
| 41-45 | 0.118 | 0.08 | 0.118 | 0.007 | 0.079 | 0.012 | | | 0.114 | 0.025 | 0.082 | 0.026 |
| 46-50 | 0.074 | 0.02 | 0.061 | 0.008 | -0.038 | 0.012 | | | 0.006 | 0.018 | 0.013 | 0.025 |
| 51-55 | 0.053 | 0.045 | 0.035 | -0.006 | 0.016 | -0.004 | | | 0.056 | 0.01 | 0.022 | 0.015 |
| >=56 | 0.007 | -0.016 | 0.012 | 0.054 | 0.028 | 0.052 | | | 0.12 | 0.046 | -0.017 | 0.041 |
| **all** | **0.095** | **0.04** | **0.079** | **0.019** | **0.017** | **0.02** | | **-0.008** | | **0.033** | **0.034** | **0.033** |