UNION DENSITY AND VARIETIES OF COVERAGE: THE ANATOMY OF UNION WAGE EFFECTS IN GERMANY

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Collective bargaining in Germany takes place at either industry or firm level, and bargaining coverage is much higher than union density. The share of a firm's employees covered can vary between 0% and 100%, suggesting that researchers should distinguish union density, coverage at the firm level, and coverage at the individual level. Using linked employer–employee data, the authors estimate OLS and quantile regressions of wages on these dimensions of union influence. They find that a higher share of employees in a firm covered by industrywide or firm-specific contracts is associated with higher wages but find no clear-cut effect on wage dispersion. Yet, holding coverage at the firm level constant, individual coverage is associated with lower wages and less wage dispersion. Higher union density reinforces the effects of coverage. But for employees in firms without coverage, density's effect is negative and thus compresses the wage distribution in firms without coverage.

> Union coverage should not be considered a natural extension of union membership [. . .] only in half a dozen OECD countries with predominantly company bargaining do the two go closely together. By contrast, in sectoral bargaining systems employer behavior combined with administrative governance of collective contracts may be more a determinant of coverage rates than union membership. OECD (2004)

The impact of wage-setting institutions on labor market performance is a recurring key issue in policy debates (OECD 1994, 2004, 2006). It is often argued that less rigid wage-setting institutions allow for greater wage

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flexibility, which—in face of asymmetric shocks—is a necessary ingredient for a well-functioning labor market. Wage-bargaining institutions differ strongly across OECD countries, with pronounced cross-country differences in coverage rate, the share of employees covered by collective bargaining and in union density, the share of union members among employees (OECD 2004). Under firm-specific bargaining—the prevailing institutional setup in the United States and a small number of other OECD countries—coverage by collective bargaining and union density basically coincide in the private sector. In contrast, in many European countries, there exists centralized wage bargaining (mostly at the sectoral level) between unions and employers' associations, and the coverage rate among employees is typically higher than union density.[1]

Germany is a key case where coverage exceeds union density largely because of contract recognitions by employers, which are legally voluntary. In recognizing collective bargaining agreements, however, firms do respond to the demands and the bargaining power of employees. In fact, three distinct wage-bargaining regimes coexist. First, *sectoral* wage-bargaining agreements (henceforth denoted as sectoral contracts, SC), which are based on centralized negotiations at the industry level, cover a large share of employees. According to the favorability principle (OECD 2004: 154), employers covered by a sectoral agreement may pay higher wages than the contract wage. This results in a wage cushion or a wage drift.[2] The first regime also includes extensions of sectoral agreements by the government to an entire industry.[3] Second, *firm-level* agreements, which are specific to employees in one firm (henceforth denoted as firm-specific contracts, FC), cover a smaller share of employees. Firm-specific bargaining and sectoral bargaining are *mutually exclusive* alternatives in Germany, that is, firm-specific bargaining is not a second round of bargaining supplementing a sectoral agreement.[4] Within the same industry, it would be the same union that engages both in sectoral and firm-specific bargaining.The third wage-bargaining regime involves those employees who are *not covered* by collective wage bargaining at all (henceforth denoted as individual wage contracts, IC). The uncovered sector has grown in recent decades (ibid.: 154).

According to the German Collective Bargaining Act *(Tarifvertragsgesetz),* collectively negotiated agreements are necessarily binding for a specific job match if the firm is a member of an employer association and the worker is a union member. But the scope of collective agreements, in particular the scope of sectoral wage agreements, goes beyond organized parties. Not only do negotiation outcomes cover union members, but employers often recognize collective bargaining outcomes for most of their employees without ex

[1]OECD (2004, chart 3.4) reports that coverage exceeds union density by more than 10 percentage points for 17 OECD countries and by more than 20 percentage points for 12 OECD countries.

[2]A wage cushion is also observed in other European countries (see, e.g., Cardoso and Portugal 2005).

[3]Contract extensions by the government have played only a negligible role until recently. Less than 1% of all employees were covered in the early 2000s due to such contract extensions (BMWA 2004).

[4]In Spain, for instance, firm-specific bargaining is a second round of bargaining (Card and de la Rica 2006).

ante legal obligation. Moreover, because of the freedom not to associate as a principle of the German constitution *(negative Koalitionsfreiheit),* collectively negotiated agreements must not dictate individual wage premia for union members (compared with nonmembers).

Uncovered employees may work either in uncovered firms exhibiting a coverage rate of 0% (i.e., with no covered employees at all) or in firms with a positive coverage rate comprising both covered and uncovered employees. Put differently, while a single employee belongs to only one of the three distinct bargaining regimes, the employee's firm may be covered by either sectoral or firm-specific bargaining—meaning that the firm has a positive coverage rate—and it may also employ uncovered employees. Typically, collective bargaining in firms with a positive coverage rate covers the majority of employees. On the one hand, uncovered employees in a firm with positive coverage may be paid less than covered employees when the firm uses noncoverage as an instrument for downward wage flexibility. For example, the firm may cease to recognize a collective agreement for newly hired employees while the incumbent workforce remains covered for a while. On the other hand, uncovered employees in a firm with positive coverage may be paid more than covered employees when the firm wants to pay higher wages to highly productive employees, possibly using more flexible payment schemes.

The related literature implies that collective bargaining is associated with higher wage levels and lower wage dispersion (Pencavel 1991; Card 1996; Addison and Schnabel 2003). Card and de la Rica (2006) argue that firm-specific bargaining allows employees with a strong bargaining position (e.g., due to high levels of specific human capital) to seize higher rents compared to more centralized forms of collective bargaining (but see Hartog, Leuven, and Teulings 2002 for an opposite view).

Empirical studies typically take union membership and union recognition or collective bargaining coverage as mere alternatives to measure union effects (Lewis 1986; OECD 2004). Studies for Germany have so far been confined to using *either* collective bargaining coverage (Stephan and Gerlach 2003, 2005; Gürtzgen 2009a, 2009b) *or* union density (Fitzenberger and Kohn 2005). We emphasize that union density and coverage (union recognition) are more than just two different indicators of collective bargaining in Germany. Union density reflects the bargaining power of unions. It is likely to have a positive effect both on wages in the covered sector and on coverage rates. Coverage rates and wages in the covered sector may also affect wage outcomes in the uncovered sector (Pencavel 1991: 172–80). The direction of these effects is ambiguous (Kahn 1978; Neumark and Wachter 1995). On the one hand, the *threat effect* implies that wages increase in the uncovered sector in response to higher coverage rates or to higher wages in the covered sector because uncovered firms want to discourage coverage. On the other hand, the *crowding effect* presumes that wage increases in the covered sector or increases in the coverage rates lower employment in the covered sector. For uncovered firms, this raises relative labor supply, resulting in downward pressure on wages in a competitive labor market.

We scrutinize the effects of union density *and* of collective bargaining coverage on the distribution of wages in both the covered and the uncovered sector. We argue that, on the one hand, union density is a proxy for union power and therefore influences the bargaining outcome in the covered sector. Collective bargaining coverage, on the other hand, captures the actual application of bargaining agreements. Moreover, our empirical analysis accounts for the likely interaction between union density and coverage as well as for spillover effects of union density on the uncovered sector.

Our contribution to the literature is fourfold: First, there is only a small international literature that accounts for differential wage effects of union density and coverage in the covered sector, and no such study has yet been conducted for Germany. This study is the first to distinguish simultaneously (1) coverage by a firm-specific collective agreement (FC) versus coverage by a sectorwide collective agreement (SC), (2) firm-level coverage measured by the share of covered employees in the firm versus coverage of individual workers, and (3) union density. We estimate the wage effects of both coverage and union density and also account for the effect of union density on the uncovered sector. Second, we use a unique linked employer-employee data set, the German Structure of Earnings Survey (GSES) for 2001, which records precisely the coverage status of individual employees, but which does not include information on union membership. Third, we impute union density for homogeneously defined labor market segments based on estimated membership equations in Fitzenberger, Kohn, and Wang (2011). As a limitation, we acknowledge that we ignore the estimation error in the imputation. Fourth, we provide both OLS and quantile regression estimates in order to estimate impacts on wage levels and on wage dispersion. As a methodological contribution, we suggest a modification of the approach taken by Angrist, Chernozhukov, and Fernández-Val (2006) for estimating a weighted quantile regression with clustered standard errors. Appendix A provides details about the econometric approach, and Appendix B, details about the data used. An additional online appendix includes further detailed information and results: http://www.empiwifo.uni-freiburg.de/discussion-papers-1.

Background and Literature Review

Bargaining models treat the negotiation of wages in the covered sector as a rent-sharing problem, the solution to which depends upon the bargaining power of the negotiating parties (e.g., in Nash bargaining). Unions bargain for a higher wage level for the work force they represent. The monopoly union model, the right-to-manage model, and the efficient bargaining model predict a positive relationship between union power and the level of wages (Oswald 1985; Farber 1986; Pencavel 1991; Naylor 2003). Union density, that is, the share of employed union members among all employees, is a measure of union power in Germany (Fitzenberger and Kohn 2005).[5] The

[5]The German literature refers to the share of employed union members among all employees as *net union density* in order to distinguish this measure from the ratio of all union members (employed or not employed) to the number of employees (*gross union density*).

higher the number of union members paying membership fees, the higher is the union's funding for union action (e.g., paying strike benefits). Financial funding and union representation on the shop floor increase individual support for union action, which raises the ability to undertake a strike and the possible damage inflicted upon employers in case of a strike.

Some studies incorporate effects of collective bargaining on aspects of the entire wage distribution (see Card, Lemieux, and Riddell 2003 for a survey of the empirical evidence on unions and wage inequality). Agell and Lommerud (1992) and Burda (1995) argue that risk averse employees have a preference for wage compression. Unions as agents of employees may be willing to trade off a lower average wage against less wage inequality. If the earnings of employees depend upon different states of nature, such as demand shocks on firms' product market, a union will bargain for a compression of the wage distribution relative to the productivity distribution (Guiso, Pistaferri, and Schivardi 2005). A 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 (Freeman 1982). These arguments predict a negative relationship between union power and wage dispersion.

German collective agreements do not constrain a firm's right to pay premia above the wage set in the collective contract (this reflects the favorability principle) such that the actual wage may exceed the contractual wage. Cardoso and Portugal (2005) refer to this gap as the *wage cushion* in order to distinguish it from the *wage drift* (the change of the gap). 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. As in Card and de la Rica (2006), firms covered by (multi- or single-) firm-specific agreements pay higher wages than firms covered by industrywide agreements.

In line with the existence of a wage cushion, the impact of collective bargaining is likely to vary along the wage distribution. If contractual wages serve as wage floors, the wage distribution is compressed from below. Büttner and Fitzenberger (2003) assume that efficiency wages are paid in the upper part of the productivity distribution, whereas contractual wages above productivity are binding for less productive employees. Then, a more powerful union will bargain for a stronger compression of the wage distribution from below.

The effects of different bargaining regimes are likely to interact with country-specific institutions and social norms (Flanagan 1999). Card and de la Rica (2006) find that firm-specific bargaining in Spain results in higher wages compared with wages set in regional and national contracts, while Hartog et al. (2002) report only minor differences between bargaining regimes in the Netherlands. Analyzing union wage effects in Italy, Dell'Aringa and Lucifora (1994) find a positive effect of recognition and a negative effect of plant-level union density.

The literature typically takes union membership and union recognition or collective bargaining coverage as alternative measures of union effects (Lewis 1986; OECD 2004).[6] Differential wage effects of coverage and union density may arise from spillover effects between the covered and the uncovered sector (Kahn 1978; Pencavel 1991: 172–80; Neumark and Wachter 1995).[7] On the one hand, a positive relationship between wages in the covered sector (and thus coverage rate or union density) and wages in the uncovered sector arises because wage outcomes in the covered sector are taken as a reference point in the uncovered sector, possibly in order to avoid coverage (threat effect).[8] On the other hand, a negative relationship between wages in the covered sector (and thus coverage rate and union density) and wages in the uncovered sector may exist because excess labor supply from the covered sector exerts pressure on the wage level in the uncovered sector (crowding effect). The latter effect may be reinforced by a decline of investment in the uncovered sector when union density increases (Vogel 2007). The empirical evidence for the United States is ambiguous. Using union density as a measure of unionism, Kahn (1978) finds that the crowding effect dominates the threat effect, while Neumark and Wachter (1995) confirm this result at the industry level but not at the city level.

Coverage by collective wage bargaining in Germany is a firm decision, which is voluntary in an *ex ante* legal sense. When recognizing sectoral collective bargaining agreements or when engaging in firm-specific bargaining, firms do respond to the demands of their employees and to the bargaining power of unions as employees' representatives. When firms decide to quit a collective bargaining agreement after it has expired, the agreement remains binding for the incumbent covered workforce for a while, and during that time, the firm can deviate from the collective agreement for only new hirings. In our empirical analysis, we conceptualize union power as union density in labor market segments defined by region, employee characteristics, and firm characteristics, and we argue that union density in a labor market segment has a positive impact on coverage. While the freedom not to associate forbids collective bargaining agreements dictating individual wage premia for union members in comparison to nonmembers, wages set at the firm level and at the individual level take collective bargaining outcomes as a reference point, be it in order to reduce transactions costs, to prevent employees from joining a union (threat effect), to elicit

[6]Only a limited literature for the United States and the United Kingdom focuses on the question whether coverage and membership (as different measures of union activity) have conceptually different impacts on wages (see, e.g., Hunt et al. 1987 or Koevets 2007). Because of the strong institutional differences between the United States and the United Kingdom, on the one hand, and Germany, on the other hand, we do not review these studies in more detail.

[7]Pencavel (1991: 163–80) emphasizes the equilibrium nature of the relationship between union and nonunion wages, the two being jointly determined.

[8]In addition to the threat effect, rents from specific human capital and the existence of hiring and firing costs or efficiency wage considerations could cause a positive spillover effect (Pencavel 1991, chapter 6). Rosen (1969) calls spillover effects other than the threat effect "indirect" effects.

higher effort by employees (Pencavel 1991: 173), or to commit to a minimum wage level in order to incentivize training effort (Dustmann and Schönberg 2009). As a result, coverage is considerably higher than union density (Schnabel 2005).

Data

Our empirical analysis is based on the German Structure of Earnings Survey (GSES, *Gehalts- und Lohnstrukturerhebung*) for the year 2001. We restrict our analysis to West Germany.[9] The GSES is a cross-sectional linked employer-employee data set containing about 850,000 employees in some 22,000 firms. Although it generally omits the public sector, the GSES covers the major part of industry and private services. There are several advantages of using the GSES 2001. It is one of the largest mandatory firm-level surveys available for Germany. Therefore, the data are more reliable than individual-level surveys or data collected without reporting obligation (Jacobebbinghaus 2002). The GSES includes not only workers in regular employment but also employees in vocational training, marginal employment, or partial retirement schemes. In the GSES 2001, wages are neither truncated nor censored, which allows us to analyze precisely the lower and the upper parts of the wage distribution. Most important, the GSES provides not only firm-level information on bargaining coverage but also the coverage status for each individual worker.

The GSES 2001 has rarely been used in the literature. Until recently, analyses with GSES data have been restricted to administrative use or to regional subsamples (for the latter, see Stephan and Gerlach 2003; Gerlach and Stephan 2006; Heinbach and Spindler 2007). Hafner (2005), Hafner and Lenz (2008), and Statistisches Bundesamt (2000, 2004) provide more detailed descriptions of the data set. We use the on-site-use version of the GSES available at the Research Data Center of the statistical offices of the federal states *(Länder)* in Wiesbaden. Details on our selection of data are provided in Appendix B. We focus on prime-age male employees working full time and analyze hourly wages for both blue-collar and white-collar workers. Our analysis controls for differences between the two groups of employees, and it excludes white-collar workers in upper and middle management positions who would be paid without reference to the system of collective wage setting. Definitions and summary statistics of the full set of variables used in our analysis are reported in the additional online appendix (see http://

[9]The reasons for this decision are as follows: First, the labor market in East Germany is still affected by the transition following the German unification. Second, union policy in East Germany is strongly oriented toward catching up to West German standards. Third, union action in East Germany relies on support by West German unions. Thus, it is unlikely that East German unions act independently. For example, when the metal workers' union went on strike in the year 2003 in East Germany to achieve the equalization of standard hours of work, the union had to rely on support from West Germany to fill its ranks (see the newspaper DIE WELT, June 23, 2003). By the time the strike affected West German firms, this support declined quickly, and the strike was discontinued without success.

www.empiwifo.uni-freiburg.de/discussion-papers/fitzenberger-1/final_ilrr_1201_additional_appendix.pdf).

Imputation of Union Density

The GSES does not provide information on union membership. We therefore extend the data set by imputing union density. In a first step, we project individual propensities for union membership for the observations in our sample based on the estimates in Fitzenberger et al. (2011), who estimate determinants of union membership by means of panel probit regressions based on data from the German Socio-Economic Panel (GSOEP), a population survey containing information on union membership status.[10]

In a second step, union density (UD) in a homogenous labor market segment is obtained by aggregating individual membership propensities in cells defined by region (7 states) × industry (30 sectors) × skill (4 groups defined by educational attainment) × age (7 five-year brackets),[11] yielding a total of 5,841 nonempty cells, denoted as labor market segments. The imputed UD is the same for all employees in a labor market segment, and we do not distinguish UD by type of bargaining because within a labor market segment it would be the same union that engages both in sectoral and firm-specific bargaining.

This definition of labor market segments 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. The fact that collective agreements further distinguish various wage groups is captured by the two dimensions of skill and age. The aggregation for the labor market segments enables us to analyze the effect of union power independent of individual membership. In the German context, it would make little sense to estimate wage effects of individual membership because collectively negotiated premia for union members are forbidden and coverage is a firm decision. This decision depends upon union power, which we proxy by UD, in a labor market segment. Hence, even if individual membership were available in the data, we would continue to use an aggregate measure of UD.

Descriptive Evidence

We focus on male employees (both blue- and white-collar) in West Germany (excluding Berlin) and distinguish three regimes of bargaining coverage:

[10]The projection is based on model specification (E) in the working paper Fitzenberger, Kohn, and Wang (2006). This specification uses only explanatory variables that are available in both the GSES and the GSOEP. The variables used involve age, gender, educational attainment, employment status (white-collar workers, blue-collar workers, civil servants; part-timers or full-timers), earnings, tenure, firm size, industry, and a set of time dummies. The empirical model is estimated separately for West Germany and East Germany. The imputations for the purpose of this article are based on estimates for West Germany.

[11]The highest age bracket contains only 55-year-old employees.

Table 1. Wage-Setting Regimes and Wages

Regime	*Share of employees*	*Log hourly wages (in Euros)*	
		Mean	*Standard deviation*
Sectoral collective contracts (SC)	0.565	2.818	0.284
Firm-specific collective contracts (FC)	0.075	2.852	0.315
Individual contracts (IC)	0.360	2.783	0.412
Total	1.000	2.808	0.338
No. of observations		316,805	

Source: Extended GSES 2001.
Note: Descriptives calculated using sampling probabilities.

(SC) sectoral collective contract negotiated between an employers' association and a union,
(FC) firm-specific contract negotiated between a single firm and representatives of its employees (typically a union), and
(IC) individual contract negotiated between employee and employer.

The first column of Table 1 displays the size of the respective regimes in our GSES sample. The numbers are broadly in line with the literature cited above, accounting for differences in the data sets used: 57% of West German employees are paid according to sectoral collective contracts, henceforth called sectoral contracts; another 8% are covered by firm-specific contracts; and about a third are covered by individual contracts.

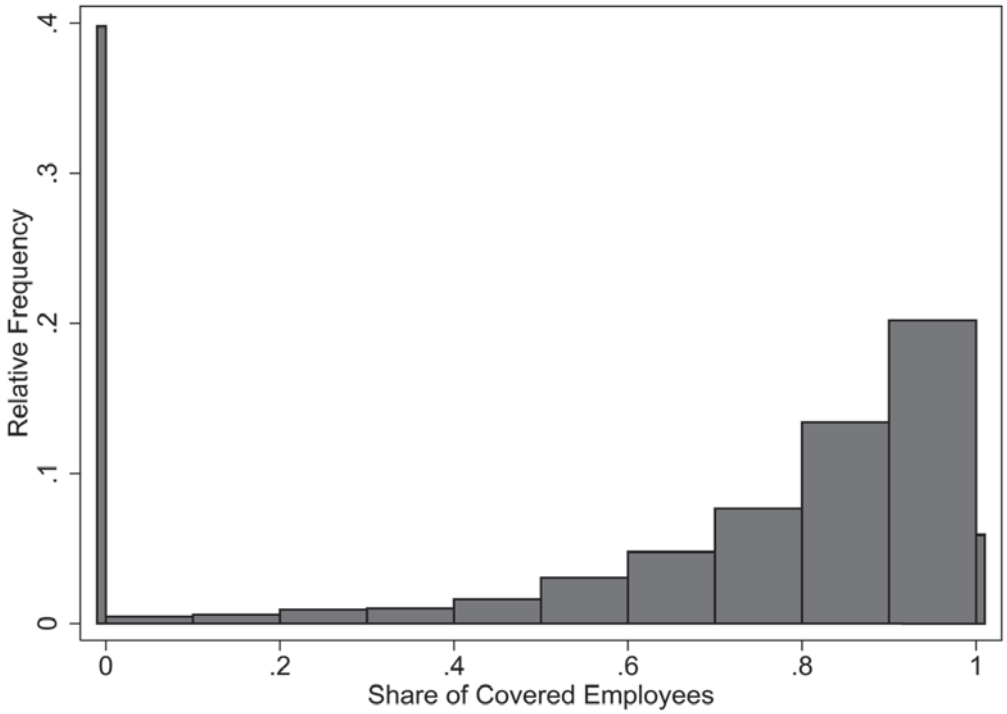
The share of covered employees within firms follows a bimodal distribution (Figure 1). About 40% of firms in the sample do not apply any sectoral or firm-specific contracts. In another 7% of firms, all employees are covered. This leaves more than one-half of all firms with partial coverage. This fact enables us to distinguish coverage effects at the individual level and at the firm level. Typically, in firms with a positive share of covered employees, contracts cover the majority of employees.

Columns two and three of Table 1 concern log hourly wages by wage-setting regimes. On average, employees with individual contracts earn the lowest wages (2.783). Wages paid according to a sectoral collective agreement are markedly higher (2.818), and the highest wages are paid by firms subject to a firm-specific contract (2.852). Wage dispersion as measured by the standard deviation of log hourly wages is lowest among employees under sectoral coverage (0.284) and only slightly higher in cases of firm-specific contracts (0.315). Employees with individually negotiated wages face a considerably higher standard deviation (0.412).[12]

Across the 5,841 labor market segments (cells) in our data, the average imputed union density UD is 18.5%. Weighted by cell employment, the weighted average of UD is 22.4%. Note that UD is not identical for all

[12]More detailed evidence on the wage distributions of different groups of employees (men, women working full-time, and women working part-time, separate for blue-collar and white-collar workers in East and West German firms) is provided by Kohn and Lembcke (2007).

Figure 1. Bargaining Coverage within Firms: Distribution of Firms with Employees Covered by a Sectoral or a Firm-Specific Collective Contract



Source: Extended GSES 2001.

employees in a firm. UD is markedly lower than collective bargaining coverage. Again, the numbers are in accordance with the literature.

Econometric Investigation

The literature and our earlier discussion suggest that both coverage by collective bargaining and a higher union density are associated with lower wage dispersion. Coverage is also associated with higher wage levels, while the link between union density and the wage level is ambiguous. Sectoral collective contracts may be associated with lower wage inequality than firm-specific contracts.

Observed differences in wage levels and in wage dispersion are not necessarily caused by the prevalence of varying bargaining regimes. First, they may conceal differences in union power between differing labor market segments. Second, they may result from underlying heterogeneity in employee or firm characteristics. We investigate both of these issues by means of OLS and quantile wage regressions. Our analysis distinguishes: (1) coverage by a sectoral collective contract versus coverage by a firm-specific collective contract, (2) extent of coverage at the firm level versus coverage of individual workers, and (3) union density. Moreover, we carefully analyze interaction

effects among the different measures. As a caveat, our analysis does not take account of the estimation error in union density.[13]

OLS Wage Regressions

We analyze the different factors that influence the wage level by means of wage regressions with individual and firm controls. Log hourly wages ($log(w)$) are regressed on the set of covariates $X \equiv [Z, F, V]$, including individual worker characteristics Z, firm characteristics F, and a vector of union variables V. The estimates are based on a sample of individuals $i = 1, \ldots, N$ in firms $c = 1, \ldots, C$. Weights are used to account for varying sampling probabilities. Moreover, since our data are sampled at the firm level and X contains information from different levels of aggregation, the estimated covariance of the estimator $\hat{\beta}$ takes account of clustering at the firm level (Froot 1989; Moulton 1990; Williams 2000).

The set of union variables V contains individual dummy variables for (1) coverage by sectoral contracts (SC) or firm-specific contracts (FC), leaving individual contracts as the base category; (2) the share of employees in each firm covered by a sectoral contract (SHARE_SC) or a firm-specific contract (SHARE_FC);[14] and (3) union density (UD). Allowing for interaction effects between the variables from different levels, a benchmark specification can be written as

$$
\begin{aligned}
(1) \qquad log(w_{ic}) = {} & \beta_0 + Z_{ic}\beta_Z + F_c\beta_F + SC_{ic}\beta_{V1} + FC_{ic}\beta_{V2} \\
& + SHARE\_SC_c\beta_{V3} + SHARE\_FC_c\beta_{V4} + UD_{ic}\beta_{V5} \\
& + SC_{ic} \cdot SHARE\_SC_c\beta_{V6} + FC_{ic} \cdot SHARE\_FC_c\beta_{V7} \\
& + SC_{ic} \cdot UD_{ic}\beta_{V8} + FC_{ic} \cdot UD_{ic}\beta_{V9} + SHARE\_SC_c \\
& \cdot UD_{ic}\beta_{V10} + SHARE\_FC_c \cdot UD_{ic}\beta_{V11} + u_{ic},
\end{aligned}
$$

where β_{V1} to β_{V5} measure base effects, β_{V6} and β_{V7} capture the different nature of individual coverage in high-coverage firms as compared to low-coverage firms, and β_{V8} and β_{V9} allow for the possibility that UD (power) effects differ by coverage. The specification allows us to test whether UD affects only covered employees or both covered and uncovered employees. Positive values of β_{V10} and β_{V11} indicate that strong unions achieve their wage objective most successfully in high-coverage firms.

Table 2 displays results for different sets of wage-bargaining indicators, using our preferred set of all other individual and firm covariates. Specification (i), including only dummy variables for individual coverage, yields

[13]Note that union density is calculated as an average in a labor market segment, which is likely to reduce somewhat the imputation error.

[14]SHARE_SC is the average of the dummy variable SC within the firm, and SHARE_FC is the average of the dummy variable FC within the firm. The large number of firms with SHARE_SC or SHARE_FC lying between 0% and 100% (see Figure 1) identify the coefficients.

Table 2. Wage Regressions I: Different Measures of the Wage-Setting System

	(i)		*(ii)*		*(iii)*		*(iv)*	
Variable	*Coefficient*	*Standard error*	*Coefficient*	*Standard error*	*Coefficient*	*Standard error*	*Coefficient*	*Standard error*
SECTOR CONTRACT	–0.009*	(0.004)			–0.107**	(0.006)	–0.048**	(0.011)
FIRM CONTRACT	0.019*	(0.010)			–0.095**	(0.013)	–0.081**	(0.031)
SHARE EMPL W / SC			0.034**	(0.005)	0.148**	(0.008)	0.176**	(0.009)
SHARE EMPL W / FC			0.067**	(0.011)	0.169**	(0.017)	0.165**	(0.018)
SHARE_SC × SC							–0.094**	(0.015)
SHARE_FC × FC							–0.012	(0.044)
R^2	0.703		0.705		0.709		0.709	
No. of observations	316,805		316,805		316,805		316,805	
	(v)		*(vi)*		*(vii)*		*(viii)*	
Variable	*Coefficient*	*Standard error*	*Coefficient*	*Standard error*	*Coefficient*	*Standard error*	*Coefficient*	*Standard error*
SECTOR CONTRACT			–0.107**	(0.006)	–0.082**	(0.012)	–0.077**	(0.014)
FIRM CONTRACT			–0.094**	(0.013)	–0.149**	(0.033)	–0.172**	(0.033)
SHARE EMPL W/ SC			0.147**	(0.008)	0.171**	(0.008)	0.166**	(0.016)
SHARE EMPL W/ FC			0.168**	(0.016)	0.165**	(0.018)	0.185**	(0.030)
SHARE_SC x SC					–0.096**	(0.015)	–0.097**	(0.015)
SHARE_FC x FC					–0.031	(0.043)	–0.025	(0.041)
UNION DENSITY	–0.139**	(0.051)	–0.111*	(0.048)	–0.296**	(0.055)	–0.300**	(0.060)
UD × SC					0.203**	(0.032)	0.180**	(0.044)
UD × FC					0.367**	(0.068)	0.461**	(0.097)
UD × SHARE_SC							0.031	(0.061)
UD × SHARE_FC							–0.103	(0.117)
R^2	0.703		0.709		0.710		0.710	
No. of observations	316,805		316,805		316,805		316,805	

Source: Extended GSES 2001.

Notes: Regressions include a full set of worker and firm characteristics: age, education, tenure, job status, age distribution in firm, tenure distribution in firm, industry, region, and working time. See the additional online appendix for full regression results. Estimation by OLS, observations weighted by inverse sampling probabilities. Clustered standard errors in parentheses.

*and **: significance at the 5% and 1% level, respectively.

significant but rather small effects, with different signs for sectoral and firm-level contracts. While employees covered by a sectoral contract earn 0.9% less than uncovered employees, those covered by a firm-specific contract earn 1.9% more. Results for the shares of covered employees in specification (ii) differ, though. Both sectoral and firm-level contracts show a positive and significant effect, which is in line with the literature. An increase in the share of employees in a firm covered by a sectoral (firm-specific) contract by 10 percentage points is associated with a 0.34% (0.67%) increase in wages. Individual coverage and firm-level coverage shares are both included in specification (iii). While the share variables show a sizable positive effect, individual coverage by firm-specific or sectoral contract shows negative effects, holding firm coverage (the share of covered employees) constant. It therefore proves important to distinguish the effects of individual coverage from the effects of firm-level shares of covered employees. In a firm with full coverage, the combined effect of individual coverage and firm coverage is

estimated to be positive (–0.107 + 0.148 = 0.041 for a sectoral contract and –0.095 + 0.169 = 0.074 for a firm-specific contract), which means that wages in a firm with full coverage are higher on average than wages in uncovered firms.

Specification (iv) allows in addition for interaction effects, which turn out negative. Thus, the effect of individual coverage is particularly negative in firms with a high share of workers covered by a sectoral contract. This result, however, does not hold for firm-specific contracts as the effect of FC × SHARE_FC is small and insignificant. Average partial effects (APEs) for individual coverage remain negative. For example, the marginal effect for individual coverage by a sectoral contract, evaluated at the average coverage rate of 0.565, is –10.1%.[15] Unless stated otherwise, marginal effects are evaluated as APEs at the respective average coverage shares. An employee in a firm with an average rate of collective coverage earns about 10% less than an uncovered employee in the same firm. In turn, the marginal effect of an increase in the share of covered employees differs between covered and uncovered employees. While both effects are positive, the effect for covered employees is reduced by the interaction term. In combination, the marginal effect for covered employees is a 0.8% wage increase for a 10 percentage points increase in the share of employees covered by a sectoral contract, while the wage increase is 1.8% for uncovered employees.

Specifications (v) to (viii) introduce UD into the regressions. The base effect of UD has a negative sign and is significant at the 1% level in all specifications.[16] Moreover, the inclusion of UD basically does not alter the effects of coverage. The coefficients of SC and FC merely become slightly more pronounced. Again, we generally find a positive effect of collective coverage at the firm level, but negative effects of individual coverage. In specification (v), the UD effect picks up the effects of the omitted coverage variables. When coverage effects are included in specification (vi), a 10 percentage points increase in UD is associated with a decline in wages of about 1%. Therefore, either unions put only a little weight on the wage-level objective or they are not very effective in using their power to increase wages. Specification (vii), which additionally allows for interaction effects between UD and individual coverage, shows a corresponding decline of about 3% for employees with individual contracts. The positive interaction effects then imply a reduction of only 1% for employees covered by a sectoral contract, and even a small wage-increasing effect of UD in cases of firm-specific contracts. This means that stronger unions achieve higher wages for covered employees only in cases of firm-specific bargaining.

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[15] $\beta_{V1} + \beta_{V6}\overline{SHARESC} = -0.048 - 0.094 \cdot 0.565 = -0.101$, where $\overline{SHARESC}$ denotes the average share of employees covered by sectoral contracts.

[16] Note that we ignore the estimation error in UD (see our discussion of imputation of union density in footnote 13). Strictly speaking, we cannot be sure that UD is significant because it is likely that standard errors are biased downward.

The inclusion of interaction terms between UD and the coverage shares in specification (viii) does not show any significant coefficients. Therefore, we resort to specification (vii) as our preferred specification for further analysis. Column (iii) of Table 3 reproduces the results of the preferred specification. The lower panel of this table reports the implied estimates of the APEs.[17] The numbers corroborate the above findings.

The APEs of individual coverage are negative, while the firm-level shares of covered employees show positive APEs. This finding is in line with a risk premium paid to individuals not covered by a collective contract, as contract wages provide wages floors for covered individuals. Uncovered individuals may be rewarded for higher flexibility, or performance pay may be more important to them.[18] Unfortunately, our analysis does not allow us to distinguish between these different explanations for the negative effect of individual coverage.

The APE of UD is also negative. This result suggests that the negative crowding effect on wages in the uncovered sector dominates the potential positive threat effect. The crowding effect is due to an increase in labor supply in the uncovered sector caused by higher wages—and thus lower employment—in the covered sector. Alternatively, it would also be consistent with the argument that firms in segments with strong unions invest less in capital (Vogel 2007). One may be concerned that the negative effect of UD may reflect a reverse causality such that employees expecting low wages may join a union to win additional protection. We cannot rule out such an effect. Unlikely, however, is that this effect dominates because it could not explain the positive interaction effect between UD and coverage (Table 2, specification (vii) that implies that stronger unions are associated with a higher wage gap between covered and uncovered employees. This interaction effect is inconsistent with UD merely reflecting low wage prospects. Note that UD varies only by labor market segments, that is, a possible selection effect would not operate via individual wage prospects, and UD is the same among covered and uncovered employees in a labor market segment. The interaction effects are very similar when UD is replaced by fixed effects for each labor market segment (Table 3, specification (iv)).

In order to test the sensitivity of our preferred specification with respect to the set of included covariates, Table 3 uses our preferred set of wage-bargaining variables and displays the results of specifications including

(i) no covariates;
(ii) 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.);

[17]The APE of, say, SC is calculated as $\widehat{APE} = \hat{\beta}_{SC} + \hat{\beta}_{SC \times SHARESC} \cdot \overline{SHARESC} + \hat{\beta}_{UD \times SC} \cdot \overline{UD}$. Since we distinguish differential impacts of, for example, UD for covered and uncovered employees, we cannot restrict our attention to APEs only.

[18]Note that our estimates control for a large set of individual and firm characteristics, including firm-size and professional status (see the additional online appendix). Of course, we cannot fully exclude the possibility of selection effects based on unobserved differences.

Table 3. Wage Regressions II: Different Sets of Covariates

	(i)		*(ii)*		*(iii)*		*(iv)*		*(v)*	
Variable	*Coefficient*	*Standard error*	*Coefficient*	*Standard error*	*Coefficient*	*Standard error*	*Coefficient*	*Standard error*	*Coefficient*	*Standard error*
SECTOR CONTRACT	0.030	(0.033)	–0.057**	(0.018)	–0.082**	(0.012)	–0.061**	(0.013)	–0.077**	(0.012)
FIRM CONTRACT	–0.169*	(0.074)	–0.121**	(0.045)	–0.149**	(0.033)	–0.129**	(0.032)	–0.146**	(0.035)
SHARE EMPL W / SC	0.708**	(0.015)	0.227**	(0.009)	0.171**	(0.008)	0.173**	(0.008)	0.170**	(0.008)
SHARE EMPL W / FC	0.644**	(0.033)	0.185**	(0.020)	0.165**	(0.018)	0.166**	(0.017)	0.161**	(0.018)
SHARE_SC × SC	–0.781**	(0.043)	–0.160**	(0.018)	–0.096**	(0.015)	–0.110**	(0.016)	–0.096**	(0.015)
SHARE_FC × FC	–0.454**	(0.073)	–0.075	(0.047)	–0.031	(0.043)	–0.044	(0.041)	–0.032	(0.044)
UNION DENSITY	–0.783**	(0.057)	0.213**	(0.040)	–0.296**	(0.055)	—	—	–0.292**	(0.057)
UD × SC	0.812**	(0.071)	0.296**	(0.059)	0.203**	(0.032)	0.156**	(0.030)	0.189**	(0.032)
UD × FC	0.783**	(0.071)	0.453**	(0.118)	0.367**	(0.068)	0.320**	(0.065)	0.367**	(0.070)
Controls										
Individual[a]	No		Yes		Yes		Yes		Yes	
Firm-level[a]	No		No		Yes		Yes		Yes	
Fixed-effects[b]	No		No		No		Yes		No	
R^2	0.143		0.660		0.710		0.731		0.709	
No. of observations	316,805		316,805		316,805		316,805		297,428	
					Average Partial Effects (APEs)					
SECTOR CONTRACT	–0.200**	(0.009)	–0.075**	(0.006)	–0.087**	(0.005)	–0.084**	(0.005)	–0.085**	(0.005)
FIRM CONTRACT	–0.025	(0.052)	–0.025**	(0.030)	–0.068**	(0.028)	–0.061**	(0.027)	–0.065**	(0.029)
SHARE EMPL W / SC	0.266**	(0.018)	0.137**	(0.009)	0.117**	(0.009)	0.111**	(0.011)	0.115**	(0.011)
SHARE EMPL W / FC	0.610**	(0.033)	0.179**	(0.019)	0.162**	(0.016)	0.162**	(0.039)	0.159**	(0.042)
UNION DENSITY	–0.265**	(0.038)	–0.414**	(0.045)	–0.154**	(0.048)	—	—	–0.157**	(0.057)

Source: Data from Extended GSES 2001.

Notes: Regressions by OLS, observations weighted by inverse sampling probabilities. Upper panel: regression coefficients. Lower panel: corresponding average partial effects. Clustered standard errors in parentheses.

* and **: significance at the 5% and 1% level, respectively.

[a] See the additional online appendix for definitions of all covariates and full regression results.

[b] Fixed effects for aggregate labor market segments as defined in Section Data, Imputation of Union Density.

(iii) worker and firm characteristics such as size and industry of the firm or average characteristics of the firm's workforce;[19]
(iv) worker and firm characteristics as in (iii), but covariate UD replaced by 5,841 dummy variables for the labor market segments (the specification still includes the interaction effects involving UD); and
(v) worker and firm characteristics as in (iii), but the analysis restricted to larger labor market segments (cells with more than 18 employees in our sample).

By changing the set of conditioning variables, we can assess the effect of selection into different wage-bargaining regimes and into different levels of UD with regard to differences in observable characteristics (Card and de la Rica 2006). Selection effects involve both types of firms and types of employees. Although our analysis cannot use a convincing research design that allows for the estimation of causal effects, one may suspect that selection on unobservables works in a similar way as the selection on observables.[20]

Controlling for both individual and firm characteristics notably reduces the effects of both coverage and UD. This way, we control in a cross-sectional wage regression for some of the likely endogeneity in UD and coverage. For example, the APE of SC is –9% in specification (iii), while it would be –20% in specification (i). For covered employees, the partial effect of SHARE_SC even changes sign. Although a higher share of covered employees is associated with a higher wage in specification (iii), the effect is negative in specification (i). The effect of UD also changes sign between specifications (ii) and (iii). The latter result suggests that the direction of selection into UD differs regarding individual and firm characteristics. On the one hand, controlling for individual characteristics increases the estimated UD coefficients. UD is negatively correlated with individual characteristics that tend to be associated with higher wages, that is, unions tend to represent workers with lower wages. On the other hand, controlling for firm characteristics reduces the estimated UD coefficients. UD is positively correlated with firm characteristics that tend to be associated with higher wages. The motivation to unionize is larger when there are rents that can be extracted from successful firms, which tend to pay higher wages.

The findings of the sensitivity analysis highlight the importance of controlling for individual as well as for firm characteristics to account for the selection effects based on observables. Therefore, we report only results of specifications controlling for both individual and firm characteristics in the discussion of the quantile regressions that follows.

[19]This specification is the same as specification (vii) in Table 2. Note that estimating the model with firm-fixed effects is not feasible because the coverage share does not vary within a firm.

[20]Note that specification (iii) in Table 3 shows an R^2 of 71%, that is, the observable variables in our linked employer–employee data explain a fairly high share of the variation in wages. Thus, unobservables are less important than is typically the case in wage regressions.

Specifications (iv) and (v) serve as additional robustness checks to account for the fact that UD is an estimated quantity.[21] Specification (iv) replaces UD by dummy variables for the 5,841 labor market segments with variation in UD. Otherwise, the specification is the same as in (iii). Again using specification (iii), (v) restricts the analysis to cells with more than 18 employees in our sample, omitting the smallest 50% of all cells. This check is reasonable because UD may involve a higher estimation error for smaller cells. Specifications (iv) and (v) show very similar coefficient estimates (and APEs) compared to specification (iii), and none of the substantive results change. We thus conclude that our estimates are unlikely to be affected substantially by the fact that UD is an estimated covariate.

Quantile Regression Results

Least squares regressions focus on explaining conditional average wages (the wage level) only. Still, collective bargaining is likely to affect the entire conditional distribution of wages as well, because unions have egalitarian objectives and union action is targeted specifically toward low-wage earners. Uncovered employees working in covered firms may receive particularly low wages when firms hire cheap labor without paying wages according to the collective bargaining agreement (e.g., after leaving an employers' association), but all incumbent workers stay covered by persisting collective bargaining contracts. Alternatively, uncovered employees working in firms also employing covered employees may receive higher wages when firms pay some highly productive employees particularly high wages without having to follow a collective contract (e.g., because these employees take management responsibilities in their firms). Possibly, such employees earn a risk premium. In contrast to workers paid a wage cushion, for whom the contract wage provides an effective minimum wage, such high-wage workers cannot rely on contract wages as a fallback position. These arguments suggest that wage bargaining and UD also affect wage dispersion, implying different partial effects at different quantiles of the conditional wage distribution.

For these reasons, we estimate quantile regressions. As we did in the OLS regressions, we employ sampling weights, and the inference has to account for clustering. We suggest a modification of the approach taken by Angrist et al. (2006) for estimating clustered standard errors in weighted quantile regression. The asymptotic variance $VAR(\hat{\beta}(\tau))$ generally depends on the observation-specific density of the dependent variable at the conditional quantile. Following Koenker (1994), we estimate the density based on the fitted values of conditional quantile regression estimates, and we choose the bandwidth based on Hall and Sheather's (1988) rule. Appendix A gives the details on how to estimate $VAR(\hat{\beta}(\tau))$ while accounting for weights and

[21] We are grateful to a referee who suggested these specifications as robustness checks. Further robustness checks similar to specification (v) can be found in the additional online appendix.

cluster effects.[22] To investigate whether accounting for cluster effects makes a difference, we re-estimate standard errors for the median regression ignoring clustering at the firm level.[23] These nonclustered but heteroscedasticity-consistent standard errors tend to be much smaller (see the additional online appendix).

Table 4 reports quantile regression results for our preferred specification. Again, the upper panel reports regression coefficients and the lower panel the corresponding APEs. In general, effects at the median are close to those obtained from least squares estimation, and the estimated coefficients are statistically significant.[24]

The effects of both coverage shares at the firm level (SHARE_SC and SHARE_FC) do not change much across the distribution. Therefore, a firm's decision to apply a sectoral or a firm-specific contract increases wages across the entire distribution in a similar way, compared to a situation of no coverage by collective bargaining. The negative impact of individual coverage is stronger at the top of the conditional distribution. While the APE of a sectoral contract is –6% at the 10th percentile, it becomes stronger decreasing to –12% at the 90th percentile. Therefore, coverage by a sectoral contract reduces wage inequality at the individual level. The adoption of a sectoral contract is in fact a means to move closer to equal pay among employees with the same observable characteristics. This may in turn encourage solidarity among the workforce. Since the coverage effect is also negative at the bottom of the wage distribution, there is no evidence for a negative selection out of collective coverage in this part of the distribution. The effect of firm-specific contracts on individual wage dispersion is also negative, but not as pronounced as that of sectoral contracts. Incidently, comparing wages under firm-specific wage contracts with those in uncovered firms (shares of covered employees are zero) shows that this gap is largest around the median.

Table 5 illustrates the effects of individual coverage. We display differences in predicted log wages between a covered and an uncovered employee in the same firm, evaluated at mean covariates and for different combinations of UD and shares of covered employees within the firm.[25] At each of the displayed quantiles, we compare employees in a labor market segment with high union density (UD = 37%) versus low union density (UD = 10%), and firms with high coverage rate (SHARE = 95%) versus low coverage rate (SHARE = 50%). For both sectoral contracts (SC, panel A) and firm-specific contracts (FC, panel B), the effects are always negative. The wage gap is smaller when union density is higher. The wage gap is also smaller in firms

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

[23]We are grateful to a referee who suggested this check.

[24]Only the interaction FC × SHARE_FC is insignificant at all quantiles, as in the OLS regression.

[25]We thank a referee for the suggestion to summarize wage differences for some representative scenarios.

Table 4. Wage Regressions III: Quantile Regressions

	(10)		*(25)*		*(50)*		*(75)*		*(90)*	
Percentile	*Coefficient*	*Standard error*	*Coefficient*	*Standard error*	*Coefficient*	*Standard error*	*Coefficient*	*Standard error*	*Coefficient*	*Standard error*
SECTOR CONTRACT	–0.035*	(0.016)	–0.049**	(0.011)	–0.071**	(0.012)	–0.105**	(0.013)	–0.124**	(0.018)
FIRM CONTRACT	–0.104**	(0.033)	–0.135**	(0.029)	–0.157**	(0.031)	–0.169**	(0.034)	–0.183**	(0.047)
SHARE EMPL W / SC	0.168**	(0.009)	0.184**	(0.009)	0.188**	(0.008)	0.176**	(0.009)	0.158**	(0.013)
SHARE EMPL W / FC	0.129**	(0.027)	0.170**	(0.018)	0.173**	(0.015)	0.159**	(0.014)	0.131**	(0.035)
SHARE_SC × SC	–0.104**	(0.019)	–0.117**	(0.014)	–0.109**	(0.014)	–0.094**	(0.016)	–0.074**	(0.022)
SHARE_FC × FC	0.002	(0.050)	–0.035	(0.036)	–0.030	(0.036)	–0.025	(0.037)	-0.010	(0.065)
UNION DENSITY	–0.173**	(0.057)	–0.223**	(0.039)	–0.256**	(0.045)	–0.315**	(0.056)	–0.391**	(0.086)
UD × SC	0.149**	(0.040)	0.151**	(0.028)	0.155**	(0.029)	0.210**	(0.035)	0.209**	(0.051)
UD × FC	0.199**	(0.061)	0.278**	(0.065)	0.349**	(0.075)	0.417**	(0.084)	0.489**	(0.074)
No. of observations	316,805		316,805		316,805		316,805		316,805	
					Average Partial Effects (APEs)					
SECTOR CONTRACT	–0.056**	(0.007)	–0.077**	(0.006)	–0.094**	(0.006)	–0.107**	(0.006)	–0.116**	(0.008)
FIRM CONTRACT	–0.059*	(0.029)	–0.076**	(0.023)	–0.081**	(0.024)	–0.078**	(0.024)	–0.074	(0.042)
SHARE EMPL W / SC	0.109**	(0.011)	0.117**	(0.008)	0.126**	(0.008)	0.123**	(0.009)	0.117**	(0.012)
SHARE EMPL W / FC	0.129**	(0.025)	0.168**	(0.016)	0.171**	(0.014)	0.157**	(0.013)	0.131**	(0.033)
UNION DENSITY	–0.074	(0.044)	–0.117**	(0.032)	–0.142**	(0.040)	–0.165**	(0.049)	–0.237**	(0.074)

Source: Data from Extended GSES 2001.

Notes: Regressions include a full set of worker and firm characteristics; see the additional online appendix for full regression results. 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 A for details of the implementation. * and **: significance at the 5% and 1% level, respectively.

Table 5. Quantile-Specific Wage Effects of Individual Coverage: Scenarios by Union Density and Bargaining Coverage within Firms[a]

Percentile	*(10)*		*(50)*		*(90)*	
UNION DENSITY\SHARE OF EMPL COVERED	0.10	0.37	0.10	0.37	0.10	0.37
	(A) Effects of Individual Coverage by Sectoral Contract					
0.50	–0.119	–0.079	–0.159	–0.117	–0.173	–0.117
0.95	–0.072	–0.032	–0.110	–0.068	–0.140	–0.083
	(B) Effects of Individual Coverage by Firm-Specific Contract					
0.50	–0.087	–0.046	–0.170	–0.128	–0.171	–0.115
0.95	–0.088	–0.047	–0.156	–0.114	–0.167	–0.111

[a]Scenarios show differences in predicted log wages based on quantile regression estimates in Table 4.
Panel (A): firm covered by a sectoral contract (SC)
$Q_{ln(w)}$ ($\tau|X = \bar{x}$, UD = ud, SC = 1, SHARE_SC = coverage, FC = 0, SHARE_FC = 0)
$-Q_{ln(w)}$ ($\tau|X = \bar{x}$, UD = ud, SC = 0, SHARE_SC = coverage, FC = 0, SHARE_FC = 0)
Panel (B): firm covered by a firm-specific contract (FC)
$Q_{ln(w)}$ ($\tau|X = \bar{x}$, UD = ud, SC = 0, SHARE_SC = 0, FC = 1,SHARE_FC = coverage)
$-Q_{ln(w)}$ ($\tau|X = \bar{x}$, UD = ud, SC = 0, SHARE_SC = 0, FC = 0, SHARE_FC = coverage)

with a higher share of covered employees. Compared with the effects of sectoral coverage, the effect of being covered in a firm with a firm-specific contract is more pronounced when the share of covered employees is high. In all cases, the gap increases along the conditional wage distribution.

The impact of UD also changes strongly across the wage distribution. The negative base effect is strongest at the upper end of the distribution. Yet, the positive interaction effects of UD and the coverage regimes SC and FC also increase throughout the distribution. Consequently, the differences in the impact of union power on covered and uncovered employees are greatest at the top of the distribution. The APE of UD indicates that, on average, a 10 percentage points increase in union density shows no significant effect at the 10th percentile but a significant reduction of 2.4% at the 90th percentile. Thus, a higher UD reduces wage inequality, which is in line with the preference of unions for less wage inequality. Our finding, however, cannot be solely attributed to unions' egalitarian policy because this would also imply positive wage effects in the lower part of the wage distribution, even if the unions were willing to accept a lower mean wage. Instead, the uniformly negative effect at all quantiles suggests that the crowding effect dominates the threat effect. At the same time, the threat effect may be responsible for mitigating the negative wage effect in the lower part of the wage distribution. The finding is also consistent with the presumption that firms in labor market segments with strong unions invest less in physical capital. This strategy would reduce labor productivity and wages across the entire distribution as a response to an increase in UD. Finally, the fact that the effect of UD is insignificant at the bottom and significantly negative higher up in the wage distribution provides further evidence against the possibility of reverse causality in the sense that employees expecting low wages would join a union. If

this were the case, we would expect a significantly negative effect of UD at the bottom of the wage distribution.

What do our results reveal concerning the differences between sectoral and firm-specific contracts? Wages are higher on average under firm-specific than under sectoral wage contracts, and this also holds along the wage distribution. While the wage difference between the two contract regimes is quite low at the bottom of the wage distribution, it grows along the wage distribution and is highest at the top (at the 90th percentile the wage gap between an employee covered by a firm-specific contract and an employee covered by a sectoral contract is about 5.5 log points in a firm with 100% coverage; see Table 4). As recognition of a sectoral wage contract being basically a firm decision, it is surprising at first glance that firms would not stick to the cheaper sectoral wage contracts. But firms may choose firm-specific agreements to respond to the demands of their employees (especially those at the median or the top of the wage distribution). These employees may have the bargaining power to extract higher rents from the firms than possible under sectoral wage contracts; see Card and de la Rica (2006). Furthermore, Gürtzgen (2009b) finds that wages paid according to firm-specific contracts have a higher responsiveness to firm profitability than industry-wide contracts. Firm-level contracts are associated with higher wage inequality among covered workers. This could be associated with, for example, higher functional flexibility in exchange for higher wages, something that is sufficiently easy to monitor at the firm level but more difficult to monitor at the sectoral level. Our data, however, do not allow us to test this hypothesis.

Conclusions

The design of wage-setting regimes in a large number of OECD countries suggests that researchers should explicitly distinguish between union density and coverage by different forms of collective bargaining. Our analysis distinguishes individual coverage, coverage at the firm level, and union density in homogenous labor markets. Using data from the German Structure of Earnings Survey (GSES) for 2001, a large-scale linked employer–employee data set, we analyze simultaneously how wages are associated with coverage and with union density.

Unfortunately, we cannot explicitly take account of the apparent endogeneity of union density and collective coverage, and therefore, strictly speaking, our results should not be interpreted as causal effects. Nevertheless, we control for different sets of covariates in our regression to assess the effects of selection based on observables. The endogeneity problem is reduced by controlling for both individual and firm characteristics. Our results highlight the importance of using rich, linked employer–employee data.

Estimating OLS and quantile regressions of wages, we find that the firm-level share of employees subject to sectoral or firm-specific collective bargaining contracts has a positive impact on the wage level; that is, firms that

adopt a collective contract pay higher wages. This effect is found along the entire wage distribution. Yet, individual bargaining coverage in a covered firm shows a negative impact both on the wage level and on wage dispersion. The negative wage effect of individual coverage is stronger at higher quantiles of the conditional wage distribution. Collective bargaining coverage thus reduces wage inequality. Our findings are in line with the hypothesis that firms apply collective contracts to implement a transparent wage policy. However, a positive premium is paid to workers in a covered firm who are not paid according to a collective contract, meaning those who are not covered individually. These workers tend to be higher paid than workers in the same firm with otherwise similar characteristics. Wages of these workers are particularly high in high-wage firms for which the coverage effect is also high, possibly because collective contracts can extract higher rents from these firms. Similar to Card and de la Rica (2006), this effect is even stronger under firm-specific bargaining than under sectoral bargaining.

Having controlled for different coverage effects, we also find significant effects of union density on the wage level and on wage dispersion. A higher union density is associated with lower wages, and the effect is strongest among uncovered individuals and at the top of the wage distribution. At the same time, a higher union density reinforces the positive wage effects of coverage at the firm level. A higher union density also reduces wage dispersion. This finding is in accordance with an egalitarian wage policy of unions. But wages in the uncovered sector decline uniformly across the entire wage distribution in response to an increase in union density. This result cannot be rationalized with unions' preference for less wage inequality alone. Instead, it suggests that the negative crowding effect of higher union density dominates the potential positive threat effect. The crowding effect is due to an increase in labor supply in the uncovered sector caused by higher wages—and thus lower employment—in the covered sector. The effect may also be due to a decline of firms' capital investment when union density increases. Our analysis does not allow us to distinguish these transmission channels, which should be explored in future research.

In light of the decline of union membership and coverage over time, future research should also analyze the relationship between the changes of union density and coverage on the one hand, and changes in the wage distribution, on the other hand. In addition to the data for 2001 used in our analysis, such research could be based on GSES data collected for the years 2006 and 2010; the data for 2010 were not available at the time of our study.

Appendix A

Standard Errors for Quantile Regression with Sampling Weights and Clustering

Clustering allows for dependence of observations within clusters (see Froot 1989; Moulton 1990; or Williams 2000 for OLS). The asymptotic distribution of $\hat{\beta}(\tau)$ for a given quantile τ in such a setting is

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

with

$$\Sigma(\tau) \equiv \tfrac{1}{N}\Sigma_{c=1}^{C} E[(\Sigma_{i\in c} X_{ic}(\tau - \mathbf{I}\{Y_{ic} < X'_{ic}\beta(\tau)\}))(\Sigma_{j\in c} X'_{jc}(\tau - \mathbf{I}\{Y_{jc} < X'_{jc}\beta(\tau)\}))] \tag{2}$$

and

$$J(\tau) \equiv \tfrac{1}{N}\Sigma_{c=1}^{C} E[\Sigma_{i\in c} f_y(X'_{ic}\beta(\tau) \mid X_{ic}) X_{ic}X'_{ic}] = E[\Sigma_{i\in c} f_u(0 \mid X_{ic})X_{ic}X'_{ic}], \tag{3}$$

for observation i in cluster c. N is the total number of observations, and C is the total number of clusters. These expressions, for the case without weights, assume that the model is correctly specified (Angrist et al. 2006) and that correlation of the error term is restricted to pairs of observations within the same cluster; f_u denotes the density of the error term (Hendricks and Koenker 1992; Koenker 2005; Melly 2006).

In contrast to Angrist et al. (2006), we follow Koenker (1994) for the estimation of the observation-specific density. We use the "Hendricks-Koenker sandwich"

$$\hat{f}_i = 2h_N / (X'_i(\hat{\beta}(\tau + h_N) - \hat{\beta}(\tau - h_N))) \tag{4}$$

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

$$h_N = \tfrac{1}{N^{1/3}} z_\alpha^{2/3}(1.5s(\tau) / s''(\tau)]^{1/3}, \tag{5}$$

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.[26] As in Koenker (1994), we use the normal distribution to estimate

$$s(\tau) / s''(\tau) = \frac{f^2}{2(f'/f)^2 + [(f'/f)^2 - f''/f]} = \frac{\phi(\Phi^{-1}(\tau))^2}{2(\Phi^{-1}(\tau))^2 + \mathbf{1}}, \tag{6}$$

In analogy to Angrist et al. (2006), we take account of sampling weights and clustering at the firm level. We acknowledge that the sampling weights in the GSES are equal for all individuals $i = 1, \ldots, N_c$ within a cluster c. With sampling weights w_c normalized to sum up to one, $\Sigma_{c=1}^{C} w_c = 1$, $\Sigma(\tau)$ and $J(\tau)$ can be estimated consistently by

$$\hat{\Sigma}(\tau) = \tfrac{1}{N}\Sigma_{c=1}^{C} w_c^2 \Sigma_{i=1}^{N_c}\Sigma_{j=1}^{N_c} X_{ic}(\tau - \mathbf{I}\{Y_{ic} < X'_{ic}\,\hat{\beta}(\tau)\})(\tau - \mathbf{I}\{Y_{jc} < X_{jc}\,\hat{\beta}(\tau)\})X'_{jc} \tag{7}$$

and

$$\hat{J}(\tau) = \tfrac{1}{N}\Sigma_{c=1}^{C} w_c \Sigma_{i=1}^{N_c} \hat{f}_{ic} X_{ic}X'_{ic}. \tag{8}$$

Appendix B

Sample Description

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*).[27] The GSES 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, and the sampling probability varies between 5.3% for the larg-

[26]The sandwich formula is extensively described in Koenker (2005: 79–80). Koenker also mentions the "Powell sandwich," which is employed by Angrist et al. (2006), for example.

[27]See Hafner (2005), Hafner and Lenz (2008), and Statistisches Bundesamt (2000, 2004) for detailed descriptions of the GSES data.

est state (North Rhine-Westphalia) and 19.4% for the smallest (Bremen). At a second stage, employees are randomly chosen from the firms sampled at the first stage. The share of employees sampled depends on firm size and ranges between 6.25% for the largest firms and 100% for firms with fewer than than 20 employees. The data set provides sampling weights.

Since 2005, the GSES 2001 is available for on-site use at the Research Data Centers of the statistical offices of the federal states (FDZ). This on-site version was made anonymous in some respects. It includes all firms and employees from 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," that is, some of the smaller German States were aggregated, and some industries have been aggregated at the two-digit level. In total, the on-site data set consists of 22,040 establishments with 846,156 employees.

We focus on prime-age (25- to 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 dropped, because compensation for these groups does not follow the regular compensation schedule and special regulations or even special collective bargaining contracts apply. We also exclude white-collar workers in the highest professional status category (category 1), who can reasonably be expected to pursue objectives of upper and middle management 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 contract identification number are dropped.

Part-time and full-time employees are distinguished from each other by employers' assessments 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.

The GSES 2001 is extended by imputed union density as explained in our the discussion of union densities. Table 6 summarizes the definitions of the collective bargaining and union variables used in this article, as well as the definitions and summary statistics of individual-level and firm-level covariates. Definitions and descriptives for all variables used in the empirical analysis are reported in the additional online appendix.

Table 6. Definitions of Most Covariates and Descriptive Statistics

Variable	*Acronym*	*Description*	*Mean*	*Standard deviation*
Collective Bargaining and Union Variables				
SECTOR CONTRACT	SC	Sectoral collective contract negotiated between an employers' association and a union applies to individual job match	0.565	0.496
FIRM CONTRACT	FC	Firm-specific contract negotiated between a single firm and representatives of its employees (typically a union or a works council) applies to individual job match (dummy variable)	0.075	0.263
INDIV CONTRACT	IC	Individual contract negotiated between employer and employee (dummy variable)	0.360	0.480
SHARE EMPL W/ SC	SHARE_SC	Share of employees in the firm covered by a sectoral collective contract (variation at firm level)	0.529	0.421
SHARE EMPL W/ FC	SHARE_FC	Share of employees in the firm covered by a firm-specific collective contract (variation at firm level)	0.071	0.239
UNION DENSITY	UD	(Net) Union density: Share of employed union members among all employees, defined for 5,841 aggregate labor market segments spanned by the dimensions region (7 states) x industry (30 sectors) x educational attainment (4 groups) x age (7 classes)	0.224	0.104
Individual-Level Covariates				
AGE (SQUARED) [(a)]		Age in years/100 (squared)	0.395	0.080
TENURE (SQUARED) [(b)]		Tenure in years/10 (squared)	0.937	0.930
LOW EDUC		Low level of education: no training beyond a school degree (or no school degree at all)	0.146	0.353
MED EDUC		Intermediate level of education: vocational training	0.688	0.463
HIGH EDUC		High level of education: university or technical college degree	0.100	0.300
EDUC N.A.		Missing information on the level of education	0.066	0.249
BC SPEC SKILL		Blue-collar worker, professional status category 1: vocationally trained or comparably experienced worker with special skills and highly involved tasks	0.118	0.323
BC VOC TRAIN		Blue-collar worker, professional status category 2: vocationally trained or comparably experienced worker	0.229	0.420
BC ON THE JOB		Blue-collar worker, professional status category 3: worker trained on-the-job	0.155	0.362
BC LABORER		Blue-collar worker, professional status category 4: laborer	0.086	0.281
WC LIM EXEC		White-collar worker, professional status category 2: executive employee with limited procuration	0.162	0.369
WC SPEC SKILL		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	0.102	0.302
WC VOC TRAIN INVOLV		White-collar worker, professional status category 4: vocationally trained or comparably experienced employee who works autonomously on involved tasks	0.099	0.298
WC VOC TRAIN AUTON		White-collar worker, professional status category 5: vocationally trained or comparably experienced employee working autonomously	0.041	0.199
WC SIMPLE TASK		White-collar worker, professional status category 6: employee working on simple tasks	0.007	0.084
NIGHT		Individual worked night shifts	0.208	0.406
SUNDAY		Individual worked on Sundays or on holidays	0.128	0.334
SHIFT		Individual worked shift	0.146	0.353
OVERTIME		Individual worked overtime	0.269	0.444

continued

Table 6. Continued

Variable	*Acronym*	*Description*	*Mean*	*Standard deviation*
Firm-Level Covariates				
FIRM SHARE FEMALE		Share of female employees	0.231	0.183
FIRM SHARE AGE1		Share of employees of age 19 or younger	0.034	0.052
FIRM SHARE AGE2		Share of employees of age 20–24	0.070	0.060
FIRM SHARE AGE3		Share of employees of age 25–29	0.096	0.063
FIRM SHARE AGE4		Share of employees of age 30–34	0.150	0.072
FIRM SHARE AGE5		Share of employees of age 35–39	0.174	0.069
FIRM SHARE AGE6		Share of employees of age 40–44	0.151	0.066
FIRM SHARE AGE7		Share of employees of age 45–49	0.124	0.064
FIRM SHARE AGE8		Share of employees of age 50–54	0.104	0.062
FIRM SHARE AGE9		Share of employees of age 55–59	0.066	0.052
FIRM SHARE AGE10		Share of employees of age 60 or older	0.032	0.042
FIRM SHARE TENURE1		Share of employees with less than 1 year of tenure	0.135	0.141
FIRM SHARE TENURE2		Share of employees with 1–2 years of tenure	0.178	0.140
FIRM SHARE TENURE3		Share of employees with 3–5 years of tenure	0.142	0.117
FIRM SHARE TENURE4		Share of employees with 6–10 years of tenure	0.164	0.116
FIRM SHARE TENURE5		Share of employees with 11–15 years of tenure	0.136	0.094
FIRM SHARE TENURE6		Share of employees with 16–20 years of tenure	0.079	0.071
FIRM SHARE TENURE7		Share of employees with 21–25 years of tenure	0.071	0.070
FIRM SHARE TENURE8		Share of employees with 26–30 years of tenure	0.048	0.056
FIRM SHARE TENURE9		Share of employees with 31 or more years of tenure	0.048	0.061
FIRM SHARE LOW EDUC		Share of employees with LOW EDUC	0.198	0.174
FIRM SHARE MED EDUC		Share of employees with MED EDUC	0.642	0.222
FIRM SHARE HIGH EDUC		Share of employees with HIGH EDUC	0.086	0.137
FIRM SHARE EDUC N.A.		Share of employees with EDUC N.A.	0.073	0.181
HOURS WORKED		Average hours worked in the firm/100	0.162	0.369
FIRM SHARE IRREG		Share of employees for whom any of NIGHT, SUNDAY, or SHIFT applies	0.245	0.276
FIRM SHARE OVERTIME		Share of employees working overtime	0.223	0.242
FIRM SHARE BC		Share of blue collar workers	0.452	0.301
FIRM SHARE NOT FTIME		Share of employees who do not work full-time	0.149	0.145
FIRMSIZE1		Firm has between 10 and 49 employees	0.238	0.426
FIRMSIZE2		Firm has between 50 and 249 employees	0.320	0.466
FIRMSIZE3		Firm has between 250 and 499 employees	0.123	0.328
FIRMSIZE4		Firm has between 500 and 999 employees	0.110	0.312
FIRMSIZE5		Firm has between 1,000 and 1,999 employees	0.069	0.254
FIRMSIZE6		Firm has 2,000 or more employees	0.140	0.347
OWN PRIVATE		Firm is privately owned	0.934	0.249
OWN PUBLIC1		Firm is partly public-owned (<50%)	0.027	0.162
OWN PUBLIC2		Firm is mainly public-owned (>50%)	0.039	0.194

Source: Data from Extended GSES 2001.

Notes: For additional firm-level variables: sector (30 two-digit NACE industries) and region (7 states) dummies, see the additional online appendix for definitions. Descriptives calculated using sampling probabilities.

[a]Mean and standard deviation for AGE only.

[b]Mean and standard deviation for TENURE only.

References

Addison, John T., and Claus Schnabel (Eds.). 2003. *International Handbook of Trade Unions.* Cheltenham: Edward Elgar.

Agell, John, and Kjel E. Lommerud. 1992. Union egalitarianism as income insurance. *Economica* 59(235): 295–310.

Angrist, Joshua, Victor Chernozhukov, and Ivan Fernández-Val. 2006. Quantile regression under misspecification, with an application to the U.S. wage structure. *Econometrica* 74(2): 539–64.

BMWA. 2004. *Tarifvertragliche Arbeitsbedingungen im Jahr 2003.* Bundesministerium für Wirtschaft und Arbeit. Accessed at http://www.bmwa.bund.de/Navigation/Arbeit/arbeitsrecht.html.

Burda, Michael C. 1995. Unions and wage insurance. CEPR discussion paper no. 1232. Stockholm: Centre for Economic Policiy Research.

Büttner, Thiess, and Bernd Fitzenberger. 2003. Integrating wage bargaining into an efficiency wage model: The relationship between wages and unemployment revisited. Unpublished manuscript. University of Mannheim.

Card, David. 1996. The effect of unions on the structure of wages: A longitudinal analysis. *Econometrica* 64(4): 957–79.

Card, David, and Sara de la Rica. 2006. Firm-level contracting and the structure of wages in Spain. *Industrial and Labor Relations Review* 59(4): 573–92.

Card, David, Thomas Lemieux, and W. Craig Riddell. 2003. Unions and the wage structure. In John T. Addison and Claus Schnabel (Eds.), *International Handbook of Trade Unions,* pp. 246–92. Cheltenham: Edward Elgar.

Cardoso, Ana Rute, and Pedro Portugal. 2005. Contractual wages and the wage cushion under different bargaining settings. *Journal of Labor Economics* 23(4): 875–902.

Dell'Aringa, Carlo, and Claudio Lucifora. 1994. Collective bargaining and relative earnings in Italy. *European Journal of Political Economy* 10(4): 727–47.

Dustmann, Christian, and Uta Schönberg. 2009. Training and union wages. *Review of Economics and Statistics* 91(2): 363–76.

Farber, Henry S. 1986. The analysis of union behavior. In Orley Ashenfelter and Richard Layard (Eds.), *Handbook of Labor Economics*, Vol. 2, pp. 1039–89. Amsterdam: North-Holland.

Fitzenberger, Bernd, and Karsten Kohn. 2005. Gleicher Lohn für gleiche Arbeit? Zum Zusammenhang zwischen Gewerkschaftsmitgliedschaft und Lohnstruktur in Westdeutschland 1985–1997. *Zeitschrift für ArbeitsmarktForschung* 38(2/3): 125–46.

Fitzenberger, Bernd, Karsten Kohn, and Qingwei Wang. 2006. The erosion of union membership in Germany: Determinants, densities, decompositions. IZA discussion paper no. 2193. Bonn: Institute for the Study of Labor.

———. 2011. The erosion of union membership in Germany: Determinants, densities, decompositions. *Journal of Population Economics* 24(1): 141–65.

Flanagan, Robert J. 1999. Macroeconomic performance and collective bargaining: An institutional perspective. *Journal of Economic Literature* 37(3): 1150–75.

Freeman, Richard B. 1982. Union wage practices and wage dispersion within establishments. *Industrial and Labor Relations Review* 36(1): 3–21.

Froot, Kenneth A. 1989. Consistent covariance matrix estimation with cross-sectional dependence and heteroscedasticity in financial data. *Journal of Financial and Quantitative Analysis* 24(3): 333–55.

Gerlach, Knut, and Gesine Stephan. 2006. Pay policies of firms and collective wage contracts—An uneasy partnership? *Industrial Relations* 45(1): 47–67.

Guiso, Luigi, Luigi Pistaferri, and Fabiano Schivardi. 2005. Insurance within the firm. *Journal of Political Economy* 113(5): 1054–87.

Gürtzgen, Nicole. 2009a. Firm heterogeneity and wages under different bargaining regimes: Does a centralised union care for low-productivity firms? *Jahrbücher für Nationalökonomie und Statistik* 229(2–3): 239–53.

———. 2009b. Rent-sharing and collective bargaining coverage: Evidence from linked employer-employee data. *Scandinavian Journal of Economics* 111(2): 323–49.

Hafner, Hans-Peter. 2005. *Gehalts- und Lohnstrukturerhebung im Produzierenden Gewerbe und im*

Dienstleistungsbereich 2001. Dokumentation. Statistische Ämter der Länder – Forschungsdatenzentrum.

Hafner, Hans-Peter, and Rainer Lenz. 2008. The German structure of earnings survey: Methodology, data access and research potential. *Schmollers Jahrbuch* 128(3): 489–500.

Hall, Peter, and Simon J. Sheather. 1988. On the distribution of a studentized quantile. *Journal of the Royal Statistical Society, Series B* 50(3): 381–91.

Hartog, Joop, Edwin Leuven, and Coen Teulings. 2002. Wages and the bargaining regime in a corporatist setting: The Netherlands. *European Journal of Political Economy* 18(2): 317–31.

Heinbach, Wolf-Dieter, and Markus Spindler. 2007. To bind or not to bind collectively? Decomposition of bargained wage differences using counterfactual distributions. Unpublished manuscript. Institut für angewandte Wirtschaftsforschung Tübingen.

Hendricks, Wallace, and Roger Koenker. 1992. Hierarchical spline models for conditional quantiles and the demand for electricity. *Journal of the American Statistical Association* 87(417): 58–68.

Hunt, Janet C., B.F. Kiker, and Glyn C. Williams. 1987. The effect of type of union on member-nonmember wage differentials. *Journal of Labor Research 8*(1): 59–65.

Jacobebbinghaus, Peter. 2002. Die Lohnverteilung in Haushaltsdatensätzen und in amtlich erhobenen Firmendaten. *Wirtschaft und Statistik* (3): 209–21.

Kahn, Lawrence M. 1978. The effect of unions on the earnings of nonunion workers. *Industrial and Labor Relations Review* 31(2): 205–16.

Koenker, Roger. 1994. Confidence intervals for regression quantiles. In Petr Mandl and Marie Hušková (Eds.), *Asymptotic Statistics: Proceeding of the 5th Prague Symposium on Asymptotic Statistics*. Heidelberg: Physica.

———. 2005. *Quantile Regression*. Cambridge: Cambridge University Press,

Koevoets, Wim. 2007. Union wage premiums in Great Britain: Coverage or membership? *Labour Economics* 14(1): 53–71.

Kohn, Karsten, and Alexander C. Lembcke. 2007. Wage distributions by bargaining regime—Linked employer-employee data evidence from Germany. *AStA Wirtschafts- und Sozialstatistisches Archiv* 1(3–4): 247–61.

Lewis, H. Gregg. 1986. *Union Relative Wage Effects: A Survey*. Chicago: University of Chicago Press.

Melly, Blaise. 2006. Estimation of counterfactual distributions using quantile regression. Unpublished manuscript. University of St. Gallen.

Mortensen, Dale T., and Christopher A. Pissarides. 1999. New developments in models of search in the labor market. In Orley Ashenfelter and David Card (Eds.), *Handbook of Labor Economics*, Vol. 3, pp. 2567–627. Amsterdam: North-Holland.

Moulton, Brent R. 1990. An illustration of a pitfall in estimating the effects of aggregate variables on micro units. *Review of Economics and Statistics* 72(2): 334–38.

Naylor, Robin. 2003. Economic models of union behaviour. In John T. Addison and Claus Schnabel (Eds.), *International Handbook of Trade Unions,* pp. 44–85. Cheltenham: Edward Elgar.

Neumark, David, and Michael L. Wachter. 1995. Union effects on nonunion wages: Evidence from panel data on industries and cities. *Industrial and Labor Relations Review* 49(1): 20–38.

OECD. 1994. *OECD Employment Outlook*. Paris: Organisation for Economic Cooperation and Development.

———. 2004. *OECD Employment Outlook*. Chapter 3, Wage-setting institutions and outcomes. Paris: Organisation for Economic Cooperation and Development.

———. 2006. *OECD Employment Outlook—Boosting Jobs and Incomes*. Paris: Organisation for Economic Cooperation and Development.

Oswald, Andrew J. 1985. The economic theory of trade unions: An introductory survey. *Scandinavian Journal of Economics* 87(2): 160–93.

Pencavel, John. 1991. *Labor markets under trade unionism*. Oxford: B. Blackwell.

Rosen, Sherwin. 1969. Trade union power, threat effects and the extent of organization. *Review of Economic Studies* 36(2): 185–96.

Schnabel, Claus. 2005. Gewerkschaften und Arbeitgeberverbände: Organisationsgrade, Tarifbindung und Einflüsse auf Löhne und Beschäftigung. *Zeitschrift für Arbeitsmarkt Forschung* 38(2/3): 181–96.

———. 2000. *Gehalts- und Lohnstrukturerhebung 2001 – Methodische Grundlagen der Erstellung des Auswahlplanes*. Dokumentation.

Statistisches Bundesamt. 2004. *Gehalts- und Lohnstrukturerhebung 2001*. Fachserie Löhne und Gehälter. [Publication series Wages and Salaries] 16, 1.

Stephan, Gesine, and Knut Gerlach. 2003. Firmenlohndifferenziale und Tarifverträge: Eine Mehrebenenanalyse. *Mitteilungen aus der Arbeitsmarkt- und Berufsforschung* 36(4): 525–38.

———. 2005. Wage settlements and wage setting: Results from a multi-level model. *Applied Economics* 37(20): 2297–306.

Vogel, Thorsten. 2007. Wage compression in collectively bargained labour contracts. Unpublished manuscript, Humboldt University Berlin.

Williams, Rick L. 2000. A note on robust variance estimation for cluster-correlated data. *Biometrics* 56(2): 645–46.