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## Collective contracts, wages and wage dispersion in a multi-level model

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## **Collective Contracts, Wages and Wage Dispersion in a Multi-Level Model**

*Gesine Stephan (IAB) and Knut Gerlach (Universität Hannover)*

# Collective Contracts, Wages and Wage Dispersion in a Multi-Level Model

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Auch mit seiner neuen Reihe „IAB-Discussion Paper“ will das Forschungsinstitut der Bundesagentur für Arbeit den Dialog mit der externen Wissenschaft intensivieren. Durch die rasche Verbreitung von Forschungsergebnissen über das Internet soll noch vor Drucklegung Kritik angeregt und Qualität gesichert werden.

Also with its new series "IAB Discussion Paper" the research institute of the German Federal Employment Agency wants to intensify dialogue with external science. By the rapid spreading of research results via Internet still before printing criticism shall be stimulated a quality shall be ensured.

**Abstract**

We use German linked employer-employee data for the years 1990, 1995 and 2001 to analyze, which dimensions of wage setting differ across three wage-setting regimes: Establishments applying sectoral collective contracts, establishments with firm-level contracts and uncovered establishments. The empirical analysis is restricted to workers without supervisory functions in larger manufacturing firms and shows that for this group of workers base wages are higher in firms applying collective contracts, while returns to human capital and the gender wage gap are reduced. Moreover, during the nineties these effects have become stronger.

**Keywords:** Collective contracts, wage flexibility, firm wage differentials, multi-level model

**JEL-classification:** J31, J51

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## 1 Introduction

A number of comparative macroeconomic studies (OECD Employment Outlook, 1997, Flanagan, 1997) analyses the impact of union density and bargaining coverage on the distribution of wages. These studies face, however, the problem that the wage distribution is affected by additional causal factors that differ between countries and that are difficult to control for. Microeconomic studies concentrate mainly on the wage effects of individual union membership (Card, 1996, Blau and Kahn, 1999, Booth and Bryan, 2001, Budd and Na, 2000, Card et al., 2003). They discuss the effects on unions on the wage structure, i.e. the wage differentials between men and women, between skilled and unskilled workers as well as between blue-collar and white-collar workers.

In continental Europe, specifically in Germany, however, with its systems of corporatist wage-setting, the application of collective wage contracts within firms is arguably more important for wage-setting and pay differentials than union membership. In West Germany less than one third of employees are union members, but almost 80 percent of workers are covered by either industry-wide collective agreements or firm-level contracts (Pfeiffer, 2003, for the year 2000), which impose minimum wage standards at the firm level. The striking difference results mainly from the fact that firms covered by collective contracts usually do not differentiate across workers with and without union membership, although they are not obliged to pay union wages to non-union members.

The main topic of our paper is to study empirically which dimensions of wage setting – base wages or returns to individual characteristics – differ across wage setting regimes in Germany during the nineties and might thus restrict the options of pay policies of firms covered by collective contracts. We distinguish three wage-setting regimes: First establishments applying collective contracts at the industry-level, second establishments with firm-level contracts and third establishments without coverage. Since union wage effects will affect wage-setting at the firm level we model the wage effects of collective contracts as multi-dimensional firm wage differentials, using linked employer-employee data (Hamermesh 1999) and applying a multi-level model of wage determination. The results show that an application of collective contracts correlates with higher firm-specific

base wages, reduced firm-specific rates of return to human capital and gender wage gaps compared to individual wage bargaining. In addition, collective contracts tend to increase base wages and compress rates of return to human capital in economic recessions.

The paper is organized as follows. Section 2 briefly discusses the theoretical background, including the basic features of the German system of industrial relations, and formulates testable hypotheses. After a short review of the literature in Section 3, Section 4 lays out the framework of the econometric model. Section 5 describes data and variables. The empirical results are discussed in Section 6 and Section 7 summarizes the results and draws some conclusions.

## **2 Theoretical Background and Hypotheses**

For a given firm we define the base wage as the wage a standard worker can expect to obtain within this firm. As firm wage differentials we define the difference between the base wage and rates of return to observed characteristics paid by this firm and the standard firm in the economy. Kramarz et al. (1996) denote these as global firm wage differentials since we cannot control for unobserved characteristics of the workforce.

There are three main sources of firm wage differentials (Groshen, 1991):

- Bargaining power of owners or managers and the workforce of a company varies across firms, as well as firms' product market power and thus their ability to pay. Thus different firms will pay rent-sharing components of different size to all or some employees.
- Dependent on the production technology chosen incentive problems might prevail and induce some firms to pay efficiency or seniority wages.
- Skill sensitive technologies and positive external effects of qualification are a source of sorting processes of employees across firms, with some firms employing mainly high-skilled, high-wage employees and others employing mainly low-paid, low-skilled workers.

If bargaining power, incentive problems or sorting processes are relevant for the entire workforce of a firm, wage differentials across firms will manifest themselves in the base wage. If the sources of firm wage differ-

entials are, however, more prevalent for skilled workers or for workers of one gender, we expect an impact on firm-specific rates of return for skills or on gender wage differentials.

Union wage policies can briefly be characterized as follows: First, unions aim to improve the living standard of their members, mainly by bargaining for higher wages or lower working hours (Freeman 1982). Models of bargaining outcomes obtain the result that the union wage mark-up over alternative income increases with union power and decreases with product market competition, labour intensity and workers' fear of job loss, while the alternative wage increases with lower unemployment and higher unemployment benefits (Layard et al. 1991). Second, unions try to standardize and compress wages across as well as within firms, in particular by attaching wages to job-grades (Freeman and Medoff, 1984). Wage compression strengthens the organizational unity among workers with different skills and tasks up to a certain degree. Additionally, union members might have preferences for wage compression if the mean exceeds the median wage or if they are risk-averse and uncertain about the future development of their wages (Agell 1999, 2002). The standardization of wages restricts opportunities for gender wage discrimination and since women are more frequently in the lower ranges of the wage distribution, they might benefit from the compression of wages.

These union wage policies have an impact on firm wage differentials if bargaining power, incentive problems or sorting processes differ across wage-setting regimes. Bargaining power will be enhanced by unionization and raises wages in companies with collective contracts while the actual size of rents to be shared depends also on firms' ability to pay. However, it is also possible that in particular those firms facing incentive problems apply collective contracts – for instance, Lazear (1981) argues that unions may act as a substitute for supervisors. Furthermore it might be that workers who are on average more productive and homogeneous self-select into firms applying collective contracts or that firms applying these contracts are on average more productive.

Under the German system of sectoral and regional bargaining employers' associations and unions conclude collective wage agreements that set a minimum wage structure for member firms of employers' associations,

and which in rare cases are extended to non-member firms by the Federal Ministry of Labour. In addition, non-members of employers' associations might agree formally or informally to meet the conditions of these industry-level agreements or refer to these agreements in individual contracts. As an alternative to the application of industry-wide collective agreements companies can negotiate directly with a union for a firm-level contract. Note that works councils do not have the right to bargain over wages, although de facto they have some impact on pay and the structure of remuneration (Hübler/Jirjahn 2003).

Since wages of uncovered firms might react faster and more strongly to macroeconomic conditions the pay differential between uncovered and covered firms might shrink in an economic upswing and widen in a recession. This does not require that potential wage reactions of covered firms are excluded. Reactions might consist of augmenting the gap between effective and contractual wages for some or all employees in an upswing and reducing the gap in a recession. They are, however, restricted by the prevailing minimum wage structure set by collective contracts and depend on the existence of wage gaps. Furthermore the wage adjustment might be more cautious and gradual since firms expect unions to compensate wage reductions by higher claims during the subsequent negotiations and to interpret pay hikes as a signal that contractual wages should be re-aligned with effective wages.

Summing up, these considerations lead to the following hypotheses:

- First, base wages will be higher in firms with collective contracts, partly as a result of the increased bargaining power of employees.
- Second, rates of return to human capital should be lower in firms applying collective contracts, since unions aim to compress wages across skill groups.
- Third, the gender specific wage differential can be expected to be lower in firms covered by collective contracts.
- Fourth and more tentatively, the impact of collective contracts on firm wage differentials is expected to vary cyclically, declining in upswings and widening in recessions.



### **3 Short Review of the Literature**

Freeman (1982) in a landmark paper shows that unionized companies have a much lower within and between dispersion of wages than comparable non-covered firms in the same industries. These findings are confirmed in a recent and detailed survey and a research update till 2001 for the USA, UK and Canada (Card, Lemieux and Riddell 2003). The authors show that unions tend to reduce wage inequality among men with different ages and educational levels, and that wage inequality among women is not affected by unions.

Hartog et al. (2000) assess the magnitudes of wage differentials under corporatist labour relations within the Netherlands. They conclude that in terms of the wage structure it is mainly the regime with firm level bargaining that differs from the collective bargaining and the individual bargaining regime. The relationship between coverage of firms by collective contracts and wage inequality in Germany has been analyzed on the basis of linked employer – employee data sets for the year 1995 by Stephan and Gerlach (2003). The authors find that the application of collective contracts is correlated with a higher base wage for all employees of a firm and that the male-female wage gap declines compared to the wage-setting regime with individual agreements.

### **4 Econometric Model**

The applied method (see for instance Raudenbush and Bryk 2002) takes account of the fact that firm-wage differentials can a) occur at several dimensions of wage-setting and that b) wage-setting in different firms is not isolated from each other. The first fact is not taken into account by studies modelling firm-specific effects on wages as one-dimensional fixed effects (see Stephan 2002 for an overview). The latter fact is disregarded in studies estimating multi-dimensional firm wage differentials using separate Ordinary Least Squares estimates for each firm (Kramarz et al., 1996, Leonard and Van Audenrode, 1996). Our study is to some degree similar to Cardoso's investigations for Portugal (Cardoso, 1999, 2000), who does, however, not control for the wage-setting regime a firm is applying.

At the first level of the model log wages  $y_{ij}$  of individual  $i = 1 \dots N$  in firm  $j = 1 \dots M$  are determined by a  $K \times 1$ -vector of explanatory variables  $X_{ij}$ , which includes a constant and  $K-1$  observed worker characteristics.

$$(1) \quad y_{ij} = X_{ij}'\beta_j + r_{ij}.$$

The individual level residual is given by  $r_{ij} \sim N(0, \sigma^2)$ . The  $K \times 1$ -vector of parameters  $\beta_j$  varies across firms, and can be interpreted as a vector of firm wage differentials. However, we do not assume purely random variations of  $\beta_j$  across firms, but take into account that at the second level of the model  $\beta_j$  is determined by a  $1 \times L$ -vector  $w_j$  of explaining variables, which includes a constant and  $L-1$  observed firm characteristics. With  $W_j = I_K \otimes w_j$  as a  $K \times K \cdot L$ -matrix it follows that

$$(2) \quad \beta_j = W_j\gamma + u_j.$$

The  $K \cdot L \times 1$ -parameter vector  $\gamma$  includes the systematic influences on wages in the economy. The  $K \times 1$ -vector of firm level residuals  $u_j \sim N(0, T)$  contains for each firm the deviation of firm-specific wage parameters from their expected value, given  $w_j$  respectively  $W_j$ , with

$$T = \text{Var}(u_j) = \begin{bmatrix} \tau_{00} & \dots & \tau_{0K} \\ \dots & \dots & \dots \\ \tau_{K0} & \dots & \tau_{KK} \end{bmatrix}.$$

Concerning the co-variances the following assumptions are made (Raudenbush and Bryk 2002, 255):  $\text{Cov}(r_{ij}, u_{kj}) = 0$ ,  $\text{Cov}(X_{kij}, r_{ij}) = 0$ ,  $\text{Cov}(w_{\ell j}, u_{kj}) = 0$ ,  $\text{Cov}(w_{\ell j}, r_{ij}) = 0$  and  $\text{Cov}(X_{kij}, u_{k'j}) = 0$  for all  $k, k'$  and  $\ell$  and with  $k = 1 \dots K$  and  $\ell = 1 \dots L$ , where  $X_{kij}$ ,  $w_{\ell j}$  and  $u_{kj}$  are single elements of  $X_{ij}$ ,  $w_j$  and  $u_j$ .

Estimation proceeds as follows. First the true parameters  $\beta_j$  in (2) are approximated by firm-specific Ordinary-Least-Square estimates  $\hat{\beta}_j$ ,

$$(3) \quad \hat{\beta}_j = W_j \gamma + u_j + e_j$$

which involves an additional error term  $e_j \sim N(0, V_j)$ . Equation (3) can be estimated by Generalized Least Squares.

$$(4) \quad \hat{\gamma} = (\sum W_j' \Delta_j^{-1} W_j)^{-1} \sum W_j' \Delta_j^{-1} \hat{\beta}_j \quad \text{with } \Delta_j = \text{Var}(\hat{\beta}_j) = \text{Var}(u_j + e_j) = T + V_j.$$

The parameter dispersion matrix  $T$  and the error dispersion matrix  $V_j$  have, however, to be estimated. Maximum likelihood estimates can be obtained by an iterative procedure, also adjusting the estimates of the fixed parameters  $\gamma$  during each step. Since Iterative Generalized Least Squares in general produces biased estimates (which can be important in small samples) unbiased restricted maximum likelihood estimates are conducted. All estimates has been carried out using the program package HLM 5.05 by Raudenbush, Bryk and Congdon.

Note that the method applied does not control for self-selection of workers into firms and of firms into wage-setting regimes. Thus, the results presented have to be interpreted as correlations rather than as causal relationships.

## 5 Data and Variables

The empirical analysis is based on the three recent waves of the Salary and Wage Structure Survey ("Gehalts- und Lohnstrukturerhebung") for the federal German State of Lower Saxony, which were conducted in the years 1990, 1995 and 2001. Lower Saxony is one of the larger federal states in northwest Germany and covers around 11 percent of all West German employees. The data are drawn as a two-stage random sample from all establishments in the entire manufacturing sector and in selected service sectors. Establishments as well as employees included in the data set differ in successive surveys. The data do thus not allow controlling for unobserved worker heterogeneity, which might be even more important in wage-setting than firm effects on wages (Abowd et al., 1999).

As we have already emphasized it is not individual union membership, but rather the application of collective wage contracts at the firm level which

has an impact on wages in Germany. The Salary and Wage Structure Survey asks, if a firm applies a specific collective contract at the industry or firm level in remunerating workers, but does not distinguish between legal obligations to meet the terms of the agreement or of adopting them voluntarily.

The analysis is restricted to full-time employees aged 16 to 65 with a working time of at least 30 weekly hours and an hourly wage of at least 5 Euro. Furthermore, workers with supervisory functions and workers not receiving collectively negotiated wages within firms applying collective contracts have been excluded from the subsequent analysis (these are typically workers with very high or very low wages). At the firm level the analysis is restricted to manufacturing companies with 100 to 10.000 employees, for which at least 20 observations are available. Note that the number of observations is smaller in 2001 compared to 1990 and 1995; the underlying reason is that the survey covered a number of additional service sectors in 2001, but less firms and workers in manufacturing.

The dependent variable analysis is log hourly gross wages. For purposes of comparison wages are converted for 1990 and 1995 from Deutsche Mark to Euros. At the individual level the following variables are included in  $X_{ij}$ : A constant, years required for the highest educational attainment (abbreviated as schooling), tenure and potential experience (to keep the model as simple as possible, both enter only in linear form), a dummy for gender, and a dummy for a blue- or white-collar worker. Schooling and potential experience are interpreted as proxies for general human capital, while tenure – although problems of endogeneity might occur – captures specific human capital. At the firm level in  $w_j$  respectively  $W_j$  the following variables are incorporated: A constant, two dummies for the application of a sectoral or firm level collective contract, mean years of schooling, the share of female employees and firm size. Mean years of schooling are supposed to mirror the mean human capital endowment within a firm. It is well established that wages decrease with the share of female employees (Bayard et al. 2003) and increase with firm size (Gerlach and Hübler 1998).

To facilitate the interpretation the variables in  $X_{ij}$  and  $W_j$  are centered on their grand mean in the multivariate analysis (Raudenbush and Bryk 2002, 32 ff.), with the exception of the dummy variables for the wage-setting regime. As a consequence the firm-specific first level constants  $\beta_{0j}$  from equation (1) indicate the base wage a standard worker – approximately 12 years of schooling, 11 years of tenure, 22 years of potential experience, 25 percent female and 25 percent white-collar worker – can expect to obtain in a firm with specific characteristics. The second level constants  $\gamma_{k0}$  from equation (2) show the wage effects of individual characteristics within otherwise standard firms – mean years of schooling, mean share of female workers and mean firm size – that do not apply a collective contract.

## 6 Empirical Results

Descriptive results for the sample investigated are summarized in Table 1. It is obvious that wages are on average lower and more dispersed for workers if firms negotiate wages individually. From 1990 to 1995 respectively to 2001 nominal wages rose by about 20 respectively 40 percent. In comparison, the harmonized consumer price index has been growing less (about 20 or 30 percent during these periods). The difference in mean log wages across firms applying collective contracts and those negotiating wages individually barely changed from 1990 to 2001. Figure 1 displays additional Kernel estimates of the distribution of log hourly wages per wage-setting regime and year.

Among the explanatory variables noticeable differences across wage-setting regimes can be detected: in companies not applying collective contracts average tenure is about 4 years shorter, the percentage of female workers is higher, and average firm size is smaller (Table 1).

Table 2 presents the estimates of the systematic parameters  $\gamma$  of the multi-level model, obtained from equation (4). Displayed probability values refer to robust, Huber-corrected standard errors (Raudenbush and Bryk 2002: 276 ff.). It has to be pointed out again that the first level constant is a function of firm characteristics and describes the base wage for a standard worker in a firm with specific characteristics, while the second

level constant describes wage components paid in an otherwise standard firm that does not apply a collective contract.

First, the economic results of an application of collective contracts will be discussed, starting with their impact on base wages. In 1990 a standard worker employed in a standard firm not applying a collective contract received a log hourly wage of 2.298. If he would had worked in a standard firm applying an industry or firm level collective contract, his wage would have increased by 4, respectively 3 percent. The wage gain of working under industry level collective contracts increases to 9 percent in 1995 and 12 percent in 2001; and to 7 percent in 1995 and 11 percent in 2001 for working under firm level collective contracts. These pay differentials are lower than the gross difference in log wages shown in Table 1. Thus a proportion of the higher wages paid in firms applying collective contracts must be due to different worker characteristics. However, as formulated in our first hypothesis, collective contracts tend to raise base wages. Furthermore, the impact of collective contracts on base wages has been rising significantly in the nineties.

We now turn to the other dimensions of firm wage policies. Compared to firms negotiating wages individually, returns to schooling are significantly lower under industry level collective contracts in 1995 and 2001, while returns to tenure are significantly lower under these as well as under firm level collective contracts in the three years investigated. This is line with our second hypothesis, which predicted compressed returns for human capital as a result of union induced wage compression. An additional striking result is that returns to schooling and tenure were more compressed by collective contracts in 2001 than in 1990. Apparently the increase in the impact of collective contracts on base wages has been offset in a great degree by a decline in returns to human capital.

The gender wage gap in 1990 in firms not applying collective contracts amounted to 21 percent; it shrank to 17 percent in 2001. A noteworthy result is that in all three years investigated the gender wage gap is about 5 percentage points smaller in firms applying collective contracts. This supports our third hypothesis.

Second, the results of the additional explanatory variables will be characterized briefly. A strong impact on firm wage differentials is found for mean years of schooling within a firm: Firm-specific base wages and in most cases rates of return to tenure and experience increase significantly with average years of schooling. This might on the one hand indicate positive external effects of qualification. On the other hand the underlying reason might be sorting: High-wage firms attract on average better qualified workers. The share of female workers within a firm is negatively related to firm-specific base wages – a larger proportion of women in a firm are correlated with lower wages paid to a standard worker. The well known firm size effect on wages manifests itself mainly in a slightly higher firm-specific base wage.

Third, empirical studies of multi-dimensional firm wage differentials show that firm-specific coefficients vary strongly across firms (Kramarz et al., 1996, Leonard and Van Audenrode, 1996, Cardoso, 2000). This is valid also for Germany: Table 2 shows that all estimated standard deviations of the macro residuals  $u_j$  from equation (2) are significantly different from zero. Furthermore, with the exception of returns to schooling, the estimated standard deviation of macro residuals has been increasing over time, which implies that wage-setting has become more heterogeneous across firms. In addition, the dispersion of individual level wage residuals  $r_{ij}$  has been rising over time.

Summing up, we find support for the first three hypotheses, namely that base wages are higher in firms applying collective contracts, while rates of return to human capital and the gender wage gap are lower compared to companies with individual wage contracts. The fourth hypothesis that differences across wage-setting regimes might change during the business cycle is also confirmed. The overall percentage difference between log mean wages across regimes hardly changed in the three years under consideration (Table 1). But in 1990 the West-German economy was exposed to an economic boom due to the strong demand in the process of reunification, while the years 1995 and 2001 are characterized by low growth rates and declining or stagnant employment, furthermore a steep decline of demand began in 2001. In accordance with the fourth hypothesis we find that compared to individual wage agreements collective con-

tracts increased base wages and compressed rates of return to human capital substantially in 1995 and 2001 with respect to 1990 (Table 2).

## 7 Conclusions

The results of our paper show that it is warranted to model the wage effects of collective contracts in Germany as firm wage differentials, taking into account differences in base wage rates as well as in rates of return to observed worker characteristics. In interpreting our results, it should be taken into account that the analysis presented is restricted to workers without supervisory functions, who are working in large firms (100 to 10.000 employees) in the manufacturing sector within one of the larger federal states of West Germany.

First, our results confirm that all investigated components of wage setting differ significantly across firms. Second, the main result of our analysis is that an application of collective contracts in Germany is correlated with higher firm-specific base wages, reduced firm-specific rates of return to human capital and gender wage gaps compared to individual wage bargaining. The results indicate that idiosyncratic firm-specific wage policies are important, while at the same time and in particular higher base wages and reduced returns to human capital might restrict the options for and the flexibility in wage-setting of firms applying collective contracts. Third, during the nineties we observe augmenting differences across wage-setting regimes in the sense that collective contracts increasingly tend to raise base wages and compress returns to human capital.

Admittedly, our results are in some sense descriptive. The important issue cannot be addressed conclusively if the observed relationship between pay components and collective contracts depends on union bargaining power and changes in union pay policy or on self-selection and sorting processes of workers into wage-setting regimes. If bargaining power of unions is an important determinant of the observed firm wage differentials – and the findings are supportive of this assumption –, the economic consequences of higher wages and reduced wage dispersion in firms applying collective contracts are ambivalent. On the one hand unions in conjunction with works councils might act as a voice mechanism improving productivity (Freeman/Medoff 1984) and as an insurance against future wage uncer-



tainty (Agell 1999, 2002). On the other hand the German system of industrial relations might enhance the segregation of the workforce into insiders and outsiders. Workers in firms applying industry level collective contracts gain from higher base wages and have on average longer tenure, while at the same time less fortunate workers earn lower wages and face higher risks of unemployment (Bertola et al. 2002). In addition, the incentives for an acquisition of human capital are reduced in core sectors which might be ominous for an economy increasingly based on information and communication technologies.

## Figures and Tables

Figure 1: Kernel estimates of log hourly wages by year and wage-setting regime

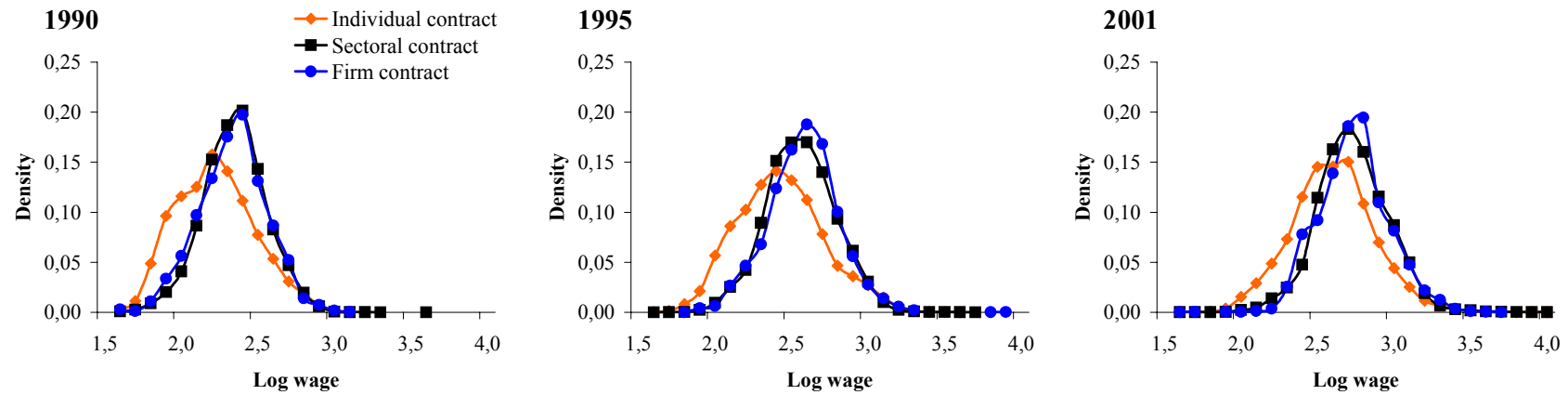


Table 1: Descriptive statistics

	Individual contract						Sectoral contract						Firm contract						
	1990		1995		2001		1990		1995		2001		1990		1995		2001		
	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.	
<b>Individual level</b>																			
Log hourly wage rate	2,22	0,25	2,43	0,28	2,60	0,27	2,35	0,21	2,56	0,23	2,73	0,23	2,34	0,22	2,58	0,23	2,74	0,22	
Years of schooling	11,46	1,33	11,54	1,53	11,88	1,47	11,45	1,30	11,55	1,39	11,66	1,44	11,29	1,25	11,51	1,46	11,59	1,34	
Tenure	7,16	7,26	8,43	7,55	8,21	7,69	10,95	9,89	12,06	9,68	11,76	9,55	12,29	10,23	12,97	9,74	10,76	9,91	
Potential Experience	17,15	11,15	19,83	10,53	19,70	9,63	20,51	11,72	21,95	10,80	22,22	9,98	21,13	11,78	21,99	10,71	23,52	9,77	
Gender (1 = female)	0,34	-	0,31	-	0,22	-	0,24	-	0,25	-	0,21	-	0,23	-	0,23	-	0,21	-	
Position (1 = White-collar worker)	0,23	-	0,27	-	0,29	-	0,21	-	0,25	-	0,23	-	0,21	-	0,22	-	0,22	-	
Number of observations	2736	-	2946	-	1470	-	19209	-	17276	-	9968	-	3079	-	2383	-	1708	-	
<b>Firm level</b>																			
Mean years of schooling	11,41	0,57	11,61	0,83	11,94	0,65	11,49	0,52	11,55	0,55	11,68	0,56	11,24	0,52	11,47	0,59	11,51	0,54	
Share of female workers	0,35	0,24	0,31	0,22	0,23	0,18	0,24	0,21	0,25	0,20	0,22	0,19	0,26	0,23	0,25	0,16	0,22	0,18	
Firm size	279	297	243	188	330	341	686	783	484	520	641	754	686	1235	650	1208	693	914	
Number of observations per firm	45	22	43	21	39	15	64	38	49	23	54	45	68	62	63	60	66	81	
Number of observations	61	-	68	-	38	-	301	-	353	-	184	-	45	-	38	-	26	-	
Increase in log wages since 1990	-	-	0,21	-	0,38	-	-	-	0,21	-	0,38	-	-	-	0,24	-	0,40	-	
Log wage differential to individual contract	-	-	-	-	-	-	0,12	-0,04	0,13	-0,05	0,13	-0,03	0,11	-0,04	0,15	-0,05	0,14	-0,04	

Source: Wage and Salary Structure Survey Lower Saxony

**Table 2: Estimates for the systematic parameters  $\gamma$  by year**

Second level (firm)	First level (individual)											
	Constant		Schooling / 10		Tenure / 10		Experience / 10		Gender		Position	
	$\gamma$	Prob.	$\gamma$	Prob.	$\gamma$	Prob.	$\gamma$	Prob.	$\gamma$	Prob.	$\gamma$	Prob.
<b>1990</b>												
Constant	2,298 **	0,00	0,274 **	0,00	0,068 **	0,00	0,020 **	0,00	-0,237 **	0,00	0,182 **	0,00
Sectoral contract	0,040 **	0,00	-0,009	0,81	-0,028 **	0,00	-0,007	0,08	0,049 **	0,00	0,006	0,70
Firm contract	0,031	0,09	-0,057	0,19	-0,028 **	0,00	-0,007	0,16	0,046 **	0,01	-0,011	0,63
Mean years of schooling	0,028 **	0,01	0,048	0,06	0,004	0,26	0,011 **	0,00	-0,011	0,16	0,000	0,98
Share of female workers	-0,143 **	0,00	-0,042	0,45	0,034 **	0,00	0,015 *	0,02	0,061 **	0,00	0,066 *	0,02
Firm size / 1000	0,027 **	0,00	-0,017	0,11	-0,002	0,19	-0,003 **	0,00	0,005	0,17	0,001	0,83
Std.-dev. $u_j$	0,083 **	0,00	0,147 **	0,00	0,023 **	0,00	0,014 **	0,00	0,059 **	0,00	0,083 **	0,00
Std.-dev. $r_{ij}$	0,118		Log Likelihood		16220		Log Likelihood starting iterations				16085	
<b>1995</b>												
Constant	2,462 **	0,00	0,313 **	0,00	0,066 **	0,00	0,019 **	0,00	-0,225 **	0,00	0,238 **	0,00
Sectoral contract	0,088 **	0,00	-0,092 *	0,01	-0,023 **	0,00	-0,010 *	0,02	0,058 **	0,00	-0,022	0,23
Firm contract	0,072 **	0,00	-0,065	0,21	-0,028 **	0,01	-0,010	0,13	0,052 **	0,00	-0,034	0,16
Mean years of schooling	0,047 **	0,00	0,000	0,99	0,008 *	0,04	0,011 **	0,00	-0,012	0,10	-0,021	0,05
Share of female workers	-0,162 **	0,00	-0,044	0,39	0,006	0,60	0,012	0,09	0,039	0,07	0,056	0,05
Firm size / 1000	0,024 **	0,00	-0,007	0,65	0,000	0,91	-0,004 **	0,00	0,003	0,49	-0,004	0,68
Std.-dev. $u_j$	0,092 **	0,00	0,131 **	0,00	0,028 **	0,00	0,015 **	0,00	0,062 **	0,00	0,104 **	0,00
Std.-dev. $r_{ij}$	0,127		Log Likelihood		12699		Log Likelihood starting iterations				12189	
<b>2001</b>												
Constant	2,580 **	0,00	0,307 **	0,00	0,089 **	0,00	0,017 **	0,01	-0,186 **	0,00	0,211 **	0,00
Sectoral contract	0,114 **	0,00	-0,121 **	0,00	-0,045 **	0,00	-0,002	0,73	0,048 *	0,01	-0,013	0,64
Firm contract	0,104 **	0,00	-0,071	0,20	-0,056 **	0,00	-0,010	0,22	0,030	0,17	-0,018	0,59
Mean years of schooling	0,039 **	0,01	0,026	0,14	0,011 *	0,02	0,006	0,07	-0,008	0,45	0,006	0,72
Share of female workers	-0,159 **	0,00	0,060	0,45	0,036	0,11	0,003	0,78	-0,021	0,62	0,027	0,62
Firm size / 1000	0,052 **	0,00	-0,005	0,75	-0,003	0,35	0,000	0,92	-0,012	0,10	0,003	0,73
Std.-dev. $u_j$	0,109 **	0,00	0,111 **	0,00	0,035 **	0,00	0,017 **	0,00	0,072 **	0,00	0,111 **	0,00
Std.-dev. $r_{ij}$	0,139		Log Likelihood		6308		Log Likelihood starting iterations				6228	
Source: Wage and Salary Structure Survey Lower Saxony												
First level constant: Base wage. Second level constant: Wage impact in firms not applying any collective contract.												
Probability values: Based on robust heteroskedasticity-resistant t-values.												
*) $\alpha = 0,05$ . **) $\alpha = 0,01$ .												

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