Discussion Paper

Discussion Paper No. 96-32

Has Earnings Inequality in Germany Changed in the 1980's?

Viktor Steiner / Kersten Wagner

ZEW

Zentrum für Europäische Wirtschaftsforschung GmbH

Labour Economics, Human Resources and Social Policy Series

Discussion Paper No. 96-32

Has Earnings Inequality in Germany Changed in the 1980's?

Viktor Steiner / Kersten Wagner

Has Earnings Inequality in Germany Changed in the 1980's?

by

Viktor Steiner
Kersten Wagner

Zentrum für Europäische Wirtschaftsforschung (ZEW)
Centre for European Economic Research
Mannheim

December 1996

Abstract

The development of the West German earnings distribution in the 1980's is analysed on the basis of both the German Socio–Economic Panel and micro–data from the Employment Register of the Federal Labour Office. We find that earnings inequality in Germany has increased very little in the 1980's, if at all. It is shown that the marked increase in earnings inequality found in previous studies based on the register data is a statistical artifact related to a change in the coding of the earnings data. Our decomposition analysis based on estimated earnings functions reveals that the relative stability of the German earnings distribution in the 1980's has not resulted from large compensating changes in the composition of the labour force on the one hand, and changes in the returns to human capital on the other. While both of these components have changed little in the observation period, the former rather than the latter component has contributed to the small increase in earnings inequality observed in the register data. If anything, the earnings differential between skilled and unskilled workers has become smaller during the 1980's, while within–inequality has contributed very little to changes in inequality. Overall, the empirical results of this study seem compatible with an institutional explanation of the stability of the German earnings distribution.

JEL classification: J31, J24

Acknowledgement

We thank Stefan Bender from the Institute for Employment Research (IAB), Nürnberg, and our colleagues Patrick A. Puhani and Florian Kraus for helpful suggestions and discussions. Matthias Almus provided excellent research assistance. We are grateful to the Centre for Survey and Methodological Research (ZUMA), Mannheim, for providing us with some calculations from the Labour Force Surveys ("Mikrozensus") held there. Partial funding from the Anglo–German Foundation under the project "Labour Markets in Transitions" is gratefully acknowledged. The usual caveats apply.

1 Introduction

International comparisons usually portray Germany as one of the few developed market economies where earnings inequality has not increased in the 1980's (OECD 1993, 1996; Freeman and Katz 1994; Gottschalk and Smeeding 1996).[1] This development is often cited as an explanation for the poor employment performance in Germany relative to the USA and the United Kingdom, where earnings inequality has markedly increased in this period. Although the factors for this increase in inequality are not well understood yet, the effects of changes in the demographic structure of the work force, international trade with low–wage countries, and labour–saving technological change feature as the main alternative explanations in the literature (for literature reviews see, e.g., Levy and Murane 1992; Burtless 1995; Gottschalk and Smeeding 1996). Since these factors should have affected all economies with similar demographic developments and exposure to international competition in the same way, one would have expected to observe their labour market effects in Germany as well.

Conventional wisdom holds that these factors have been accomodated by different price and quantity adjustments in the two countries: whereas they have changed the wage structure in the United States and the United Kingdom, they have led to employment adjustment in Germany. These differences are usually explained by the much greater importance of institutional rigidities, such as legal regulations, trade unions and income support schemes in Germany relative to these countries (see, e.g., Siebert 1994, especially chapters 5, 7 and 8; Abraham and Houseman 1995). This view seems also compatible with the observation that, both in absolute terms and relative to the U.S., the compression of earnings in Germany is greater at the bottom of the distribution than at the top (Blau and Kahn 1996). However, some observers remain skeptical about the empirical relevance of institutional factors for the development of earnings and employment in the German labour market (see, e.g., Franz 1995, pp. 32ff). In fact, there even seems to be no consensus on whether or not the German earnings distribution has changed at all in the 1980's.

For Germany, several empirical studies based on various data sources and methodologies have found very little change in the distribution of earnings in the 1980's, if any.[2] This stylized fact has been challenged in a series of recent papers, all based on micro data from the Employment Register of the German Federal

[1] Here and in the following, Germany always refers to West Germany before unification.

[2] These studies include OECD (1993, 1996), Steiner et al. (1994), Bellmann, Reinberg and Tessaring (1994), Hauser and Becker (1994), De New and Schmidt (1994), Abraham and Houseman (1995), Fitzenberger et al. (1995), Burkhauser, Holtz–Eakin and Rhody (1996), Becker (1996), and Gosling (1996).

Labour Office. In particular, Möller and Bellmann (1995a, 1995b, 1996) and Möller (1996) find that earnings inequality among German men has substantially increased in the 1980's, both within the manufacturing sector and in the whole economy. As this data source supposedly has more accurate earnings information than the previous studies, the implicit assumption seems to be that they provide a more reliable description of the development of earnings inequality. However, since a formal comparison based on this and alternative data sources as well as different methodologies has not been attempted yet, it is unclear how to evaluate the conflicting evidence.

Given the disagreement on the purely empirical question whether earnings inequality in Germany has increased, remained constant or has even decreased, it comes as no surprise that very little is known about the underlying economic factors of the development of German earnings in the 1980's. The only studies we are aware of which try to unveil the underlying economic factors of changes in the structure of earnings in the 1980's are by Abraham and Houseman (1995) and Möller (1996). The former authors relate in an informal way the development of labour demand and supply as well as institutional factors to their empirical finding that earnings inequality in Germany has remained rather stable or has even slightly decreased in the 1980's. Möller (1996) decomposes changes in earnings into several components and finds that labour supply effects would have resulted in an even more compressed earnings structure had they not been overcompensated by the effects of non–neutral technological change, while changes in the industry structure of employment and economic rents as well as shifts in product demand have contributed very little to the alleged increase in earnings inequality. Whatever the merit of these alternative approaches, their conclusions obviously depend on whether earnings inequality has changed at all, and, if so, in which direction.

Therefore, the first aim of this paper is to analyse the development of the German earnings distribution in the 1980's on the basis of two data sets: The German Socio–Economic Panel (GSOEP) and a random sample of the Employment Register of the Federal Labour Office (IABS). While the former has been the main data source in previous studies of earnings inequality, the latter has only recently become generally available for scientific use. The main characteristics of these two data sets will be briefly described in section 2, while a descriptive analysis of the development of earnings inequality in the 1980's is provided in section 3. The second aim of the paper is to contribute to an understanding of the main economic factors which have shaped the German earnings distribution in the 1980's. To this end, we estimate empirical earnings functions as described in section 4, where the contribution of human capital as measured by formal skills and labour market experience is emphasised. In section 5, we decompose observed changes in earnings inequality into changes in observed characteristics, in particular general skills and labour market experience, and their "prices" (rental rates) as well as unobserved factors following the methodology first proposed by Juhn, Murphy and

Pierce (1993). In the final section, we summarise the main results of the paper and draw some conclusions.

2 Sample Design and Earnings Information in the IABS and the GSOEP

In terms of sample representativeness, the quality of earnings data, and the availability of other relevant information, the German Socio-Economic Panel (GSOEP) and the micro data from the Employment Register of the Federal Labour Office ("IAB-Beschäftigtenstichprobe")[3], seem the most appropriate data sources for the analysis of changes in the distribution of earnings in the 1980's.[4] While the GSOEP has been widely used in the past, the IABS has only recently become generally available for scientific use. Since sampling schemes and the way earnings information is collected differ substantially between the GSOEP and the IABS, we briefly describe the respective sample design of the GSOEP and the IABS first and then evaluate the earnings information contained in these two data sources.

The GSOEP is a household survey conducted on a yearly basis since 1984 when some 12,000 individuals in about 6,000 households were interviewed. The GSOEP is considered representative with respect to certain demographic and socio-economic characteristics for the non-institutionised population living in Germany (for a description see, e.g., Burkhauser 1991; Wagner, Burkhauser and Behringer 1993). However, foreigners from the former "guest-worker" countries, i.e., Turkey, Italy, Greece, Spain, Portugal, and the former Yugoslavia, were deliberately oversampled in order to account for sample attrition due to expected return migration and disproportionately high non-response among foreigners. A special feature of the GSOEP is that new respondents are added to the sample only in so far as they are related to the initially included households, e.g. by marriage. Persons

---

[3] IAB is shorthand for "Institut für Arbeitsmarkt- und Berufsforschung" which is the research institute of the German Federal Bureau of Labor. The papers by Bellmann and Möller referred to in the introduction are based on a data set which was only available for research within the IAB and which is not the same as has now been made generally available by the IAB.

[4] The main shortcomings of the alternative data sources used in some of the empirical studies cited in footnote 2 are the following. For the Labor Force Survey ("Mikrozensus"): (i) earnings are coded in relatively broad categories and (ii) income from other sources than work cannot be identified (Bellmann, Reinberg and Tessaring 1994); for the Income and Consumption Surveys ("Einkommens- und Verbrauchsstichproben"): (i) very expensive to obtain, (ii) very limited information on human capital variables, foreigners are not included, (iii) at present, the latest available year is 1988 (for more details see Becker 1996, pp. 7ff); for the ALLBUS data ("Allgemeine Bevölkerungsumfrage der Sozialwissenschaften"): (i) a very large percentage of non-reported earnings (De New and Schmidt 1994, p. 151); (ii) only net earnings seem to be available which are unsuitable for the present analysis, (iii) the sampling scheme seems to be unknown and, consequently, weighting factors are unavailable.

under the age of sixteen years living in these households are also interviewed after they have passed this age limit. Since the number of persons entering the sample does not compensate for sample attrition, the GSOEP shows substantial changes over time, both in the number of persons interviewed in each wave and with respect to sample composition, which do not reflect overall population changes. To account for sample attrition in general and the initial oversampling of foreigners in particular, the GSOEP provides weighting factors for each cross section (for details see Pischner and Rendtel 1993). These weights are used for most of the calculations based on the GSOEP below.

The IABS is a 1% random sample of all dependently employed persons living in Germany covered by the social security system. According to social security legislation, the self–employed, civil servants, full–time students (working less than 20 hours per week) and those who are only irregularly employed or earn less than a certain small amount per month (DM 590 in 1996) are not covered by the system (Bender et al. 1996, p. 8). The data base from which the IABS is drawn includes about 80 percent of all employed people in Germany. The share of registered employees varies substantially among industries, and also somewhat over time. At the moment, the IABS covers the period January 1, 1975 to December 31, 1990. In each of these years, about 200,000 individuals were randomly sampled from the population (for details see Bender et al. 1996, pp. 19ff).

For the empirical analysis we have selected the following subsamples from the IABS and the GSOEP, respectively. First, the self–employed, their family members, and civil servants were excluded from the GSOEP because incomes of these groups are determined by other factors than the earnings of employees. Second, we exclude females from the analysis because the IABS does not contain information on hours worked, only an indicator variable for half–/full–time employment, and we know from the GSOEP that working hours vary substantially among women. Third, men aged below 16 or above 66 years as well as apprentices are excluded from the sample.[5] Finally, overlapping employment spells, which mainly refer to people holding more than one job at the same time, are excluded because there is no information available on the number of hours worked in each of these jobs in the IABS.[6] The number of observations remaining in the two samples after these stepwise selections are shown in Table 1 for two years, where the choice of the year 1984 is motivated by the analysis below.

---

5 These particular age restrictions are given in the IABS.

6 For the details on how overlapping employment spells are treated in the IABS see Bender et al. (1996, pp. 16ff, pp. 74ff).

Table 1 Stepwise selection of data from the IABS and the GSOEP for 1984 and 1990

	1984		1990	
	number of cases	attrition in percent	number of cases	attrition in percent
	IABS			
full sample (males), of which	132,614		137,902	
with earnings	129,723	2.18	135,028	2.08
not part–time or apprentice	118,573	8.60	125,045	7.39
not older than 66 years	118,110	0.39	124,871	0.14
not holding another job	101,063	14.43	106,848	14.43
with valid earnings information	101,013	0.05	106,806	0.04
	GSOEP			
full sample (males), of which	3,976		3,443	
with earnings	3,103	21.96	2,656	22.86
not part–time or apprentice	2,500	19.43	2,242	15.59
not older than 66 years	2,498	0.08	2,242	0.00
with valid earnings information	2,486	0.48	2,239	0.13

Source: IABS and GSOEP, waves 1–10, own calculations.

Since the GSOEP also includes the non–employed, its share of those without earnings is, of course, much higher than in the IABS. With the exception of the substantial increase in the number of part–time employees and apprentices in the GSOEP, attrition rates due to the various selection criteria have remained fairly constant between 1984 and 1990. In the IABS the increase in absolute numbers between these two years reflects the growth of employment that occurred in the German economy in this period, whereas sample attrition in the GSOEP was considerably higher than the number of persons entering the panel during this period.

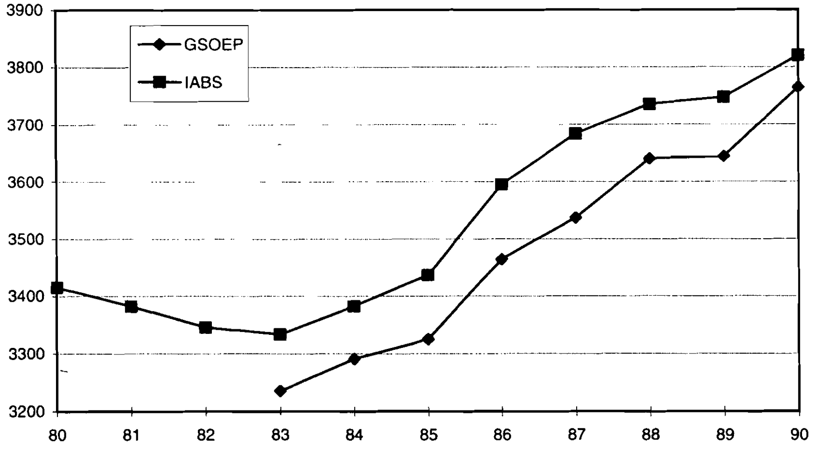
Aside from the very large sample size, the greatest advantage of the IABS is its supposedly reliable earnings data. Employers are legally requested to report earnings of their employees covered by the social security system to the Federal Labour Office. This information is then passed on to the social security agencies where it is used as the basis for the calculation of the amount of the public pension of each covered employee. The exact amount of gross earnings has to be reported, and there are legal sanctions for false reporting by the employer. In contrast, earnings information in the GSOEP is, of course, voluntarily provided by the interviewees. This implies substantial non–response and frequent "rounding" of earnings at particular amounts, e.g. monthly earnings of DM 2,000, 2,500, 3,000, and so on.

On the other hand, the IABS has also certain disadvantages relative to the GSOEP. First, as mentioned above, there is no information on working hours in the IABS, only the part–time/full–time distinction is available. Second, reported earnings include fringe benefits, such as the 13th and 14th monthly pay as well as christmas and holiday bonuses, and there is no way to distinguish them from "normal" earnings. As will be shown below, a change in the way these benefits used to be treated in the IABS leads to a very severe problem in interpreting changes in earnings inequality. Third, earnings in the IABS are right–censored at the social security threshold, i.e. the amount of earnings up to which social security contributions have to be paid. If earnings exceed this threshold, which is adjusted to the growth rate of economy–wide gross earnings in the previous year, it is only known that they are at least as high as this threshold. In the 1980's, the proportion of right–censored cases in the IABS has varied between about 8 and 11 percent. However, it varies greatly between skill groups, reaching about 60 percent on average for graduates. This poses problems for the interpretation of standard inequality measures and the estimation of earnings functions as well as for the decomposition analysis below.

Monthly gross earnings in the GSOEP are recorded in each wave both for the month before the interview and retrospectively in the so–called income calendar. The latter gives average monthly gross earnings for the months employed in the previous calendar year. Thus, in the first wave of the panel this retrospective earnings information refers to the year 1983, in the second to the year 1984, and so on. Information on the amount of fringe benefits received for the previous calendar year are recorded separately in the GSOEP. Gross earnings including fringe benefits are obtained by dividing the sum of the amounts of the 13th and 14th monthly pay as well as holiday and christmas bonuses by the number of months employed and adding the resulting amount to "normal" gross monthly earnings. We have excluded a few observations with implausibly low (less than DM 1,000 per month) or very high (more than DM 25,000) earnings from the GSOEP sample (see the last line in Table 1). Since, for the reasons given above, earnings are expected to be correctly reported in the IABS, we have applied no such restrictions here.

For the two samples, the development of real monthly gross earnings in the 1980's, deflated by the cost–of–living index for all households, is plotted in Figure 1. Since right–censoring of earnings in the IABS renders the arithmetic mean an unsuitable measure of their overall development, we use the the median here. To account for the mentioned sample attrition and the over–representation of guest workers, calculations based on the GSOEP use weighted data.

Figure 1 **Median male real earnings (in DM), 1980 – 1990**



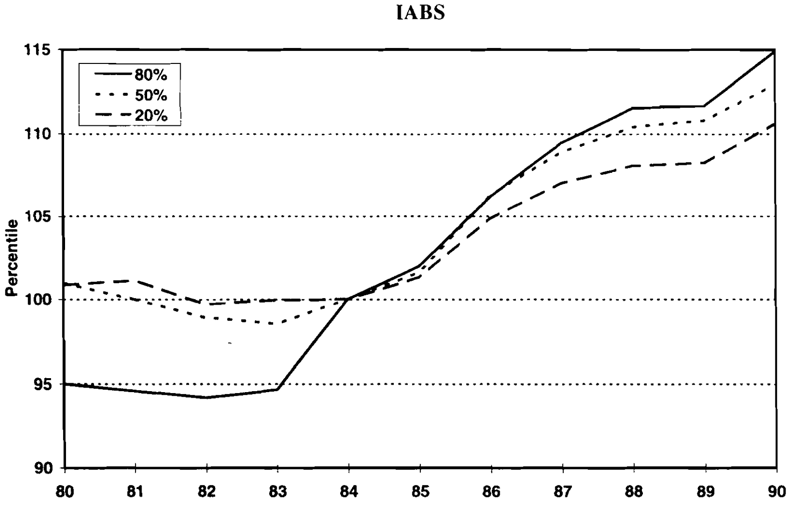
Note: Nominal earnings are deflated by the cost–of–living index.

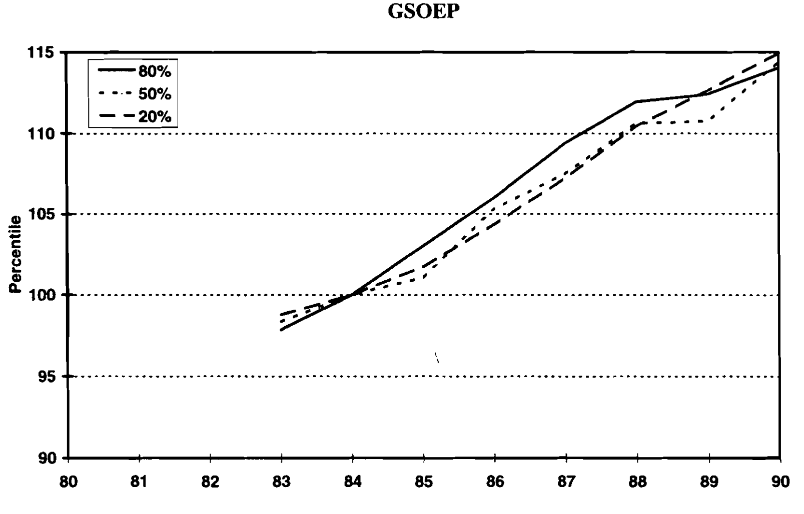
Figure 1 shows very similar developments of median earnings in the two data sets between 1983 and 1990, although the level of earnings is somewhat higher in the IABS. Given that the difference in levels remains fairly constant over time, comparisons of changes in the overall development of earnings should yield quite similar results for these two data sets. However, they do differ with respect to changes in earnings inequality over time, as we show in the next section.

3 Development of Earnings Inequality

There are various measures used in the literature to describe the development of earnings inequality over time (for a survey see, e.g., Cowell 1995). Summary measures, like the Gini coefficient, can detect overall changes in the distribution of earnings. For a given change in inequality, the various inequality measures do not necessarily give the same results, but may depend on the part of the distribution where this change occurs (Cowell 1995, chapter 3). Inequality measures which explicitly take changes in different parts of the earnings distribution into account are percentile ratios. In the present context, these measures have the additional advantage that, by chosing an appropriate upper percentile, their calculation is not affected by the right–censoring of earnings in the IABS. To characterise the lower part of the earnings distribution we choose the 20–percent percentile here, while the upper part is described by the 80–percent percentile and the middle part by the median.

Figure 2 Percentiles of real earnings 1980 – 1990 (1984 = 100)





Although this choice may seem somewhat arbitrary, it does not make much difference for the development of inequality measures based on percentile ratios whether one uses these or some other percentiles, such as the lowest and highest decile, or the first and upper quartile. The development of the chosen percentiles for the IABS and the GSOEP data is shown in Figure 2, where their values have been normalised to 100 for the year 1984.

The rationale for this normalisation is immediately apparent from Figure 2, where the most striking development is the marked increase in the 80–percent percentile of about 6 percentage points between 1983 and 1984 in the IABS. Given that earnings inequality tends to change only slowly over time, if at all, this strong increase should make one wonder whether it is really related to real factors or rather indicative for some change in the way the data is collected in the IABS. For the following reason, the latter is most likely to be the case.

Since 1984, the legal regulations for the reporting of earnings render it mandatory for firms to include fringe benefits in the amount of reported earnings. Before that date, the inclusion of fringe benefits was voluntary. It is therefore likely that firms frequently reported only "normal" earnings, as has also been observed by Bender et al. (1996, pp. 14ff) and Schmähl and Fachinger (1994, p. 188). It is also likely that both the incidence and the level of fringe benefits is higher for employees in the upper part of the earnings distribution. As a correlation analysis on the basis of the GSOEP data for the year 1984 shows, this supposition is in fact supported by a statistically significant positive relationship between the ratio of fringe benefits to "normal" earnings on the one hand and the latter variable on the other.[7]

Furthermore, our understanding that the jump in the 80–percent percentile between 1983 and 1984 is related to the mentioned measurement problem and does in no way reflect a real increase in inequality is reinforced by the development of the respective percentile in the GSOEP between these two years, which does not show any increase. On the other hand, in the IABS the share of right–censored cases increased sharply from less than 8 percent in 1983 to more than 11 percent in 1984, which seems quite unusual. Hence, we have to conclude that there is a severe break in the IABS earnings data, and that analyses of overall changes in earnings inequality based on this source can only rely on data for the period 1984 to 1990 at the moment.

For this period, the development of the percentile ratios in Table 2 shows a very small increase of earnings inequality in the IABS both in the lower and the upper part of the distribution. The difference between the upper (80–percent percentile) and the lower part (20–percent percentile) of the distribution has changed by about

[7] The correlation coefficient between these two variables is 0.156.

5 percentage points. In contrast, our calculations based on the GSOEP show that percentile ratios have remained virtually constant within the observation period, both in the lower and the upper part of the distribution. Furthermore, these percentile ratios are at very similar levels in both data sets.

To test the sensitivity of results to the choice of the particular percentiles used in these calculations, we also report the development of two widely used summary inequality measures, i.e. the Gini coefficient and the Mean Logarithmic Deviation (MLD) of earnings, for the years 1984 to 1990 in Table 2. Whereas the Gini coefficient is rather sensitive to changes in the middle part of the distribution, the MLD should react more sensitively to changes in its tails. Since censored observations cannot meaningfully be included in the calculation of these measures, they may be misleading under certain circumstances. For example, if earnings of a relatively large number of persons exceed the social security threshold in a particular year, these summary measures would show a decrease in inequality, although overall inequality may in fact have increased. To make the summary inequality measures comparable between the two data sets, we also report them for the GSOEP with the earnings data artificially right–censored at the respective social security threshold.

The summary measures show a very modest increase in earnings inequality when calculated on the basis of the IABS, while they have remained constant or have even slightly decreased on the basis of the GSOEP. Thus, they give fairly the same results as the percentile ratios. Note that the development of these summary measures is very similar for the artificially censored GSOEP sample and for the full sample. This suggests that changes in the uppermost part of the distribution are unlikely to have changed the result for the IABS as well. Of course, the level of earnings inequality is considerably higher in the full GSOEP sample.

Table 2 Inequality measures for real gross monthly earnings calculated from the IABS and the GSOEP, 1984 – 1990

	IABS		GSOEP (all)		IABS		GSOEP (right censored)		GSOEP (all)	
	50 / 20	80 / 50	50 / 20	80 / 50	Gini	MLD	Gini	MLD	Gini	MLD
1984	1.2383	1.3489	1.2730	1.3695	0.1465	0.0412	0.1459	0.0348	0.2070	0.0692
1985	1.2418	1.3540	1.2647	1.3960	0.1521	0.0440	0.1414	0.0322	0.2104	0.0713
1986	1.2549	1.3477	1.2848	1.3785	0.1516	0.0435	0.1432	0.0336	0.2105	0.0723
1987	1.2602	1.3559	1.2763	1.3939	0.1508	0.0430	0.1431	0.0330	0.2142	0.0740
1988	1.2656	1.3624	1.2751	1.3858	0.1559	0.0453	0.1452	0.0338	0.2114	0.0726
1989	1.2674	1.3596	1.2518	1.3900	0.1593	0.0465	0.1431	0.0336	0.2068	0.0699
1990	1.2643	1.3726	1.2671	1.3652	0.1520	0.0429	0.1461	0.0353	0.2040	0.0676

$Gini = \frac{2}{n^2 \bar{y}} \sum_i i(y_i - \bar{y})$, $MLD = \frac{1}{n} \sum_i \ln\left(\frac{\bar{y}}{y_i}\right)$, where n = sample size, y_i = earnings of i – th individual, $\bar{y}$ = mean earnings.

Note: Calculations using the GSOEP are based on weighted data (see section 2). 50 / 20 and 80 / 50 are percentile ratios.

An additional piece of valuable information on the distribution of earnings is provided by a decomposition of earnings inequality into the share of inequality accounted for by within and between demographic and socio–economic groups, respectively. The MLD has the convenient property that it is decomposable into these two components (Jenkins 1995, pp. 37ff). Table 3 reports results from this decomposition by skill and experience groups, which are of special interest for the following analysis. The former refer to *unskilled*, *skilled*, and employees with university education (*graduates*), the latter to 0 – 9, 10 – 19, 20 – 29, 30 – 39, and more than 40 years of potential labour market experience (for exact definitions see section 4.1 below). For the GSOEP, we present results for both the sample of artificially right–censored observations and the full sample.

Table 3 Decomposition of earnings inequality (MLD) into within– and between–group inequality by skill group and labour market experience

	IABS		GSOEP (censored)		GSOEP (all)	
	1984	1990	1984	1990	1984	1990
MLD	0.0412	0.0429	0.0347	0.0353	0.0692	0.0676
			skill groups			
within	0.0388	0.0402	0.0323	0.0323	0.0531	0.0525
between	0.0024	0.0027	0.0025	0.0030	0.0161	0.0151
			experience groups			
within	0.0369	0.0392	0.0317	0.0337	0.0629	0.0622
between	0.0043	0.0037	0.0031	0.0016	0.0063	0.0055

$$MLD = \underbrace{\sum_k \nu_k MLD_k}_{within} + \underbrace{\sum_k \nu_k \ln(1/\lambda_k)}_{between},$$

where k = index for group, v_k = sample share of k^{th} group, $\lambda_k = \bar{y}_k / \bar{y}$.

Notes: 1) GSOEP data are weighted (see section 2). 2) Due to rounding errors the sum of the components of MLD is not always equal to MLD.

These decompositions show that most of observed earnings inequality is accounted for by inequality within skill and experience groups in both years and, except for the decomposition according to skill groups in the complete GSOEP sample, between–group inequality is negligible. Furthermore, from these calculations we may also conclude that there has been very little change both in within– and between–earnings inequality over time, and the little we do observe for earnings below the social securtiy threshold is mainly related to changes in within–inequality. Only for the complete GSOEP sample has inequality between skill groups contributed somewhat to the small observed change in overall earnings inequality.

The decompositions in Table 3 refer to specific groups and do not take the effect of other variables on inequality within these groups into account. They also do not tell us how changes in between inequality are related to changes in observed skills on the one hand and changes in their rental rates ("prices") on the other. To disentangle these factors, a more refined analysis is required. This analysis is based on empirical earnings functions described in the following section.

4 Empirical Earnings Functions

4.1 Econometric Specification

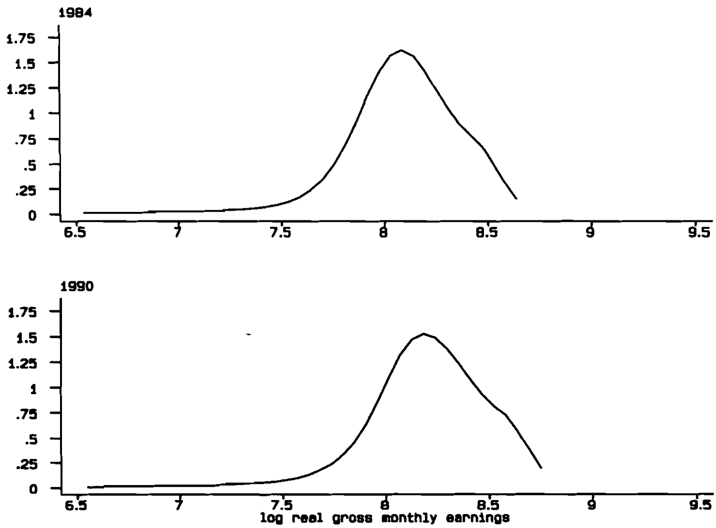
Following human capital theory, wage differentials in competitive labour markets should mainly reflect productivity differences between skill groups where both demand and supply side factors play a role (see Willis, 1986 for a survey of the relevant theory). In the long–run, wages for identical skills could only differ as far as they represent compensating differentials for some other, possibly unobserved, factors affecting costs to firms or preferences of workers, such as monitoring costs, risks associated with a particular job, the work environment, and so on. In imperfectly competitive labour and product markets other factors, like the relative strength of labour unions, minimum wages, and "efficiency wage" considerations also play a role (see Katz 1986 for a survey of the literature). These factors may modify the relationship between an individual's wage and his or her (observed) human capital endowment to some extent, but they are unlikely to supersede this basic relationship.

In econometric work it is usually assumed that, conditional on a set of human capital and other explanatory variables, log–earnings are normally distributed. As the kernel density estimates in Figure 3 show[8], this assumption seems indeed appropriate for the GSOEP data. For the IABS data the truncated distribution of observed earnings also seems compatible with this assumption.

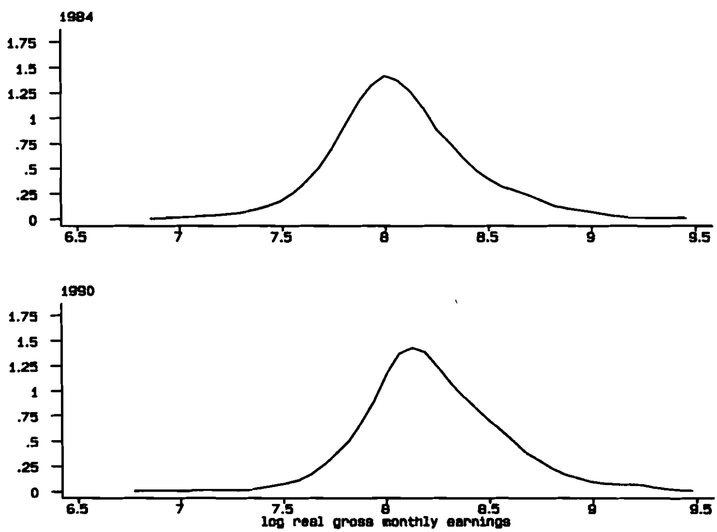
[8] The estimates use Epanechnikov kernels as implemented in STATA 4.0 with a bandwidth of 0.07 units. For descriptions of this statistical tool see, e.g., Silverman (1986).

Figure 3 Kernel density estimates of log real gross monthly earnings

IABS



GSOEP



To allow for right–censored observations in the estimation, we specify the following censored regression model:

$$(1)\qquad \begin{aligned} y_{it}^{*} &= \alpha_t' SKILL_{it} + \beta_{1t} EXP_{it} + \beta_{2t} EXP_{it}^{2} \\ &\quad + \gamma_t'\left(SKILL_{it}, EXP_{it}, EXP_{it}^{2}, FOR_{it}\right) + \delta_t' Z_{it} + u_{it} \equiv B_t' X_{it} + u_{it}, \end{aligned}$$

where y^* = latent earnings variable, with $y_{it}^{*} = \begin{cases} y_{it}, & \text{if } y_{it}^{*} < c_t \\ c_t, & \text{otherwise} \end{cases}$

y = (natural) log of gross monthly earnings

c = log of social security threshold

SKILL = vector of educational/vocational dummies

EXP = labour market experience

FOR = a dummy for foreigner

Z = a vector of industry and firm size dummies including a constant

X ≡ [SKILL, EXP, EXP^2, FOR, Z]

B ≡ [α', β_1, β_2, γ', δ'] = corresponding (vectors of) parameters

u = error term, $u_{it} \sim N(0, \sigma_t^2)$, $E(u_{it}, X_{it}) = 0$, for all i, t.

N(•) is the normal distribution function with zero mean and variance σ_t^2, E the expectation operator; the first index refers to individual i (i=1,2...n) and the second to year t (t=1984, 1990).

Note that the dependent variable in equation (1) refers to an individual's earnings rather than his wage rate, which human capital theory tries to explain. This choice of the dependent variable is motivated by the lack of hours information in the IABS. However, given that for full–time employed men there is little variation in hours worked, we do not expect our estimation results to be much affected by this choice of the dependent variable.

An individual's human capital is proxied by his vocational/educational qualification and labour market experience, where the former represents formal qualification usually acquired before labour market entry and the latter relates to skills due to formal training and informal learning on the job. Following usual practice, we define an individual's potential *labour market experience* as: *age – years of schooling – six years*. Years of schooling are derived from the highest vocational/educational degree as summarised in Table 4, where the classification is given by the information available in the IABS.[9]

Table 4 Years of schooling by vocational/educational category

	Vocational degree/higher education	Years of schooling
1.	No vocational degree, no higher education	10
2.	Vocational degree, but no university entry level degree [a)]	12.125
3.	University entry level degree	13
4.	Polytechnical degree [b)]	15
5.	Vocational degree and university entry level degree	15.125
6.	University degree	18

a) "allgemeine/fachgebundene Hochschulreife"

b) "Fachhochschulabschluss"

Rather than using years of schooling, we prefer to proxy an individual's *formal qualification* by a set of dummy variables, which allows for a more flexible specification of the relationship between earnings and vocational/educational qualification. Since the number of observations for some of the categories listed in Table 4 is rather small in the GSOEP, we had to aggregate them into three: no vocational/educational degree (1.), vocational degree/higher education (2., 3., and 5.) and university/polytechnical degree (4. and 6.). Thus, in the estimation we include two dummies for *skilled* and *graduates* with the *unskilled* as the reference group.

A central implication of human capital theory is that individual earnings increase with labour market experience at a decreasing rate because the older one gets the less profitable additional investments in human capital become (Mincer 1974). Empirically, this should show up in concave earnings–experience profiles implying $\beta_1 > 0$ and $\beta_2 < 0$ in equation (1). Since it seems likely that the returns to labour market experience depend on the level of vocational/educational qualification, we include interaction terms between these variables in the set of regressors. We also expect that human capital effects differ between natives and foreigners, either because some of foreigners' human capital acquired abroad was devalued on immigration (see, e.g., Licht and Steiner 1994) or simply because foreign vocational/educational degrees are not considered formally equivalent to similar

9 This classification has also been used by Bellmann, Reinberg and Tessaring (1994) and by Möller and Bellmann in their studies cited above. For vocational degrees the average duration of apprenticeship education across the various occupations is used.

ones obtained in Germany. As these effects may depend on the level of formal qualification as well, we also allow for trivariate interaction terms between the skill dummies, experience (and its square), and foreigner status. This specification is more general than usually found in the empirical literature on earnings functions, which seems appropriate given our results on the large variance of earnings within skill and experience groups (see Table 3).[10]

In addition to human capital variables we include a dummy variable for foreigners as well as industry and firm size dummies in the earnings equation to account for other potential factors affecting earnings. Foreigners may receive lower wages even if differences in human capital endowment, industry allocation and firm size effects are controlled for if there is some sort of discrimination against them (Velling 1995). Although the reasons for the substantial industry and firm size effects are not well understood, their empirical importance has been established in several econometric studies for Germany (see, e.g., Gerlach and Hübler 1990, Schmidt and Zimmermann 1991, De New and Schmidt 1994, Gerlach and Hübler 1995, Möller and Bellmann 1995a, 1996). Due to the relatively small sample size in the GSOEP we had to aggregate industries into 13 categories as defined in Appendix 1, which also describes the aggregation of the considerably more detailed industry classification in the IABS into these categories. Since there is no appropriate information in the IABS[11], we cannot control for potential other regional effects, such as regional labour market conditions, which has been the topic of recent empirical research on the "wage–curve" (for Germany see, e.g., Wagner 1994, Rendtel and Schwarze 1995). However, from the results of previous research we would expect that these effects are of little quantitative importance and are mainly controlled for by the industry dummies included in our earnings functions.

Summary statistics of the variables included in the earnings function for the IABS and the GSOEP are provided in Appendix 2. They refer to the years 1984 and 1990, for which estimation results from the earnings function will be reported below. Differences in sample shares between the IABS and the GSOEP should not affect our conditional analysis. However, estimated coefficients between the two samples may differ because of differences in the meaning of categories of explanatory variables or in the degree of heterogeneity within these categories. For example,

---

[10] That the slope of earnings–experience profiles may depend on the skill level is also indicated by the results in Fitzenberger et al. (1995), Möller and Bellmann (1996), and Gosling (1996). This hypothesis is also in line with the results in Fitzenberger and Kurz (1996) who show that the effects of human capital variables in earnings functions estimated by quantile regressions on the GSOEP vary considerably by quantile.

[11] To fulfill certain legal requirements of data protection, the detailed regional information available in the Employment Register has been aggregated into three regional types for firms with less than 500 employees, while for larger firms no regional information at all is available in the IABS (for details see Bender et al. 1996, pp. 47ff).

the coding of firm–size categories differs somewhat between the IABS and the GSOEP, and there may be measurement error in the vocational qualification categories in the latter, for the reason mentioned above. Furthermore, the composition of foreigners is not comparable between the two data sets. Whereas the IABS should be representative for all dependently employed foreigners in the respective year, the GSOEP heavily oversamples former "guest workers" (see section 2). Fortunately, these measurement problems do not directly affect the human capital effects for natives, which are of main interest in our conditional analysis.

4.2 Estimation Results

For the IABS data, estimation of equation (1) is based on a variant of the standard Tobit model with a constant (across individuals) upper threshold value.[12] Since earnings in the GSOEP are not censored, equation (1) reduces to the standard semi–loglinear regression model which, under the above assumptions about the error term, can be estimated by OLS. As it is well known, selectivity bias may occur if the factors not controlled for in the estimation of the earnings function are correlated with those determining labour force participation, i.e. the estimated effects of explanatory variables in the earnings function may differ between the employed for whom we observe earnings and in the whole population. The standard approach to correct for potential selectivity bias in the estimation of earnings functions is the two–step procedure first proposed by Heckman (1979), where a selectivity–correction term (the inverse Mill's ratio) obtained from a first–stage reduced–form Probit model of labour force participation is included as additional regressor in the second–stage estimation of the earnings function.

This two–step estimation procedure is only credible if there are variables strongly affecting labour force participation but having no effect on earnings (Rendtel 1992; Puhani 1996). Since household composition (marital status, children) and other household income should not affect *gross* earnings but are generally considered important determinants of labour force participation, these variables would qualify as credible exclusion restrictions in the earnings function. These variables are available in the GSOEP but, with the exception of marital status, not in the IABS. Therefore, we have only tested for selectivity bias in the OLS earnings functions estimated on the GSOEP data. The results (available on request) show that the selectivity term is significant in the estimation for 1984 and insignificant for 1990. However, with the exception of the interaction term between nationality and graduates, estimated parameters in the selectivity–corrected earnings equation for 1984 also changed very little. Therefore, we only report estimation results without selectivity correction below.

---

12 For a description of the Tobit model see, e.g., Maddala (1983, pp. 151ff).

Maximum Likelihood Tobit and OLS estimation results for the earnings functions based on the IABS and the GSOEP data for the years 1984 and 1990 are summarised in Table 5. To test the sensitivity of estimation results to the particular method employed, we have artificially censored observed earnings in the GSOEP at the social security threshold and estimated the earnings function by Maximum Likelihood Tobit. Estimation results for this model are reported in Appendix 3. Since there is hardly any difference between the OLS and Tobit estimation results based on the GSOEP, we will not comment on the latter here. However, from this result we would conclude that the Tobit model is also likely to yield similar parameter estimates as would be obtained by OLS if the IABS earnings data were not right–censored.

To arrive at the specific form of the earnings functions reported in Table 5 we started from the more general specification in equation (1) and tested for the statistical significance of the various interaction terms between skill dummies, labour market experience, and nationality. As it turned out, all trivariate interaction terms between these variables were insignificant at conventional levels in all specifications, whereas interaction terms between skill groups and labour market experience were only statistically significant in the estimated earnings functions based on the IABS data.[13] Estimated coefficients on these interaction terms from the GSOEP are qualitatively similar to those in the IABS but not statistically significant at the 5 percent level, probably due to the relatively small sample size of the GSOEP. Except for the interaction term for foreigners with higher education in the estimates based on the IABS, all coefficients on the bivariate interaction terms with nationality are also (jointly) statistically significant. In the final re–estimation of the earnings equations reported in Table 5 insignificant interaction terms were excluded.

[13] Naturally, coefficients of interaction terms including experience and its square were tested for joint significance. The chosen critical significance level is 5% for the GSOEP and 1% for the IABS; the higher level for the IABS should account for its huge sample size.

Table 5 Earnings functions estimated on the IABS and the GSOEP for 1984 and 1990

Variable	IABS (Tobit)				GSOEP (OLS)			
	1984		1990		1984		1990	
	Coeff	|t|	Coeff	|t|	Coeff	|t|	Coeff	|t|
constant	7.53	498.5	7.74	515.7	7.54	107.0	7.62	106.4
skill group (unskilled)								
skilled	8.89	10.9	9.48	11.6	18.88	8.1	16.9	7.2
graduate	45.72	27.1	37.53	24.8	62.40	19.3	59.32	18.2
experience	2.89	40.8	1.96	26.6	3.38	12.8	3.83	13.3
experience^2	–4.74	32.6	–2.93	19.2	–6.26	10.6	–6.93	11.2
experience * skilled	1.20	15.6	0.98	12.3	—		—	
experience^2 * skilled	–2.45	15.1	–1.72	10.3	—		—	
experience * graduate	2.17	11.4	2.45	14.4	—		—	
experience^2 * graduate	–3.90	8.6	–4.39	10.9	—		—	
foreigner * skilled	–5.92	8.7	–7.02	10.4	–11.88	3.9	–9.79	3.2
foreigner * graduate	—		—		–37.21	5.2	–40.51	5.5
foreigner * experience	–0.55	4.7	0.10	0.9	–1.14	2.7	–1.89	4.2
foreigner * experience^2	0.26	1.0	–0.69	2.8	2.06	2.2	3.07	3.2
foreigner	8.80	7.1	1.33	1.1	8.00	1.6	19.16	3.9
12 industry dummies	$\chi^2(12) = 3465$		$\chi^2(12) = 5498$		F(12,N)=6.34		F(12,N)=5.90	
3 firm size dummies	$\chi^2(3) = 4724$		$\chi^2(3) = 6804$		F(3,N)=24.01		F(3,N)=35.49	
σ	0.2749		0.2826		0.2703		0.2644	
adj. R^2					0.370		0.383	
log L full model	–19 937.25		–24 006.13					
log L constant	–45 267.51		–49 270.92					
Number of cases (n)	94 119		99 535		2 248		1 938	

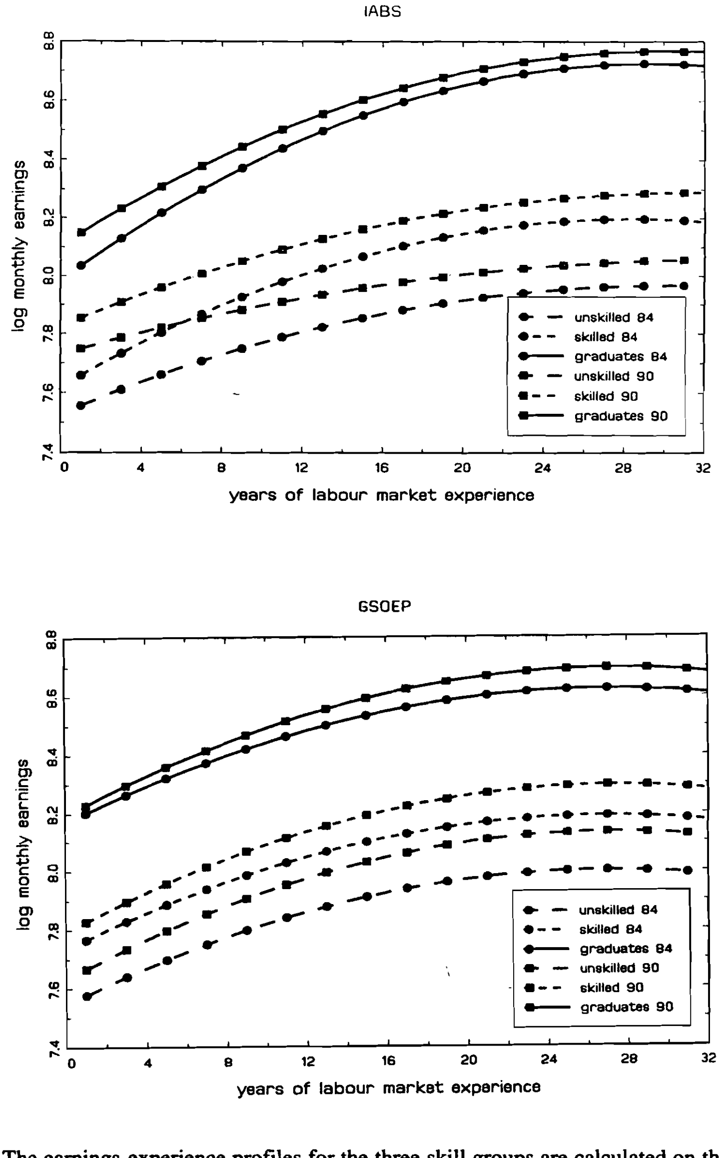
Notes: 1) For dummy variables, the base categories are given in parantheses. 2) Except for the constant term, all parameters are multiplied by the factor 100 (respectively by the factor 10,000 for experience squared and the respective interaction terms). 3) '*' denotes an interaction term. 4) Coefficient estimates for the industry and firm size dummies are shown in the appendix. 5) The χ^2–test refers to the likelihood ratio statistics, which is defined as $-2(L_I - L_0)$, where L_I refers to the unrestricted and L_0 to the restricted model, respectively. 6) '—' denotes insignificant interaction terms.

As the OLS estimation results for the GSOEP data show, the model explains about 40 percent of the variance in log earnings in both 1984 and 1990, which is at a similar level as usually reported for earnings functions estimated on large cross–sections. The estimated standard error of the OLS regression for 1984 is somewhat higher than for 1990 indicating that inequality within groups defined by the explanatory variables in the model has slightly decreased. While this is also consistent with the estimated error variance in the Tobit model based on the artificially censored earnings data in the GSOEP (see Appendix 3), the Tobit estimates for the IABS show an increase in within–inequality. For both years, within earnings inequality as measured on the basis of the IABS exceeds the estimates based on the GSOEP.

By far the largest percentage of the explained variance is accounted for by the human capital variables, whereas industry and firm size effects – although significant at conventional levels – play a relatively minor role in earnings determination. Dropping the industry dummies, the R^2 of the earnings function (adjusted for degrees of freedom) estimated on the 1990 GSOEP data falls from 0.383 to 0.367, while dropping also the firm–size dummies reduces the adjusted R^2 to 0.319. On the other hand, leaving out the human capital variables from the earnings function would reduce it to 0.170. Likewise, in the Tobit model estimated on the IABS 1990 data the standard error increases only slightly from 0.283 in our preferred specification to 0.291 (0.307) when the industry (and firm size) dummies are excluded, whereas it increases to 0.333 in the specification without human capital variables (these values are not reported in Table 5). As the comparison of these statistics with those obtained for the year 1984 shows, the relative importance of the factors determining individual earnings has changed little within the observation period.

In the interpretation of estimation results, we therefore focus on the effects of the human capital variables here (parameter estimates for the industry and firm–size dummies are reported in Appendix 4). Because of the remaining interaction terms between the skill dummies and labour market experience (and its square), coefficent estimates of these variables are difficult to interpret and to compare between the two different samples and between years. We therefore plot estimated earnings–experience profiles by skill group in Figure 4. Since the composition of foreigners in the two samples differs substantially (see section 2), we restrict this comparison to Germans.

Figure 4 **Estimated earnings–experience profiles for German employees by skill group, 1984 and 1990**



Note: The earnings-experience profiles for the three skill groups are calculated on the basis of the estimates in Table 5 with the values of the other explanatory variables set to the respective base categories.

As expected, estimated earnings–experience profiles exhibit the typical concave shape implied by human capital theory, even if they are rather flat compared to those usually reported for the U.S. (see, e.g., Murphy and Welch 1990). The estimates based on the IABS show that the earnings–experience profile of graduates is steeper than for skilled workers, whose profile in turn is steeper than that of the unskilled. While earnings–experience profiles have become somewhat flatter for all skill groups between 1984 and 1990, differences between skill groups have changed little in this period. For example, evaluated at 25 years of labour market experience, the experience differential between graduates and skilled workers has increased from about 30 to 35 percent between 1984 and 1990, while it has remained at about 55 percent between graduates and the unskilled. However, the earnings differential of graduates with little labour market experience has decreased relative to both skilled and unskilled workers. In contrast, for both 1984 and 1990 the estimates based on the GSOEP imply parallel earnings–experience profiles for the three skill groups, i.e. their slopes do not differ significantly from each other. Compared to the estimates from the IABS for the year 1990, earnings differentials between graduates and the skilled as well as the unskilled are higher in the GSOEP for those with little labour market experience and smaller for more experienced employees. Overall, estimated skill differentials based on the GSOEP have changed little within the observation period.

A quantitative comparison between our estimated earnings–experience profiles with those reported in previous studies for Germany is rendered difficult by differences in specification, estimation methods and observation periods, as well as the way estimation results are reported. However, we may note that Fitzenberger et al. (1995, figure 10) and Möller and Bellmann (1996, tables 2 and 3) on the basis of data drawn from the Employment Register and Gosling (1996) for the GSOEP also find that the slopes of their estimated earnings–experience profiles are the steeper the higher the skill level.[14] As to the relative size of these experience differentials, our reading of these studies is that the estimates reported by Fitzenberger et al. (1995) and Gosling (1996) are roughly similar to ours, while those derived by Möller and Bellmann (1996, table 3) differ substantially from these estimates. For example, for 1984 they report maximum experience differentials for the unskilled, the skilled and graduates of, respectively, about 80, 90 and 140 percent achieved by each group at around 25 years of potential labour market experience. In contrast, our estimates imply experience differentials of about 50, 80 and 95 for equivalently defined groups for that year, while those reported by Fitzenberger et al. (1995,

[14] Fitzenberger et al. (1995) and Gosling (1996) use age as a proxy for potential labor market experience (trying also to control for cohort effects). These authors as well as Möller and Bellmann (1996) estimate their earnings (wage) equations separately for the various skill groups, but do not report whether group differences between the estimated profiles are statistically significant. Other studies cited in footnote 2 generally do not allow for different slopes of estimated earnings–experience profiles.

figure 10) would even suggest considerably smaller experience differentials for their similarly defined skill groups.[15] While the difference to this latter study could be due to cohort effects, for which we do not (and cannot) control in our cross–section regressions, the more substantial differences to the estimates produced by Möller and Bellmann (1996) are hard to reconcile with ours. Frankly, we are very skeptical about their estimates given the available evidence from other studies as well as our own estimates based on both the IABS and the GSOEP.

Because of the more reliable earnings information in the IABS (see section 2) and its large sample size we would consider the estimates based on this data source somewhat more reliable than those obtained on the basis of the GSOEP. However, taking into account the large sampling variance in the GSOEP relative to the IABS, there may in fact be very little difference between the estimated earnings–experience profiles for German employees and their changes in the observation period as obtained from these two data sources.

5 Decomposition Analysis

In the 1980's, substantial structural changes in the German labour market occurred. The share of unskilled labour decreased, while university graduates increasingly entered the labour market. The employment share of manufacturing declined while the service sector expanded and, related to this structural change, male employment decreased relative to women's. Under competitive conditions, the implied changes in the demand for and supply of labour should have affected the relative prices of different skills. Alternatively, if non–competitive factors played an important role in wage determination, the employment shift from manufacturing to services should have changed relative industry rents and firm–size wage differentials. Hence, opposite price and quantity adjustments could well have left the earnings distribution more or less unchanged although economic factors may have played their role.

Since changes in the distribution of skills and industry structure within the observation period differs somewhat between the IABS and the GSOEP, part of the difference in earnings inequality changes may be related to compositional effects. As Appendix 2 shows, the most striking differences refer to (changes in) the distribution of skill groups in the two samples. One possible explanation for the differences in levels would be that, because education is valued highly in society, respondents in the GSOEP tend to upgrade their answers to their actual

[15] If one equates age with labor market experience, the 25–years' experience differentials as can be read off from their figure 10 by drawing a vertical line at age 50 would be about 10, 30 and 70 percent. However, note that these profiles refer to median (and first quartile) earnings within the groups.

vocational/educational level. However, changes in the shares of skill groups over time also differ in the two data sets. The decrease in the share of unskilled employees, the slight increase of those with vocational qualification or higher education, and the substantial increase of university graduates as observed in the IABS is in line with the respective changes of these groups in the Labour Force Survey.[16] In contrast, the GSOEP data show an increase of employees with no vocational/educational degree.

Following Juhn, Murphy and Pierce (1993) and Blau and Kahn (1996) we decompose observed (changes in) earnings differentials between two years into changes due to relative prices for different skills, observed individual characteristics and unobserved factors.[17] The only other empirical study for Germany that tries to decompose changes in the structure of earnings in the 1980's we are aware of is by Möller (1996). On the basis of the methodology proposed by Bound and Johnson (1992), he decomposes changes in earnings into three components: shifts in product demand, changes in labour supply by skill groups and a residual term from his earnings regressions which he equates with non–neutral technological change. A central result of this study is that most of the alleged increase in earnings inequality can be "explained" by non–neutral technological change. While our decomposition is more descriptive in nature, it offers an alternative way of looking at the same issues as in Möller's study.

As Juhn, Murphy and Pierce (1993) have shown, the changes in earnings inequality between two years can be decomposed into three different effects:

- a *measured characteristics effect*,
- an *earnings coefficients effect*,
- and an *earnings equation residual effect.*

We start from the earnings equation in (1) and define

[16] Data from the Labor Force Survey show that the share of unskilled male workers has declined from 20.7 to 15.3 percent between 1982 and 1989 (the nearest years to ours for which this information is available), while the share of university graduates has increased from 7.2 to 10 percent in this period. We thank the people at ZUMA, Mannheim, who have made these numbers available to us.

[17] Juhn, Murphy and Pierce (1993) use this methodology to decompose US earnings inequality over time, Blau and Kahn (1996) employ it to decompose earnings differentials between the U.S. and a number of other countries at a point in time.

(2) $$y_{it}^{*} = B_t' X_{i,t} + u_{it} \equiv B_t' X_{it} + \sigma_t e_{it}.$$

By definition, the error term u_{it} can be written as the product of σ_t and e_{it}, where σ_t is the standard deviation of the residuals in year *t*, and e_{it} is the *i*–th standardised residual with mean zero and variance one.

The decomposition analysis can be based on the earnings functions estimated by OLS or, with a straightforward extension, on the Tobit model as well. Empirical residuals for the non–censored observations can be calculated using the conditional expectation of earnings (Maddala 1983, pp. 158):

(3) $$\hat{u}_{it} \equiv y_{it} - E\left(y_{it} | y_{it}^{*} < c_t\right) = y_{it} - \hat{B}_t' X_{it} - \hat{\sigma}_t \hat{\lambda}_t, \text{ with } \hat{\lambda}_t = \frac{\phi(\bullet)}{\Phi(\bullet)}.$$

In equation (3), *E* is the expectation operator, σ_t is the OLS (Tobit) standard error for year *t*, λ_t is the Mill's ratio, $\phi(\bullet)$ and $\Phi(\bullet)$ denote the standard normal density and distribution functions evaluated at $\left(c_t - \hat{B}_t' X_{it}\right) / \hat{\sigma}_t$, where a carat ("∧") above a variable or vector stands for an estimate. Using equation (3), we have for the non–censored observations:

(4) $$y_{it} | y_{it}^{*} \leq c_t = \hat{B}_t' X_{it} + \hat{\sigma}_t \hat{\lambda}_t + \hat{\sigma}_t \hat{e}_{it}.$$

To decompose changes in earnings inequality between 1984 and 1990, we define the following auxiliary function

(5) $$Y_{1,i} = \hat{B}_{84}' X_{i,90} + \hat{\sigma}_{90} \hat{\lambda}_{i,90} + \hat{\sigma}_{84} \hat{e}_{i,90}.$$

In this equation, the vector of explanatory variables in the year 1990 is multiplied by the vector of estimated parameters for the year 1984, and the standardized residuals for the year 1990 are transformed in such a way that they obtain their corresponding position in the distribution of residuals in the year 1984.

Define another auxiliary function, Y_2, given by

(6) $$Y_{2,i} = \hat{B}_{90}' X_{i,90} + \hat{\sigma}_{90} \hat{\lambda}_{i,90} + \hat{\sigma}_{84} \hat{e}_{i,90},$$

where the vector of explanatory variables in the year 1990 is evaluated at the estimated parameter vector for that year, and the other terms on the right–hand side of the equation are defined as in equation (5).

Then, the difference in the distribution of observed (non–censored) earnings in the year 1984, $y_{i,84}$, and $Y_{1,i}$ measures the change in earnings inequality between 1984 and 1990 resulting from changes in observed individual characteristics between these two years. This *measured characteristics effect* gives the change in earnings inequality attributable to changes in the endowment of human capital and the distribution of other determinants of earnings in the sample between the two years. On the other hand, the difference between the distribution of $Y_{2,i}$ and $Y_{1,i}$ measures the change in inequality arising from changes in estimated parameters between the two years; it is called the *earnings coefficients effect* and, in particular, refers to changes in the returns to human capital. The remaining *earnings equation residual effect* is given by the difference in the distribution of $y_{i,90}$ and $Y_{2,i}$, which includes the effects of unobserved characteristics and their "prices" on earnings as well as measurement errors.

An important advantage of this decomposition relative to other methods is that it is not restricted to some summary measure of inequality, but allows us to describe changes in inequality in different parts of the earnings distribution. In Table 6 we summarise results of this decomposition analysis for the 90/50–percentile and the 50/10–percentile ratio, respectively. To account for the large share of foreigners and sample attrition, we present the calculations also for the weighted GSOEP data. Given that the analysis uses non–censored cases only, and taking into account the fact that the percentage of right–censored cases in the sample is roughly 10 percent, we use the 90–percent instead of the 80–percent percentile here. To make the results comparable between the two data sets, the decomposition based on the GSOEP data only takes into account earnings below the social security threshold. However, basing the calculations on all observations would have changed the results of the decomposition analysis very little. To adjust for the smaller number of observations, the lower part of the distribution is represented by the 10–percent percentile here. Note that the change in the 50/10–percentile ratio between 1984 and 1990 is only 0.5 percent for the non–censored earnings in the IABS sample, compared to about 5 percent for the 50/20–percentile ratio based on all observations (Figure 2). For the GSOEP, these changes seem negligible.

Table 6 Decomposition of changes in earnings inequality, 1984 – 1990

Change of the inequality measures	IABS	GSOEP	
		weighted	unweighted
Δ(50/10 percentile)	*+0.0053*	*–0.0184*	*–0.0202*
measured characteristics effect	+0.0165	–0.0201	–0.0233
wage coefficients effect	–0.0120	+0.0044	+0.0046
wage equation residual effect	+0.0008	–0.0027	–0.0015
Δ(90/50 percentile)	*+0.0227*	*+0.0289*	*+0.0190*
measured characteristics effect	+0.0252	+0.0336	+0.0305
wage coefficients effect	–0.0078	–0.0047	–0.0100
wage equation residual effect	+0.0053	–0.0001	–0.0015

Note: Δ(50/10–percentile ratio) = log of 50/10–percentile ratio in 1990 – log of 50/10–percentile ratio in 1984, and analogously for the log of the 90/50–percentile ratio.

The main message from the decomposition of the rather small changes in the 50/10– and 90/50–percentile ratios is that they do not result from large counteracting effects of their components. In particular, for the IABS the decomposition shows that in the lower part of the distribution the positive measured characteristics effect is more or less compensated for by the negative earnings coefficients effect, but both of these effects are themselves very small. The slight compression of the earnings structure in the lower part of the distribution observed both in the weighted and the unweighted GSOEP data is mainly related to changes in measured characteristics, while changes in the returns to skills seem to have had very little effect. For the upper part of the earnings distribution the two data sets yield very similar results: the small increase in earnings inequality is related to the positive measured characteristics effect, which is slightly reduced by the negative earnings coefficients effect. This result is consistent with the increase in the share of graduates within the observation period accompanied by a slight reduction in the estimated skill differential of gradutates with little labour market experience. That the measured characteristics effect differs somewhat between the IABS and the GSOEP is not surprising given the mentioned differences in sample composition, in particular with respect to changes in the skill composition of the labour force. Furthermore, the sign of the earnings equation residual effect differs between the two data sets, but it is of no quantitative importance anyway.

6 Summary and Conclusion

Our analysis based on data both from the German Socio–Economic Panel and the Employment Register of the Federal Labour Office has shown that earnings inequality in Germany has increased very little in the 1980's, if at all. This is in line with most previous studies based on the GSOEP and other data sources, but contradicts the results of several recent studies based on micro data from the Employment Register. In particular, we have shown that the marked increase in relative earnings in the upper part of the distribution observed in the register data between 1983 and 1984 is a statistical artifact related to a change in the way fringe benefits used to be previously treated in this data source before 1984. Between 1984 and 1990, the register data show a modest increase in earnings inequality. In contrast, the GSOEP data show little change in overall earnings inequality, but indicate a small compression of the earnings structure in the lower part of the distribution. Overall earnings inequality is mainly related to inequality within skill groups and groups with similar labour market experience, while inequality between these groups plays only a minor role. Furthermore, there has been little change in earnings inequality both within and between employees with different skills and labour market experience.

As our estimation results based on empirical earnings functions show, human capital variables account for by far the largest percentage of the explained variance in earnings, whereas industry and firm–size effects play a relatively minor role in earnings determination. Estimated earnings–experience profiles exhibit the typical concave shape implied by human capital theory, where at least the estimates based on the register data show that the earnings–experience profile of graduates is steeper than for skilled workers, whose profile in turn is steeper than that of the unskilled. While earnings–experience profiles have become flatter for all skill groups between 1984 and 1990, differences between skill groups have changed little in this period. The only noticeable change occurred for graduates with little labour market experience whose earnings differential relative to both skilled and unskilled workers has slightly decreased, but remains substantial. This result is also in line with the empirical evidence reported by Bellmann, Reinberg and Tessaring (1994) as well as Weißhuhn and Büchel (1993) on the basis of different data sources.

Our decomposition analysis based on the methodology proposed by Juhn, Murphy and Pierce (1993) reveals that the relative stability of the German earnings distribution in the 1980's has not resulted from large compensating changes in the composition of the labour force on the one hand, and changes in the returns to human capital on the other. While both of these components have changed little in the observation period, the former rather than the latter component has contributed to the small increase in earnings inequality observed in the register data. If anything, the earnings differential between skilled and unskilled workers has become smaller during the 1980's, which is in marked contrast to the development in the U.S. and U.K. labour markets and in line with the view of the predominance of institutional rigidities over market forces in the German labour market referred to in the introduction. An alternative explanation would be that technological change has led to the obsolescence of skills acquired during previous apprenticeship training. According to Blechinger and Pfeiffer (1996), the degree of skill obsolescence as measured by a subjective indicator has markedly increased since the mid–1980's for all experience groups, and this effect seems to be the stronger the more labour market experience a skilled worker has acquired. On the other hand, the small reduction in the earnings differential of graduates with little labour market experience is also compatible with the hypothesis that the increased labour supply of graduates has not been compensated for by a higher relative demand for highly skilled labour in Germany, as has previously been proposed by Abraham and Houseman (1995) and Gottschalk and Smeeding (1996) as an explanation for changes in the U.S. earnings distribution.

As our decomposition analysis has also shown, changes in within–inequality have contributed very little to changes in inequality between 1984 and 1990. This result contradicts the conclusion by Möller (1996) that the increase in the labour supply of skilled workers and, in particular, graduates had substantially reduced their earnings differential relative to unskilled workers in the 1980's would this labour supply effect not have been overcompensated by the increased demand for highly skilled labour resulting from non–neutral technological change. Therefore, whether one relates the residual from an earnings regression to technological change, some other unobserved factors or simply measurement error, changes in inequality within skill groups have not contributed to an increase in earnings inequality in the 1980's.

Overall, the empirical results of this study seem compatible with an institutional explanation of the stability of the German earnings distribution where, in contrast to the U.S. and to some extent the U.K. as well, several factors may have prevented earnings of those negatively affected by technological and structural change to fall relative to those whose skills have become more valuable. These factors include effective wage floors set by collective bargaining agreements, unions' "solidaristic wage policy" aiming at uniform relative wage increases, and income support schemes characterized by high earnings replacement ratios together with the widespread use of early retirement schemes. Although the relative importance of these factors could not be assessed in this study, we hope to have clarified the main stylized facts any specific theory about the development of the distribution of German earnings in the 1980's would have to take into account.

References

Abraham, Katherine and Susan N. Houseman (1995): Earnings Inequality in Germany; in: Richard B. Freeman and Lawrence F. Katz (eds.), Differences and Changes in Wage Structure, University of Chicago Press.

Becker, Irene (1996): Did Earnings Inequality in the Federal Republic of Germany Increase from the 1960s to the 1980s?, EVS–Projekt Arbeitspapier Nr. 8, University of Frankfurt/Main.

Bellmann, Lutz, Alex Reinberg and Manfred Tessaring (1994): Bildungsexpansion, Qualifikationsstruktur und Einkommensverteilung, in: Rainar Lüdeke (ed.), Bildung, Bildungsfinanzierung und Einkommensverteilung II, Berlin, Duncker & Humblot.

Bender, Stefan, Jürgen Hilzdegen, Götz Rohwer and Helmut Rudolph (1996): Die IAB–Beschäftigtenstichprobe 1975–1990, Beiträge zur Arbeitsmarkt– und Berufsforschung 197, Nürnberg.

Blau, Francine D. and Lawrence M. Kahn (1996): International Differences in Male Wage Inequality: Institutions versus Market Forces, Journal of Political Economy, 104, 791–837.

Blechinger, Doris and Friedhelm Pfeiffer (1996): Technological Change and Skill Obsolescence: The Case of German Apprenticeship Training; ZEW Discussion Paper No. 96–15, Mannheim.

Bound, John and George Johnson (1992): Changes in the Structure of Wages in the 1980's: An Evaluation of Alternative Explanations, American Economic Review, 82, 371–392.

Burkhauser, Richard V. (1991): An introduction to the German Socio–Economic Panel for English speaking researchers, Cross–National Studies in Aging Program Project Paper No. 1, Syracuse University.

Burkhauser, Richard V., Douglas Holtz–Eakin and Stephen E. Rhody (1996): Labor Earnings Mobility and Inequality in the United States and Germany during the Growth Years of the 1980s, Cross–National Studies in Aging Paper 12, Syracuse University.

Burtless, Gary (1995): International Trade and the Rise in Earnings Inequality, Journal of Economic Literature, 33, 800–816.

Cowell, Frank A. (1995): Measuring Inequality; London, Prentice Hall/Harvester Wheatsheaf.

De New, John P. and Christoph M. Schmidt (1994): The Industrial Structure of German Earnings 1980–1990, Allgemeines Statistisches Archiv, 78, 141–159.

Fitzenberger, Bernd and Claudia Kurz (1996): New Insights on Earnings across Skill Groups and Industries: An Analysis based on the German Socioeconomic Panel, Mimeo, University of Konstanz.

Fitzenberger, Bernd, Reinhard Hujer, Thomas E. McCurdy and Reinhold Schnabel (1995): The Dynamic Structure of Wages in Germany 1976 - 1984. A Cohort Analysis; Diskussionspapier 22–1995, Center for International Labor Economics, University of Konstanz.

Franz, Wolfgang (1995): Die Lohnfindung in Deutschland in einer internationalen Perspektive: Ist das deutsche System ein Auslaufmodell?; Beihefte der Konjunkturpolitik – Applied Economics Quarterly, 43, 31 – 57.

Freeman, Richard B. and Lawrence F. Katz (1994): Rising Wage Inequality: The United States vs. other Advanced Countries, in: Richard B. Freeman (ed.), Working under different rules, New York, Russel Sage Foundation.

Gerlach, Knut and Olaf Hübler (1995): Betriebsgrösse und Einkommen. Erklärungen, Entwicklungstendenzen und Mobilitätseinflüsse; in: Viktor Steiner and Lutz Bellmann (eds.), Mikroökonomik des Arbeitsmarktes, Beiträge zur Arbeitsmarkt– und Berufsforschung 192, Nürnberg.

Gosling, Amanda (1996): The Changing Distribution of Wages in the UK and West Germany 1984 to 1992, Mimeo, Institute for Fiscal Studies, London.

Gottschalk, Peter and Timothy M. Smeeding (1996): Cross National Comparisons of Levels and Trends in Inequality, Luxembourg Income Study, Working Paper No. 126.

Hauser, Richard and Irene Becker (1994): The Development of the Income Distribution in the Federal Republic of Germany during the Seventies and Eighties, EVS–Projekt Arbeitspapier No. 1, University of Frankfurt/Main.

Heckman, James J. (1979): Sample Selection as a Specification Error, Econometrica, 47, 153–161

Jenkins, Stephen P. (1995): Accounting for Inequality Trends: Decomposition Analyses for the UK, 1971–86, Economica, 62, 29–63.

Juhn, Chinhui, Kevin M. Murphy and Brooks Pierce (1993): Wage Inequality and the Rise in Returns to Skill, Journal of Political Economy, 101, 410–442.

Katz, Larry F. (1986): Efficiency wage theories: a partial evaluation, in: Stanley Fischer (ed.): NBER Macroeconomics Annual 1986, Cambridge, MIT Press.

Levy, Frank and Richard J. Murnane (1992): U. S. Earnings Levels and Earnings Inequality: A Review of Recent Trends and Proposed Explanations, Journal of Economic Literature, 30, 1333–1381.

Licht, Georg and Viktor Steiner (1994): Assimilation, labour market experience and earnings profiles of temporary and permanent immigrant workers in Germany, International Review of Applied Economics, 8, 130–156.

Maddala, G. S. (1983): Limited–dependent and qualitative variables in econometrics, Cambridge et al., University Press.

Mincer, Jakob (1974): Schooling, Experience and Earnings, New York, Columbia University Press.

Möller, Joachim (1996): Technological Change, Unemployment, and Recent Trends in Human Capital Formation – Did the German Wage Structure Respond to these Impulses?, Regensburger Diskussionsbeiträge Nr. 280, Universität Regensburg.

Möller, Joachim and Lutz Bellmann (1995a): Zur Entwicklung der interindustriellen und qualifikatorischen Lohnstruktur im Verarbeitenden Gewerbe, in: Wolfgang Franz and Viktor Steiner (eds.): Der westdeutsche Arbeitsmarkt im strukturellen Anpassungsprozeß, ZEW–Wirtschaftsanalysen, Bd. 3, Baden–Baden, Nomos.

Möller, Joachim and Lutz Bellmann (1995b): Institutional Influences on Interindustry Wage Differentials, in: Friedrich Buttler et al. (eds.): Institutional Framework and Labor Market Performance, Comparative views on the U. S. and German economies, London and New York, Routledge.

Möller, Joachim and Lutz Bellmann (1996): Qualifikations– und industriespezifische Lohnunterschiede in der Bundesrepublik Deutschland, in: ifo Studien, 42, 235–272.

Murphy, Kevin M. and Finis Welch (1990): Empirical Earnings Profiles; Journal of Labor Economics, 8, 202 – 229.

OECD (1993): Employment Outlook, chapter 5, Paris.

OECD (1996): Employment Outlook, chapter 3, Paris.

Pischner, Rainer and Ulrich Rendtel (1993): Quer– und Längsschnittgewichtung des Sozio–oekonomischen Panels, DIW Diskussionspapier Nr. 69, Berlin.

Puhani, Patrick A. (1996): Foul or Fair? The Heckman Correction for Sample Selection and Its Critique – A Short Survey; Mimeo, ZEW Mannheim.

Rendtel, Ulrich (1992): On the Choice of a Selection–Model when Estimating Regression Models with Selectivity, DIW–Discussion Paper No. 53, Berlin.

Rendtel, Ulrich and Johannes Schwarze (1995): Zum Zusammenhang zwischen Lohnhöhe und Arbeitslosigkeit, in: Viktor Steiner and Lutz Bellmann (eds.): Mikroökonomik des Arbeitsmarktes, Beiträge zur Arbeitsmarkt– und Berufsforschung 192, Nürnberg.

Schmähl, Winfried and Uwe Fachinger (1994): Prozeßproduzierte Daten als Grundlage für sozial– und verteilungspolitische Analysen. Erfahrungen mit Daten der Rentenversicherungsträger für Längsschnittanalysen, in: Richard Hauser, Notburga Ott and Gert Wagner (eds.): Mikroanalytische Grundlagen der Gesellschaftspolitik, Band 2: Erhebungsverfahren, Analysemethoden und Mikrosimulation, Berlin, Akademie Verlag.

Schmidt, Christoph M. and Klaus F. Zimmermann (1991): Work Characteristics, Firm Size and Wages; Review of Economics and Statistics, 73, 705–710.

Siebert, Horst (1995): Geht den Deutschen die Arbeit aus? Neue Wege zu mehr Beschäftigung; Bertelsmann, München.

Silverman, B. W. (1986): Density Estimation for Statistics and Data Analysis, London, Chapman and Hall.

Steiner, Viktor et al. (1994): Struktur und Entwicklung der Einkommens– und Vermögensverteilung in Baden–Württemberg und im Bundesvergleich; Gutachten im Auftrag des Ministeriums für Arbeit, Gesundheit und Sozialordnung Baden–Württemberg, Stuttgart.

Velling, Johannes (1995): Wage Discrimination and Occupational Segregation of Foreign Male Workers in Germany; ZEW Discussion Paper No. 95–04, Mannheim.

Wagner, Gert, Richard V. Burkhauser and Fredericke Behringer (1993): The English language public use file of the German Socio–Economic Panel; Journal of Human Resources, 28, 429–433.

Wagner, Joachim (1994): German wage curves, 1979 – 1990; Economics Letters, 44, 307–311.

Weißhuhn, Gernot, Felix Büchel (1993): Bildungsexpansion und Verteilung der Arbeitseinkommen. Eine theoretisch–empirische Analyse mit Längsschnittdaten aus der Beschäftigtenstatistik; in: Reinar Lüdeke (ed.), Bildung, Bildungsfinanzierung und Einkommensverteilung I, Berlin, Duncker & Humblot.

Willis, Robert J. (1986): Wage determinants: a survey and reinterpretations of human capital earnings functions, in: O. Ashenfelter and R. Layard (eds.): Handbook of Labor Economics, 1, North Holland, Amsterdam.

Appendix

Appendix 1 Industry classification in the IABS and in the GSOEP

IABS	GSOEP	Aggregated industries	
25–32	09	mechanical engineering (reference category)	
00–08	01–04	agriculture, forestry, fishing, energy, mining	1
09–13	05–06	chemical products, oil products, rubber	2
14–24	07–08	stone, clay, glass, primary metals, fabricated metals	3
33–39	10	data processing machines and office equipment, electrical machinery, instruments	4
40–58	11–13	lumber, furniture, paper, printing, leather, textiles, apparel, food, tobacco	5
59–61	14–15	construction	6
62	16–18	wholesale and retail trade	7
63–68	19–21	transportation	8
69	22–23	banking, insurance	9
70,72–73, 86, 90	24–26, 30, 32	personal services, eating and drinking, other professional services, private households	10
74–85	27–29	education, entertainment, communication, hospitals, health care, business services, professional services	11
71,87–89, 91–94	31, 33–34	non–profit making organisations, welfare services, public utilities	12
—	35–37	other industries, missings	MV

Note: The numbers in the first column refer to the two–digit classification in the IABS, the numbers in the second column to the corresponding classification in the GSOEP and the last column indicates the number of the industry dummy used in the estimation. MV indicates "missing values".

Appendix 2 Descriptive statistics of the variables in the earnings function from the IABS and the GSOEP, 1984 and 1990

	IABS		GSOEP	
	1984	1990	1984	1990
log gross monthly earnings (in DM)	8.08 (0.30)	8.20 (0.30)	8.13 (0.36)	8.27 (0.36)
foreigner (German)	0.09	0.09	0.10	0.11
experience (in years)	21.98 (11.87)	21.21 (12.30)	21.34 (11.44)	21.94 (11.46)
skill group (unskilled)				
skilled	0.72	0.73	0.75	0.72
graduates	0.07	0.08	0.10	0.12
industry (mechanical engineering)				
1	0.05	0.04	0.03	0.03
2	0.06	0.06	0.07	0.07
3	0.08	0.08	0.13	0.13
4	0.10	0.10	0.06	0.09
5	0.10	0.09	0.11	0.10
6	0.10	0.09	0.15	0.12
7	0.10	0.10	0.08	0.06
8	0.05	0.05	0.05	0.05
9	0.04	0.04	0.04	0.04
10	0.02	0.02	0.01	0.02
11	0.07	0.08	0.06	0.07
12	0.08	0.08	0.08	0.07
firm size (< 20 employees)				
20 – 99 | 20 – 199	0.21	0.22	0.28	0.26
100 – 1000 | 200 – 2000	0.34	0.35	0.25	0.26
≥ 1000 | ≥ 2000	0.25	0.26	0.29	0.30
observations (N)	94 119	99 535	2 248	1 938
% right–censored	11.5	12.2		

Notes: 1) The statistics for the GSOEP refer to weighted data (see section 2). These are reported here because they have been used for the decomposition reported below, although the earnings functions have been estimated on the unweighted data. 2) To save space, statistics for the various interaction terms between vocational/educational dummies and labor market experience as well as nationality are included in the earnings functions are not reported here. 3) For dummy variables, base categories are given in parentheses. 4) The names of the industry dummies are given in Appendix 1. 5) Numbers in parentheses are standard deviations of metric variables.

Appendix 3 Earnings functions estimated on GSOEP for 1984 and 1990, Tobit model

Variable	1984		1990	
	Coeff	| t |	Coeff	| t |
constant	7.56	111.5	7.63	111.1
skill group (unskilled)				
skilled	18.14	2.2	16.11	7.2
graduate	60.72	3.34	56.2	17.4
experience	3.27	12.8	3.68	13.3
experience^2	–6.09	10.6	–6.72	11.3
foreigner * skilled	–11.26	3.9	–9.16	3.1
foreigner * graduate	–37.86	5.3	–35.77	5.0
foreigner * experience	–1.02	2.5	–1.74	4.1
foreigner * experience^2	1.86	2.1	2.84	3.1
foreigner	6.45	1.4	17.53	3.8
12 industry dummies	$\chi^2(12) = 78$		$\chi^2(12) = 62$	
3 firm size dummies	$\chi^2(3) = 76$		$\chi^2(3) = 107$	
σ	0.2581		0.2510	
log L full model	–328.92		–233.92	
log L constant	–852.20		–691.53	
Number of cases (N)	2 248		1 938	

Notes: 1) For dummy variables, the base categories are given in parantheses. 2) Except for the constant term, all parameters are multiplied by the factor 100 (respectively by the factor 10,000 for experience squared and the respective interaction terms. 3) '*' denotes an interaction term. 4) The χ^2–test refers to the likelihood ratio statistics, which is defined as $-2\cdot(L_{full\ model} - L_{restricted\ model})$, degrees of freedom are in parantheses.

Appendix 4 Estimated industry and firm size effects in the earnings functions (Table 5)

Variable	IABS				GSOEP (OLS)			
	1984		1990		1984		1990	
	Coef.	|t|	Coef.	|t|	Coef.	|t|	Coef.	|t|
industry (mechanical engineering)								
1	–3.70	7.7	–6.06	12.0	–6.11	1.8	–4.84	1.4
2	3.25	7.3	1.95	4.5	1.78	0.7	–0.16	0.1
3	–3.20	8.2	–3.44	8.6	–7.04	3.3	–6.24	2.9
4	–1.01	2.7	–2.42	6.6	–3.90	1.4	0.13	0.1
5	–5.70	15.0	–6.88	17.8	–8.51	3.6	–0.85	3.4
6	–4.34	11.1	–5.21	13.0	–6.65	3.0	–3.39	1.4
7	–3.56	9.3	–5.61	14.6	–7.64	2.6	–6.53	2.1
8	–3.85	8.4	–9.32	20.5	–6.62	2.2	–11.45	3.7
9	13.63	25.0	13.06	24.1	13.22	3.4	9.35	2.5
10	–25.42	35.0	–30.71	47.7	–16.09	3.5	–19.57	3.5
11	–0.51	1.2	–2.98	7.2	–0.33	0.1	–6.87	2.2
12	–11.90	29.6	–17.42	43.2	–13.27	4.9	–11.88	4.0
firm size (small)								
20 – 99 | 20 – 199	11.25	39.0	13.59	46.8	8.41	4.7	8.67	4.4
100 – 1000 | 200 – 2000	15.83	57.9	19.25	70.0	9.14	4.8	11.71	5.7
≥ 1000 | ≥ 2000	20.65	66.5	24.95	80.2	16.18	8.4	20.32	9.8

Notes: 1) For dummy variables, the base categories are given in parantheses. 2) All parameters are multiplied by the factor 100. 3) For dummy variables, base categories are given in parentheses. 4) The names of the industry dummies are given in Appendix 1.