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Wage Structure and Labor Mobility in the West German Private Sector, 1993–2000

Holger Alda, Lutz Bellmann, and Hermann Gartner

8.1 Introduction

Since the early 1990s, West German firms have had to deal with sharp changes of the economic environment. The German Unification and the emerging competitors in Eastern European countries seem to be the most important ones. At the same time, some labor market institutions in Germany became less rigid—for example, regulation on temporary work. But other institutions are unchanged, so that by and large Germany remains a country with highly regulated labor markets. Thus, international literature characterizes the German economy as a coordinated one (for example, Hall and Soskice 2003). Our study gives an overview of the West German wage structure (their dynamics) and of the mobility in firms of the West German private sector during the 1990s and sheds light on the role of labor market institutions in Germany.

The following are the main questions of our analyses: How much of the German wage dispersion can be attributed to firm and worker characteristics? Are there differences if firms are confronted with different institutions?

We address especially the system of collective agreements and the apprenticeship training system. The role of collective agreement in setting wages is seen in Germany as very strong, especially in combination with works councils, because it links the aims of unions—normally formulated on the branch level and negotiated in collective contracts—directly to single

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firms. The Organization for Economic Cooperation and Development (OECD) states that the German wage-bargaining system is centralized on a medium level (the single Federal States of Germany, *Bundesländer*) and coordinated on a high level (OECD 1997). According to Calmfors and Driffill (1988), this system leads to suboptimal labor market performance because wages do not react sufficiently to macroeconomic shocks.

To examine this point, we will compare separately for different years wages and turnover of firms covered by collective contracts with firms not covered by collective contracts, using propensity score matching. We found that the difference of wages and turnover between firms with and without collective contracts alternates sharply during the business cycle. For example, the workers' wage changes during a boom in firms without collective contracts are higher than in firms with collective contracts, whereas during a recession, they are lower, suggesting that firms without collective contracts can react more flexibly to macroeconomic shocks.

The second property of German labor market institutions we address is the system of vocational training. This system certifies a large range of occupations. For firms covered by collective agreements, the wages are negotiated specifically for occupational groups. Furthermore, if the occupational structure of a national workforce reflects the scale of worker productivity, then there might be reasons for firms to set wages according to occupations. It may be, therefore, expected that wages and wage changes are tied to occupations.

To dig deeper into the role of occupations for wage differences, we ask the following: Can occupational wage differences be explained by differences in observed or unobserved characteristics of firms that employ workers within certain occupations? Or can they be explained by differences in unobserved characteristics of the workers? To answer these questions, we use the method of Abowd, Kramarz, and Margolis (1999). We find that a large part of the occupational wage differences can be explained by unobserved personal characteristics. This means workers with good unobserved characteristics are sorted into high-wage occupations.

With rapidly growing technological and organizational change, we assume that the instrument of setting wages by rather rigid defined occupations loses its power in predicting or signaling single worker productivity. Therefore, we examine the development of the role of occupations in wage setting by analysis of variance technique. The results support our assumption.

The chapter proceeds as follows. In the next section, we describe the macroeconomic environment for German firms in the 1990s and refer more deeply to labor market institutions that are affecting the wage and mobility patterns. The data are described in section 8.3. In section 8.4, we discuss the empirical results. Section 8.5 summarizes and concludes the chapter.

8.2 Macroeconomic Environment and Labor Market Institutions in Germany

8.2.1 Macroeconomic Environment in the 1990s

For a first glance, the macroeconomic situation is described in table 8.1 by the development of the West German gross domestic product (GDP) and the respective unemployment rates during the 1990s.

In the first years after the German Unification, the West German economy benefited from the growing demand for goods and services in the former German Democratic Republic. The West German GDP grew substantially from 1990 to 1992, but not enough to lower or at least stabilize the unemployment rate. Then, in 1993 there was a slump in economic activities. In 1994 and 1995, the GDP grew again slightly. Since 1998, the growth of the GDP is joined with a decrease of the unemployment rate. The peak of the GDP growth rate was reached in 2000 with about 3 percent. In order to map a business cycle, we choose for our empirical study the years 1993, 1995, and 2000; 1993 is a slump year, 2000 a boom year. In 1995, the growth rate is average, and the unemployment rate remains almost stable.

8.2.2 Labor Market Institutions in Germany

On the OECD scale of rigidities and employment protection, Germany ranks in the midfield (OECD 1999). Despite the trend of deregulating the German labor market in the 1990s, there are still several institutions that enforce the position of insiders. Outsiders have, especially during recessionary periods, only small chances to enter or reenter the (internal) labor

Table 8.1 **GDP and unemployment rate in West Germany (1991–2000)**

Year	GDP	Growth GDP 1 year (%)	Unemployment rate
1991	1,567,693		.063
1992	1,594,951	1.74	.066
1993	1,557,562	–2.34	.082
1994	1,578,491	1.34	.092
1995	1,600,479	1.39	.093
1996	1,607,803	0.46	.101
1997	1,629,703	1.36	.110
1998	1,664,769	2.15	.094
1999	1,697,689	1.98	.088
2000	1,749,554	3.06	.078

Sources: For GDP, German Central Statistical Office. For unemployment rate, Federal Employment Service.

Note: Gross domestic product (GDP) is at 1995 prices in millions of euros (West Germany only).

market. Four of the most important institutions in Germany affecting wage setting and worker mobility are the system of vocational training, works councils, collective wage contracts, and the protection of workers against dismissal.

The System of Vocational Training

The German system of vocational education is called a dual system because the apprentice is trained partly in the firm and partly in a vocational school. The system has developed from preindustrial apprenticeship roots and prevails not only in Germany, but similarly in Austria, Denmark, and Switzerland (compare with Winkelmann 1997). The training continues between two and three and a half years, so firms invest remarkable time and money in the training of apprentices. The German vocational system reduces the mobility of employees, especially in the group of young, skilled blue-collar workers in the first years after finishing their training, because establishments try to amortize their investment in human capital by longer job tenure of their trainees (Schwerdt and Bender 2003). In several branches, collective agreements guarantee that apprentices can stay for at least one year in the firm after the training.

The German apprenticeship system has deep impacts on the skill composition of the workforce, on tenure tracks, and, consequently, on the wage setting and wage changes of employees. The apprenticeship system and the resulting occupational composition of the workforce is responsible for a clear distinction between skilled and unskilled workers. The occupational characteristics are institutionalized by certificates and occupation regulations—especially in manufacturing and trades, but also in the private and public sector.[1]

In general, the German workforce can be roughly divided into low-, medium-, and high-skilled workers (unskilled, skilled, and workers with a university degree). The apprenticeship system and the resulting occupational structure are mainly a matter of medium skills. In section 8.4, we estimate for all three skill levels of manufacturing, private and public service occupations, the average wage return rate using different sets of covariates, and worker and firm characteristics, respectively. Furthermore, we decompose the variance of workers' average wage change according to firm and occupation.

Works Councils

Another notable institution is the setup of works councils. They have a strong legal base in Germany. A works council is guaranteed by law in all firms with more than five employees, if the majority of the firms' employ-

1. An occupational scheme with fewer distinctions also exists for unskilled workers, but this is often only regulated in collective contracts.

ees want to elect one. Furthermore, in firms with more than twenty employees, the works council must agree to dismissals. In case of mass dismissals, the regional labor office and the firms have to draft a social plan to avoid cases of social hardships, if possible. Lots of studies have been made about the effect of works councils on wages and mobility of employees (e.g., Addison et al. [2004]). Nearly all studies conclude that the mobility of workers is hampered by this institution.

Collective Wage Contracts

Especially in larger firms, works councils often coincide with collective agreements. Table 8.2 shows the proportions of full-time workers covered by collective agreements on the firm or branch level[2] and shows for the years 1998 and 2002 how many of these covered full-time workers are working in a firm with a works council.[3]

The coverage of works councils and collective agreement on full-time workers in larger firms is above 90 percent. Firms that are members in an employers' association can deviate from paying collectively agreed wages only by negotiating with the workers on the firm level, but nevertheless, the branch union must agree to the result of the bargaining. Firms that are not members in an employers' association have no restrictions in setting wages. Statutory minimum wages exist only in the construction sector. Negotiated wages must be paid only for union members, but, in fact, negotiated wages are paid to all employees in a firm. The coverage of collective agreement is higher in manufacturing than in the private service sector. Also, the increase of bargained wage is often higher in manufacturing. A high-level coordinated bargaining needs some kind of standards to deal with firm and regional heterogeneities in the branches. This could be occupations, for instance.

Some firms pay more than negotiated wages, especially for high-wage jobs. This additional payment is a component of flexibility in wage setting in rigid labor markets (Kohaut and Schnabel 2003).[4] In this perspective, paying higher wages than fixed by collective agreements will cause larger wage dispersions *within* firms. On the other hand, for example, Büttner and Fitzenberger (1998) show that wages are equal to collective arrangements, especially at the bottom of the wage distribution. If both are present in a

2. Approximately 10 percent of all private firms have wage arrangements on the firm level. The share is rising. For table 8.2, we group both outward forms of collective agreement into one category.

3. In 1993 and 1995, the information is not available. We choose the years 1998 and 2002 in order to show that the coverage of collective agreement over full-time workers is still decreasing.

4. Another form of additional flexibility in paying workers could be employee participation in asset formation or share ownership. In the year 1998, 5 percent of all West German firms use this form of payment (Möller 2001) covering about 15 percent of the total West German workforce.

specific firm, we may find no difference in the within-wage dispersion because in unionized firms, the whole within-wage dispersion might be shifted to the right.

As table 8.3 shows, the proportion of firms paying more than fixed by collective agreement decreases between 1993 and 2000 by 14 percentage points. These firms pay in 1993, on average, 13.4 percent more than bargained; in 2000, they pay 11.5 percent more.

In section 8.4 we will test by nonparametric propensity score matching, whether unionized and nonunionized firms differ in their average wage level, their wage change, the within-firm wage dispersion, and in their mobility patterns (entry and exit rates, percentage of core workers).

Table 8.2 **Works councils and collective agreement: Coverage on full-time employees in the West German private sector**

	Coverage of collective agreement		Coverage of collective agreement and works councils[a]	
Class size of employees	1998	2002	1998	2002
1–4	.46	.45	Not possible	Not possible
5–19	.65	.55	.05	.05
20–99	.73	.62	.24	.29
100–199	.79	.72	.60	.61
200–499	.85	.81	.79	.76
500+	.96	.94	.95	.92
Total	.78	.71	.51	.48

Source: IAB-Establishment-Panel 1998 and 2002, weighted values.

[a]100 percent are the proportions of the rows on the left.

Table 8.3 **Proportion of firms paying more than collectively agreed wages, average, and distribution of this payment (in percent above tariff wage) on firm level (proportion: firms covered by collective agreement in the West German private sector)**

Year	Proportion	Mean	Standard deviation	10th percentile	90th percentile
1993	.41	.134	.076	.05	.25
1995	.32	.112	.073	.05	.20
1998	.23	.111	.066	.05	.20
2000	.27	.115	.071	.05	.20

Source: IAB Establishment Panel 1993–2000, weighted values.

Notes: Reading example: In the year 2000, 27 percent of all German unionized firms pay at least to some of their workers higher wages than collectively bargained. On average, this additional payment is 11.5 percent higher than fixed by the respective collective contract. The standard deviation is about 7 percent. The 10th percentile of *these* firms are paying 5 percent higher wages than fixed by collective agreement, the 90th percentile is 20 percent.

The Protection of Workers against Dismissal

A prominent example for the protection of insiders is the German Protection Against Dismissal Acts (PADA), which applies for all firms with more than five (between 1996 and 1998 and since 2004 for firms with more than ten) employees. In the field of application of the PADA, firms are obliged to take into account for their dismissals fairness considerations to avoid cases of social hardship. As a result, if an employer wants to dismiss employees, it has to select young employees (workers with short job tenure) instead of others, especially older, married workers and employees with children. In all of the firms included in the analysis, this law is valid. Thus, we can expect that the mobility of individuals is mainly determined by younger persons with shorter job durations (for an investigation of worker flows and dismissal protection, see Bauer, Bender, and Bonin [2004] and Verick [2004]).[5]

Other Institutions

In Germany, there is a large wedge between labor costs and net wages. Because of the cost of German Unification, the wedge increased during the 1990s: According to the OECD (2005), the income tax plus employee and employer contributions for social security for a single person without children increased in Germany from 46.4 in 1993 to 51.8 in 2000 (as percentage of labor costs). This may be the main reason that, despite a moderate development of wages, unemployment did not fall during the 1990s.

A further institution affecting unemployment and wages is unemployment benefits. Compared to OECD countries, the replacement ratio ranges in the midfield in the 1990s, but the duration of benefits was very high. With a sufficient work history, older unemployed workers are entitled to unemployment benefits for up to thirty-two months. The strictness of work availability conditions are criticized as lax. The duration of benefit entitlement and the criteria for benefit receipt was thoroughly reformed only after 2000.

Some other institutions of the German labor market are deregulated already in the middle of the 1990s: the Federal Employment Service loses the exclusive right of placing workers in jobs. Restrictions for temporary work agencies are relaxed, and it becomes easier for firms to employ workers by fixed-term contracts—resulting in a increasing proportion of fixed-term workers (compare with table 8.4 in section 8.3). We expect, therefore, that a rising part of wage dynamics during the 1990s could be explained by the mobility of workers instead of the adjustment of wages for stayers.

5. Both studies found no significant differences in the level of employment between firms in which the PADA is valid and in which it is not. But there are differences in the structure of employment.

8.3 Data Section

We use the German linked employer-employee data of the Institute for Employment Research (LIAB), the LIAB data link firm-level data from the IAB Establishment Panel (a survey), to administrative individual data from the employment statistics register.[6]

The employment statistics register is based on the integrated notification procedure for the health, pension, and unemployment insurances, which was introduced in 1975. Employers are obliged to report information about all employees covered by social security to the social security agencies. They submit the notifications at the beginning and the end of any employment period as well as each year on December 31st. The notifications include the date of employees' entry and exit, wages, gender, qualification, and the current occupation (defined by a three-digit code). There are legal sanctions for misreporting. The employment statistics register covers more than 90 percent of all employees in manufacturing and 75 percent in the service sector. Freelancers, civil servants, self-employed persons, and workers with earnings below a minimum level are not eligible for the social security system and, therefore, are not included in the worker-level data.

The IAB Establishment Panel is a survey conducted since 1993. The unit "Establishment" refers not to an enterprise or company as a commercial aggregate, meaning that we are not able to identify multiplant firms in our data.[7] Our observation unit firm is smaller than in linked employer-employee data from many other countries. The IAB Establishment Panel is a sample drawn from the so-defined establishments included in the employment statistics register according to stratification cells of the establishment size class (ten categories) and the industry (sixteen categories).[8] These stratification cells are also used for weighting the data set. The population for the survey are all firms with at least one employee covered by the social security system.

To correct for panel attrition, exit of firms, and newly founded units, the samples are augmented regularly, leading to an unbalanced panel. The attrition of the largest firms can only be corrected by an increasing number of medium-sized firms. The reason for this is not only the absence of appropriate larger firms. Especially due to outsourcing activities during the 1990s, the average firm size in Germany was decreasing.

The IAB establishment oversamples larger firms, meaning that there is al-

6. Appendix A gives a short description of the two data sets that are linked to the LIAB.

7. In this sense, we make hereafter no difference between the terms *firm, establishment,* and *employer*.

8. From 2000 onward, the stratification is done according to twenty industries.

Table 8.4 **Weighted and unweighted proportions of selected forms of employment on firm level (population: firms with at least 25 full-time employees)**

	Proportion of:			
	Part-time workers		Fixed-term contracts	
Year	Unweighted	Weighted	Unweighted	Weighted
1993	.09	.13	.02	.03
1995	.17	.22	n.a.	n.a.
2000	.20	.28	.08	0.9

Source: IAB Establishment Panel 1993, 1995, 2000.
Note: n.a. = not applicable.

ways a difference between weighted and unweighted results.[9] To illustrate the effect of the weighting procedure for the firm-level data, table 8.4 shows the weighted and unweighted values of the proportion of part-time workers and fixed-term contracts. Smaller establishments are sampled with a lower probability so that weighting increases their proportion. The weighted values for the proportions of both employment forms are higher because small firms employ a higher share of part-time and fixed-term contract workers.

A short note to the result: the increase in the share of part-time workers is mostly driven by the rising participation rate of females in the labor market, whereas fixed-term contracts are distributed more equally between males and females. However, both forms of employment are characterized in the literature as one instrument of firms in order to gain more employment flexibility. Due to the increasing proportions of both forms of employment, we expect higher mobility on firm level at the end of our observation period.

The LIAB data are constructed by merging the IAB Establishment Panel with the data of the employment statistics register using an administrative firm identifier. The IAB has developed two types of the LIAB: the cross-section model and the longitudinal model. An overview about the LIAB, the two data models, and the several versions is given by Alda, Bender, and Gartner (2005); further details are described in Data Reports (Alda 2005a,b,c,d). We compute the descriptive statistics with the LIAB cross-sectional model, version 1. This data set includes in each year the employment spells of the persons employed at June 30th in a firm surveyed by the IAB Establishment Panel.[10]

9. As a rule of thumb, a small establishment with, say, less than five workers, represents approximately 3,000 firms of the national economy, while the largest ones, say, with more than 1,000 employees, represents, on average, only 1.2 firms.

10. June 30th is the reference date of the questions in the IAB Establishment Panel.

The construction of the cross-sectional LIAB allows us to identify movers and stayers as well as compute job duration and the change in wages only by identifying the workers in the same firm on June 30th in two sequenced years.[11] We constructed the tenure variable by checking whether an employee in year t appears also in the same firm in $t - n$ ($n \in 1,2, \ldots$). With larger n, we observe fewer firms due to panel fluctuation. Therefore, we differentiate only between workers with tenure of more or less than three years. Furthermore, in the cross-sectional LIAB, we cannot observe employees after leaving a surveyed firm. It follows that we are not able to compute the change in wages for workers who change their employer with this data model.[12]

The firm size is constructed by aggregating the number of workers covered by the social security system in the employment statistics register. We include in the analysis only firms with at least twenty-five employees in t, where part-time workers, apprentices, and workers not covered by the social insurance system do not count.

Results from tables 8.6, 8.7, 8.8, and 8.10 are computed with the LIAB longitudinal model, version 1. The longitudinal model, version 1, is based on all surveyed firms interviewed between 1999 and 2001 *in each year*. The corresponding employee data contain all persons who work at least one day between 1996 and 2001 in these firms. The complete working histories of these persons are applicable for the time period 1990 to 2001.

Although both samples—the LIAB cross-sectional and longitudinal model—are representative of the German economy, they differ in some technical aspects and the time period covered. While we restrict the cross-sectional data to firms in the private sector with at least twenty-five full-time employees, the analyses based on the LIAB longitudinal model covers all firms, including the public sector, with at least three full-time employees.[13] Consequently, the results for the average wage and other statistics differ slightly between the two data models. All key variables and definitions (appendix B) are—if applicable—the same in both data models.

However, independent of the LIAB model, two problems occur in the administrative employee data:

First, all wages in the employment register are left-truncated and right-censored. The observable gross wages are left-truncated because workers

11. This means first, identify firms, which are in the t and $t - 1$ part of the panel. Second, identify the employees, who are observed in t and $t - 1$. They are defined as stayers. Third, identify workers with only one observation. Workers only observed in t are entries; workers only observed in $t - 1$ are exits. For the first year of the panel, 1993, we use another procedure. For this year, we calculate entries, exits, and wage changes by drawing additional information from the employment register that are not included in the cross-sectional LIAB. This is also the reason why we have the highest number of observations in 1993.

12. With the exception of employees moving to another surveyed firm, the number of these movers is too small for calculating the change in wages for persons changing their employer.

13. The private sector is identified via the legal form of the surveyed firms.

with wages below a certain limit are not obliged to pay contributions for social security. More important is that the wages are also right-censored because the contribution to the social security system must only be paid up to a contribution limit, meaning that this threshold is the highest observable wage in the respective year. The contribution limit rises from year to year. For example, in the year 2000, it corresponds to a gross monthly wage of 3,427 euros. Between 8 and 15 percent of all observations of a year are censored. In the group of employees with a university degree, 50 percent of their wages are censored.

The right-censoring of the wage has implications on the distribution of wages and, therefore, for our wage statistics. To correct this, we impute the censored wages using a tobit estimation of a Mincerian earnings function augmented by ten sector and ten occupation dummies. The imputed wage is calculated as the expected wage ($x'\beta$) plus an error term drawn from a truncated normal distribution.[14]

The second problem is the employment statistics differ only between full- and part-time workers, without further information about working hours. Therefore, part-time workers and switchers from part-time to full-time (and opposite) are excluded from our analyses.

We also exclude apprentices from our data set.[15] All descriptive wage statistics for the cross-country comparison are based on continuing workers in continuing firms. Appendix B gives an overview for all the key variables (and their definitions) we apply in this chapter.

8.4 Empirical Findings

We present each descriptive table of wage levels, wage changes, and the mobility patterns for the cross-country comparison twice, with weighted and unweighted values. They are printed in appendix C. We focus least on the wage statistics of the unweighted results because they are more precise. The weighted values give an impression of how the oversampling of larger firms in the IAB Establishment affects the results. All figures and tables show monthly gross wages in euros. We deflated the wages with the official consumer price index with the base year 2000.

Additionally, to describe statistics on wage structure, we use an analysis of variance (ANOVA) technique. We ask especially how much of the variance of wages can be explained by firm-fixed effects and by human capital and how much of the variance of wage changes can be explained by firm effects and by occupational group.

We analyze the role of occupational group in wage setting more deeply

14. The method is described in Gartner (2005).

15. Apprentices work full time and receive wages fixed by collective agreements. Their wages are much lower even than those of unskilled blue-collar workers.

by applying a similar method as developed by Abowd, Kramarz, and Margolis (1999) and applied by Andrews, Schank, and Upward (2004). The method allows us to differ between occupational effects, observed and unobserved firm effects, and observed and unobserved person effects.

A further topic we address more deeply is the effect of collective agreements on wages and worker mobility. To identify this effect, we apply a nonparametric kernel matching algorithm and bootstrap standard errors of the treatment effect with 200 repetitions. Our sample contains 120 firms without collective agreements in 1993 (91 in 1995 and 193 in 2000). The probit estimation of the propensity scores uses as covariates the average age of workers in a firm; a dummy for workers council; one regional dummy; and proportions of females, of fixed-term workers (not included in 1995), of blue-collar workers, and of six different qualification groups. The results are listed in appendix table 8F.1 and discussed in the following subsections.

Before discussing wage and mobility patterns at the firm level, we should take a glance at demographical firm patterns: table 8.5 shows the number of West German firms, their average size, and the employment growth on firm level. During the 1990s, the number of firms is increasing. At the same time, the firm size decreases. The negative growth of employment on firm level refers only partly to a negative macroeconomic growth of employment, because the negative employment growth on firm level is partly compensated by the increasing number of firms. Comparing the growth rates, it seems that firms substitute a part of employees covered by social security

Table 8.5 **Number of firms, average firm size, and employment growth on firm level in Germany (1993–2000)**

		Firm size				Employment growth	
		All employees		Employees covered by social security			
Year	No. of firms	Mean	CV	Mean	CV	All employees	Employees covered by social security
1993	1,596,596	18.50	0.13	14.78	0.10		
1994	1,608,418	18.24	0.12	14.72	0.10	–1.9	1.1
1995	1,624,600	18.21	0.14	14.63	0.12	1.9	–1.1
1996	1,633,744	17.85	0.14	13.93	0.12	1.6	0.0
1997	1,639,029	17.46	0.14	13.62	0.12	1.4	–5.2
1998	1,643,586	17.41	0.14	13.48	0.12	2.0	–4.3
1999	1,652,821	17.19	0.15	13.58	0.13	–3.2	–2.4
2000	1,712,406	16.65	0.15	13.28	0.12	0.5	–3.8

Source: IAB Establishment Panel 1993–2000, weighted values.

Note: Firms with at least one employee covered by social security are included. CV = coefficient of variation.

by workers with no connection to the social security system—for example, freelancers or low wage earners. But due to the increasing coefficient of variation, one cannot be sure about this. Concerning their average number of employees, German firms became more heterogeneous during our observation period.[16]

Organizational change is responsible for the increasing number of newly founded firms and the downsizing of the existing firms. There were many outsourcing activities in Germany, especially at the end of the 1990s. The newly founded firms have a more homogenous workforce than the "old" firms had before the outsourcing. Therefore, we expect that the wage dispersion between firms is increasing during the 1990s, while the within-firm wage variance in decreasing. In other words, we expect larger firm effects at the end of our observation period due to more (and smaller) high- and low-wage firms.

8.4.1 Structure of Wages within and between Firms

In this section, we discuss the development of wages on firm level and worker level during the 1990s. The descriptive statistics are presented in the appendix tables 8C.1 (unweighted values) and 8C.2 (weighted values). In figure 8.1, we plot the kernel densities of the workers' log wage distribution in the years 1993, 1995, and 2000 and in figure 8.2 the distribution of the firm average wage for the same years.[17]

The distribution of workers' wages shifted to the right, and the dispersion of wages is increased. This means that higher wages increased more than lower wages. The distribution of firm average wage shifted also to the right and exhibits a higher dispersion. Germany has, in the year 2000, more high- and low-wage firms than in 1993. Appendix table 8C.1 supports this result: the standard deviation of the employees' and firms' average wage increases in our observation period. Workers' and firms' wages became more unequal in Germany during the 1990s.

How is the observed within-firm wage dispersion affected by our example of a labor market institution, namely collective contracts?

The results of matching firms with and without collective contracts (second row in appendix table 8G.1) shows no significant wage compression in firms covered by collective contracts compared to nonunionized firms. The average wage in firms with a collective contract is higher, but significantly only in the boom year 2000. Collective contracts shift the within-wage distribution to the right, on the upper bound of wages as well as on the lower bound. The mean comparison shows that for discussing the descriptive

16. Details of the firm size distribution shows especially large firms downsize during the 1990s. The increase of the coefficient of variation is, therefore, determined by medium-sized firms.

17. We cut off all censored wages for figure 8.1.

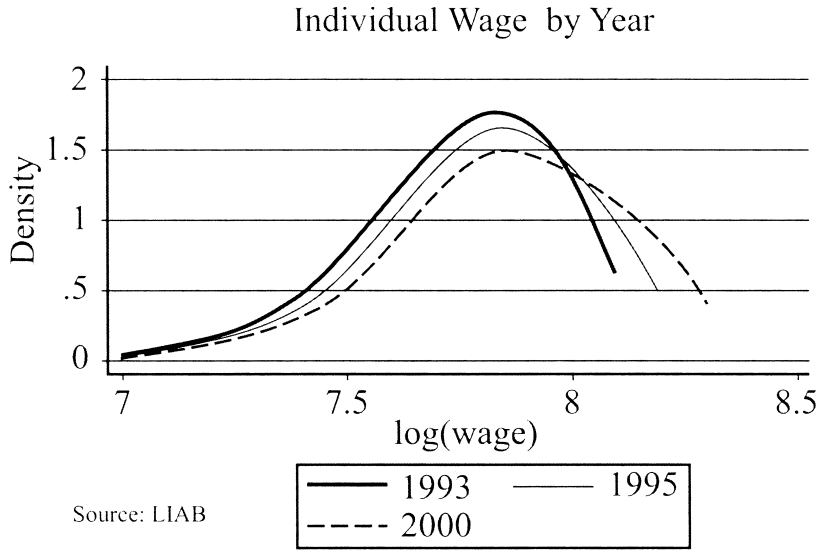

Fig. 8.1 German workers' and firms' wage distribution in 1993, 1995, and 2000: Individual wage by year

Source: LIAB cross-sectional model, version 1.

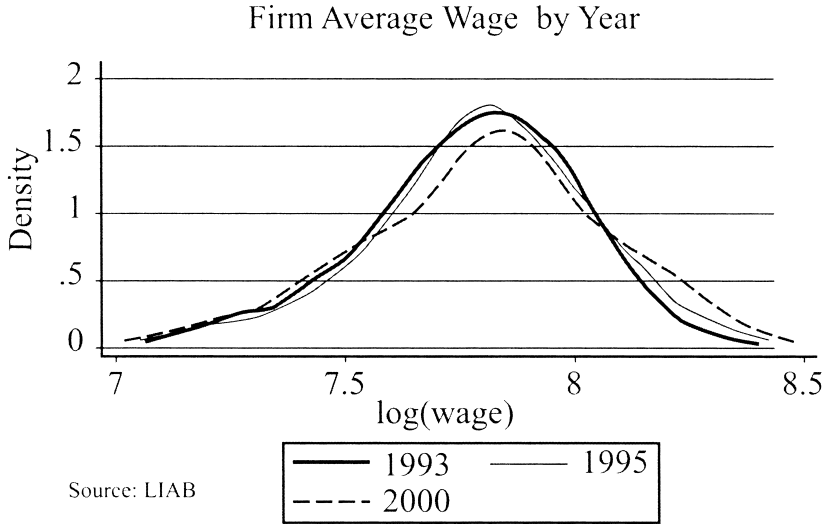

Fig. 8.2 German workers' and firms' wage distribution in 1993, 1995, and 2000: Firm average wage by year

Source: LIAB cross-sectional model, version 1.

results, we do not have to take especially into account a clear difference between unionized and nonunionized firms.

Table 8C.1 shows the following:

- The higher standard deviation is mostly driven by the development at the upper bound of wages on individual *and* firm level. The logs of individuals' and firms' wages were rising by about 0.1 log points in the 90th percentile, but in the 10th percentile, the individual wage rises by 0.05 log points, and the firm wage even decreased slightly.
- While at the upper bound of the firms' wage distribution the within-wage dispersion became more unequal (column: average standard deviation of firms' average wage), at the lower bound of the firms' wage distribution, the within-wage dispersion became more equal.
- The average standard deviation of firms' average wage was about 30 percent of the overall average wage. This means that still a bulk of wage variation in the German economy was within firms, not between firms, but the latter became more important during the end of the observation period.
- The distribution of the individual wage shifted to the right. That is, the weight of higher wages has increased, which is also true for the distribution of firms' average wage, because the proportion of high-wage firms increased from 1993 onward. The contrast between the distributions for the years 1993 and 2000 is very clear, whereas the 1995 distribution is in-between.
- Workers aged twenty-five to thirty and workers aged forty-five to fifty exhibited a similar development of wages (appendix table 8C.1). Again, wages at the upper bound of the wage distribution increased much more than at the lower bound.
- The wages for persons aged forty-five to fifty were higher than for younger people. This can only partly be explained by the fact that larger firms pay higher wages and employ older workers. The correlation between the log size and the average age of workers in firms is 0.111 in 1993, 0.026 in 1995, and only 0.02 in 2000 (but all coefficients are significant on the 5 percent level). Wage regressions show the usual U-shaped wage return rate for age. One year older corresponds, ceteris paribus, to a higher wage for workers aged thirty of 2.8 percent (aged forty: 1.6 percent; aged fifty: 0.4 percent).[18]
- The correlation between the average tenure and the firm size decreases. The (log) size correlates with the average tenure on firm level in the year 1996 with 0.375 and in 2000 with 0.284 (1993, 1995 not applicable). One interpretation of this result is that in stable or slump years, larger firms keep their workers with longer job duration more

18. These results refer to the observation period 1996 to 2001.

than in boom years. Another interpretation is simply that large firms grow in boom years.[19] We have to leave open here whether the weaker correlation in 2000 also corresponds with worker mobility mostly driven by employers or the respective employees (we come back to this point by discussing the mobility results). However, wage regressions show that the average wage return for one additional year of job duration is, ceteris paribus, 2.1 percent in the time period 1996 to 2001.

Beside these descriptive results, linked employer-employee data allow computing the proportion of the variance of wages that can be explained by the variance of human capital and by the variance of firm-specific effects (Groshen 1989, 1991; Stephan 2001). Table 8.6 shows the coefficient of determination, R^2, which can be attributed to human capital, firm-specific effects, and their interaction by estimating a Mincerian earnings function.

For the years 1993 to 2000, a clear trend emerges: the importance of the firm-specific effect increases, whereas that of the human capital effect decreases. This means that unobserved firm effects or sorting to firms according to unobserved personal characteristics affect more and more the distribution of wages, whereas sorting according to observed personal characteristics plays a smaller role. This may be driven by the decreasing firm size, which is accompanied by more within-homogeneity of firms. The R^2 related to the interaction of firm-specific and human capital effects remains almost stable over that time period. These results fit very well into the results of our descriptive analyses of the wage structure.

Wage levels and within-firm wage variance are correlated positively (appendix table 8C.1). Of course, larger firms pay higher wages and use a wider range of different occupations, but the increasing within variance of wages in the observation period can only be partly explained by a wider range of occupations.[20]

8.4.2 Occupational Wage Differentials and Heterogeneity of Workers and Firms

We analyze more deeply the relation between occupations and wages: What is the reason for wage differentials between occupations? Can occupational wage differentials be explained by the following?

- Differences in the productivity of occupations
- Observed differences in characteristics of firms that have a demand for these occupations

19. This seems unlikely. A comparison of the weighted and unweighted values in appendix table 8C.5 shows that the employment growth in 2000 is "larger" (in the sense of a less negative growth) in smaller establishments.

20. This can be seen in table 8C.5: firms use less occupations at the end of our observation period than at the beginning. The nearly unchanged weighted values for the observed time period show that only larger firms reduced their number of occupations.

Table 8.6 **Analysis of variance of workers' wages**

	Adjusted R^2 of ANOVA		
	1993	1995	2000
Firm effects	0.273	0.284	0.347
Human capital	0.448	0.445	0.386
Human capital + firm effects	0.587	0.586	0.595

Source: LIAB cross-sectional model, version 1.
Note: Firms with at least twenty-five full-time employees are included.

- Unobserved differences in characteristics of firms that have a demand for these occupations
- Unobserved differences in employees that work in this occupation

To answer this question, we estimate wage regressions using the LIAB longitudinal data.[21] The first regression model (1) includes ten covariates of personal characteristics x_{it} (like job tenure, education level, job experience, and others) and dummies B_{it} for ten occupational groups. The second model (2) uses in addition twenty-one different observable firm characteristics w_{jt} (like their reorganization activities, the existence of a workers council or collective agreement, worker flow characteristics [i.e., the churning rate], and many others).[22] Model (3) includes additionally unobserved firm heterogeneity ψ_j and unobserved person heterogeneity θ_i. The three models are, therefore, formulated as[23]

$$(1) \qquad y_{it} = \mu + x_{it}\beta + B_{it}\zeta + \varepsilon_{it}$$

$$(2) \qquad y_{it} = \mu + x_{it}\beta + B_{it}\zeta + w_{jt}\gamma + \varepsilon_{it}$$

$$(3) \qquad y_{it} = \mu + x_{it}\beta + B_{it}\zeta + w_{jt}\gamma + \theta_t + \psi_j + \varepsilon_{it}.$$

The time index t refers to June 30th of each year between 1996 and 2001. To estimate model (3), we sweep out the unobserved heterogeneities on firm and worker level by subtracting averages on spell level (a spell is defined by an unique worker-firm combination). A short description of this "spell-fixed-effect" regression gives us appendix F. The models (1) and (2) are pooled ordinary least squares (OLS) regressions. The wage regressions are based on 2,282,926 observations (worker years) of 673,606 full-time workers. We are interested in the zeta coefficients of the occupation groups (table 8.7).

21. In order to downsize the wide range of occupations, we recode the three-digit occupational code into ten occupational groups. The original three-digit-code does not fit well into up-to-date international classifications (ISCO-88 would be possible with the applicable three-digit code).

22. All covariates for the models (1) to (3) are listed in appendix D.

23. Symbols and indexes are explained in appendix E.

Table 8.7 **ζ coefficients for occupational groups in West Germany (1996–2001)**

	Coefficients from model:		
	(1)	(2)	(3)
Unskilled manual occupations		Reference	
Skilled manual occupations	0.196	0.146	0.019
Technicians, engineers	0.293	0.284	0.058
Unskilled service occupations	n.s.	–0.004	n.s.
Skilled service occupations	0.148	0.045	0.031
Semiprofessionals	0.303	0.146	0.059
Professionals	0.467	0.342	0.100
Unskilled civil servant occupations	0.058	0.047	0.003
Skilled civil servant occupations	0.262	0.223	0.048
Managers	0.458	0.426	0.127

Source: LIAB longitudinal model, version 1 for 1996 to 2001.

Notes: Uses 2.28 million y_{it}-observations; all coefficients are significant on a level of $\alpha < 0.01$; n.s. = not significant; models are explained in the text.

The occupational returns in column (1) control only for observed worker characteristics. The results in column (2) control additionally for observed firm characteristics. The more the specific occupational group is—relative to the unskilled manual occupations—sorted into high-wage firms (expressed by $w_{jt}\gamma$), the lower is the zeta coefficient of model (2) compared to model (1). But they differ only slightly. Accordingly, only a small part of occupational wage differentials can be explained by differences in observed characteristics of firms that have a demand for these occupations. Exceptions of the small, observable firm effects are the skilled service occupations and semiprofessionals or professionals, meaning that especially high-wage firms employ workers with such occupations.

Model (3) controls additionally for unobserved heterogeneity of workers and firms. The interpretation of the differences between the zeta coefficients from model (2) and (3) is quite similar. The more the occupational wage differentials could be explained by unobserved characteristics of workers and firms, the lower is the zeta coefficient in model (3) compared to model (2). In most cases, the zeta coefficient is even substantially lower. Only for skilled service occupations do the unobserved worker and firm characteristics have just a small effect on the wage return rates in this occupational group.

To summarize, if we control for unobserved firm and worker characteristics, there are often only small wage differences between different occupational groups. Thus, we can conclude that firms set wages not only by occupations but also for other observed and unobserved person and firm characteristics.

Table 8.8 **Correlation between observed and unobserved worker and firm characteristics**

	$\hat{\theta}_i$	$\hat{\psi}_j$	$x_{it}\hat{\beta}$	$w_{jt}\hat{\gamma}$
Unobserved worker characteristics ($\hat{\theta}_i$)	1.0000			
Unobserved firm characteristics ($\hat{\psi}_j$)	–0.0960	1.0000		
Observed worker characteristics ($x_{it}\hat{\beta}$)	0.3787	0.0002	1.0000	
Observed firm characteristics ($w_{jt}\hat{\gamma}$)	–0.0276	–0.2376	–0.0417	1.0000

Source: LIAB longitudinal model, version 1 for 1996 to 2001.

Note: The table uses 673,606 averages on the level of persons, based on 2,282,926 y_{it}-observations.

To investigate this further, table 8.8 shows the correlations of the observed and unobserved workers' and firms' characteristics.

Like in many countries,[24] the correlation between unobserved firm and worker characteristics, $\text{corr}(\hat{\theta},\psi) = -0.0960$, has the wrong sign if one expects that "good" employers have "good" workers.[25] Also, the correlation between unobserved firm characteristics, ψ, and observed worker characteristics, $w_{jt}\hat{\gamma}$, looks somewhat skewed.[26] Whereas a plausible result is that observed and unobserved worker characteristics correlate positively, $\text{corr}(\hat{\theta}, x_{jt}\hat{\beta}) = 0{,}3787$. This means that high-skilled workers also accumulate unobserved abilities for which employers pay higher wages.

The correlation of the observed firm characteristics with the observed and unobserved worker characteristics is weak. This suggests that the estimated coefficients of one side of the labor market are not affected if we ignore the other side. But, on the other hand, as shown for the occupational groups in table 8.7, the returns for observable workers' characteristics sometimes differ remarkably if we control for observed and unobserved firm characteristics.

Referring to the unobserved worker heterogeneities, further investigations (Alda 2006) show that unobservable good workers are more likely to

24. Abowd, Creecy, and Kramarz (2002) reports a strong negative correlation of –0.283 for the French and –0.025 for Washington State data. Goux and Maurin (1999) estimate (depending on the time period) +0.01 to –0.32. Gruetter and Lalive (2003) report –0.543 for Austria, and Barth and Dale-Olsen (2003) –0.47 to –0.53 for Denmark.

25. Andrews, Schank, and Upward (2004) report for Germany a correlation of nearly zero (–0.0172) in the time period 1993 to 1997 with comparable LIAB data, but fewer and different covariates. One reason for their weak correlation is that they did not use characteristics of individuals that describe their labor market behavior (e.g., times of unemployment and leave of absence for family phases). These covariates are positive correlated with the unobserved person effects (meaning that the higher the integration in the labor market and the less there are events and times of unemployment, the higher is the unobserved person effect on wages). The correlation with the vector of covariates referring to labor market integration and the unobserved person effect θ_i is + 0.1526.

26. The reason might be too little turnover between the firms in the sample.

be sorted into larger firms, in firms that reduce hierarchies and increase workers' responsibilities, in firms that have less turnover, and those who are tied by collective agreement on the firm level.[27]

8.4.3 Wage Dynamics

The statistics for the wage dynamics are printed in appendix tables 8C.3 and 8C.4. Figure 8.3 shows the kernel densities for the change in wages on individual, figure 8.4 on the firm level.

The change in wage for workers (figure 8.3) and the change of the firms' average wage (figure 8.4) give no clear picture. Both distributions shift to the right from 1993 to 1995. Between 1995 and 2000, there is a slight shift to the left. The peak of the density function changes only for individuals. On the firm level, the peaks are in all years nearly on the same level.

The change of wages varies not only between firms. There is also a wide range of within variation in the change of wages, increasing during the observation period. The 90/10 ratio of the standard deviation of the change in firms' average wage is 2.383 in the year 1993, 2.545 in 1995, and 2.814 in the year 2000. Two interpretations are possible:

First, rising wage growth rate differences might reflect wage-level differences. Maybe the wages in human capital-intensive firms grew very fast, while wages remain nearly unchanged in nonintensive firms. A tied argument is that heterogeneous firms have a large mixture of skills. Then there would be a high variance of wage growth rates within firms and little variation in the means across firms.

Second, the growth rate differences might reflect institutional or sectoral differences. These could be unions or industries. Collective contracts, for instance, might compress wages as well as their growth rates. To test this hypothesis, we estimate the effect of collective contracts on change in wages by a matching approach (appendix G). But the results only partly support the second hypotheses, because firms with and without collective contracts do not differ significantly in their average change in wages in any observed year. Only the coefficient of variation of the change in wages is in all years lower in unionized firms, significantly in the year 1993 and in 2000. Firms covered by collective contracts treat their workers regarding the wage change more equally than nonunionized firms.

However, depending on the year, the standard deviation of the change in firms' average wage is higher than the average change in workers' wage. Further analyses are needed to interpret this. From the rough tenure variable in the LIAB cross-sectional model (appendix table 8C.3), we can deduce no clear interpretation for the results. If wages within a firm grow

27. If firms pay wages by collective agreement on branch level, the averages of the unobserved person effects on firm level are smaller, but, nevertheless, higher than in firms not covered by unions. Hence, the wage regressions control for the observable average effect of collective agreement on the firm and branch levels.

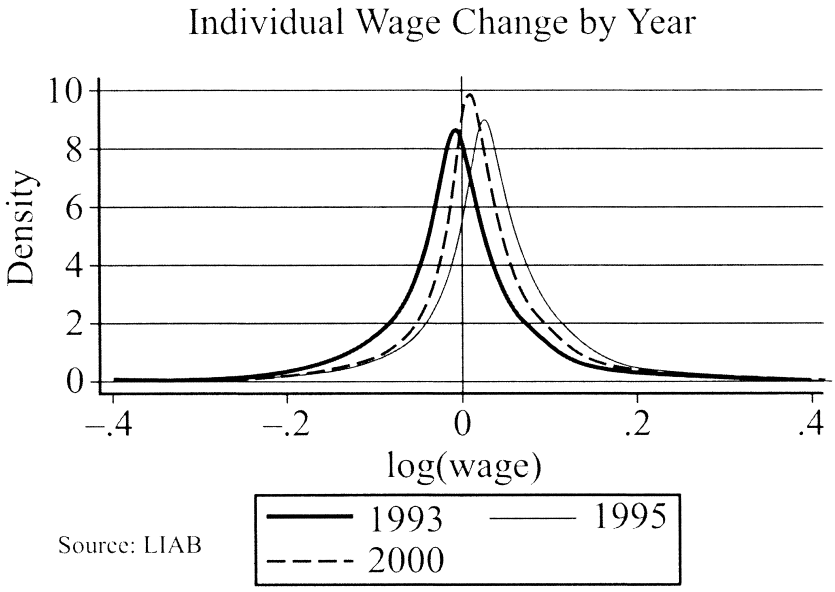

Fig. 8.3 Change in log wages on worker and firm level: Individual wage change by year
Source: LIAB cross-sectional model, version 1.

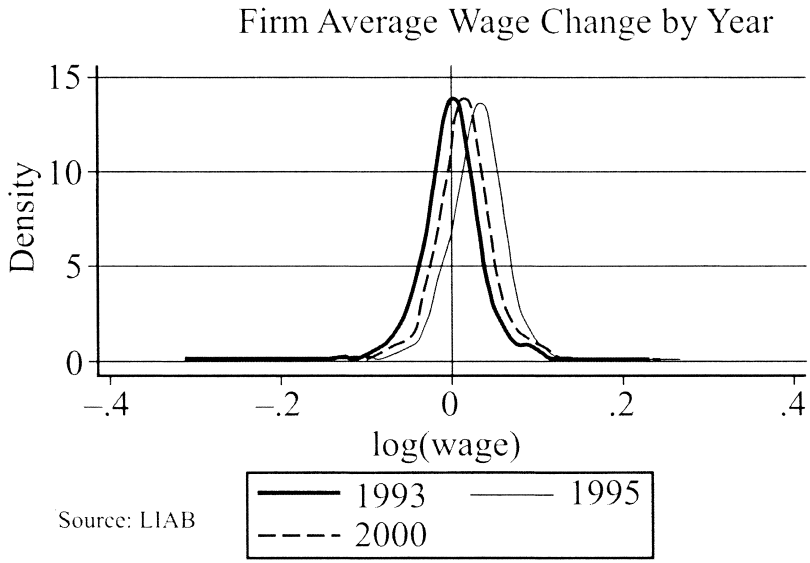

Fig. 8.4 Change in log wages on worker and firm level: Firm average wage change by year
Source: LIAB cross-sectional model, version 1.

differently, the *average* change in wages for workers is not able to tell us what drives this development. The high standard deviation of wage changes supports this argument. It seems that within firms, winners and losers (in terms of their wage change) coexist at the same time. Different working conditions might be a reason, for example, fixed in the design of the working contract at the date of entrance assuming it is a firm's reaction of a yearly changing economic environment.

In table 8.9, we investigate this further by looking at the change in wages using the LIAB longitudinal model due to a more precise record of the tenure variable. The table summarizes the change in wages by years of job duration.

We distinguish between males and females. The reason for this is that—despite that males have, on average, higher wage growth rates than females—we can observe a fairly clear trend for male workers. An entrance cohort at a certain time can be identified by diagonals. Each year an entrance cohort is going one group downward until they finally reach the group with job duration of over five years. The male entrance cohort 1997 to 1998 (this is the category tenure one to two years in the year 1999) has in all years the highest growth rates relative to all other groups. It follows that wage growth rates are joined with the date of entrance in a firm. Rising wage differentials between otherwise equal workers (e.g., regarding their skills or occupation) *within* firms are, therefore, to some extent a consequence of their date of entrance into the firm, meaning that rising wage differentials between firms for workers with comparable human capital are partly a result of firm heterogeneities.

How much of the wage change variance is attributed to firms' fixed effect and how much to occupations? We again use analysis of variance, but instead of a vector of human capital, we apply the information of workers'

Table 8.9 **Change in wages by job tenure (1999–2001)**

	Males			Females		
	1999	2000	2001	1999	2000	2001
All employees	126.75	54.51	46.03	86.64	35.93	24.62
Tenure						
Less than 1 year	88.08	–5.82	–9.19	47.25	37.75	40.09
1–2 years	178.93	99.14	99.51	97.52	91.63	64.62
2–3 years	150.89	130.96	95.27	49.41	65.12	56.26
3–4 years	158.46	95.35	116.11	87.93	41.84	58.05
4–5 years	97.17	86.50	67.76	62.83	50.19	28.90
5+ years	125.64	89.08	72.00	67.60	28.60	17.54

Source: LIAB longitudinal model, version 1.

Note: Monthly gross average wage change in euros.

Table 8.10 **Analysis of variance of changes in workers' log wages referring to occupation and firm fixed effects**

	Adjusted R^2 of ANOVA		
	1993	1995	2000
Occupation	0.1801	0.1383	0.1689
Firm	0.0856	0.1275	0.1341
Occupation + firm	0.2171	0.2214	0.2474

Source: LIAB cross-sectional model, version 1.

Note: About 330 occupations according to the three-digit classification in the administrative data are included.

occupation. We estimate three regression models: the first regresses the change in wages only on fixed effects for about 330 occupations. The second includes only fixed-firm effects. The third includes occupational as well as firm-fixed effects. Table 8.10 shows the adjusted R^2 for the regression models.

In 1993, the occupation has a much larger effect on the change in wages than the firm. This suggests that firms set wages more by occupations than due to their own heterogeneities. In 1995, there is nearly no difference between firm and occupational effects on the change in wages. In 2000, the influence of both, firms and occupation, on the average wage change is rising. The firm effect on wage changes became higher during the observation period, which is a similar development for wage levels (table 8.6). Also, the interpretation is quite the same. Firm heterogeneities became more important for the development of workers' wages. The occupation effect on the change in wages exhibits no clear time trend. However, in each year, the occupation better explains the variance in the change of wages for workers than the firm.

The analysis of table 8.10 allows us to come back to the interpretation that firm heterogeneities are more important for the change of worker wages within specific entrance cohorts. Table 8.11 repeats the analyses of variance of table 8.10, but now we run separate regressions for each entrance cohort.[28]

For most of the entrance cohorts—especially for the later ones—the picture changed, compared to table 8.10. As suggested by discussing table 8.9, the firm better explains the variance of wage changes of employees with shorter durations. Only for workers with job durations of more than eight years in 1997 does the occupation better predict the change in wages than the firm. Comparing 1997 and 2000 exhibits the same picture as the

28. The results of tables 8.10 and 8.11 are not directly comparable because we have to switch between the LIAB data models.

Table 8.11 **Analysis of variance of changes in workers' log wages referring to occupation and firm effects by tenure**

	Adjusted R^2 of ANOVA					
	Occupation		Firm		Firm + occupation	
Entrance cohort	1997	2000	1997	2000	1997	2000
1999/2000		0.209		0.266		0.381
1998/1999		0.110		0.183		0.228
1997/1998		0.121		0.174		0.240
1996/1997	0.216	0.141	0.232	0.143	0.328	0.227
1995/1996	0.129	0.135	0.186	0.157	0.235	0.222
1994/1995	0.151	0.125	0.178	0.158	0.254	0.230
1993/1994	0.159	0.107	0.157	0.145	0.234	0.207
1992/1993	0.144	0.146	0.185	0.172	0.233	0.247
1991/1992	0.123	0.145	0.134	0.147	0.202	0.241
1990/1991	0.127	0.141	0.149	0.169	0.210	0.231
1990 and earlier	0.115	0.114	0.093	0.137	0.175	0.203

Source: LIAB longitudinal model, version 1.

other statistics: in 2000, the firm effects are more important than in 1997, and the human capital (here approximated by occupation) can explain less of the change of workers wages. The combination of the occupation and the firm explains the variance of the wage change of earlier entrance cohorts in 2000 better than in 1997.

To conclude, wage growth rates are joined with the date of entrance by the employer. In addition, firms employ a large mixture of skills. This means there is a lot of within-variance of the change in wages and less variation in the means across firms, as shown in figures 8.3 and 8.4.

8.4.4 Mobility

This section discusses exit and entry rates on the establishment level. The differences between weighted and unweighted values are here more important, because in a smaller firm, one exiting worker increases the proportion of exits more than in a larger one. Due to the oversampling of larger firms in our sample, weighted values reflect the mobility for the typical German firm; unweighted values express the mobility in larger firms.

The growth rate of the firm size is computed as $2(N_t - N_{t-1})/(N_t + N_{t-1})$ with N as the total number of full-time workers. Entry and exit rates were constructed as $2E_t/(N_t + N_{t-1})$. E is the total number of exits or entries in the firm. The correlations are computed with the log wages on the firm level. We calculated the mobility patterns separately for high-wage jobs, low-wage jobs, and for all jobs.

Mobility: All Jobs

Appendix table 8C.5 presents the results for all jobs. As mentioned in section 8.3, the average firm size decreases during the 1990s (table 8.5), but the decreasing firm size in our sample is also partly a result of sample attrition. The weighted values correct for this selectivity. The large firm size and the large standard deviation of the firm size in the unweighted values compared with the weighted values is a typical result of the oversampling. However, according to other studies, larger German firms especially became smaller in the second half of the 1990s because of in- and outsourcing. Therefore, we observe a negative growth of full-time jobs on the establishment level. As noted in section 8.2, this decline in the number of full-time jobs is partly compensated by an increasing number of part-time jobs.

The number of occupations declines during the period in larger firms by approximately 30 percent. This may be a result of the declining firm size, but could also reflect the old-fashioned occupational classification system of the 1970s. Occupations in the declining industrial sector are more microscopically classified than occupations in the expanding service sector. Last but not least, firms sometimes really drive down their number of occupations to concentrate on their core business.

The exit rate for all jobs rises from 0.19 to 0.23 in our observation period. These values are slightly higher than in Norway and Sweden, but still lower than in Denmark, France, or Italy. The entry rate rises from 0.16 to 0.18. This is comparable to the Nordic countries. The rising entry and exit rates may be attributable to the flexibilization of the labor market institutions. Furthermore, the exit rates are higher than the entry rates, reflecting the decline of full-time employment in the 1990s.

Could the rising firm turnover be connected to the declining coverage of collective contracts?

As the matching of firms with and without collective contracts (appendix table 8G.1) shows: exit rates in firms with collective contracts are by 7.7 percent significantly lower in the slump year 1993. At other points of the business cycle, there are no differences between unionized and nonunionized firms. Also, the entry rates differ in both types of firms. In 1993 and 2000, firms with a collective contract hire significantly fewer employees (on average, about 3 percent). These mean comparisons show that especially in more turbulent economic times, collective contracts influence mobility patterns. They are protecting insiders, at least in the years 1993 and 1995 (last column of appendix table 8G.1).

However, despite the institutional treatment, as expected, high- and low-wage firms differ in their mobility patterns. Firms in the top decile of firm wages exhibit lower exit and entry rates than firms in the bottom decile. This is shown by the unweighted as well as the weighted results.

The growing mobility of workers has consequences for the percentage of

core workers (defined as persons with job tenure over three years). There are fewer core workers in the year 2000 than in former years. Collective contracts could not prevent this development, as the mean comparison of the propensity score matching shows (appendix table 8G.1, last column): Firms with collective contracts protect—compared to firms without collective contracts—insiders in the years 1993 and 1995 better than in 2000, and, consequently, the difference between the two groups diminishes.

Finally, the correlation patterns in Mobility: All Jobs show:

- The correlation of the exit and entry rates with the average firm wage is negative. This means that high-wage firms have a lower turnover. The reason for this may be that firms try to keep their human capital. But the correlation is getting weaker at the end of the observation period.
- As expected, exit rates are lower and entry rates are higher if firms raise the wages for their workers. This suggests that growing firms raise wages to attract new workers.
- Firms with a higher variance of wages exhibit higher worker mobility, shown by the positive correlation between the entry/exit rate and the standard deviation of the average wage.

Mobility: High-Level Jobs and Mobility: Low-Level Jobs

The mobility patterns of all jobs, high-level jobs, and low-level jobs differ in some points. The definition of high- and low-level jobs is based on the occupational classification (on a three-digit level). We rank occupations by their median wage. High-level jobs are above the 80th percentile of the wage distribution. Low-level jobs are below the 20th percentile.

The following are the main results:

- High- and low-level jobs are a matter of larger establishment. Therefore, the number of high- and low-level jobs differs strongly between weighted and unweighted values.
- As expected, high-wage earners are less mobile in high-wage firms and more mobile in low-wage firms (low-level jobs and vice versa). In all kind of firms, the exit and entry rates of low-level jobs are higher than the rates of high-level jobs. This is consistent with predictions of human capital theory. High-wage workers have accumulated more firm-specific human capital and receive, therefore, higher returns if they stay in the firm.
- In 2000, the entry rate of low-level jobs is higher than the exit rate. This suggests an expanding sector of low-wage jobs in Germany.
- High-wage firms have a lower turnover of high-level jobs and a higher turnover of low-level jobs. If high-wage firms can be regarded as high human capital firms, they have little reason for a high turnover.
- The correlation between the average wage change and the entry rates is for both kinds of jobs negative in 1995 and positive in 2000. If firms

Table 8.12 **Exit rates of top, middle, and bottom earners**

	1993	1995	2000
90th percentile wage (top earners)	0.133	0.131	0.178
Median-wage (middle earners)	0.129	0.118	0.158
10th percentile wage (bottom earners)	0.232	0.219	0.283
Exit-90th percentile wage (compressed)	0.139	0.145	0.211
Exit-90th percentile wage (spread out)	0.126	0.116	0.142

Source: LIAB cross-sectional model, version 1.

grow in boom years, then these firms may raise their wages to attract workers. A supporting argument is—as already discussed in section 8.4.2 (table 8.8)—that the change in wages for the new hires (with job duration of one to three years) is higher than for employees with longer job tenure.

The relation between the wage dispersion in a firm and the turnover of the high-level jobs is more complicated. The turnover of high- and low-level jobs is lower if the wages within firm are more compressed—with only one exception (entry rate of high-level jobs in 1993). We can expect this only for the low-level jobs. As stated in section 8.2, in firms with workers councils or collective contracts, the wages are more compressed, and low-wage workers are better protected against dismissals. It seems that high-wage earners more often leave firms with compressed wage structures (table 8.12).

There are two differences between the appendix tables 8C.6 and 8C.7 and table 8.12. First, the top, middle, and bottom earners are not calculated by the median wage of occupations but by the wage of people.[29] Second, we calculate the 90th percentile instead of the 80th percentile. However, table 8.12 shows that middle earners are the group with the most stable employment. This may be an effect of the strong insider position of skilled blue-collar workers resulting from the German apprenticeship system. The wages for skilled blue-collar workers are fixed by collective agreements, and unemployment for this skill group is low. Many firms that are not covered by unions also pay tariff wages if they require these skills, so that blue-collar workers—who are the majority of middle earners—have no incentives to change their employer.

The mobility of bottom earners is often induced by the employer, while top earners more often exit from firms with a compressed wage structure.[30] This suggests that they quit more often to seek their chances elsewhere.

29. Middle-wage earners are in the 45th to 55th percentile of the wage distribution.

30. A firm has a compressed wage structure if the value of the 90/50 ratio of the within-firm wage distribution is below the average of the 90/50 ratio of all firms in the German economy. A spread out wage structure is defined for firms who have a 90/50 ratio above this average.

8.5 Summary and Outlook

The West German private sector is characterized by a rising inequality of wages during the 1990s. At the same time, firm heterogeneities became more important for the wage setting and the within- and between-firm variation of wages. To understand the development of wages, we must, therefore, ask, what do the firms do?

There were a lot of reorganization activities in German firms in the 1990s. Outsourcing, new customer-producer relationships, and changes in the work organization were necessary for making firms more competitive. Such activities change the wage structure between and within firms. Wage structures in Germany are rather rigid, and payment adjustments can be more expected via the mobility of workers. Skill-biased technological change affects both the risks of job loss and the wage development of different skill groups (e.g., Bauer and Bender 2002; Kölling and Schank 2003). The institutional frame of the German labor market can be described more or less as protecting insiders. But during the 1990s, employers gain more flexibility in designing fixed-term contracts and employing temporary workers. All this is resulting in a large mixture of heterogeneous workers in heterogeneous firms, in the sense that some of them are more affected by new developments than others. This explains a part of the rising wage inequality and the larger wage dispersion.

The following are further results of analyzing the within and between-variance of wage levels:

- The rising within-variance of wages can only be partly explained by a change in firms' mixture of occupations.[31] The occupational wage differentials are affected by sorting and unobserved characteristics of workers. If we controlled for unobserved firm and worker characteristics, there are only small occupational wage differentials. This means that firms set wages not only by occupations but also for other observed and, especially, unobserved human capital. For example, unobservable good workers work more often in firms that reduce hierarchies, improve worker responsibilities, and have fewer worker flows.
- The wage structure of firms is only partly affected by unions. Unionized firms pay in 2000, on average, significantly higher wages and have in 1995 a more compressed wage structure, whereas in other years, we find no significant differences between unionized and nonunionized firms.
- A decomposition of the variance of wages shows that the importance of the firm-specific effect increases, whereas that of the human capital effect decreases. The R^2 attributed to the interaction of both human

31. We estimate an average wage return rate for workers of, ceteris paribus, 1 percent, if their employer drives down the proportion of different occupations in his or her firm by 5 percent (relative to all of his or her employees).

capital and firm-specific effects remains almost stable during the years 1993 to 2000.

Analyses of the wage changes show that firms exhibit a wide range of change in wages:

- In general, workers with shorter job durations receive higher wage changes than workers with longer job durations.
- The range of the change in wage, especially on the individual level, is getting wider during the 1990s. The 90/10 ratio of the standard deviation of the change in firms average wage is 2.383 in 1993 and 2.814 in the year 2000, whereas the mean remains nearly unchanged.
- Referring to all employees, it looks like wage changes are affected more by occupation than by firm. But wage growth rates are connected with the date of entry in a firm—and the wage growth rates of the same entrance cohort differ between heterogeneous firms. If we control for the date of entry, the firm explains the change in wages better than the occupation.
- We find nearly no significant differences between unionized firms and nonunionized ones. Only in 1995 is the change in wages for workers more compressed if wages are collectively bargained.

The worker mobility increased in the second half of the 1990s and suggests that this is not only driven by the business cycle but also by a trend of deregulation of the German labor market. On the other hand, several institutions tend to protect insiders. It can be concluded that a notable part of the higher mobility in the second half of the 1990s was undertaken by a minority of employees, while the majority of employees still remained in stable employment.

Such mobility patterns also become obvious in our tables for the cross-country comparison (appendix tables 8C.5 to 8C.7):

- While the entry rates in most cases grew moderately (but, nevertheless, there was more mobility), the exit rates become higher during the 1990s.
- Nevertheless, stable employment is still normal in Germany. The protection of insiders became most obvious in the percentage of workers with a duration of job tenure of more than three years. Especially in stable years, the proportion of core (full-time) workers rises in German establishments.

What can be topics for future research? There are two general aspects: the development of the data, and questions about wages and mobility patterns.

The linked employer-employee data from Germany (LIAB) take major steps forward. New technologies allow the building up of better data sets, making a wider range of investigations possible. In the foreground of the

further development of the LIAB is the association of the two LIAB data models. This means the integration of workers' histories with the cross-sectional model for all firms of the IAB establishment panel. Meanwhile, over 10,000 firms join in the West and nearly 5,000 in the East Germany panel. Integrating key variables to the associated administrative individual data—like daily precise job durations, the wage of workers by the former employer, durations of unemployment, participation on programs of active labor market policy, and many more—will make research with LIAB data not only easier, but also more fruitful.

To better understand the structure and dynamics of wages and the mobility of employees in Germany, we would like to take a deeper look into the firms in order to understand what is happening *between* them. Maybe this includes firm closing and how newly founded units develop over time, with special attention given to the in- and outsourcing activities of other firms.[32] What is the impact on the skill-wage premium? What follows for the mobility of workers in an economy? Such questions might also give a partial answer to how internal labor markets change over time. Do workers become more equal within firms and more different between firms?

At the end, we would like to note that—and this seems to be consistent in a cross-country comparison—unobservable worker and firm characteristics become more important. They are correlated with the observables and possibly can be regarded as a key for the understanding of wage dispersion as well as the sorting on (national) labor markets, especially whether countries become more equal in labor market mechanisms.

Appendix A

Description of the Data

Description of the data comes from Andrews, Schank, and Upward (2004, 13–14).

The IAB Establishment Panel (*Betriebspanel*)

The IAB Establishment Panel covers the period 1993 to the present of firms located in West and 1996 to the present in East Germany. Establishments are selected by using a fairly complicated weighting procedure. The IAB Establishment Panel covers, unweighted, 1 percent of all firms (but nearly every larger one) and about 8 percent of all employees. Information on each establishment includes, among others:

32. An investigation of wage structures in newly founded units with LIAB data is given by Brixy, Kohaut, and Schnabel (2007).

- Total employment
- Standard and overtime hours
- Output
- Exports
- Investment
- Urbanity
- Ownership
- Technology (subjective measure)
- Organizational change
- Profitability
- Age of firms and whether parent is a single firm

The Employment Statistic Register (*Beschäftigtenstatistik*)

For the other side of the labor market, the IAB has access to the federal employment statistics register. It starts in 1975 in West Germany and 1992 in East Germany. It contains about 400 million records, covering about 46 million employees. Information on each worker includes the following:

- Gender, age, and nationality
- Start and end of every employment spell
- Occupation (three-digit)
- Daily gross wages (left-truncated and right-censored)
- Qualifications (education/apprenticeship)
- Industry, region
- Establishment identification number
- Information about multiple jobs and times of unemployment

By using the establishment identification number, the IAB is able to associate each worker in the employment statistics register with an establishment in the IAB Establishment Panel.

Appendix B

Variables and definitions

Remark

The structure of the linked employer-employee data sets of the IAB is described in the data sections in this chapter and in IAB Discussion Paper no. 6/2005. Hereafter, we describe how the applied key variables are defined.

Wages

Wages are gross wages and include all bonus payments. The wages are applicable on a precise daily base. They are multiplied by 30.5 to get

monthly wages. Wages are truncated at a lower bound and censored at an upper bound. Censored wages are imputed as described by Gartner (2005). We deflate all wages by the consumer price index (2,000 = 100). All wages and statistics refer to full-time employees. The monthly wages are restricted to the interval [500; 22,026] euros (in log wages [5.5;10]).

Full-Time Employees

The employee data contain no information about the working hours, only whether they are full-time or part-time workers. Therefore, we include only full-time workers. Apprenticeships are excluded from all analyses.

Movers

We use the LIAB cross-sectional data. In this model, movers can only be identified if they move to another firm, which is also part of the IAB Establishment Panel in the following year. We did not use this information for the cross-country comparison. In the longitudinal model, it is possible to follow the working history of people. The correlations of observed and unobserved employer and employee characteristics are based on this LIAB longitudinal data.

Tenure

In the cross-sectional model, it is only possible to check whether the individual identifier occurs in three consecutive years. In the longitudinal model, it is possible to compute job durations on a precise daily base (left-censored at January 1st, 1990). We use this information to report the correlation of the firm size with tenure.

Sector Classification

We use the sector classification from the IAB Establishment Panel. We excluded all firms in the public sector and all firms in public ownership. In the manufacturing sector—which is a subpopulation of the whole sample—we exclude the agrarian sector as well as mining and construction firms. The number of remaining firms in manufacturing are as follows: 1993: 1,161; 1995: 915; 2000: 730).

Mobility and Growth Rates

All mobility rates are based on the formula $2 \times E_t/(N_{t-1} + N_t)$, where E is the event (entries, exits), and N is the total number of employees. This means, for example, that the exit rate of high-level jobs is based on all exits of high-level jobs times two, divided by the sum of all existing high-level jobs at time t and at time t_{t-1}. Growth rates are quite similarly constructed: $2 \times (N_t - N_{t-1})/(N_t + N_{t-1})$.

High- and Low-Level Jobs and Top, Middle, and Bottom Earners

To define high- and low-level jobs, we compute for each occupation (on a three-digit level) the median wage. High-level jobs are those jobs in the top 80 percent decile of the wage distribution, low-level jobs are in the bottom 20 percent decile.

Top earners are people in the 90th percentile of the yearly wage distribution, bottom earners are in the 10th percentile, and middle earners are in the 45th to 55th percentile.

Coefficient of Variation

This is constructed as $r = \sigma/|\bar{y}|$, where r is the coefficient, σ the standard deviation, and y the (change in) wage on firm level. For the tables about wage dynamics, the coefficient of variation is much higher than for the structure of wages. In the tables about wage dynamics, the coefficient is, therefore, divided by 100.

Size

All size information used is based only on full-time employees excluding apprenticeships. For the cross-country comparison, there have to be at least twenty-five full-time employees in a firm, for analyses with the longitudinal LIAB data, three.

Switch Rate

The switch rate measures a change in the occupational code of a full-time employee between t and $t - 1$ of all nonmovers in a firm.

Appendix C

Tables on Wage and Mobility Patterns

Table 8C.1 **Structure of wages within and between firms (unweighted values; in euros)**

	Monthly wages			Log monthly wages		
	1993	1995	2000	1993	1995	2000
Average wage[a]	3,089.97	3,187.36	3,314.24	7.989	8.018	8.052
Median	2,855.75	2,934.31	3,054.59	7.957	7.984	8.024
SD	995.96	1,048.59	1,144.24	0.303	0.308	0.328
90th percentile	4,438.33	4,606.65	4,844.97	8.398	8.435	8.486
75th percentile	3,569.87	3,697.24	3,850.25	8.180	8.213	8.256
25th percentile	2,408.41	2,469.87	2,543.85	7.787	7.811	7.841
10th percentile	2,076.52	2,126.95	2,175.74	7.638	7.662	7.685
No. of workers	1,613,662	1,059,419	622,307	1,613,662	1,059,419	622,307
Average of firm average wage[b]	2,774.89	2,875.68	2,861.15	7.869	7.884	7.878
Median	2,758.07	2,845.02	2,820.62	7.890	7.895	7.897
SD	557.49	601.23	677.69	0.213	0.220	0.251
90th percentile	3,493.73	3,664.33	3,806.67	8.115	8.145	8.192
75th percentile	3,144.38	3,263.71	3,251.82	8.021	8.037	8.038
25th percentile	2,408.39	2,478.56	2,430.48	7.747	7.758	7.747
10th percentile	2,078.78	2,145.13	2,007.83	7.589	7.611	7.547
No. of firms	2,163	1,709	1,578	2,163	1,709	1,578
Average of SD of wages[b]	790.99	818.24	829.83	0.267	0.266	0.274
Median	790.18	821.16	833.26	0.264	0.264	0.271
SD	210.66	226.69	265.19	0.062	0.064	0.076
90th percentile	1,061.06	1,113.54	1148.94	0.346	0.345	0.366
75th percentile	929.03	973.55	1014.69	0.306	0.304	0.315
25th percentile	648.77	663.67	657.91	0.226	0.225	0.225
10th percentile	524.44	522.29	473.57	0.191	0.190	0.189
No. of firms	2,163	1,709	1,578	2,163	1,709	1,578

Average CV of wages[b]	0.288	0.284	0.293	0.034	0.034	0.035
Median	0.286	0.286	0.291	0.033	0.033	0.034
SD	0.067	0.071	0.081	0.008	0.009	0.010
90th percentile	0.370	0.372	0.387	0.044	0.044	0.047
75th percentile	0.329	0.327	0.339	0.039	0.039	0.040
25th percentile	0.245	0.245	0.243	0.029	0.029	0.028
10th percentile	0.206	0.202	0.196	0.024	0.024	0.024
No. of firms	2,163	1,709	1,578	2,163	1,709	1,578
Correlation (average wage, SD of wage)[b]	0.571**	0.589**	0.616**	n.a.	n.a.	n.a.
Average wage for workers between 25 and 30[a]	2,708.43	2,731.13	2,832.01	7.878	7.887	7.916
Median	2,628.39	2,647.54	2,738.93	7.874	7.881	7.915
SD	639.17	634.27	740.02	0.227	0.224	0.257
90th percentile	3,483.24	3,504.48	3,688.77	8.156	8.161	8.213
75th percentile	3,003.81	3,038.16	3,190.57	8.007	8.019	8.067
25th percentile	2,293.15	2,319.55	2,360.98	7.737	7.749	7.767
10th percentile	2,023.95	2,053.61	2,062.87	7.612	7.627	7.631
No. of workers	292,220	172,243	69,017	292,220	172,243	69,017
Average wage for workers between 45 and 50[a]	3,280.06	3346.05	3,438.98	8.046	8.064	8.086
Median	3,040.57	3,095.89	3,161.72	8.019	8.038	8.059
SD	1,072.67	1,115.22	1,204.48	0.313	0.318	0.336
90th percentile	4,706.99	4,833.69	5,048.48	8.457	8.483	8.527
75th percentile	3,920.19	3,981.54	4,082.18	8.274	8.289	8.314
25th percentile	2,514.67	2,560.34	2,612.21	7.829	7.847	7.867
10th percentile	2,136.32	2,166.89	2,211.54	7.667	7.681	7.701
No. of workers	227,483	158,982	105,460	227,483	158,982	105,460

Source: Linked employer-employee data of the Institute for Employment Research/Germany, cross-sectional model, version 1.

Notes: SD = standard deviation; CV = coefficient of variation.

[a]Observation = a person

[b]Observation = a firm.

**Significant at the $\alpha < 0.005$ level.

Table 8C.2 **Structure of wages within and between firms (weighted values; in euros)**

	Monthly wages			Log monthly wages		
	1993	1995	2000	1993	1995	2000
Average wage[a]	2808.99	2874.33	3,021.66	7.882	7.904	7.947
Median	2614.68	2662.79	2,778.85	7.869	7.887	7.929
SD	984.09	1025.72	1,130.84	0.343	0.347	0.368
90th percentile	4150.29	4284.84	4,552.66	8.331	8.363	8.423
75th percentile	3291.25	3361.08	3,576.89	8.099	8.120	8.182
25th percentile	2151.25	2194.55	2,267.37	7.674	7.693	7.726
10th percentile	1776.12	1813.39	1,858.69	7.482	7.503	7.527
No. of workers	9,083,054	8,187,154	4,652,141	9,083,054	8,187,154	4,652,141
Average of firm average wage[b]	2,535.99	2,595.01	2,645.80	7.773	7.780	7.795
Median	2,507.45	2,546.38	2,623.53	7.779	7.801	7.809
SD	555.01	597.57	690.68	0.233	0.242	0.269
90th percentile	3,251.58	3,347.32	3,616.41	8.045	8.073	8.148
75th percentile	2,895.55	2,925.65	3,044.09	7.931	7.935	7.972
25th percentile	2,171.04	2,220.07	2,151.13	7.644	7.648	7.618
10th percentile	1,847.67	1,875.74	1,799.47	7.465	7.482	7.455
No. of firms	292,220	172,243	69,017	292,220	172,243	69,017
Average of SD of wage[b]	703.75	708.16	760.17	0.269	0.265	0.286
Median	695.81	693.25	762.97	0.265	0.261	0.277
SD	224.42	248.17	289.53	0.076	0.084	0.105
90th percentile	992.09	1,038.20	1,110.95	0.367	0.363	0.416
75th percentile	850.89	862.11	972.49	0.320	0.316	0.335
25th percentile	547.89	533.42	556.28	0.218	0.209	0.218
10th percentile	414.79	388.57	362.78	0.173	0.160	0.160
No. of firms	292,220	172,243	69,017	292,220	172,243	69,017

Average CV of wages[b]	0.281	0.278	0.289	0.035	0.034	0.037
Median	0.277	0.276	0.288	0.034	0.033	0.035
SD	0.082	0.091	0.095	0.010	0.011	0.014
90th percentile	0.384	0.386	0.416	0.047	0.047	0.054
75th percentile	0.334	0.327	0.346	0.041	0.041	0.043
25th percentile	0.226	0.218	0.226	0.028	0.027	0.028
10th percentile	0.177	0.167	0.164	0.023	0.020	0.020
No. of firms	292,220	172,243	69,017	292,220	172,243	69,017
Correlation (average wage, SD of wage)[b]	0.498**	0.480**	0.604**	n.a.	n.a.	n.a.
Average wage for workers between 25 and 30[a]	2,472.50	2,490.99	2,571.29	7.779	7.786	7.809
Median	2,395.12	2,425.38	2,451.72	7.781	7.794	7.804
SD	650.78	657.61	765.63	0.261	0.263	0.299
90th percentile	3,286.77	3,299.86	3,515.17	8.097	8.101	8.164
75th percentile	2,795.77	2,822.11	2,956.56	7.935	7.945	7.991
25th percentile	2,049.23	2,066.89	2,084.02	7.625	7.633	7.642
10th percentile	1,763.34	1,767.69	1,766.04	7.475	7.478	7.476
No. of workers	2,075,194	1,402,819	548,181	2,075,194	1,402,819	548,181
Average wage for workers between 45 and 50[a]	3,033.17	3,069.02	3,142.69	7.956	7.964	7.982
Median	2,828.37	2,842.27	2,890.66	7.947	7.952	7.969
SD	1,071.39	1,121.66	1,197.33	0.357	0.364	0.381
90th percentile	4,459.18	4,583.83	4,743.76	8.402	8.431	8.464
75th percentile	3,683.26	3,689.56	3,776.64	8.211	8.213	8.236
25th percentile	2,289.23	2,306.39	2,339.59	7.736	7.743	7.757
10th percentile	1,853.41	1,857.98	1,879.18	7.525	7.527	7.538
No. of workers	1,327,249	1,159,054	770,242	1,327,249	1,159,054	770,242

Source: Linked employer-employee data of the Institute for Employment Research/Germany, cross-sectional model, version 1, weighted values.

Notes: SD = standard deviation; CV = coefficient of variation.

[a]Observation = a person.

[b]Observation = a firm.

**Significant at the $\alpha < 0.005$ level.

Table 8C.3 **Wage dynamics (unweighted values; in euros)**

	Change in monthly wages					
	Change in log monthly wages					
	1993	1995	2000	1993	1995	2000
Average change in wage[a]	–29.82	136.08	63.13	–0.101	0.043	0.018
Median	–26.67	105.48	43.21	–0.100	0.039	0.016
SD	486.69	482.26	601.42	0.115	0.112	0.013
90th percentile	294.74	476.43	444.63	0.094	0.147	0.131
75th percentile	80.89	238.19	171.86	0.296	0.083	0.059
25th percentile	–144.83	11.08	–48.33	–0.051	0.004	–0.017
10th percentile	–372.37	–163.01	–299.75	–0.118	–0.053	–0.089
No. of workers	1,612,065	1,058,246	621,576	1,612,065	1,058,246	621,576
Average of firm average change in wage[b]	–9.44	103.43	53.67	–0.004	0.038	0.021
Median	–1.01	100.52	48.46	–0.001	0.038	0.019
SD	80.57	95.16	90.83	0.027	0.034	0.034
90th percentile	75.83	214.74	148.51	0.025	0.072	0.055
75th percentile	39.28	154.22	94.99	0.013	0.055	0.035
25th percentile	–49.55	51.81	10.87	–0.017	0.023	0.006
10th percentile	–109.31	5.97	–34.62	–0.039	0.004	–0.012
No. of firms	2,163	1,709	1,578	2,163	1,709	1,578
Average of SD of change in wage[b]	217.41	210.17	207.16	0.073	0.069	0.070
Median	209.51	203.61	199.28	0.071	0.066	0.067
SD	71.37	73.77	81.81	0.019	0.020	0.024
90th percentile	311.77	307.57	317.35	0.094	0.090	0.096
75th percentile	264.51	255.27	254.62	0.083	0.079	0.081
25th percentile	168.29	157.57	151.62	0.060	0.057	0.055
10th percentile	130.83	120.84	112.77	0.051	0.049	0.045
No. of firms	2,163	1,709	1,578	2,163	1,709	1,578

Average CV[c] of change in wages[b]	4.814	3.849	6.086	0.228	0.231	0.294
Median	3.423	2.755	3.822	0.223	0.219	0.284
SD	107.33	26.309	385.056	0.058	0.069	0.097
90th percentile	9.127	7.639	15.978	0.307	0.313	0.392
75th percentile	5.487	4.219	8.046	0.249	0.259	0.336
25th percentile	2.189	1.742	1.553	0.186	0.188	0.238
10th percentile	0.989	0.816	–4.934	0.159	0.161	0.191
No. of firms	2,163	1,709	1,578	2,163	1,706	1,578
Average change in wage for people with tenure <3 years[a]	34.75	156.25	94.51	0.012	0.053	0.030
Median	18.09	117.59	54.61	0.007	0.046	0.021
SD	443.73	467.19	558.82	0.118	0.118	0.138
90th percentile	336.82	500.61	461.33	0.119	0.163	0.149
75th percentile	137.28	258.54	197.19	0.054	0.095	0.073
25th percentile	–84.71	23.55	–26.61	–0.036	0.009	–0.010
10th percentile	–254.06	–134.86	–203.64	–0.093	–0.048	–0.071
No. of workers	236,672	165,071	105,938	236,672	165,071	105,938
Average change in wage for people with tenure ≥3 years[a]	–40.93	132.36	56.68	–0.014	0.042	0.017
Median	–33.54	103.45	41.10	–0.012	0.038	0.015
SD	492.86	484.90	609.62	0.105	0.111	0.120
90th percentile	284.58	471.55	440.42	0.083	0.144	0.121
75th percentile	68.94	234.15	166.52	0.026	0.081	0.156
25th percentile	–154.89	8.64	–53.66	–0.046	0.003	–0.018
10th percentile	–392.05	–168.39	–321.58	–0.107	–0.054	–0.092
No. of workers	1,375,393	893,175	515,638	1,375,393	893,175	515,638

Source: Linked employer-employee data of the Institute for Employment Research/Germany, cross-sectional model, version 1.

Notes: SD = standard deviation; CV = coefficient of variation.

[a]Observation = a person.

[b]Observation = a firm.

[c]Divided by one hundred.

Table 8C.4 **Wage dynamics (weighted values; in euros)**

	Change in monthly wages			Change in log monthly wages		
	1993	1995	2000	1993	1995	2000
Average change in wage[a]	–13.82	103.49	57.08	–0.005	0.036	0.016
Median	–13.71	78.86	37.22	–0.006	0.032	0.014
SD	405.27	398.19	485.91	0.108	0.104	0.129
90th percentile	255.01	378.33	364.73	0.092	0.131	0.127
75th percentile	81.05	188.90	148.10	0.033	0.073	0.056
25th percentile	–110.37	–1.84	–38.67	–0.043	–0.001	–0.015
10th percentile	–294.32	–144.37	–215.48	–0.104	–0.053	–0.075
No. of workers	9,069,945	8,187,154	4,646,177	9,069,945	8,187,154	4,646,177
Average of firm average change in wage[b]	6.51	73.33	36.94	0.003	0.031	0.018
Median	6.35	71.29	36.26	0.003	0.032	0.018
SD	94.71	98.65	105.52	0.038	0.039	0.041
90th percentile	115.87	177.89	143.22	0.047	0.071	0.060
75th percentile	54.48	124.58	87.27	0.022	0.051	0.036
25th percentile	–43.16	18.91	–10.21	–0.017	0.012	–0.001
10th percentile	–95.49	–35.57	–69.94	–0.041	–0.009	–0.021
No. of firms	292,220	172,243	69,017	292,220	172,243	69,017
Average of SD of change in wage[b]	189.82	180.21	185.73	0.072	0.068	0.071
Median	181.54	166.99	168.60	0.069	0.062	0.065
SD	76.26	78.41	93.09	0.027	0.027	0.038
90th percentile	296.17	285.94	310.75	0.108	0.097	0.105
75th percentile	236.89	222.80	243.11	0.085	0.082	0.084
25th percentile	135.12	121.86	126.14	0.053	0.051	0.048
10th percentile	96.84	90.27	80.85	0.043	0.040	0.037
No. of firms	292,220	172,243	69,017	292,220	172,243	69,017

Average CV[c] of change in wages[b]	1.213	0.061	0.163	0.214	0.074	0.510
Median	0.048	0.027	0.039	0.045	0.024	0.034
SD	31.55	0.156	2.322	0.262	0.040	4.712
90th percentile	0.217	0.119	0.182	0.093	0.092	0.207
75th percentile	0.095	0.052	0.088	0.092	0.047	0.078
25th percentile	0.025	0.017	0.021	0.022	0.014	0.019
10th percentile	0.152	0.011	0.014	0.014	0.010	0.014
No. of firms	292,220	172,243	69,017	292,220	172,243	69,017
Average change in wage for people with tenure <3 years[a]	27.61	115.40	73.78	0.011	0.044	0.026
Median	13.48	85.01	46.08	0.067	0.037	0.019
SD	356.03	374.94	481.62	0.113	0.111	0.133
90th percentile	283.85	388.67	389.21	0.114	0.144	0.137
75th percentile	119.53	199.81	167.38	0.052	0.082	0.067
25th percentile	–74.59	6.64	–29.35	–0.033	0.003	–0.013
10th percentile	–223.79	–128.74	–183.85	–0.091	–0.051	–0.073
No. of workers	2,089,873	2,002,997	1,160,379	2,089,873	2,002,997	1,160,379
Average change in wage for people with tenure ≥3 years[a]	–26.22	99.64	51.65	–0.009	0.033	0.016
Median	–21.28	77.17	36.60	–0.008	0.303	0.014
SD	418.09	405.36	517.64	0.106	0.102	0.119
90th percentile	242.58	374.98	360.59	0.829	0.126	0.114
75th percentile	67.77	185.52	143.07	0.026	0.069	0.052
25th percentile	–121.17	–4.019	–36.78	–0.046	–0.002	–0.014
10th percentile	–317.24	–150.51	–223.47	–0.107	–0.054	–0.073
No. of workers	6,980,071	6,184,157	3,486,152	6,980,071	6,184,157	3,486,152

Source: Linked employer-employee data of the Institute for Employment Research/Germany, cross-sectional model, version 1, weighted values.

Notes: SD = standard deviation; CV = coefficient of variation.

[a]Observation = a person.

[b]Observation = a firm.

[c]Divided by one hundred.

Table 8C.5 **Mobility: All jobs**

	Unweighted values			Weighted values		
	1993	1995	2000	1993	1995	2000
Employees	812.415	696.544	453.927	100.315	94.229	86.165
SD	2119.559	1552.058	1286.649	395.994	310.298	374.508
No. of occupations	35.012	33.351	26.455	13.776	13.152	13.013
SD	27.262	25.798	21.565	11.056	10.612	10.356
Employment growth	–0.049	–0.020	–0.047	–0.017	–0.002	–0.042
SD	0.153	0.163	0.237	0.151	0.158	0.231
Exit rate	0.169	0.147	0.202	0.187	0.163	0.227
SD	0.135	0.132	0.204	0.132	0.128	0.195
Exit rate, top decile of firm wages	0.154	0.156	0.226	0.183	0.137	0.223
SD	0.183	0.182	0.246	0.177	0.142	0.199
Exit rate, top quartile of firm wages	0.147	0.139	0.193	0.161	0.127	0.213
SD	0.158	0.152	0.210	0.144	0.133	0.182
Exit rate, bottom decile of firm wages	0.246	0.209	0.338	0.247	0.228	0.292
SD	0.153	0.140	0.213	0.153	0.147	0.184
Exit rate, bottom quartile of firm wages	0.209	0.179	0.306	0.219	0.191	0.291
SD	0.127	0.150	0.229	0.134	0.139	0.181
Entry rate	0.111	0.121	0.150	0.159	0.157	0.179
SD	0.102	0.113	0.156	0.125	0.141	0.177

Entry rate, top decile of firm wages	0.097	0.109	0.137	0.200	0.227	0.161
SD	0.101	0.139	0.155	0.152	0.194	0.151
Entry rate, top quartile of firm wages	0.090	0.096	0.125	0.137	0.117	0.150
SD	0.085	0.105	0.135	0.125	0.118	0.148
Entry rate, bottom decile of firm wages	0.182	0.194	0.306	0.200	0.227	0.248
SD	0.143	0.169	0.271	0.152	0.194	0.234
Entry rate, bottom quartile of firm wages	0.147	0.162	0.261	0.181	0.187	0.250
SD	0.123	0.143	0.231	0.132	0.166	0.218
Percentage of employees who switch jobs[a] internally	0.027	0.021	0.020	0.024	0.014	0.015
SD	0.048	0.035	0.045	0.052	0.030	0.034
Percentage of workers who have been at firm 3+ years	0.664	0.665	0.590	0.585	0.584	0.545
SD	0.194	0.275	0.337	0.217	0.282	0.324
Correlation (exit rate, log average wage)[b]	–0.225**	–0.143**	–0.109**	–0.248**	–0.267**	–0.165**
Correlation (exit rate, log average wage change)[b]	–0.017**	–0.118**	0.015	0.006	–0.026**	–0.025**
Correlation (exit rate, SD of log wage)[b]	0.079**	0.079**	0.062**	0.114**	0.125**	–0.080**
Correlation (entry rate, log average wage)[b]	–0.321**	–0.291**	–0.244**	–0.218**	–0.292**	–0.183**
Correlation (entry rate, log average wage change)[b]	0.205**	0.069**	0.073**	0.142**	0.089**	0.014
Correlation (entry rate, SD of log wage)[b]	0.139**	0.128**	0.093**	0.057**	0.073**	–0.118**

Source: Linked employer-employee data of the Institute for Employment Research/Germany, cross-sectional model, version 1.

Notes: SD = standard deviation. All statistics are on the establishment level.

[a]Change in the 3-digit occupational code.

[b]Observation = a firm.

**Significant at the $\alpha < 0.005$ level.

Table 8C.6 **Mobility: High-level jobs**

	Unweighted values			Weighted values		
	1993	1995	2000	1993	1995	2000
Employees	157.661	131.322	68.213	29.900	28.225	21.523
SD	313.019	257.689	123.875	72.246	60.801	42.907
No. of occupations	15.290	14.098	9.595	6.786	6.596	5.495
SD	12.728	11.612	7.740	5.302	4.984	4.103
Employment growth	–0.081	–0.105	–0.080	–0.089	–0.030	–0.099
SD	0.308	0.317	0.385	0.339	0.329	0.387
Exit rate	0.114	0.116	0.159	0.119	0.119	0.156
SD	0.186	0.190	0.242	0.254	0.260	0.292
Exit rate, top decile of firm wages	0.121	0.131	0.182	0.148	0.113	0.175
SD	0.173	0.178	0.223	0.175	0.127	0.185
Exit rate, top quartile of firm wages	0.109	0.109	0.156	0.106	0.088	0.167
SD	0.149	0.141	0.192	0.138	0.120	0.180
Exit rate, bottom decile of firm wages	0.134	0.149	0.269	0.159	0.184	0.358
SD	0.307	0.317	0.524	0.410	0.389	0.719
Exit rate, bottom quartile of firm wages	0.116	0.141	0.226	0.127	0.155	0.286
SD	0.232	0.291	0.452	0.323	0.366	0.604
Entry rate	0.060	0.074	0.091	0.079	0.086	0.093
SD	0.111	0.175	0.183	0.171	0.239	0.220

Entry rate, top decile of firm wages	0.062	0.065	0.093	0.092	0.087	0.101
SD	0.080	0.081	0.131	0.121	0.122	0.117
Entry rate, top quartile of firm wages	0.053	0.054	0.081	0.075	0.061	0.089
SD	0.068	0.066	0.118	0.099	0.091	0.139
Entry rate, bottom decile of firm wages	0.104	0.110	0.219	0.127	0.118	0.125
SD	0.229	0.276	0.421	0.304	0.331	0.367
Entry rate, bottom quartile of firm wages	0.079	0.100	0.138	0.096	0.093	0.997
SD	0.169	0.256	0.338	0.234	0.278	0.351
Percentage of employees who switch jobs[a] internally	0.026	0.019	0.019	0.024	0.013	0.014
SD	0.060	0.049	0.068	0.077	0.047	0.055
Percentage of workers who have been at firm 3+ years	0.636	0.669	0.628	0.561	0.627	0.605
SD	0.259	0.310	0.391	0.277	0.330	0.389
Correlation (exit rate, log average wage)[b]	–0.046**	–0.047**	–0.031**	–0.090**	–0.117**	–0.055**
Correlation (exit rate, log average wage change)[b]	–0.004	–0.129**	0.025**	0.007	–0.067**	0.138**
Correlation (exit rate, SD of log wage)[b]	–0.063**	–0.089**	–0.075**	–0.072**	–0.103**	–0.146**
Correlation (entry rate, log average wage)[b]	–0.128**	–0.137**	0.016	–0.096**	–0.143**	–0.013
Correlation (entry rate, log average wage change)[b]	0.118**	–0.004	–0.055**	0.135**	–0.013	0.060**
Correlation (entry rate, SD of log wage)[b]	0.053**	–0.035**	–0.051**	–0.001	0.016	–0.092**

Source: Linked employer-employee data of the Institute for Employment Research/Germany, cross-sectional model, version 1.

Notes: SD = standard deviation. All statistics are on the establishment level.

[a]Change in the 3-digit occupational code.

[b]Observation = a firm.

**Significant at the $\alpha < 0.005$ level.

Table 8C.7 **Mobility: Low-level jobs**

	Unweighted values			Weighted values		
	1993	1995	2000	1993	1995	2000
Employees	223.284	181.506	111.529	66.920	59.406	54.314
SD	839.317	562.563	494.572	300.380	217.421	301.362
No. of occupations	17.890	16.660	11.807	11.795	10.997	9.409
SD	17.825	16.750	13.458	10.090	9.539	9.223
Employment growth	–0.039	–0.081	–0.060	–0.027	–0.084	–0.044
SD	0.305	0.303	0.360	0.231	0.237	0.348
Exit rate	0.252	0.222	0.317	0.240	0.214	0.313
SD	0.189	0.206	0.319	0.182	0.178	0.264
Exit rate, top decile of firm wages	0.333	0.349	0.450	0.309	0.298	0.451
SD	0.295	0.342	0.429	0.352	0.287	0.367
Exit rate, top quartile of firm wages	0.309	0.298	0.383	0.312	0.288	0.377
SD	0.261	0.291	0.374	0.299	0.273	0.317
Exit rate, bottom decile of firm wages	0.251	0.211	0.316	0.218	0.203	0.327
SD	0.159	0.143	0.211	0.129	0.118	0.168
Exit rate, bottom quartile of firm wages	0.225	0.186	0.289	0.211	0.176	0.262
SD	0.137	0.105	0.237	0.116	0.123	0.197
Entry rate	0.181	0.203	0.352	0.203	0.241	0.373
SD	0.182	0.192	0.363	0.184	0.229	0.329

Entry rate, top decile of firm wages	0.248	0.277	0.476	0.261	0.359	0.420
SD	0.269	0.297	0.495	0.249	0.386	0.465
Entry rate, top quartile of firm wages	0.216	0.245	0.418	0.232	0.313	0.409
SD	0.229	0.258	0.430	0.219	0.321	0.410
Entry rate, bottom decile of firm wages	0.190	0.201	0.306	0.189	0.212	0.369
SD	0.163	0.179	0.287	0.143	0.181	0.335
Entry rate, bottom quartile of firm wages	0.163	0.176	0.267	0.176	0.183	0.322
SD	0.142	0.153	0.244	0.144	0.167	0.305
Percentage of employees who switch jobs[a] internally	0.022	0.015	0.021	0.020	0.012	0.023
SD	0.074	0.054	0.083	0.062	0.051	0.090
Percentage of workers who have been at firm 3+ years	0.831	0.767	0.708	0.835	0.728	0.733
SD	0.234	0.327	0.403	0.202	0.349	0.395
Correlation (exit rate, log average wage)[b]	0.134**	0.193**	0.187**	0.078**	0.099**	0.112**
Correlation (exit rate, log average wage change)[b]	0.024**	–0.025**	0.045**	0.088**	0.016**	–0.022**
Correlation (exit rate, SD of log wage)[b]	–0.057**	–0.087**	–0.083**	–0.051**	–0.035**	–0.104**
Correlation (entry rate, log average wage)[b]	0.046**	0.099**	0.194**	0.135**	0.008	0.156**
Correlation (entry rate, log average wage change)[b]	0.181**	0.083**	0.039**	0.070**	0.055**	–0.015
Correlation (entry rate, SD of log wage)[b]	–0.057**	–0.067**	–0.158**	–0.131**	–0.100**	–0.257**

Source: Linked employer-employee data of the Institute for Employment Research/Germany, cross-sectional model, version 1.

Notes: SD = standard deviation. All statistics are on the establishment level.

[a]Change in the 3-digit occupational code.

[b]Observation = a firm.

**Significant at the $\alpha < 0.005$ level.

Appendix D

Covariates in the Wage Regressions for Table 8.6 and 8.7 (Full Regression Results, Including Coefficients, are Published in Alda [2006, chapter 5])

Worker Characteristics

Time/Spell Variant ($= x_{it}$)

age (age^2/100; age^3/10,000)	tenure (in years)	education level
current occupation group	multiple jobs (yes/no)	days of employment / days of unemployment $\times$ 100
days of employment / days unobserved $\times$ 100	number of employers	number of unemployment phases

Time/Spell Invariant

gender	nationality	of leave of absence (e.g., sabbaticals)

Firm Characteristics

Time/Spell Variant ($= w_{it}$)

size (ten dummies)	collective agreement (branch/ firm level; yes/no)	works council (yes/no)
economic situation (subjective measure)	paying more than tariff wages (yes/no)	sum of investment (log) per capita
weekly worked hours	outsourcing activities	vacancies
organizational change	number of occupations	churning

proportions of fixed-term contracts, females, and university degrees

Time/Spell Invariant

ownership sector (ten dummies) parent is single (yes/no) urbanity

Appendix E

Symbols and Indexes for Wage Regressions

Indexes

i: individuals	*j*: firms	*t*: time (years)

Symbols

μ : constant
x : observable time-variant person characteristics
w : observable time-variant firm characteristics
θ_i : unobserved person fixed-effect
ψ_j : unobserved firm fixed-effect
B : occupation groups
Note: θ_i and ψ_j include the time invariant covariates of people or firms.

Appendix F

Estimation of Fixed-Firm and Person Effect

A more detailed description of the regression techniques is given by Andrews, Schank, and Upward (2004):

For the spell-level fixed effect regression (Spell-FE), we define:

$$\lambda_s = \theta_i + \psi_j \tag{E1}$$

for each unique worker-firm combination (= spell). Neither θ_i nor ψ_j vary within a spell. The wage regression is then

$$y_{it} = x_{it}\beta + w_{jt}\gamma + \lambda_{ijt} + \varepsilon_{it}, \tag{E2}$$

with

$$\bar{\lambda}_s = \sum \frac{\lambda_{ijt}}{n} = \lambda_{ijt}. \tag{E3}$$

n is the number of observations (worker years) within a specific spell. Computing the mean deviations for each observation within a spell is:

$$y_{it} - \bar{y}_s = (x_{it} - \bar{x}_s)\beta + (w_{jt} - \bar{w}_s)\gamma + (\lambda_{ijt} - \bar{\lambda}_s) + (\varepsilon_{it} - \bar{\varepsilon}_s). \tag{E4}$$

Because of (E3), $\bar{\lambda}_s - \lambda_{ijt} = 0$. The estimator is consistent because he sweeps out both unobserved heterogeneities. He is not the most efficient one (because a least square dummy variable regression, LSDV, is).

The time-invariant covariates are constant within a spell and, therefore, swept out. The following example for a standard one-way-fixed model with worker data only shows how the wage effect of the time-invariant covariates are identified. The one-way wage regression is:

$$y_{it} = \mu + x_{it}\beta + \theta_i + \varepsilon_{it}. \tag{E5}$$

The standard fixed effect (FE) estimator of β can be interpreted as an instrumented variable (IV) estimator (Andrews, Schank, and Upward 2004, 10; Verbeek 2004, section 10.2.5). Then we can formulate

$$\text{(E6)} \qquad \hat{\beta}_{FE} = [\Sigma_i \Sigma_t (X_{it} - \overline{x}_i)'(X_{it} - \overline{x}_i)]^{-1} \Sigma_i \Sigma_t (X_{it} - \overline{x}_i)'(Y_{it} - \overline{y}_i)$$
$$= [\Sigma_i \Sigma_t (X_{it} - \overline{x}_i)' x_{it}]^{-1} \Sigma_i \Sigma_t (X_{it} - \overline{x}_i)' V_{it}.$$

Further details for the Spell-FE regression can be found in Andrews, Schank, and Upward (2004, 10–11). All variables correlated with the unobservables are instrumented by their mean deviations. Time-invariant variables are "instrumented with themselves," making the usual random effect assumption. The estimator is a special case of Hausman and Taylors' 1981 estimator.

For explicitly calculating (and not sweeping out) the unobserved fixed effects, we set all firm effects with less than sixteen movers into a single common effect. This allows us to connect all groups (forty-five) into one by constructing an artificial firm that contains all firms (and workers) who experience little turnover. After this procedure, we time-demean the remaining firm dummies (this is what Andrews, Schank, and Upward (2004) call $FE_i LSDV_j$) and compute θ_i with the estimated values of ψ_j.

Appendix G

Table 8G.1 **Firm is covered by collective contract compared to firms without collective contract—average treatment effects on the treated**

	1993	1995	2000
Average wage			
Collective contract	2,704.07	2,744.75	2,838.53
Without col. contract	2,656.02	2,736.61	2,711.09
Average treatment effects	48.05	8.13	127.44
t-value	0.64	0.08	2.33
Within firm standard deviation			
Collective contract	772.90	804.97	831.06
Without col. contract	807.61	825.87	815.63
Average treatment effects	–34.71	–20.89	15.42
t-value	–1.16	–0.6	0.7
Change in wage			
Collective contract	19.56	93.71	54.18
Without col. contract	12.73	88.85	60.42
Average treatment effects	6.82	4.86	–6.24
t-value	0.56	0.24	0.72
Coefficient of variation of change in wage			
Collective contract	0.289	0.297	0.294
Without col. contract	0.312	0.307	0.308
Average treatment effects	–0.2288	–0.0099	–0.0139
t-value	–2.47	–0.71	–1.73

Table 8G.1 (continued)

	1993	1995	2000
Exit rate			
Collective contract	0.181	0.170	0.210
Without col. contract	0.257	0.194	0.220
Average treatment effects	–0.077	–0.024	–0.01
t-value	–3.58	–1.03	0.58
Entry rate			
Collective contract	0.160	0.166	0.165
Without col. contract	0.192	0.178	0.190
Average treatment effects	–0.032	–0.012	–0.026
t-value	–2.04	–0.52	–1.95
Percentage of workers who have been at firm 3+ years			
Collective contract	0.587	0.595	0.546
Without col. contract	0.500	0.509	0.519
Average treatment effects	0.087	0.086	0.027
t-value	3.49	2.08	0.95

Source: LIAB, cross-sectional model, version 1.

Notes: Firms with at least twenty-five full-time employees. In 1993, there are 120 (1995: 91; 2000: 193) firms without collective agreement in the sample, whereas firms with collective contract are ten times more. We reverse, therefore, the treatment in the matching procedure. For a better reading, we multiplied the average treatment on the treated times minus one. Between four (in 1993) and seventeen firms (in 2000) are not covered by the region of common support. These firms are excluded.

Bootstrapped *t*-values according to H_0: identical mean values. Monthly gross wages; mobility variables defined as proportions.

We apply a kernel matching and calculated bootstrapped standard errors with 200 repetitions. The probit estimation of propensity scores uses as covariates the average age of workers in a firm, existence of a workers council, one regional dummy, three dummies for firm size and eight for branches and proportions of females, of fixed-term workers, of blue-collar workers and of six different qualification groups. Pseudo-R^2 is varying between 0.29 and 0.15.

References

Abowd, J. M., R. Creecy, and F. Kramarz. 2002. Computing person and firm effects using linked longitudinal employer-employee-data. U.S. Census Bureau Technical-Paper no. 2002-6. Washington, DC: U.S. Census Bureau.

Abowd, J. M., F. Kramarz, and D. Margolis. 1999. High wage workers—High wage firms? *Econometrica* 67:251–333.

Addison, J. T., L. Bellmann, C. Schnabel, and J. Wagner. 2004. The reform of the German Works Constitution Act: A critical assessment. *Industrial Relations* 43:392–420.

Alda, H. 2005a. *Betriebe und beschäftigte in den linked employer-employee daten* (Firms and employees in the linked employer-employee data [LIAB] of the Institute of Employment Research). FDZ Data Report no. 1. Nuremberg: Institute for Employment Research.

———. 2005b. *Die Verknüpfungsqualität der LIAB daten* (The quality of linking LIAB data). FDZ Methodology Report no. 2. Nuremberg: Institute for Employment Research.

———. 2005c. *Datenbeschreibung der version 1 des LIAB querschnittmodells* (Data description for the first version of the LIAB cross-sectional model). FDZ Data Report no. 2. Nuremberg: Institute for Employment Research.

———. 2005d. *Datenbeschreibung der version 1 des LIAB längsschnittmodells* (Data description for the first version of the LIAB longitudinal model). FDZ Data Report no. 3. Nuremberg: Institute for Employment Research.

———. 2006. *Beobachtbare und unbeobachtbare betriebs- und Personeneffekte auf die Entlohnung: Beiträge aus der Arbeitsmarkt- und Berufsforschung 298* (*Observed and unobserved effects of firm and worker characteristics on wages: Features of employment and occupational research 298*). Nuremberg: Institute for Employment Research.

Alda, H., S. Bender, and H. Gartner. 2005. The linked employer-employee dataset of the IAB (LIAB). IAB Discussion Paper no. 06/2005. Nuremberg: Institute for Employment Research.

Andrews, M., T. Schank, and R. Upward. 2004. Practical estimation methods for linked employer-employee-data. IAB Discussion Paper no. 3/2004. Nuremberg: Institute for Employment Research.

Barth, E., and H. Dale-Olsen. 2003. Assortative matching in the labour market? Stylised facts workers and plants. Paper presented at the EALE 2003 Conference. 9–11 September, Lisbon, Portugal.

Bauer, T., and S. Bender. 2002. Technological change, organizational change, and job turnover. IZA Discussion Paper no. 570. Bonn: Institute for the Study of Labor.

Bauer, T., S. Bender, and H. Bonin. 2004. Dismissal protection and worker flows in small establishments. IZA Discussion Paper no. 1105. Bonn: Institute for the Study of Labor.

Büttner, T., and B. Fitzenberger. 1998. Central wage bargaining and local wage flexibility: Evidence from the entire wage distribution. ZEW Discussion Paper no. 98-39. Mannheim, Germany: Center for European Economic Research.

Brixy, U., S. Kohaut, and C. Schnabel. 2007. Do newly founded firms pay lower wages? First evidence from Germany. *Small Business Economics* 29:161–71.

Calmfors, L., and J. Driffill. 1988. Bargaining structure, corporatism, and macroeconomic performance. *Economic Policy* 6:14–61.

Gartner, H. 2005. The imputation of wages above the contribution limit with the German IAB employment sample. FDZ Methodenreport no. 2/2005. Nuremberg: Institute for Employment Research.

Goux, D., and E. Maurin. 1999. Persistence of inter industry wage differentials: A reexamination using matched worker-firm panel data. *Journal of Labor Economics* 17:492–533.

Groshen, E. L. 1989. Do wage differences among employers last? Federal Reserve Bank of Cleveland Working Paper no. 8802. Cleveland, OH Federal Reserve Bank of Cleveland.

———. 1991. Five reasons why wages vary among employers. *Industrial Relations* 30:350–83.

Gruetter, M., and R. Lalive. 2003. Job mobility and industry wage differentials: Evidence from employer-employee matched data. University of Zurich. Mimeograph.

Hall, P., and D. Soskice, eds. 2003. *Varieties of capitalism.* New York: Oxford University Press.

Kohaut, S., and C. Schnabel. 2003. *Verbreitung, ausmaß und determinanten der übertariflichen entlohnung* (Coverage, intensity, and determinants of wages above tariff arrangements). *Mitteilungen aus der Arbeitsmarkt- und Berufsforschung* 36:661–71.

Kölling, A., and T. Schank. 2003. Skill-biased technological change, international trade and the wage structure. Chair for Labor Market and Regional Policy Discussion Paper no. 14. Nuremberg: University of Erlangen-Nuremberg.

Möller, I. 2001. *Mitarbeiterbeteiligung: Ein weg zu höherer produktivität* (Employee profit sharing: A way to higher productivity). IAB *Kurzbericht* 9/2001. Nuremberg: Institute for Employment Research.

Organization for Economic Cooperation and Development (OECD). 1997. *Employment Outlook 1997.* Paris: OECD.

———. 1999. *Employment Outlook 1999.* Paris: OECD.

———. 2005. *Taxing wages 2004/2005.* Paris: OECD.

Schwerdt, W., and S. Bender. 2003. *Was tun lehrlinge nach ihrer ausbildung? Eine analyse mit dem linked employee-datensatz des IAB* (What do apprentices do after their training? An investigation with the linked employer-employee data of the IAB). *Mitteilungen aus der Arbeitsmarkt- und Berufsforschung* 36:46–59.

Stephan, G. 2001. *Firmenlohndifferentiale—Eine empirische Untersuchung für die Bundesrepublik Deutschland* (*Firm wage differentials: An empirical investigation for the Federal Republic of Germany*). Frankfurt a. M: Campus.

Verbeek, M. 2004. *A guide to modern econometrics.* 2nd ed. New York: Wiley.

Verick, S. 2004. Threshold effects of dismissal protection legislation in Germany. IZA Discussion Paper no. 991. Bonn: Institute for the Study of Labor.

Winkelmann, R. 1997. How young workers get their training: A survey of Germany versus the United States. *Journal of Population Economics* 10:159–70.