Union Wage Effects in Germany: Union Density or Collective Bargaining Coverage?

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Abstract: The design of the German wage-setting system offers the opportunity to explicitly distinguish between the effect of union power as measured by net union density (NUD) and the effect of collective bargaining coverage. Using linked employer-employee data, we simultaneously analyze the effect of both union variables on the structure of wages. Ceteris paribus, a higher share of employees covered by collective or firm-level contracts is associated with higher wages. Yet bargaining coverage has negative impacts on individual wage levels and on wage dispersion. The average partial effect of NUD is also negative, and most strikingly so in upper parts of the distribution. In line with an insurance motive, union representation thus compresses the wage structure.

Keywords: Union density, collective bargaining coverage, wage structure, quantile regression, linked employer-employee data, Germany.

JEL-Classification: J31, J51, J52.

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Contents

1 Introduction

The impact of institutions on economic performance in general, and on wage setting in the labor market in particular, is currently under debate (OECD 2006). In times of increasingly heterogeneous economic conditions the catchword is eurosclerosis, stating that institutional rigidities restrain labor market performance and the dynamics of economic development. A major focus in this context is on the impact of trade unions; see, e. g., the handbook of Addison and Schnabel (2003).

The main channel for unions to influence the wage structure is through collective bargaining. In Germany, this influence goes beyond mere negotiation of wage premia for union members since collective agreements on individual membership premia are forbidden by constitutional law. Given the high rate of collective bargaining coverage in the German labor market, union-bargained wages apply to the better part of all employees and unions influence the wage structure of members as well as of non-members. The design of the German wage-setting system thus offers the possibility to explicitly distinguish between the effects of union density and collective bargaining coverage. We argue that net union density as a proxy for union power governs the union's threat point in the collective bargaining process and therefore *determines* the bargaining outcome. Collective bargaining coverage, on the other hand, captures the *actual application of* bargained agreements. So density and coverage offer a pre-bargaining and a post-bargaining indicator for unions' influence in the labor market.

The empirical literature on the impact of unions on the German wage structure has so far been confined to using *either* union membership (e. g., Fitzenberger and Kohn (2005)) *or* collective bargaining coverage (e. g., Stephan and Gerlach (2003, 2005)). Our study extends upon this literature and analyzes both effects simultaneously.

We use a newly available linked employer-employee data set, the German Structure of Earnings Survey (GSES, *Gehalts- und Lohnstrukturerhebung*) 2001, which provides individual and firm-level information including an indicator for collective bargaining coverage. Since there is no detailed information on net union density available for Germany, we impute propensities to be a union member for the individuals in the GSES from GSOEP-based estimations of Fitzenberger, Kohn, and Wang (2006). Taking averages of these propensities, we project net union densities for homogeneously defined labor market segments. We then employ OLS and quantile regressions in order to estimate the impact of both union density and bargaining coverage on wage levels and wage dispersion.

From a methodological point of view the analysis involves the challenge to estimate the asymptotic distribution of a weighted quantile regression estimator accounting for clustering, as the estimations contain regressors from different levels of aggregation.

While substantiating the need to employ firm-level as well as individual-level data, our results show a positive effect of firms' decisions to apply collective or firm-level contracts on the level of wages. Given the share of covered employees in a firm, however, employees with individual contracts ceteris paribus earn higher wages. Moreover, collective bargaining coverage is found to reduce wage inequality. On average, the impacts of net union density on the wage level and on wage dispersion are also negative. While striving for equal wages, powerful unions even make concessions regarding the wage level. Our findings thus are in line with an insurance motive of union representation.

The course of the paper is organized as follows. Section 2 outlines the design of the German system of collective wage bargaining and reviews empirical literature on the links between union density, bargaining coverage, and the structure of wages. Our econometric investigation is presented in section 3. Section 4 concludes.

2 The German System of Collective Bargaining

In the tradition of Calmfors and Driffill (1988), cross-country comparative studies usually use single indices to reduce dimensionality when operationalizing labor market institutions.[1] Corresponding empirical evidence on the relationship between the institutional design of the labor market on the one hand and measures of economic performance such as GDP, unemployment rates, and the level of wages on the other hand, is generally ambiguous. The only exception is a stable correlation of institutional settings and the wage structure: Higher degrees of centralization and coordination of wage bargaining are ceteris paribus associated with lower wage dispersion.[2]

In addition to sensitivity with respect the chosen measure, comparative studies based on single measures exhibit several shortcomings. For example, Soskice (1990) and Rowthorn (1992) emphasize the concomitant importance of coordination *and* centralization. The effect of particular institutional elements is likely to interfere with other country-specific institutions and has to be interpreted with reference to social norms within a society (Flanagan 1999).

In the Anglo-Saxon literature union power is defined as the product of union density and the union wage gap; see Addison, Bailey, and Siebert (2004). This concept is inappropriate for Germany because collective agreements constituting discriminatory wage

[1] See the surveys in Kenworthy (2001, 2003), OECD (1997, 2004), or Schettkat (2003).

[2] See the synopses in Aidt and Tzannatos (2002), Blanchflower (2006), Flanagan (1999), Gerlach and Meyer (1995), OECD (1997, 2004), and the handbook articles of Blau and Kahn (1999) and Nickell and Layard (1999).

policies with disadvantages for non-members are forbidden by constitutional law (negative freedom of association, *negative Koalitionsfreiheit, Grundgesetz Art. 9*). As wage gains from union membership are not internalized, there exists a free-rider problem of missing individual incentives to join a union.[3] In fact, the scope of collective agreements goes beyond the organized parties. Wages set at the firm level as well as individually bargained wages are adapted towards collective bargaining agreements, be it in order to reduce transaction costs or not to create incentives for employees to join a union.[4] Prevalent wage-setting models in the literature therefore assume that collective bargaining agreements apply to all employees; see, e. g., Fitzenberger (1999, chapter 6).

The design of the German wage-setting system thus offers the possibility to explicitly distinguish between the effects of union density and collective bargaining coverage. The literature to date consists of complementary strands which focus on either union membership or collective bargaining coverage. The following paragraphs summarize existing evidence on union density, collective wage bargaining, and the respective impacts on the structure of wages.

2.1 Union Membership and Union Power

Union membership, which had only shown some variation with the business cycle in former decades, has been steadily declining in recent decades; see Bosch (2004), Ebbinghaus (2003), and Fitzenberger, Kohn, and Wang (2006). The early 1980's mark the beginning of a pronounced trend towards deunionization: having started out at a gross union density (GUD, defined as the ratio of union members to the number of employees in the labor market) of about 40%, GUD was down to a historically low level of 27% by the year 2004. Deunionization was interrupted by a unification effect in 1990, when West German unions were very successful in recruiting members in Germany. However, the upsurge in aggregate GUD was not sustainable, and deunionization continued even more rapidly in the 1990's and 2000's. Some trade unions have responded to the decline in size by merging; see, e. g., Keller (2005). To date, however, unions have not been able to reverse the trend; see also Ebbinghaus (2003) and Fichter (1997).

[3]However, there are additional motives for union membership. The literature discusses selective incentives provided in addition to public goods (Olson 1965), collective-voice mechanisms (Hirschmann 1970), or the existence of social norms (Akerlof 1980, Booth 1985).

[4]Collective agreements can also be declared generally binding by the Minister for Labor and Social Affaires. The direct impact of this provision may be of minor relevance—only 0.8% of all employees subject to social security contributions are covered by agreements which are binding by declaration (BMWA 2004). Yet the mere possibility of such a declaration constitutes incentives per se; see OECD (1994).

Union density governs the union's threat point in the collective bargaining process and therefore is pivotal to the outcome of the bargaining. Fitzenberger and Kohn (2005) argue that net union density, i. e., the share of employed union members among the number of employees, is an appropriate measure for union power. The higher the number of union members paying membership fees, the higher is the union's funding. In case of industrial conflicts, higher financial power enables the union to pay strike benefits for a longer period of time. Financial power and intensive personal representation in the firm increase individual support for union action, the probability and the length of a strike, and therefore the expected damage inflicted upon employers. Furthermore, financially powerful unions can invest more in public relations in order to sanitize their public image. Yet financial obligations also increase with the size of the union. Relative financial power is thus mirrored best by the share of contributors among potentially represented workers. Moreover, as union growth comes along with increased heterogeneity within the union, conflicting interests and contradictory statements increasingly undermine the union's representative role; see also Ebbinghaus (2003) and Keller (2005). Thus net union density is preferable as compared to both gross union density and the absolute number of union members.

Net union density (NUD) for homogenously defined labor market segments can not be inferred from union records and thus has to be estimated. A number of studies estimates individual determinants of union membership based on survey data.[5] Estimated membership propensities can then be used to project NUD. Aggregate NUD usually falls short of GUD by about 10 percentage points. Fitzenberger, Kohn, and Wang (2006) report that after German unification, membership in East Germany started out at a higher level than in West Germany but exhibited a stronger decline afterwards. Aggregate NUD for the years 1993 and 2003 were 38% and 19% in East and 27% and 21% in West Germany.

2.2 Union Power and the Wage Structure

Bargaining models treat the negotiation of wages as a rent-sharing problem, the solution to which depends upon the bargaining power of the negotiating parties. In classical models unions enforce a high wage level for the represented work force. Models such as monopoly unions, right-to-manage models, or efficient bargaining predict a monotonic positive relationship between union power and the level of bargained wages; see the surveys of Farber (1986), Oswald (1985), and Naylor (2003).

[5] Lorenz and Wagner (1991), Fitzenberger, Haggeney, and Ernst (1999), Schnabel and Wagner (2003, 2005), Beck and Fitzenberger (2004), Goerke and Pannenberg (2004), Fitzenberger, Kohn, and Wang (2006).

Some more recent studies also incorporate effects on higher moments of the wage distribution. Agell and Lommerud (1992) and Burda (1995) focus on wage dispersion and discuss an insurance motive for union membership. Faced with uncertainty of future productivity or wages, risk averse employees a priori have a taste for wage compression. If the income of employees depends upon different states of nature such as demand shocks on the firm's product market (Cardoso and Portela 2005), a union acts as agent of the work force and bargains for a compression of the wage distribution relative to the productivity distribution.[6] The compression effect is also consistent with search and matching theories (Mortensen and Pissarides 1999). By enforcing "equal pay for equal work" a union additionally seeks to limit favoritism and discrimination by superiors and colleagues, and to encourage solidarity among the work force; see Freeman (1982).[7] Ceteris paribus, the degree of wage compression is the higher, the higher the bargaining power of the union.

Yet risk-reducing insurance or equity considerations come at the price of an insurance premium or discount. If a union has a strong preference for wage equality and also wants to prevent negative employment effects, this effect can overcompensate the union's strive for a higher wage level such that a higher net union density is accompanied by a lower wage level. A priori, the sign of the overall level effect is ambiguous as there is a trade-off between reduced inequality and a higher wage level (Calmfors 1993).

At any rate, the impact of unions on the wage structure likely varies across the wage distribution. If collectively bargained wages serve as wage floors, the (conditional) wage distribution is compressed from below. In the wage bargaining model of Büttner and Fitzenberger (2003), for example, efficiency wages are paid in the upper part of a productivity distribution, whereas union-bargained wages above marginal productivity are binding for less productive matches. This is in line with the perception of a union representing mainly less productive employees and striving for higher wages particularly at the lower end of the distribution. Then compression of the wage distribution from below is the higher, the stronger the influence of the union.

As collective agreements on explicit disadvantages for non-members are forbidden by the negative freedom of association, the estimation of individual membership premia is not appropriate for Germany.[8] The sparse empirical literature thus evaluates the impact of union power at more aggregate levels. Using data from the IAB employment

[6]The reallocation implied by a compressed wage structure can be understood as a substitute for explicit means of redistribution such as taxation; see Agell (1999, 2002).

[7]Though the "equal pay for equal work" campaign originally focused on equal pay for female employees, it has become a commonplace for all anti-discriminatory policies.

[8]This notion is also supported by individual-level regressions in Goerke and Pannenberg (2004), who find no significant effect of individual union membership on wages.

sample (IABS) 1985–1997 and GSOEP-based union membership projections from Beck and Fitzenberger (2004), Fitzenberger and Kohn (2005) estimate the link between union power—as measured by net union density—and measures of the wage structure within and between labor market cells spanned by the dimensions year of observation, industry, skill-level, and age of the employees. A higher union density is ceteris paribus associated with lower within and between-cell wage dispersion as well as with a lower wage level. The results thus corroborate the insurance argument. In line with a minimum wage interpretation of union-bargained wages, the wage distribution is compressed disproportionately from below.

Büttner and Fitzenberger (1998) analyze the joint impact of industry-level collective bargaining and local agreements on the wage distribution. Using the IABS 1975–1990, they find that overall economic conditions—as measured by the national rate of unemployment—are taken into account at the centralized level of wage bargaining. Resulting contract wages work as minimum wages and affect the wage distribution mainly in the lower part. On the other hand, local specifics—captured by regional unemployment rates—result in incentive wages which cause higher flexibility at the upper end of the wage distribution. Pooled cell-data regressions for the period 1976–1990 further indicate that union influence reduces wage dispersion: A higher net union density ceteris paribus comes along with an (albeit insignificant) increase in wages at low quantiles of the distribution and a (significant) decrease at higher quantiles.

Also drawing on the IABS 1975–1990, Fitzenberger (1999, chapter 6) estimates a structural model of industry-level wage bargaining. A union maximizes a Stone-Geary utility function with specific weights for employment, average wages, and—in some of the specifications—wage dispersion within two skill classes of the work force. In line with a right-to-manage assumption as in Pencavel and Holmlund (1988), employment is determined by the firms. There are effects of habit formation in the function weights for employment and average wages, and unions put specific emphasis on the employment target. In specifications that include wage dispersion in the objective function, unions put a positive weight on the reduction of dispersion and make concessions in particular with respect to the employment objective. In manufacturing, an increase in net union density is associated with a significantly stronger preference for high employment relative to wage levels and to the reduction of wage dispersion.

2.3 Collective Bargaining Coverage

Employees are paid according to individual contracts between the employee and the firm or according to a collective agreement. The collective agreement can be negotiated between a union and an employers' association, a union and a firm, or a works council and a firm. Arrangements between firm and works council are only allowed to govern wages or salaries if the firm is not subject to a collective contract or if the collective contract explicitly allows for this type of arrangement. Firm-level agreements involving a union are allowed to set wages even if a collective agreement exists, as long as the firm-level agreement is more specific than the collective agreement. Collective contracts may also contain an opening clause explicitly allowing deviations from the terms of the contract under particular circumstances. So the decision whether to apply a collective contract or not is basically left to the firms. In the interpretation of Dustmann and Schönberg (2004), firms use collective contracts as a commitment device.

Collective bargaining coverage, as measured by the share of employment contracts following collective agreements, was relatively stable in West Germany until the end of the 1990's but has been declining since. By the year 2003, 45% (70%) of West German firms (employees) were covered by a collective agreement (Schnabel 2005). With respective shares of 26% and 47%, coverage in East Germany was markedly lower. The "erosion" towards more decentralized wage setting is examined by a group of studies using firm-level data,[9] and it is reconfirmed by survey evidence from works councils discussed in Bispinck and Schulten (2003); see also Bosch (2004).

2.4 Bargaining Coverage and the Wage Structure

If wage policies set in collective agreements reflect unions' objectives, firms' decisions to adopt a collective agreement have two effects. First, differences between covered and non-covered segments would increase as the result of the unions' strive for higher wages. Second, wage compression induced through the collective contract would reduce within-segment inequality. The question which effect would prevail has been discussed for some time in the Anglo-Saxon context; see Card, Lemieux, and Riddell (2003). Related literature for Germany again is still sparse.

Dustmann and Schönberg's (2004) analysis reveals that firms applying collective contracts as a commitment device ceteris paribus employ a higher share of workers with an apprenticeship degree. Moreover, the employed linked data of the IAB employment statistics and the IAB establishment panel suggest that under collective coverage, employee turnover is higher, wage cuts occur more often, and (conditional) wages have a lower variance.

A couple of studies analyze subsamples of the German Structure of Earnings Survey

[9] Kohaut and Bellmann (1997), Bellmann, Kohaut, and Schnabel (1999), Kohaut and Schnabel (2003b, 2003a).

(GSES, *Gehalts- und Lohnstrukturerhebung*). Using different cross sections (1990, 1995, 2001) of the subsample for Lower-Saxony, Gerlach and Stephan (2002, 2005b, 2005a) report Kernel density estimates of log wage distributions for labor market regimes with and without collective and firm-level wage agreements and estimate firm-level wage regressions. In the manufacturing sector, average hourly wages paid in accordance with a collective or a firm-level agreement are higher than the average of individually negotiated wages. Yet unconditional as well as conditional wage dispersion is highest among individual contracts. Differences between regimes increased between the years 1990 and 2001. Similar results are obtained by Bechtel, Mödinger, and Strotmann (2004) based on the GSES subsample for Baden-Württemberg. Multi-level regression models in Stephan and Gerlach (2003, 2005) reveal that differences in individual wages are consistent with a higher base wage in case of collective coverage. Returns to human capital—skill, experience, and tenure—as well as residual wage dispersion are lower under collective coverage. Gerlach and Stephan (2006) note that collective agreements compress within-firm compensation schemes across occupations.

Heinbach (2005) merges the GSES subsample for Baden-Württemberg with information on the existence of an opening clause in collective agreements. When distinguishing between collective agreements with and those without opening clauses in firm-level regressions, he finds that mean wages for blue-collar workers in manufacturing are lower under opening clauses, but no significant wage differences exist for white-collar workers. Moreover, no significant differences exist regarding wage dispersion as measured by the standard deviation of wages.

A collective agreement does not constrain a firm's right to pay premia above the wage set in the collective contract. So actual wages may differ substantially from the contractual wage. This aspect is examined by the wage-drift literature and studies related to nominal, notional, or real wage rigidity; see, e. g., Bauer, Bonin, and Sunde (2003) and Pfeiffer (2003). Cardoso and Portugal (2005) analyze the gap between contractual and actual wages for employees covered by different types of collective agreements in Portugal.[10] They find that the positive effect of union strength—as measured by the share of covered employees—on the level of contractual wages is partly offset by a smaller wage cushion. So higher contractual wages in sectors with a high share of covered employees do not lead to higher actual wages. Besides, firms covered by (multi- or single-) firm-level agreements pay higher wages than firms covered by sectoral agreements.

[10] Cardoso and Portugal (2005) refer to this gap as "wage cushion" (p. 877) in order to distinguish it from the notion of wage drift, which traditionally focusses on the change of the gap.

3 Econometric Investigation

Summarizing the evidence from the previous section, wage dispersion is expected to be lowered by collective bargaining agreements and net union density. With respect to the effects on the wage level, coverage is likely to result in higher wages, whereas the impact of union density is a priori ambiguous. This section analyzes both issues simultaneously.

We restrict our analysis to West Germany for two reasons. First, union policy in East Germany is strongly aligned to an adaption of West German standards. So wage policies are not set independently but with regard to West German wages. Second, in case of industrial conflicts, union action in East Germany relies on solidarity from West German unions. It is therefore not reasonable to assume that East German unions set their objectives independently.[11]

3.1 Data

Our study is based on the German Structure of Earnings Survey (GSES, *Gehalts- und Lohnstrukturerhebung*) 2001, a cross-sectional linked employer-employee data set containing about 850,000 employees in some 22,000 firms. Missing essentially the public sector, the GSES covers the major part of industry and private services. There are several advantages to using the GSES 2001. It is one of the largest mandatory surveys available for Germany. The sample not only includes workers in regular employment, but also employees in vocational training, marginal employment, or partial retirement schemes. In contrast to earlier GSES waves and to the IAB linked employer-employee data set (LIAB), wages are neither truncated nor censored so that lower and upper parts of the wage distribution can be analyzed precisely. The data are gathered from firms' official reporting obligations. Therefore, they are more reliable than information from individual-level surveys or data not covered by duties of disclosure (Jacobebbinghaus 2002).

The GSES 2001 has only recently been made available for research.[12] So far, analyses with GSES data have been restricted to administrative use or to regional subsamples (cf. Fitzenberger and Reize (2002, 2003) and the studies cited in section 2.4). For descriptions of the data set see Hafner (2005) and Statistisches Bundesamt (2000, 2004).

[11]When the metal working union *IG Metall* went on strike for the equalization of West and East German hours of work in the year 2003, the union had to rely on "strike tourists" from West Germany to fill their ranks. This was deemed "common practice" by union representative (DIE WELT, 06/23/2003). However, by the time the strike affected West German firms, the solidarity of West German employee representatives declined rapidly, and the strike was finally broken off.

[12]In fact, the wave 2001 so far is the only one available. Preceding cross sections are scheduled to be made available in the future.

Details on the on-site-use version employed in this study and our selection of data are given in appendix A. We focus on prime-age male employees working full-time and analyze hourly wages for both blue-collar and white-collar workers.[13] Definitions of variables used and summary statistics are displayed in table 1.

Since the GSES does not provide information on union membership, we extend the GSES by imputing individual propensities for union membership from Fitzenberger, Kohn, and Wang (2006), who estimate determinants of union membership using survey data from the German Socio-Economic Panel (GSOEP) for East and West Germany. Net union density (NUD), our measure for union power, is then obtained by means of aggregation at a cell level spanned by the dimensions region (7 states) $\times$ industry (30 sectors) $\times$ skill (4 groups defined by educational attainment) $\times$ age (6 five-year brackets), yielding a total of 5,841 cells.

The cell definition is advantageous because it reflects the structure of the German wage bargaining system. The regional dimension and the sector classification account for the fact that collective negotiations take place at the industry level in different bargaining regions (*Tarifbezirke*). The observation that collective agreements further differentiate between various wage groups is captured by the skill dimension. The cell-level aggregation enables us to analyze the effect of union power independently of individual membership. As pointed out in section 2.2 above, it would make no sense to estimate individual membership premia.

3.2 Descriptive Evidence

In a companion paper (Kohn and Lembcke 2006) we provide detailed evidence for wage distributions of different groups of employees (men, women working full-time, and women working part-time), separately for blue-collar and white-collar workers in East and West German firms. In this paper, we focus on male employees (both blue and white-collar) in West Germany (excluding Berlin) in order to circumvent a number of selection problems.

3.2.1 Net Union Density and Collective Bargaining Regimes

We consider three regimes of bargaining coverage.

- CC: collective contract negotiated between an employers' association and a union.
- FC: firm-level agreement negotiated between a firm and a union or a works council.

[13]Our analysis combines blue-collar and white-collar workers as unions are assumed to follow one cohesive policy for all represented workers.

- IC: individual contract negotiated between employee and employer.

The first row of table 2 displays the size of the respective regimes inferred from the employed GSES data. The numbers are in line with those in the literature cited above. 57% of West German employees are paid according to a collective contract. With another 8% covered by a firm-level agreement, this leaves about a third of the work force with individual contracts.

Turning to the share of covered employees among firms, figure 1 reveals a bimodal distribution. While about 40% of all employees work in firms which do not apply any collective or firm-level agreement, another half of all employees works in firms with more than 80% of covered workforce. So either firms apply a collective or a firm-level agreement and have a high share of covered employees, or they do not subject themselves to collective coverage at all.

Table 3 reports summary statistics for cell-level net union density NUD. Whereas the first row reports raw numbers for the cells, the second row provides an employment-weighted measure by summarizing at the individual level.[14] With respective average NUD of 19 and 23%, net union density is markedly lower than collective bargaining coverage. Again, the numbers match those in the literature.

3.2.2 Wage Levels and Wage Dispersion by Bargaining Regime

Rows two to five in table 2 summarize log hourly wages by wage-setting regimes. On average, employees with individual contracts earn the lowest wages (2.786). Wages paid according to a collective agreement are markedly higher (2.810), and highest wages are paid by firms subject to a firm-level agreement (2.833). Wage dispersion as measured by the standard deviation of log hourly wages is lowest among employees under collective coverage (0.286) and only slightly higher in case of firm-level contracts (0.314). Employees with individually negotiated wages however face a remarkably higher variation (0.420).

The descriptive evidence thus is consistent with the considerations in the literature outlined above. Yet the observed differences in wage levels and wage dispersion are not necessarily caused by the different bargaining regimes. First, they may conceal differences in union power between different labor market segments. Second, they may result from underlying heterogeneity in employee or firm characteristics. Both of these issues are investigated in the next section.

[14]Note that the statistics at the individual level in table 3 do not summarize imputed individual propensities for union membership, but the assigned cell-level union density.

3.3 OLS and Quantile Wage Regressions

We analyze the different channels of union impact on the wage distribution by means of wage regressions with individual and firm-level controls.

Consider the conditional specification for log hourly wage Y,

$$Y = E(Y|X) + u = X\beta + u, \tag{1}$$

which can be estimated by OLS based on a sample of individuals $i = 1, ..., N$ in firms $c = 1, ..., C$. Sampling weights account for different sampling probabilities. Moreover, since our data were sampled with clustering at the firm level and our set of covariates X contains information from different levels of aggregation, the estimated covariance of the estimator $\hat{\beta}$ has to account for clustering (Froot 1989, Williams 2000, Wooldridge 2002).

Least squares regressions focus on the wage level only. We further employ quantile regressions in order to investigate whether effects differ across the conditional wage distribution, yielding insights into the effects on wage dispersion. Conditional quantiles as introduced by Koenker and Bassett (1978),

$$Q_Y(\tau|X) = X\beta(\tau), \tag{2}$$

can be estimated for a given quantile $\tau \in (0, 1)$ by minimizing over β the objective function

$$\frac{1}{N}\sum_{c=1}^{C}\sum_{i=1}^{N_c}\rho_\tau[Y_{ic} - X_{ic}\beta(\tau)], \tag{3}$$

where the residuals u_{ic} are weighted in an asymmetric way by the check function

$$\rho_\tau(u_{ic}) = \begin{cases} \tau u_{ic} & \text{for} \quad u_{ic} \geq 0 \\ (\tau - 1)u_{ic} & \text{for} \quad u_{ic} < 0 \end{cases}. \tag{4}$$

Again, sampling weights can be employed and inference has to account for clustering. We show in appendix B how to estimate the asymptotic variance $VAR(\hat{\beta}(\tau))$ accounting for weights and cluster effects.[15]

Estimation results are displayed in tables 4 to 6. First, table 4 displays least squares results for different sets of union variables, using our preferred set of all individual and firm-level covariates.[16] We analyze six specifications which include different measures of union impact:

[15] So far, the approach is not standard in econometric software packages such as STATA, which is employed in this paper. Bootstrapping as an alternative way to estimate $VAR(\hat{\beta}(\tau))$ is not feasible due to computational constraints at the FDZ.

[16] For a sensitivity analysis regarding the covariates see table 5 below.

(i) collective contracts (CC) and firm-level contracts (FC) captured by individual dummy variables, with individual contracts as base category.

(ii) the share of employees in each firm covered by a collective contract (SHARECC) or a firm-level contract (SHAREFC), with the share of employees with individual contracts as base category.

(iii) combination of (i) and (ii) plus interaction terms for collective contracts (CC×SHARECC) and firm-level contracts (FC×SHAREFC).

(iv) net union density (NUD), aggregated at the cell level.

(v) dummy variables for individual coverage, the share of covered employees, NUD and interaction terms for individual coverage with NUD (NUD×CC, NUD×FC) and with the share of covered employees (CC×SHARECC, FC×SHAREFC).

(vi) specification (v) plus interaction of coverage share and NUD (NUD×SHARECC, NUD×SHAREFC).

Specification (i), including only individual dummy variables, yields different signs for the effects of collective and firm-level contracts. While employees subject to a collective contract earn 0.9% less than employees with individual contracts, employees with a firm-level contract earn 1.9% more. Both coefficients are significant at the 5% level. Results for the shares of covered employees in specification (ii) are different, though. Here, both collective and firm-level contracts show a positive and significant effect, as also reported in comparable firm-level studies (Gerlach and Stephan 2005b, Heinbach 2005, Bechtel, Mödinger, and Strotmann 2004). An increase in the share of employees in a firm covered by a collective (firm-level) contract by 10 percentage points (pp) is associated with a 0.34% (0.67%) increase in wages. Individual coverage and firm-level shares are combined in specification (iii), which also allows for interaction effects. The results show a more informative pattern. While individual coverage by a collective or firm-level contract and the interaction terms have negative signs, the shares both have a positive impact. For example, the marginal effect for individual coverage by a collective contract, evaluated at the average coverage rate of 0.565, is –10.1%.[17] So an employee in a firm with an average rate of collective coverage ceteris paribus earns about 10% less than an uncovered employee in the same firm. The marginal effect of an increase in the share of covered

[17] $-0.048 - 0.094 \cdot 0.565 = -0.101$. If not indicated otherwise, illustrative numbers for marginal effects in the following are evaluated at the respective average coverage shares. When interpreting the results of our preferred specification below we explicitly turn to average partial effects.

employees differs for covered and uncovered employees. While both effects are positive, the effect for covered employees is augmented by the interaction term. In combination, the marginal effect for covered employees is a 0.8% wage increase for a 10 pp increase in the share of covered employees, while the wage increase is 1.8% for uncovered employees. Coefficients for all union variables except for FC×SHAREFC are significant at the 1% level.

Specifications (iv) to (vi) introduce net union density into the regressions. In all specifications the base effect of net union density has a negative sign and is significant at the 1% level. Specification (v) indicates that an increase in NUD of 10 pp is ceteris paribus associated with a decline in wages by about 3% for employees with individual contracts. However, the positive interaction effects imply a reduction of only 1% for employees covered by a collective contract, and even a slightly wage-increasing effect of NUD in case of firm-level contracts. So either unions put only a small weight on their wage-level objective, or they are not very effective in transforming their power into a wage pay-off. Stronger unions achieve higher wages for covered employees only if the bargaining takes place at the firm level.

As compared to specification (iii), the inclusion of NUD in specification (v) does basically not alter the effects of bargaining coverage. Only the coefficients of CC and FC become slightly more pronounced. Again, we generally find a positive effect of collective coverage at the firm level, but negative ceteris paribus effects of collective bargaining coverage for the individual. It therefore proves important to distinguish the effects of individual coverage and of the rate of covered employees in a firm.

The inclusion of interaction terms between NUD and the coverage shares in specification (vi) does not have additional explanatory power. It neither yields significant coefficients, nor does it raise the R^2. So we resort to specification (v) as our preferred specification for further analysis.

Row (c) of table 5 reproduces the results of our preferred specification (v). In the lower panel of this table we further report normalized results in the sense that the coefficients of the non-interacted variables are average partial effects (APE).[18] The numbers corroborate the above findings. On average, the partial effect of individual coverage is negative, while the firm-level shares of covered employees have a positive effect. This finding would be in line with a risk premium paid to individuals who do not subject themselves to collective bargaining coverage.[19] The APE of net union density is also negative. This finding would

[18]The APE of, say, CC is calculated as $\widehat{APE} = \hat{\beta}_{CC} + \hat{\beta}_{CC\times SHARECC} \cdot \overline{SHARECC} + \hat{\beta}_{NUD\times CC} \cdot \overline{NUD}$. With demeaned variables, coefficients can be directly interpreted as average partial effects.

[19]Note that our estimations control for a large set of individual and firm characteristics, including, i. a., firm-size and professional status (see table 1). Of course, we can not fully exclude the possibility of

be in line with an insurance premium in accordance with the insurance motive for union representation as discussed in the literature (Agell and Lommerud 1992, Burda 1995).

In order to test the sensitivity of our preferred specification with respect to the set of included covariates, table 5 uses our preferred set of union variables and displays the results of specifications including

(a) no covariates.

(b) only worker characteristics such as human capital variables (educational attainment, age, tenure) and workplace-related characteristics (region, indicators for shift-work or work on Sundays, etc.).

(c) worker (see above) and firm characteristics such as size and industry of the firm or average characteristics of the firm's workforce.[20]

Controlling for individual-level and firm-level characteristics notably reduces the partial effects of both collective coverage and net union density. For example, the average partial effect of CC is –9% in specification (c), while it would be –20% in specification (a). For covered employees, the partial effect of SHARECC even changes sign—whereas a higher share of covered employees is associated with a higher wage in specification (c), the effect would be negative in specification (a). The effect of NUD also changes sign between specifications (b) and (c).

The findings of the sensitivity analysis highlight the importance of controlling for individual as well as firm-level characteristics. The effects of both NUD and bargaining coverage on the level of wages are substantially reduced if the full set of employer-employee information is controlled for. As omitted individual or firm-level characteristics are taken up by the union and regime variables, there is in fact selection on observables.

At any rate, union effects may be expected to differ across the distribution, reflecting, e. g., union policies targeted specifically towards low-wage earners. We analyze differences across the conditional wage distribution by means of quantile regressions for our preferred specification in table 6. Again, the upper panel reports regression coefficients, and the lower panel corresponding average partial effects. In general, effects at the median are close to those obtained from least squares estimation, and the estimated coefficients are significant.[21]

selection effects based on unobserved differences within the categories of worker and firm characteristics.

[20]This specification is the same as specification (v) in table 4. Note that estimating the model with firm-fixed effects is not feasible because the share variables, and in particular coverage shares, do not vary within a firm.

[21]Only the interaction of FC and SHAREFC is insignificant at all quantiles, as in the OLS regression.

The effects of coverage shares at the firm level (both SHARECC and SHAREFC) do not change much across the distribution. So a firm's decision to apply a collective or a firm-level contract shifts wages across the entire scale upwards in a similar way. However, the negative impact of collective bargaining coverage for the individual is stronger in upper parts of the conditional distribution. While the APE of a collective agreement is –6% at the 10th percentile, it increases up to –12% at the 90th percentile. Therefore, collective coverage reduces wage inequality. The adoption of a collective contract is in fact a means to reduce unjustified (as judged on the basis of observable characteristics) pay gaps between employees, thereby encouraging solidarity among the workforce. The effect of firm-level agreements on wage dispersion is also negative, but not as pronounced as that of collective contracts.

The impact of union density also varies markedly across the wage distribution. The negative base effect is strongest at the upper end of the distribution. Yet the positive interaction effects of NUD and the coverage regimes CC and FC also increase throughout the distribution. Consequently, the differences in the impact of union power on covered and uncovered employees are most severe at the upper end of the distribution. The APE of NUD indicates that, on average, a 10 pp increase in union density comes along with an (insignificant) reduction of wages by 0.7% at the 10th percentile, and with a significant reduction of 2.4% at the 90th percentile. So in fact, union power reduces wage inequality. This finding is consistent with the results in the literature. Recalling the negative effect on wage levels, it is particularly in line with an insurance motive of union representation.

4 Conclusions

The design of the German wage-setting system offers the opportunity to explicitly distinguish between the effects of union power as measured by union density and the actual bargaining outcome measured by collective bargaining coverage. Using data from the German Structure of Earnings Survey (GSES) 2001, a newly available linked employer-employee data set, we simultaneously analyze both channels of union impact on the structure of wages.

Employing OLS and quantile wage regressions, we find that the share of employees subject to collective bargaining or firm-level agreements has a positive impact on the average wage—firms which employ a collective contract on average pay higher wages. However, individual benefits are higher for uncovered employees—ceteris paribus, individual coverage by a collective contract results in a lower average wage. The impact of individual coverage is stronger at higher quantiles of the conditional wage distribution.

Collective bargaining coverage thus reduces wage inequality. The findings are in line with the hypothesis that firms apply collective agreements in order to follow a transparent wage policy. However, a risk premium is paid to individuals who do not subject themselves to collective bargaining coverage.

We also find significant effects of net union density on the wage level and on wage dispersion. A higher share of union members in the relevant labor market segment is ceteris paribus associated with a lower wage, and the effect is strongest at the upper end of the wage distribution. So union power also reduces wage dispersion. In line with an insurance motive of union representation, unions' equity considerations even overcompensate their strive for higher wage levels.

Our results further highlight the importance of using linked employer-employee data in order to control for worker as well as firm characteristics when evaluating union effects. Unfortunately, our estimations can not take account of the apparent endogeneity of union density and collective coverage, and so the results should not be interpreted as causal effects. The cross-sectional data do not provide adequate instruments for exclusion restrictions, and the implementation of structural models proves to be intricate; compare Fitzenberger (1999, chapter 6).

Departing from the results in this study, future research might focus on interaction of unions and collective bargaining with additional country-specific institutions; see, e. g., Hübler and Jirjahn (2003), Jirjahn (2003), and Klikauer (2004) on the interaction of collective bargaining, union representation, and firm-level co-determination in Germany. Future availability of additional GSES waves will render the exploitation of variation over time feasible. Finally, union effects on the wage structure *and* on employment should be analyzed simultaneously.

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A German Structure of Earnings Survey 2001

The German Structure of Earnings Survey (GSES, *Gehalts- und Lohnstrukturerhebung*) 2001 is a linked employer-employee data set administered by the German Statistical Office in accordance with European and German law (European Council Regulation (EC) No 530/1999, amended by EC 1916/2000; German Law on Wage Statistics, *LohnStatG*). It is a sample of all firms in manufacturing and private service sectors with at least ten employees. Sampling takes place at the firm or establishment level. At a first stage, firms are randomly drawn from every Federal State, where the sampling probability varies between 5.3% for the largest state (North Rhine-Westphalia) and 19.4% for the smallest (Bremen). At the second stage, employees are randomly chosen from the firms sampled at the first stage. The share of employees sampled depends upon the firm size and ranges between 6.25% for the largest firms and 100% for firms with less than 20 employees. The data set provides sampling weights.

The GSES 2001 is available for on-site use at Research Centers of the Federal States' Statistical Offices (FDZ) since 2005. This study uses an anonymized use-file which includes all firms and employees form the original data except for one firm in Berlin (the only firm in Berlin falling into NACE section C). Regional information is condensed to 12 "states", and some industries have been aggregated at the two-digit level. Overall, the use-file consists of 22,040 sites with 846,156 sampled employees.

We focus on prime-age (25–55-year-old) male full-time employees in West Germany (without Berlin), including both blue and white-collar workers. Employees in vocational training, interns, and employees subject to partial retirement schemes are left out because compensation for these groups does not follow the regular compensation schedule, but special regulations or even special collective bargaining agreements do apply. We also exclude white-collar workers in the highest professional status category (category 1) who can reasonably be expected to pursue management objectives and whose wages are hardly in the focus of collective wage setting. Individuals who worked less than 90% of their contractual working hours in October 2001 and individuals paid subject to a collective contract with a missing identification number for the agreement are dropped.

Part-time and full-time employees are distinguished based on the employer's assessment recorded in the GSES. For blue-collar workers, actual working time and not contractual working time is relevant for monthly payments. We exclude individuals with an actual working time of more than 390 hours in October 2001.

We analyze gross hourly wages including premia. This measure is more appropriate than wages without premia if premia are paid on a regular basis. We impose a lower bound of one euro for hourly wages.

B Standard Errors for Quantile Regression with Sampling Weights and Clustering

The asymptotic distribution of $\beta(\tau)$ for a given quantile τ in a non-iid setting is

$$\sqrt{N}(\hat{\beta}(\tau) - \beta(\tau)) \sim N(0, J(\tau)^{-1}\Sigma(\tau)J(\tau)^{-1}) \tag{5}$$

with

$$\Sigma(\tau) \equiv E[(\tau - \mathbb{1}\{Y < X'\beta(\tau)\})^2 XX'] \tag{6}$$

and

$$J(\tau) \equiv E[f_y(X'\beta(\tau)|X)XX'] = E[f_u(0|X)XX'], \tag{7}$$

assuming a correctly specified model (Angrist, Chernozhukov, and Fernández-Val 2006). f_u denotes the density of the error term; compare Hendricks and Koenker (1992), Koenker (2005), and Melly (2006).

We estimate $VAR(\hat{\beta}(\tau))$ by

$$\widehat{VAR}(\hat{\beta}(\tau)) = \frac{1}{N}\hat{J}(\tau)^{-1}\hat{\Sigma}(\tau)\hat{J}(\tau)^{-1} \tag{8}$$

with

$$\hat{\Sigma}(\tau) = \frac{1}{N}\sum_{i=1}^{N}(\tau - \mathbb{1}\{Y_i < X_i'\hat{\beta}(\tau)\})^2 X_i X_i' \tag{9}$$

and

$$\hat{J}(\tau) = \frac{1}{N}\sum_{i=1}^{N}\hat{f}_i X_i X_i' \tag{10}$$

for the case without weights and without clustering. We use the "Hendricks-Koenker sandwich"

$$\hat{f}_i = 2h_N / \left(X_i'(\hat{\beta}(\tau + h_N) - \hat{\beta}(\tau - h_N))\right) \tag{11}$$

and employ Hall and Sheater's (1988) rule for the bandwidth h_N:

$$h_N = \frac{1}{N^{1/3}} z_\alpha^{2/3}[1.5s(\tau)/s''(\tau)]^{1/3}, \tag{12}$$

where z_α satisfies $\Phi(z_\alpha) = 1 - \alpha/2$ for the construction of $1 - \alpha$ confidence intervals and $s(\tau)$ denotes the sparsity function.[22] As in Koenker (1994), we use the normal distribution to estimate

$$s(\tau)/s''(\tau) = \frac{f^2}{2(f'/f)^2 + [(f'/f)^2 - f''/f]} = \frac{\phi(\Phi(\tau)^{-1})^2}{2(\Phi(\tau)^{-1})^2 + 1}. \tag{13}$$

In analogy to Angrist, Chernozhukov, and Fernández-Val (2004), we take account of sampling weights by replacing (9) with

$$\hat{\Sigma}(\tau) = \frac{1}{N} \sum_{i=1}^{N} w_i^2 (\tau - \mathbb{1}\{Y_i < X_i' \hat{\beta}(\tau)\})^2 X_i X_i' \tag{14}$$

and (10) with

$$\hat{J}(\tau) = \frac{1}{N} \sum_{i=1}^{N} w_i \hat{f}_i X_i X_i'. \tag{15}$$

Clustering allows for dependence of observations within clusters (see Froot (1989) and Williams (2000) for the case of OLS). We take account of clustering at the firm level and acknowledge that the sampling weights in the GSES are equal for all individuals $i = 1, ..., N_c$ in a cluster c. With sampling weights w_c normalized to sum to one, $\sum_{c=1}^{C} w_c = 1$, (14) and (15) generalize to

$$\hat{\Sigma}(\tau) = \frac{1}{N} \sum_{c=1}^{C} w_c^2 \sum_{i=1}^{N_c} \sum_{j=1}^{N_c} X_{ic} (\tau - \mathbb{1}\{Y_{ic} < X_{ic}' \hat{\beta}(\tau)\})(\tau - \mathbb{1}\{Y_{jc} < X_{jc} \hat{\beta}(\tau)\}) X_{jc}' \tag{16}$$

and

$$\hat{J}(\tau) = \frac{1}{N} \sum_{c=1}^{C} w_c \sum_{i=1}^{N_c} \hat{f}_{ic} X_{ic} X_{ic}'. \tag{17}$$

[22] The sandwich formula is extensively described in Koenker (2005, pp. 79–80). Koenker also mentions the “Powell sandwich”, which is employed by e. g., Angrist, Chernozhukov, and Fernández-Val (2006).

C Tables and Figures

Table 1: Definition of Variables

Label	Description	mean	std. dev.
Individual Level			
AGE	Age in years/10.	3.963	0.799
AGESQ	AGE squared.	16.34	6.441
TENURE	Tenure in years/10.	0.924	0.923
TENURESQ	TENURE squared.	1.705	2.716
LOW_EDUC	Low level of education: no training beyond a school degree (or no school degree at all).	0.144	0.351
MED_EDUC	Intermediate level of education: vocational training.	0.679	0.467
HIGH_EDUC	High level of education: university or technical college degree.	0.108	0.311
NA_EDUC	Missing information on the level of education.	0.069	0.253
BC_STAT1	Blue-collar worker, professional status category 1: vocationally trained or comparably experienced worker with special skills and highly involved tasks.	0.119	0.323
BC_STAT2	Blue-collar worker, professional status category 2: vocationally trained or comparably experienced worker.	0.225	0.418
BC_STAT3	Blue-collar worker, professional status category 3: worker trained on-the-job.	0.156	0.363
BC_STAT4	Blue-collar worker, professional status category 4: laborer.	0.084	0.277
WC_STAT2	White-collar worker, professional status category 2: executive employee with limited procuration.	0.162	0.369
WC_STAT3	White-collar worker, professional status category 3: employee with special skills or experience who works on his own responsibility on highly involved or complex tasks.	0.103	0.303
WC_STAT4	White-collar worker, professional status category 4: vocationally trained or comparably experienced employee who works autonomously on involved tasks.	0.104	0.305
WC_STAT5	White-collar worker, professional status category 5: vocationally trained or comparably experienced employee working autonomously.	0.040	0.196
WC_STAT6	White-collar worker, professional status category 6: employee working on simple tasks.	0.008	0.087
NIGHT	Individual worked night shifts.	0.228	0.436
SUNDAY	Individual worked on Sundays or on holidays.	0.153	0.391
SHIFT	Individual worked shift.	0.147	0.354
OVERTIME	Individual worked overtime.	0.264	0.441
Firm Level			
S_FEM	Share of female employees.	0.325	0.241
S_AGE1	Share of employees of age 20 or younger.	0.041	0.067
S_AGE2	Share of employees of age 21–25.	0.078	0.075
S_AGE3	Share of employees of age 26–30.	0.096	0.074
S_AGE4	Share of employees of age 31–35.	0.145	0.082
S_AGE5	Share of employees of age 36–40.	0.174	0.069
S_AGE6	Share of employees of age 41–45.	0.143	0.076
S_AGE7	Share of employees of age 46–50.	0.121	0.075

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... table 1 continued

Label	Description	mean	std. dev.
S_AGE8	Share of employees of age 51–55.	0.103	0.073
S_AGE9	Share of employees of age 56–60.	0.068	0.063
S_AGE10	Share of employees of age 61 or older.	0.042	0.056
S_TENURE1	Share of employees with less than 1 year of tenure.	0.162	0.157
S_TENURE2	Share of employees with 1–2 years of tenure.	0.205	0.150
S_TENURE3	Share of employees with 3–5 years of tenure.	0.150	0.125
S_TENURE4	Share of employees with 6–10 years of tenure.	0.168	0.120
S_TENURE5	Share of employees with 11–15 years of tenure.	0.117	0.097
S_TENURE6	Share of employees with 16–20 years of tenure.	0.064	0.072
S_TENURE7	Share of employees with 21–25 years of tenure.	0.055	0.068
S_TENURE8	Share of employees with 26–30 years of tenure.	0.039	0.059
S_TENURE9	Share of employees with 31 or more years of tenure.	0.038	0.062
S_LOW_EDUC	Share of employees with LOW_EDUC.	0.198	0.194
S_MED_EDUC	Share of employees with MED_EDUC.	0.639	0.227
S_HIGH_EDUC	Share of employees with HIGH_EDUC.	0.072	0.136
S_NA_EDUC	Share of employees with NA_EDUC.	0.113	0.229
HOURSWORKED	Average hours worked in the firm.	154.2	23.7
S_IRREG	Share of employees for whom any of NIGHT, SUNDAY, or SHIFT applies.	0.178	0.232
S_OVERTIME	Share of employees working overtime.	0.178	0.260
S_BC	Share of blue collar workers.	0.478	0.327
S_NOT_FT	Share of employees who do not work full-time.	0.224	0.212
FIRMSIZE1	Firm has between 10 and 49 employees.	0.416	0.493
FIRMSIZE2	Firm has between 50 and 249 employees.	0.350	0.477
FIRMSIZE3	Firm has between 250 and 499 employees.	0.109	0.312
FIRMSIZE4	Firm has between 500 and 999 employees.	0.073	0.260
FIRMSIZE5	Firm has between 1000 and 1999 employees.	0.040	0.195
FIRMSIZE6	Firm has 2000 or more employees.	0.020	0.140
SECTOR1	Mining and quarrying (NACE: 10–14)	0.011	0.105
SECTOR2	Manufacture of food products, beverages and tobacco (NACE: 15–16)	0.034	0.181
SECTOR3	Manufacture of textiles and textile products; leather and leather products (NACE: 17–19)	0.019	0.138
SECTOR4	Manufacture of wood and wood products; pulp, paper and paper products (NACE: 20–21)	0.033	0.179
SECTOR5	Publishing, printing and reproduction of recorded media (NACE: 22)	0.036	0.186
SECTOR6	Manufacture of coke, refined petroleum products and nuclear fuel; chemicals and chemical products (NACE: 23–24)	0.027	0.162
SECTOR7	Manufacture of rubber and plastic products (NACE: 25)	0.033	0.178
SECTOR8	Manufacture of other non-metallic mineral products (NACE: 26)	0.028	0.164
SECTOR9	Manufacture of basic metals; fabricated metal products, except from machinery and equipment (NACE: 27–28)	0.055	0.229
SECTOR10	Manufacture of machinery and equipment n.e.c. (NACE: 29)	0.045	0.207
SECTOR11	Manufacture of electrical machinery and apparatus n.e.c. (NACE: 31)	0.025	0.157
SECTOR12	Manufacture of electrical and optical equipment; radio, television, and communication equipment and apparatus (NACE: 30 + 32)	0.021	0.144

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... table 1 continued

Label	Description	mean	std. dev.
SECTOR13	Manufacture of medical, precision and optical instruments, watches and clocks (NACE: 33)	0.023	0.149
SECTOR14	Manufacture of transport equipment (NACE: 34–35)	0.032	0.176
SECTOR15	Manufacture n.e.c. (NACE: 36–37)	0.024	0.154
SECTOR16	Electricity, gas and water supply (NACE: 40–41)	0.025	0.155
SECTOR17	Construction (NACE: 45)	0.082	0.274
SECTOR18	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel (NACE: 50)	0.031	0.173
SECTOR19	Wholesale trade and commission trade except of motor vehicles and motorcycles (NACE: 51)	0.056	0.231
SECTOR20	Retail trade, except from motor vehicles and motorcycles; repair of personal and household goods (NACE: 52)	0.050	0.219
SECTOR21	Hotels and restaurants (NACE: 55)	0.027	0.161
SECTOR22	Land transport; transport via pipelines; air transport (NACE: 60 + 62)	0.028	0.165
SECTOR23	Water transport (NACE: 61)	0.008	0.088
SECTOR24	Supporting and auxiliary transport activities; activities of travel agencies (NACE: 63)	0.044	0.204
SECTOR25	Post and telecommunications (NACE: 64)	0.023	0.150
SECTOR26	Financial intermediation, except from insurance and pension funding; activities auxiliary to financial intermediation, except from insurance and pension funding (NACE: 65 + 67.1)	0.022	0.148
SECTOR27	Insurance and pension funding, except compulsory social security; activities auxiliary to insurance and pension funding (NACE: 66 + 67.2)	0.016	0.126
SECTOR28	Real estate activities; renting of machinery and equipment without operator and of personal and household goods (NACE: 70–71)	0.015	0.123
SECTOR29	Computer and related activities (NACE: 72)	0.022	0.146
SECTOR30	Research and development; other business activities (NACE: 73–74)	0.075	0.264
PUBLIC1	Firm is privately owned.	0.923	0.267
PUBLIC2	Firm is partly public-owned (<50%).	0.021	0.144
PUBLIC3	Firm is mainly public-owned (>50%).	0.056	0.230
REGION1	Firm is located in Schleswig-Holstein or Hamburg.	0.106	0.308
REGION2	Firm is located in Lower Saxony or Bremen.	0.158	0.365
REGION3	Firm is located in North Rhine-Westphalia.	0.203	0.402
REGION4	Firm is located in Hesse.	0.105	0.306
REGION5	Firm is located in Rhineland-Palatinate or Saarland.	0.104	0.305
REGION6	Firm is located in Baden-Württemberg.	0.158	0.365
REGION7	Firm is located in Bavaria.	0.166	0.372

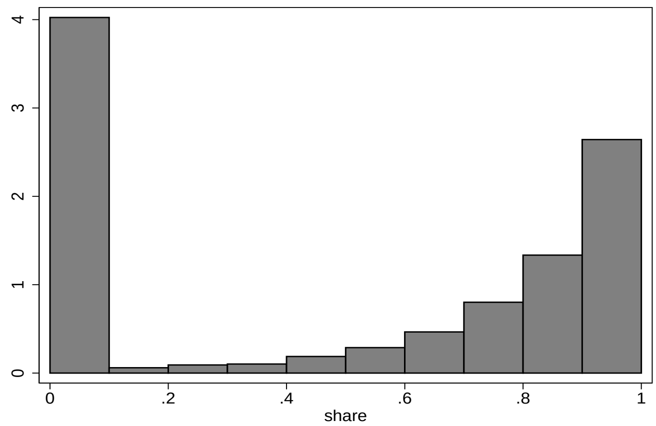
Data source: Extended GSES 2001.

Table 2: Wage Setting Regimes and Wages

regime	coverage share	log hourly wages mean	min	max	std. dev.
collective coverage (CC)	0.565	2.810	0.056	4.700	0.286
firm-level coverage (FC)	0.075	2.833	1.434	4.754	0.314
individual coverage (IC)	0.360	2.786	0.046	5.097	0.420
total		2.804	0.046	5.097	0.343
N	316,805				

Log hourly wages (in Euros). Data source: Extended GSES 2001.

Figure 1: Bargaining Coverage Within Firms



Histogram: Share of employees covered by collective or firm-level contracts as fraction of firm's total employment. Data source: Extended GSES 2001.

Table 3: Net Union Density

	mean	min	max	std. dev.	#
Cells	0.188	0	0.500	0.979	5,841
Employees	0.228	0	0.500	0.098	316,805

Data source: Extended GSES 2001.

Table 4: Wage Regressions I: Different Measures of the Wage Setting System

	(i)		(ii)		(iii)		(iv)		(v)		(vi)	
variable	coef.	std. dev.	coef.	std. dev.	coef.	std. dev.	coef.	std. dev.	coef.	std. dev.	coef.	std. dev.
CC	-0.009*	(0.004)			-0.048**	(0.011)			-0.082**	(0.012)	-0.085**	(0.005)
FC	0.019*	(0.010)			-0.081**	(0.031)			-0.149**	(0.033)	-0.070**	(0.026)
SHARECC			0.034**	(0.005)	0.176**	(0.009)			0.171**	(0.008)	0.172**	(0.008)
SHAREFC			0.067**	(0.011)	0.165**	(0.018)			0.165**	(0.018)	0.159**	(0.018)
CC×SHARECC					-0.094**	(0.015)			-0.096**	(0.015)	-0.097**	(0.015)
FC×SHAREFC					-0.012	(0.044)			-0.031	(0.043)	-0.021	(0.041)
NUD							-0.458**	(0.142)	-0.296**	(0.055)	-0.304**	(0.051)
NUD×CC									0.203**	(0.032)	0.193**	(0.045)
NUD×FC									0.367**	(0.068)	0.496**	(0.100)
NUD×SHARECC											0.027	(0.062)
NUD×SHAREFC											-0.135	(0.119)
R^2	0.703		0.705		0.709		0.703		0.710		0.710	
N	316,805		316,805		316,805		316,805		316,805		316,805	

Regressions include a full set of worker and firm characteristics. Estimation by OLS, observations weighted by inverse sampling probabilities. Clustered standard errors in parentheses. */ **: significance at the 5% / 1% level. Data source: Extended GSES 2001.

Table 5: Wage Regressions II: Different Sets of Covariates

	(a)		(b)		(c)≡(v)	
	coef.	std. dev.	coef.	std. dev.	coef.	std. dev.
CC	0.030	(0.033)	-0.057**	(0.018)	-0.082**	(0.012)
FC	-0.169*	(0.074)	-0.121**	(0.045)	-0.149**	(0.033)
SHARECC	0.708**	(0.015)	0.227**	(0.009)	0.171**	(0.008)
SHAREFC	0.644**	(0.033)	0.185**	(0.020)	0.165**	(0.018)
CC×SHARECC	-0.781**	(0.043)	-0.160**	(0.018)	-0.096**	(0.015)
FC×SHAREFC	-0.454**	(0.073)	-0.075	(0.047)	-0.031	(0.043)
NUD	-0.783**	(0.057)	0.213**	(0.040)	-0.296**	(0.055)
NUD×CC	0.812**	(0.071)	0.296**	(0.059)	0.203**	(0.032)
NUD×FC	0.783**	(0.171)	0.453**	(0.118)	0.367**	(0.068)
Controls						
individual characteristics	no		yes		yes	
firm-level characteristics	no		no		yes	
R^2	0.143		0.660		0.710	
N	316,805		316,805		316,805	
			Average Partial Effects			
CC	-0.200**	(0.009)	-0.075**	(0.006)	-0.087**	(0.005)
FC	-0.025	(0.052)	-0.025	(0.030)	-0.068*	(0.028)
SHARECC	0.266**	(0.018)	0.137**	(0.009)	0.117**	(0.009)
SHAREFC	0.610**	(0.033)	0.179**	(0.019)	0.162**	(0.016)
NUD	-0.265**	(0.038)	0.414**	(0.045)	-0.154**	(0.048)

Regressions by OLS, observations weighted by inverse sampling probabilities. Upper panel: regression coefficients. Lower panel: corresponding average partial effects. Clustered standard errors in parentheses. */ **: significance at the 5% / 1% level. Data source: Extended GSES 2001.

Table 6: Wage Regressions III: Quantile Regressions

Percentile	(10)		(25)		(50)		(75)		(90)	
	coef.	std. dev.	coef.	std. dev.	coef.	std. dev.	coef.	std. dev.	coef.	std. dev.
CC	-0.035*	(0.016)	-0.049**	(0.011)	-0.071**	(0.012)	-0.105**	(0.013)	-0.124**	(0.018)
FC	-0.104**	(0.033)	-0.135**	(0.029)	-0.157**	(0.031)	-0.169**	(0.034)	-0.183**	(0.047)
SHARECC	0.168**	(0.009)	0.184**	(0.009)	0.188**	(0.008)	0.176**	(0.009)	0.158**	(0.013)
SHAREFC	0.129**	(0.027)	0.170**	(0.018)	0.173**	(0.015)	0.159**	(0.014)	0.131**	(0.035)
CC×SHARECC	-0.104**	(0.019)	-0.117**	(0.014)	-0.109**	(0.014)	-0.094**	(0.016)	-0.074**	(0.022)
FC×SHAREFC	0.002	(0.050)	-0.035	(0.036)	-0.030	(0.036)	-0.025	(0.037)	-0.010	(0.065)
NUD	-0.173**	(0.057)	-0.223**	(0.039)	-0.256**	(0.045)	-0.315**	(0.056)	-0.391**	(0.086)
NUD×CC	0.149**	(0.040)	0.151**	(0.028)	0.155**	(0.029)	0.210**	(0.035)	0.209**	(0.051)
NUD×FC	0.199**	(0.061)	0.278**	(0.065)	0.349**	(0.075)	0.417**	(0.084)	0.489**	(0.074)
N	316,805		316,805		316,805		316,805		316,805	
					Average Partial Effects					
CC	-0.056**	(0.007)	-0.077**	(0.006)	-0.094**	(0.006)	-0.107**	(0.006)	-0.116**	(0.008)
FC	-0.059*	(0.029)	-0.076**	(0.023)	-0.081**	(0.024)	-0.078**	(0.024)	-0.074	(0.042)
SHARECC	0.109**	(0.011)	0.117**	(0.008)	0.126**	(0.008)	0.123**	(0.009)	0.117**	(0.012)
SHAREFC	0.129**	(0.025)	0.168**	(0.016)	0.171**	(0.014)	0.157**	(0.013)	0.131**	(0.033)
NUD	-0.074	(0.044)	-0.117**	(0.032)	-0.142**	(0.040)	-0.165**	(0.049)	-0.237**	(0.074)

Regressions include a full set of worker and firm characteristics. Quantile regression, observations weighted by inverse sampling probabilities. Upper panel: regression coefficients. Lower panel: corresponding average partial effects. Clustered standard errors in parentheses; see appendix B for details of the implementation. */ **: significance at the 5% / 1% level. Data source: Extended GSES 2001.