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Abstract

This paper studies how decentralization of wage bargaining from sector to firm-level influences wage levels and wage dispersion. We use detailed panel data covering a period of decentralization in the Danish labor market. The decentralization process provides variation in the individual worker's wage-setting system that facilitates identification of the effects of decentralization. We find a wage premium associated with firm-level bargaining relative to sector-level bargaining, and that the return to skills is higher under the more decentralized wage-setting systems. Using quantiel regression, we also find that wages are more dispersed under firm-level bargaining compared to more centralized wage-setting systems.

Keywords: Wage bargaining, decentralization, wage dispersion

JEL Classification: J31, J51, C23.

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1 Introduction

Several advanced countries have undergone a process towards more decentralized wage bargaining in the labor market over the past decades. A comparison between the 1970s and the 1990s reveals that not a single OECD country moved towards centralization, whereas a considerable number moved towards greater decentralization according to OECD (2004). In many countries, this movement has been accompanied by a steady decline in union densities, while the extent of bargaining coverage has typically been unchanged. Decentralization of collective bargaining may have important implications for wage formation and wage dispersion in particular, but only scarce microeconometric evidence exists to document such effects.

The principal aim of this paper is to empirically examine the movement of decentralization in wage bargaining in terms of its impact on wage dispersion. From a theoretical standpoint decentralization may lead to increased wage dispersion because firm- and individual-specific characteristics are more likely to enter the wage contracts, while under centralized bargaining egalitarian union preferences are easier to accomplish.[1] Obviously, changes in wage dispersion may have important direct welfare implications through increased income inequality, but there may also be more indirect consequences. A movement away from a standard wage rate applying to all workers means that wages are more in accordance with individual productivity and local conditions, which tends to reduce misallocation, inefficiencies and unemployment in the labor market. In contrast to this view, Moene and Wallerstein (1997) argue that centralized bargaining tends to bolster expanding progressive industries and hamper declining ones, while local bargaining allows less productive plants to reduce wages and remain in operation. Also, when risk-averse individuals face uncertainty about their position in the income distribution, unions may improve welfare by compressing the wage structure, see Agell and Lommerud (1992). In any case, it is clear that the link between bargaining level and wage dispersion is important for welfare, and a first step should be to empirically assess the extent to which decentral-

[1] See e.g. Farber (1978) and Booth (1984) for theoretical models explicitly handling the role of wage dispersion in union preferences.

ization increases wage dispersion. Cross country evidence suggests that centralized wage setting generally leads to less wage dispersion (see e.g. Rowthorn 1992, Wallerstein 1999 or OECD 2004), but studies based on cross section micro data do not reach unanimous conclusions (this literature is reviewed in the next section). In this paper we employ a matched worker-firm data set from Denmark covering a period of decentralization of wage bargaining. Our data allow us to assess whether a change in the centralization level of wage bargaining affects wages within job spells, and how these wage changes are distributed across workers depending on characteristics such as educational attainment and labor market experience. We also directly estimate how decentralization affects the wage distribution using quantile regression.

Another aspect of decentralization is its impact on wage *levels*. A number of different explanations for higher mean wages under firm level bargaining may be put forth. First, higher wages at the local level may be due to rent sharing, see e.g. Blanchflower, Oswald and Sanfey (1996). Second, firms with local bargaining may encourage workers to work harder by offering higher wages through efficiency wage considerations, see e.g. Akerlof and Yellen (1988). Third, firm level bargaining may involve higher wages and lower employment due to insider-outsider effects, see Fitzenberger and Franz (1999). Fourth, it may be argued that decentralization of collective bargaining makes it less likely that unions internalize externalities of many different types, see Calmfors (1993). For example, decentralized wage increases may lead to higher product prices, thus increasing the cost of inputs for other firms. Such externalities may be taken into account in more centralized bargaining settings and may induce unions to restrain their wage demands. However, Calmfors and Driffill (1988) argue that the relationship between centralization and wage outcomes is hump shaped. At the national, level unions internalize externalities and moderate their wage demands, but at the firm level they also restrain wage demands because higher wages lead to higher product prices and lower demand for the goods produced by the firm, thereby reducing employment in the firm. At the industry level neither of these mechanisms are present to the same extent, and so unions negotiate for higher wages at this level. For open economies Danthine and Hunt (1994) show

that the hump shaped relationship between wages and centralization level flattens out as product market competition increases, and so the room left open for diverging wage policies narrows. Thus, the prediction concerning the impact of decentralization on wage levels is less clear-cut and is ultimately an empirical question.

We have access to a very rich longitudinal data set for private sector workers in the Danish labor market. The Danish labor market is interesting to study because four different wage-setting systems, representing three different levels of centralization, coexist, and so their influence on wage formation may readily be compared. First, in one segment of the labor market wages are negotiated at sector level for all workers – this is the so-called standard-rate system. Clearly, the scope for wages to reflect individual productivity is limited under this system. Second, a considerable part of the labor market has bargaining between unions and employers at the sector level over a contractual wage, which is accompanied by local bargaining at the firm level over an individual wage supplement (the minimum-pay and minimum-wage systems). In this case, wages may be in more accordance with individual qualifications due to the local-level bargaining. Third, a segment of the labor market has no centrally negotiated contractual wage, and wages are entirely determined at the firm level. Importantly, our data set covers a period where many labor market segments changed wage-setting system towards bargaining at more decentralized levels. In particular, the importance of the segment with only firm-level bargaining has increased during our sample window.

The longitudinal dimension of the data is crucial for two main reasons. First, identification of the effects of decentralization on wage dispersion is greatly facilitated by the change of wage-setting system over time for many workers. Second, in contrast to the existing empirical evidence, longitudinal data allows us to control for unobserved heterogeneity. Our empirical analysis follows two different approaches. We first run standard Mincerian wage regressions with fixed effects within jobs. We find that wages are on average higher under firm-level bargaining and that the return to skills is higher at the local level. Second, we also apply a recently developed panel data quantile regression method since this, in a very transparent way, illustrates the impact of wage-setting sys-

tems in different quantiles of the wage distribution. We find that decentralization of wage bargaining increases wage dispersion, i.e., wages are most dispersed under the most decentralized system – firm-level bargaining.

The paper is organized as follows. Section 2 briefly reviews the existing empirical literature on unions and the dispersion of wages. Section 3 describes the institutional framework for wage bargaining in Denmark. This section also summarizes the aggregate development towards more decentralized wage bargaining in Denmark in the 1990s. Section 4 describes the data set, section 5 outlines the empirical framework, and the results are presented in section 6. Section 7 concludes.

2 Unions and the dispersion of wages

The impact of unions on wage formation and wage dispersion is a subject that has long attracted the attention of economists. There exists a large literature assessing the wage differential between union and non-union workers and the impact of unions on wage inequality (see e.g. Freeman 1980 for an early exposition and Card et al. 2004 for a more recent review). This is an interesting issue in Anglo-Saxon countries, where it makes sense to focus on union membership of the individual worker. However, in most continental European countries the relevant measure is the centralization level of bargaining, because even in countries with low union densities, bargaining agreements are typically extended to the majority of the workforce. In this section we briefly review the existing microeconometric evidence of the impact of the bargaining level on wage formation.

One of the first studies of the subject is Dell'Aringa and Lucifora (1994), who investigated the Italian metal-mechanical industry with establishment survey data from 1990. They found a positive wage differential in firms where unions are recognized for local bargaining as compared to firms where only the national bargaining wages apply. In addition, they find that firm-level bargaining raises wages more for white collar workers than for blue collar workers.

These results are consistent with a more recent paper by Card and de la Rica (2006),

who study the effect of firm-level contracting relative to regional or national contracts in Spain. They use the European Structure of Earnings Survey (ESES) from 1995, which is a matched worker-firm data set with information on whether the worker belongs to a multi-employer bargaining regime or a regime with single-employer bargaining (firm-level bargaining). They show that there is a positive wage premium of 5-10% associated with single-employer bargaining. Interestingly, they also find that the premium is higher for more highly-paid workers. They take this as weak evidence of a more flexible wage structure under firm-level bargaining.

Two other recent contributions use the ESES data set for 1995 to examine the effect on wage dispersion. Dell'Aringa and Pagani (2007) perform a variance decomposition of the ESES data for Italy, Belgium, and Spain. In Italy and Belgium there is no clear effect of single-employer bargaining on wage dispersion, while for Spain, consistently with Card and de la Rica (2006), they find a small positive effect. In addition to the variance decomposition, Dell'Aringa and Pagani estimate a quantile regression model separately for each wage-setting system to compute wage inequality measures conditional on the different explanatory variables. Thus, when taking observable heterogeneity into account, they find that, if anything, single-employer bargaining tends to decrease wage dispersion in Italy and Belgium, while the opposite is true for Spain.

Plasman et al. (2007) also perform a variance decomposition exercise and find for Belgium, Denmark, and Spain that decentralized bargaining increases the mean wage. Furthermore, single-employer bargaining increases the dispersion of wages in Denmark and Belgium while it decreases the wage dispersion in Spain, which is in contrast to the findings of Card and de la Rica (2006) and Dell'Aringa and Pagani (2007).

Using a cross section data set for 1991, Hartog et al. (2002) investigate the impact of different bargaining regimes on wages in the Netherlands, and they find that mean wages under firm-specific and industry-level contracting are very similar. They also observe workers in firms with no collective bargaining and in firms with mandatory extensions of an industry agreement, and wage differentials between regimes were found to be no larger than 4%. Also in terms of wage dispersion modest differences are found among the four

regimes, but firm-specific bargaining yields the greatest residual variation of wages.

Comparing contractual wages and actual wages, Cardoso and Portugal (2005) find for Portugal a substantial wage cushion with industry averages of 20-50% of the contractual wages. From tobit regressions it is found that the effects of worker and firm characteristics on contractual wages and the wage drift have the same sign, so that wage drift stretches the wage distribution. A measure for the degree of union bargaining power is constructed as the concentration of bargaining, and Cardoso and Portugal find that the higher concentration is, the higher contractual wage rate and – by interacting this bargaining power measure with worker attributes – the lower returns to these attributes will be. Interestingly, the higher contractual wage rate is offset by a smaller wage drift.

The wage bargaining institutions in Germany share several characteristics with the Danish institutions, so the German case is of particular interest. Several empirical studies have provided cross-sectional estimates of the wage effects of different bargaining regimes in Germany, and most tend to find that average wages and wage dispersion are higher under firm-level bargaining compared to sector-level bargaining, see Fitzenberger et al. (2008) for a recent survey of these studies. One study for Germany deserves special mention, as it estimates the impact of the wage-setting level on individual mean wages using longitudinal data. Gürtzgen (2006) finds that unobserved heterogeneity is responsible for much of the observed wage premia associated with industry- and firm-level contracting (relative to no coverage of collective bargaining contracts), but positive premia for industry-level contracts in West Germany and for firm-level contracts in East Germany remain. While we also estimate the impact of the wage-setting level on individual mean wages, our primary focus is on its impact on wage dispersion.

To sum up, most results indicate that wages are higher when they are negotiated at the firm level as compared to the industry level. However, this result is refuted by the evidence from the Dutch labor market. With regard to the effects on wage dispersion the evidence is more mixed although most results suggest that local bargaining leads to higher wage dispersion than industry level bargaining.

A distinguishing feature is that all the mentioned studies use cross section data (except

Gürtzgen 2006), and a caveat applying here is that there may be unobserved differences between workers covered by centrally and locally negotiated wage contracts. For example, it may be argued that if firms with local bargaining reward observed skills such as education more generously, they will likely also reward unobserved skills better. Furthermore, if local bargaining is known to imply more dispersed wages, the Roy (1951) model would suggest that high-ability workers sort into decentralized bargaining segments. Hence, we expect a positive correlation between local bargaining and unobserved ability, and that appropriately controlling for unobserved heterogeneity implies smaller estimated effects of local bargaining arrangements.

Along the same lines, risk averse workers may select into centralized bargaining systems with more compressed wage structures, and they may be willing to pay a price in terms of lower average wages to do so. Worker-level risk aversion is unobserved, so again failure to control for unobserved heterogeneity may lead to upward bias in the coefficient to local bargaining systems.

With access to longitudinal data covering a period of decentralization we are in a position to take account of unobserved heterogeneity and we may more reliably identify the effects of decentralization since the decentralization process provides time variation in the individual worker's wage-setting system.

3 The Danish wage-setting systems

Whereas job protection is low in Denmark, the wage setting has been rather inflexible – Denmark has been one of the OECD countries with the most compressed wage structures – which in part is due to a combination of three factors. First, the benefit system is generous with a high benefit level for low income groups and a long benefit period of up to four years. Second, the Danish labor market is highly organized on both employer and worker sides: The share of union members among all employees remained at a relatively stable level around 75% in the 1990s, and in 2000 more than 80% were covered by a collective agreement cf. OECD (2004). Third, wage bargaining has historically been centralized,

but, as explained below, this has changed during the 1980s and 1990s. According to Boeri et al. (2001) the centralization/coordination index of the bargaining system (which lies between 0 and 1) has for Denmark dropped from 0.64 for the period 1973-1977 to 0.47 for 1983-1987 and 0.34 for 1993-1997.

The dominant bargaining parties at the national level in Denmark are the Confederation of Danish Employers (DA) and the Danish Confederation of Trade Unions (LO). The DA/LO area is important, not only because it covers around 45% of the private labor market, but also because DA and LO historically have been first movers in negotiations, thus setting the tone for the remaining part of the labor market including the public sector. The process of decentralization started in 1989 with major organizational changes taking place initially on the employer side. Up until the late 1980s the Confederation of Danish Employers had been able to sustain their dominant position within the employer side because of a rather fragmented structure with a large number of small member organizations, but in 1989 a structural reform was implemented in which several sector level employer organizations were merged.[2] The employer side pushed for this change because increased internationalization and technological change meant that wage contracts under the standard-rate system were not flexible enough to accommodate specific conditions at the local level. As part of this process the Confederation of Danish Industry (DI) was formed as a merger in 1991, and this signaled a clear shift of power from the national level to the sector level.[3] The wage-setting system adopted by DI was a system that combines sector-level bargining with wage settlement at the local level (the so-called "minimum-wage system", see below), which implied a shift away from a centralized wage-setting system for a considerable part of the member firms. The employee side did not oppose the decentralization movement partly because of the reasoning that labor demand might suffer if firms were not given more flexibility, and partly because schemes for mandatory

[2]The number of member organizations declined from 150 in 1989 to 50 after the reform. Since then, the number of members declined further to 13 in 2005. Several member organizations also merged on the employee side during the 1990s and 2000s to match this development – the number of organizations dropped from 30 in 1990 to 18 in 2005.

[3]Workers under DI accounted for more than half of the entire wage bill of the DA/LO area. Also, as a symbol of the change of power the CEO of DA switched to become the CEO of DI.

labor market pensions, on-the-job training, and child care leave were introduced in return.

The shift from national-level bargaining to sector-level bargaining in the early 1990s was accompanied by a shift towards collective agreements stipulating only general conditions such as working hours, rules for flexible working hours and minimum wages. Increasingly, wage settlements were left to the local level. In addition, the previous syncronization of bargaining with two-year intervals was abandonded such that differences in contract length (three and four years) were allowed. However, it is important to emphasize that some key aspects of the bargaining process are maintained at the centralized level. First, the right to call a conflict must still be coordinated and approved at the central level. Second, the sector-level employer orgainzations must have collective agreements approved by DA. Finally, the official conciliator maintains a central role in settling agreements when the parties cannot reach a compromise themselves. Therefore, the process of decentralization in Denmark is classified as "organized" or "centralized" decentralization, cf. Andersen (2003).

There are four different wage-setting systems in Denmark: First, under the *standard-rate system* ("normallønssystemet") actual wages of workers are set by the industry collective agreement and the wages are not modified at the firm level. Second, under the *minimum-wage system* ("minimallønssystemet") the wage rates set at the industry level represent a floor and are intended to be used only for very inexperienced workers. Hence, for other workers this wage rate is supplemented by a personal pay supplement. In practice, the personal pay supplements are often negotiated collectively with the cooperation of the workplace union members' representative. Third, a somewhat similar *minimum-pay system* ("mindstebetalingssystemet") exists. Rather than operating with a personal pay supplement on top of the industry-level negotiated wage rate, the minimum-pay system uses a personal wage. The wage rate negotiated at the industry level can be thought of as a safety net in the form of a minimum hourly rate that must be paid under all circumstances. Finally, under *firm-level bargaining* ("uden lønsats") the collective agreements state that wages are negotiated at the plant or firm level without any centrally bargained wage rates.

Table 1 shows the development in the use of these four wage-setting systems in the DA/LO area. As is evident, there has been a trend towards more decentralized and flexible wage setting, where the proportion with a standard wage rate was more than halved. Since 1993 the most decentralized wage-setting system (firm-level bargaining) has grown from a coverage of 4% to 22% in 2004. For the two two-tiered wage-setting systems (minimum-wage and minimum-pay) we also see considerable variation over time. In the empirical analysis below we use data for 1992-2001, so we capture the increased importance of firm-level bargaining in particular but also a shift from the standard-rate system to the minimum-pay system in the beginning of the period.

For the purposes of this paper it is important to understand the forces behind the change of wage-setting systems. As mentioned above, the shift from the standard-rate system to more decentralized systems in the early 1990s was facilitated by mergers of several smaller organizations on both the employer and employee side. A similar reasoning may be applied to explain the change towards the most decentralized system, firm-level bargaining, for some bargaining segments in the mid 1990s. One bargaining segment making the transition to firm-level bargaining is the area covering office clerks, which is a relatively large segment. Several smaller member organizations were merged (both employer and employee organizations merged) and only the most decentralized wage-setting system was deemed flexible enough to accommodate the different needs and conditions in this new, enlarged labor market segment. It should also be mentioned that segments that remained under the centralized standard-rate system are largely characterized by routine tasks (e.g. transport, warehouse work, and production line work), where it makes less sense to differentiate wages across workers.

4 Data and descriptive statistics

Our data is a matched employer-employee dataset drawn from administrative registers in Statistics Denmark. The core of the data is the Integrated Database of Labor Market Research (IDA), which identifies workers and plants consistently over time. We have

access to information about individual characteristics for the full population of workers for the years 1992-2001. We add to this dataset wage and income information based on tax files from the Income Register in Statistics Denmark.

The first challenge we face is to determine which collective agreement (and thus wage-setting system) the individual worker belongs to. To accomplish this, we use detailed industry and occupation variables. The industry code follows the NACE industry classification, and the occupation variable is based on the so-called DISCO code, which is the Danish version of the ISCO-88 classification. We use the most disaggregated definition of the industry and occupation codes, i.e., the six-digit NACE code and the four-digit DISCO code. By using these industry and occupation variables to define bargaining segments of the labor market we follow the two bargaining parties at national level, LO and DA, who use the codes to assess the economic implications of proposals for the workers and employers they represent. That is, we determine the bargaining segments in the same way as DA and LO when the parties evaluate the bargaining outcome. However, the construction of such bargaining segments is not completely flawless. For example, a firm may wish to stay outside its industry's collective agreement and we will not be able to see this in the data. Nevertheless, we are confident that our allocation of workers into bargaining segments is fairly accurate since we end up with a distribution of workers across wage-setting systems that resembles Table 1 quite closely (more on this below). We have identified 36 bargaining segments within the DA/LO area, which corresponds to a coverage rate of roughly 85% of total DA/LO employment. Coupled with information about the bargaining system each segment operates under in each year, it was straightforward to partition all workers into the four wage-setting systems under consideration.

A long list of individual socioeconomic characteristics are used as control variables in the analysis. We use dummies for gender, the presence of children, marriage, immigrant status, city size ('Copenhagen', 'Large city', and 'Rural'), education ('Unskilled', 'Vocational Education', 'Short term higher education' and 'Long term higher education'),[4]

[4]The classification of education groups rely on a Danish education code that corresponds to the International Standard Classification of Education (ISCED). 'Higher education' basically corresponds to the two highest categories (5 and 6) in the ISCED, *i.e.*, the individual has a tertiary education.

and experience (measured as actual labor market experience since 1964). We also control for plant size as defined by the number of employees and variables measuring the labor force composition at plant level. Furthermore, in all regressions we include a full set of industry dummies (25 industries) interacted with a full set of year dummies to capture differences in business conditions across industries (e.g., demand shocks, import penetration, technological change, etc.).

The hourly wage rate is clearly an important individual level variable in the analysis, and this wage rate is calculated as the sum of total labor income and mandatory pension fund payments divided by the total number of hours worked in any given year. The measure for total labor income as such is highly reliable since it comes from the tax authorities, and the pension fund payments are also available in the registers. These payments were introduced in the early 1990s, and have been rising throughout the sample period, but not in a uniform manner across collective bargaining segments of the labor market and they are therefore important to account for.

The use of annual hours to measure the wage rate is common in the literature, see e.g. Christensen et al. (2005), but one concern is that annual hours are measured with less precision. Information about annual hours comes from the mandatory pension fund, ATP, which collects a relatively modest mandatory pension fund payment from all workers in the Danish labor market. The payment depends on the number of hours worked in the following way: i) no payment if working 0-9 hours per week, ii) 1/3 of full time payment if working 9-18 hours per week, iii) 2/3 full time payment if working 18-27 hours per week, and iv) full time payment if working 27 or more hours per week. The hours worked are then imputed from knowledge about a worker's ATP group. If the worker is registered as having paid full-time ATP, then the hours worked are measured as the number of hours corresponding to the standard 37 hour workweek. This is a rather crude measure of hours worked, but in what follows we look only at full time workers, which helps alleviate measurement errors arising due to the grouped nature of the variable. Still, our hours

'Vocational education' is defined as the final stage of secondary education encompassing programs that prepare students for direct entry into the labor market. Thus, persons with just high school or equivalent or less than that are classified as 'Unskilled'.

measure does not capture overtime work, so this gives an upward bias in the measured hourly wage rate. To the extent that this bias is related to the bargaining system it may impact on the estimated effects of decentralization. However, for a portion of our sample over the years 1997-2001 we have data for overtime work, so we can directly assess whether overtime hours are nonrandomly distributed across bargaining systems. We find that overtime work is limited and that there is no clear relationship with decentralization. On average, workers under the standard-rate system have 36.7 hours of overtime work per year while workers under firm-level bargaining have 12.1 hours of overtime work. Workers belonging to the two two-tiered wage-setting systems have 17.9 and 46.5 hours of ovetime work per year, respectively. This suggests that our results are unlikely to be affected by the issue of overtime work.

We impose the following sample selection criteria: First, we include only full-time workers aged 25-65 years employed in one of the DA/LO bargaining segments. We leave out the young workers to make sure our sample consists of workers who are fully attached to the labor market and are not enrolled in the apprenticeship system or the ordinary education system (we also leave out workers receiveing scholarships for ordinary education). Second, to reduce the impact of measurement error we discard observations where the hourly wage rate is unobserved, is measured with low precision according to Statistics Denmark, or belongs to the top or bottom half percentiles of the wage distribution. Third, we omit observations where the worker is employed by a plant with less than five employees because the smallest plants are less likely to be covered by the DA/LO agreements. Finally, to reduce estimation time we extract a 30% random sample of the remaining workers, which leaves us with a sample of about 1.14 million worker-year observations.

The sample version of Table 1 is Table 2. Even though we only distinguish between 36 bargaining segments and, thus, leave out a small part of the DA/LO segment, the development in Table 2 resembles that of Table 1 quite closely. As described above, much of the decentralization process in Denmark took place before 1992, but we still have considerable time variation in the data.

Table 3 reports summary statistics for all observations in the data and by wage-setting

system. Differences in observed worker characteristics across wage-setting systems are revealed, as firm-level bargaining has relatively high proportions of women, workers with further education and high tenure, and the average plant size is biggest under this system. In contrast, unskilled workers are disproportionately employed under the standard rate system.

Table 4 shows means and standard deviations of log hourly wage rates in the four different wage-setting systems. We show both unadjusted means and standard deviations and standardized means and standard deviations to account for differences in observed characteristics across wage-setting systems. The standardization follows the routine by DiNardo et al. (1996). A key insight revealed by Table 4 is that wages on average are highest under firm-level bargaining and lowest under the standard rate system. The two intermediate wage-setting systems, minimum pay and minimum wage, have roughly the same mean wages. These differences persist when adjusting for observable worker characteristics, and wage dispersion is now lowest under the standard rate system.

With our longitudinal data set, identification of the impact of wage-setting system on wages rests on the existence of workers who change wage-setting system. This can happen for two reasons: the bargaining segment may change its system as part of the decentralization process or the worker may change jobs. Table 5 tracks the workers in our sample who change wage-setting system in each year. The second column shows the total number of workers changing wage-setting system, and these numbers correspond to a transition rate of between 3 and 14% each year. Columns 3-6 decompose the total annual changes further. First, the entire bargaining segment can change wage-setting system due to the decentralization process (column 3), which contributes with the majority of transitions.[5] Second, a worker can change occupation and/or industry and, thereby, potentially also bargaining segment and wage-setting system (columns 4-6).

[5]It should be noticed that it is only the year in which a collective agreement is initiated that the wage-setting system changes. For most bargaining segments this happened every second year in the early 1990s. This explains the large number of changes in 1993, 1995, and 1997. However, some collective agreements in 1995 and 1997 had a duration of three years. The small number of decentralization changes in for example 1994 are workers who were in the sample in 1992 and 1994 but were out of the sample in 1993.

Since the wage-setting system variable is constructed based on the industry and occupation codes, measurement error may arise – in particular the occupation code is known to be unstable within job spells in some years – and this may bias our estimates. In relation to panel data estimations of a union membership effect on wages Freeman (1984) argues that measurement error in the union membership variable will lead to a downward-biased estimate of the effect. However, when entire bargaining segments change wage-setting system as in our data, measurement error is less of a problem compared to the situation where we only rely on workers changing jobs and, thereby, wage-setting systems. The data still include job changers, however, (see columns 4-6 in Table 5) so in the empirical analysis below we restrict the sample further to reduce potential problems with measurement error. Specifically, we discard all workers who change wage-setting system because of a shift in the occupation code (column 5) unless they also change employer. This reduces the number of wage-setting system changes due to occupation changes by approximately 90%.

As a final piece of descriptive evidence we document in Table 6 the transitions between the four wage-setting systems caused by decentralization. Several key points emerge. First, consistently with a process of decentralization no bargaining segments switch to the standard rate system and no bargaining segments switch from firm-level bargaining. Second, more than half of all transitions are accounted for by bargaining segments changing from the minimum-pay system to firm-level bargaining. Third, no segments change directly from the standard-rate system to firm-level bargaining. Fourth, almost 16,000 transitions are due to segments switching between the two intermediate wage-setting systems, minimum-wage and minimum-pay. As described above, these two wage-setting systems both operate with a wage floor set at the sector level combined with subsequent firm-level bargaining, and given the similar wage structure documented in Table 4, we group these two systems together to ease interpretation in what follows.[6] We label the two intermediate wage-setting systems 'two-tiered bargaining'.

[6] In the wage regressions below we also entered dummies for the two intermediate wage setting systems separately, but we found no significant differences.

5 Empirical framework

To assess the impact of decentralization on wage dispersion we employ two different empirical models. First, we run standard Mincer wage regressions with controls for observed and unobserved heterogeneity. These will show the impact of decentralization on wage levels and whether decentralization raises the return to skills. Second, we use panel data quantile regression to show in a more detailed way how decentralization affects the wage distribution.

5.1 Mean wage regression model

We assume that individual wages are determined as:

$$y_{ijt} = x_{ijt}\beta + \gamma_1 FIRMLEVEL_{ijt} + \gamma_2 TWOTIERED_{ijt} + \varphi_{kt} + \alpha_i + \epsilon_{ijt}, \qquad (1)$$

where y_{ijt} is the log of the hourly wage of worker i in plant j at time t, and x_{ijt} is the vector of individual explanatory variables. $FIRMLEVEL$ and $TWOTIERED$ are dummies capturing the individual worker's wage-setting system with the standard rate system acting as the reference category.[7] φ_{kt} captures industry and time effects, i.e., a dummy for each combination of year t and industry k is included. We use different approaches to modeling the individual unobserved component α_i. As a first specification, α_i is simply modeled as a worker-fixed effect. Here, identification of γ_1 and γ_2 rests on over-time variation in the worker's wage-setting system, which could be due to both decentralization changes and job changes, cf. Table 5.

Because of the potentially endogenous nature of job changes we also estimate an extended version of the model:

$$y_{ijt} = x_{ijt}\beta + \gamma_1 FIRMLEVEL_{ijt} + \gamma_2 TWOTIERED_{ijt} + \varphi_{kt} + \alpha_{ij} + \epsilon_{ijt}. \qquad (2)$$

[7] When interpreting the coefficient γ_1 it should be kept in mind that no bargaining segments switch directly from the standard rate system to firm-level bargaining, cf. Table 6.

In this case, the unobserved component, α_{ij}, is modeled as a so-called job-spell fixed effect (Abowd et al. 1999). That is, a fixed effect is included for every combination of worker and plant. This means that γ_1 and γ_2 are identified off of variation in the wage-setting system within a job spell, so job changes are excluded as a source of identification. Within-spell variation in the wage-setting system is only caused by the bargaining segment changing wage-setting system, i.e., decentralization.

Finally, for the purposes of comparison with the subsequent panel data quantile regression model we also estimate a Mundlak (1978) version of equation (2), where the unobserved component is approximated by averages of the observed covariates. An alternative and more flexible correlated random effect estimator is proposed by Chamberlain (1982), but in the case of an unbalanced panel it reduces to Mundlak's estimator. For the correlated random effect estimator, the unobservable component is expressed as a restricted linear projection onto a vector of observables, denoted S_{ij}, plus a disturbance, v_{ij}. In particular,

$$\begin{aligned} \alpha_{ij} &= S_{ij}\theta + v_{ij} \\ &= \psi + \bar{x}_{ij}\lambda + \pi_1 \overline{FIRMLEVEL}_{ij} + \pi_2 \overline{TWOTIERED}_{ij} + v_{ij}, \end{aligned} \tag{3}$$

where $\overline{z}_{ij} = \frac{1}{T_{ij}} \sum_{t=1}^{T_{ij}} z_{ijt}$ defines averages and where T_{ij} indicates the number of years worker i has been employed in plant j. By inserting (3) in equation (2) we get the estimating equation from which we (by standard random effect GLS estimation routines) obtain the job-spell Mundlak correlated random effect estimator.

A major advantage of our empirical model vis-à-vis the existing literature is that we exploit time variation in the wage-setting system of the individual worker. In the job-spell fixed effects model (2) the time variation comes from changes in the wage-setting system that are due to the decentralization process, while wage-setting system changes through job moves are excluded as a source of identification. This raises the question about whether wage-setting system changes due to the decentralization process, i.e., entire bargaining segments changing wage-setting systems, are truly exogenous. We cannot completely rule

out that decentralization of a bargaining segment's wage-setting system is a consequence of changes in e.g. work practices, technology, increased international competition or similar unobserved qualifications of the employees that also affect wages. However, several aspects make this less likely to be the case.

First, recall from section 3 that the process of decentralization in Denmark is labeled "centralized" decentralization. In many cases decentralization happened through mergers of smaller organizations on both the employer and employee side, and often only local level wage-setting systems were flexible enough to meet the needs of a larger labor market segment. Also, even for the decentralized labor market segments several parts of the bargaining process are maintained at the centralized level. Finally, the wage-setting systems are defined at the level of relatively large bargaining segments (36 segments in total in our data), and the employees within a firm typically belong to different bargaining segments and thus wage-setting systems. This centralized way of decentralizing the bargaining system means that the scope for individual firms or workers to influence the process is relatively limited.

Second, the wage-setting system of the individual worker may in principle not be exogenous due to its group level nature (the group being the bargaining segment of the labor market), because group level variables may be subject to the "reflection problem" as described by Manski (1993). For example, we could observe a positive effect of decentralization on wages simply because workers forming the same group share similar unobserved characteristics, and not because decentralization facilitates e.g. rent sharing and efficiency improvements. Again, the panel dimension of our data is useful because any time invariant unobservables are accounted for by use of worker fixed effects, job-spell fixed effects or correlated random effects. In addition, observed changes in e.g. labor market experience and demographic characteristics are controlled for. Still, changes in unobserved ability might be correlated with decentralization, which would lead to biased estimates. However, relative to the existing cross section evidence the use of panel data allows us to reduce the size of this problem substantially.

Third, one might worry that firms experiencing unobserved shocks (for example due

to technological change, offshoring, or import penetration) will push for wages to be negotiated at the firm level. Such time-varying shocks are more likely to be correlated with decentralization if they are industry-wide, or they hit firms in entire bargaining segments. In an attempt to capture shocks to industries of this kind we include as additional controls a full set of industry dummies interacted with a full set of year dummies.

5.2 Wage quantile regression model

Quantile regression techniques for panel data in the presence of unobserved and correlated components have only recently been developed. This section very briefly describes the approach and our wage quantile regression specification.

As in the linear panel model setting, there is a choice between quantile regression fixed effects estimators and correlated random effects estimators. Koenker (2004) proposes a dummy variable-based fixed-effects estimator for quantile regression where the problem of a large amount of parameters to be estimated (in case of large N and small T) is mitigated by an added penalty term and simultaneous estimation of the desired quantiles. Unfortunately, estimation for large N and small T can be a very difficult task owing to the nature of the objective function. Because N is indeed very large in our application the estimator unfortunately turned out to be infeasible to implement successfully.

Abrevaya and Dahl (2008) suggest a simpler correlated random effect estimator based on the ideas of Mundlak (1978) and Chamberlain (1984). In a simulation study, Bache et al. (2011) show that the correlated random effects approach works well even for very small T and is numerically feasible for very large values of N. For these reasons, we report quantile regression estimators based on the model with correlated random effects. It should be emphasized that, as in the linear mean model, this estimator relies heavily on the extent to which the linear projection provides a reasonable approximation of α. For example, if α is a pure random effect, then the approach is very inefficient, as the included variables have poor explanatory power.

The wage quantile regression model with correlated random effects that corresponds

to the job-spell mean wage regression specification given by equation (3) is represented by the following two equations

$$\begin{aligned} q(X_{ijt}, S_{ij}, \tau) &\equiv x_{ijt}\beta(\tau) + \gamma_1(\tau) FIRMLEVEL_{ijt} + \gamma_2(\tau) TWOTIERED_{ijt} \\ &\quad + \varphi_{kt}(\tau) + S_{ij}\theta(\tau), \qquad (4) \\ y_{ijt} &= q(X_{ijt}, S_{ij}, u_{ijt}), \qquad (5) \end{aligned}$$

where $X_{ijt} = (x_{ijt}, FIRMLEVEL_{ijt}, TWOTIERED_{ijt}, \varphi_{kt})$ and the vector of covariates S_{ij} is defined as in the mean wage equation. Under the assumption that S_{ij} is a sufficient vector of covariates such that $u_{ijt}|X_{ijt}, S_{ij} \sim$ uniform$(0,1)$, the quantity of interest, $\beta(\tau)$, is identified from the data, and can be estimated by means of standard quantile regression of y on $x, FIRMLEVEL, TWOTIERED$, φ_{kt}, and S, as shown by Abrevaya and Dahl (2008) and Bache et al. (2011).

A final comment regarding practical implementation of the sampling distribution of coefficient estimates is in order. For all of the above models, a bootstrap procedure is the preferred method of obtaining standard errors. It is important to note that since observations over the time dimension for worker i are not independent, the bootstrap samples should consist of "blocks" that include all observations for the sampled cross sectional elements. Further, as noted by Koenker (2005, page 108), sub-sampling has a computational advantage over re-sampling with equal performance and is thus preferred when the cross section dimension is large as in this case. For a detailed description of the sub-sampling procedures the reader is referred to Buchinsky (1994, 1998).

6 Results

This section first presents results for the impact of wage-setting systems on mean wages. This is followed by results for the impact on wage dispersion using the panel data quantile regression approach.

6.1 Wage levels

While our focus is on the the impact of decentralization on wage dispersion, it is instructive to first study how mean wages differ across wage-setting systems controlling for individual heterogeneity. Table 7 reports estimation results from a pooled OLS, worker fixed-effects and job-spell fixed-effects models. In addition, to provide a basis for comparison with subsequent panel data quantile regression results, we also show results for the correlated random effects model. Included in all models are the demographic variables and human capital variables described in section 4. However, in the fixed-effects models time invariant variables drop out. A small number of workers are observed with changing educational attainment, but these observations are dropped in the fixed effects models to get a cleaner identification of interaction effects between education and wage-setting dummies.

For the pooled OLS regression in column 1 we find that wages are 6.1% higher under firm-level bargaining than under the standard-rate system, where wages are negotiated at the most centralized level. This is in line with Card and de la Rica (2006), who find that firm-level contracting is associated with a 5-10% wage premium in their cross-section data analysis for Spain. However, this quite substantial wage differential is reduced to 3.7% once unobserved heterogeneity is controlled for through worker fixed effects. This clearly suggests that it is important to control for unobserved heterogeneity, and that failure to do so leads to an upward bias in the coefficient, i.e., unobserved ability may be better rewarded under local bargaining. We find no significant difference in mean wages between two-tiered bargaining and the standard-rate system in the pooled OLS regression or in the worker fixed-effects model.

In the worker fixed-effects model (2) identification of the effects of wage-setting systems comes from over-time variation in the wage-setting system variables. This can happen either because the bargaining segment changes its system as part of the decentralization process or becaue the worker changes jobs from one bargaining segment of the labor market to another. In the latter case, endogeneity may particularly be an issue as, e.g., highly paid workers in the standard-rate system may be inclined to change to jobs under firm-level

bargaining to receive higher wages. Alternatively, low-paid or low-skilled workers may gain from switching to jobs under the standard-rate system. As argued in the previous section, one way to exclude this source of variation in the wage-setting system is to estimate the job-spell fixed effects model instead, which is therefore our preferred specification. Column 3 of Table 7 shows that the effect of firm-level bargaining now increases to 4.7%, while the effect of two-tiered bargaining remains insignificant. The estimated effect of firm-level bargaining means that job moves involving a change of wage-setting system to firm-level bargaining on average are associated with smaller wage changes than those resulting from pure decentralization changes.[8] Compared with the pooled OLS coefficient, the wage premium associated with firm-level bargaining is still roughly 25% smaller in the job-spell fixed effect model, which underlines the importance of controlling for unobserved heterogeneity.

Finally, in the correlated random effects model in column (4) we find effects of wage-setting systems that are very close to the job-spell fixed effects model, suggesting that this model is a useful basis for the panel data quantile regressions below.

The time dimension in our data allows us to investigate if the estimated decentralization effects are immediate or if it takes time for wages to adjust to a new wage-setting system. For example, under two-tiered bargaining a wage floor is first set at the sector level and then supplemented by local adjustments at the firm level. In such systems the more central wage negotiators may foresee that there may be additional average increases on the top of the wage floor leading them to be more moderate in setting the floor since they expect that this pay will subsequently be marked up by additions at the local level. Likewise, it may take longer to set wages under firm-level bargaining relative to more coordinated and centralized systems. If this is the case, the effect of decentralization on wages may be underestimated if the time dimension is not taken into account.

Column 1 of Table 8 extends the job-spell fixed effects model with variables measuring the number of successive years the worker has been under either firm-level bargaining or

[8] When interpreting this effect, it should be kept in mind that no bargaining segments switch directly from the standard rate system to firm-level bargaining, cf. Table 6. Instead, identification rests entirely on decentralization changes from two-tiered bargaining to firm-level bargaining.

two-tiered bargaining. We include variables for one year, two years, three years, and four years or more. In this approach only observations for 1995-2001 enter the sample. We find no effect of firm-level bargaining in the first year, but there is an effect of 2.5% in the second year, which rises to 3.3% in the third year under firm-level bargaining. If the worker has had wages negotiated under firm-level bargaining for four or more years, the wage premium relative to the standard-rate system is 5.8% surpassing the mean effect estimated in Table 7. For two-tiered bargaining we find a weak positive effect of 1.5% after three years. This provides evidence for lagged effects under this this wage-setting system as discussed above.

The downside of using the approach in column 1 is that observations in the beginning of our sample period are dropped, and the more time categories we include the more observations will be dropped. One way to include more time categories (up to 7 years) without losing too many observations is to keep all observations for which we know exactly how many years the worker has been under firm-level bargaining or two-tiered bargaining. For worker-wage-setting system spells that begin prior to our sample period we do not know how long time the worker has been under a given wage-setting system, and so these left-truncated observations are discarded. In column 2 of Table 8 we use this approach and find effects of firm-level bargaining for the first three years that are close to the effects found in column 1. It is now seen that the effect of firm-level bargaining converges to around 5% after five years under this wage-setting system. Again, we find some small positive effects of two-tiered bargaining after three to five years.

6.2 The return to skills

Having established that wages on average are higher under firm-level bargaining even after controlling for observed and unobserved heterogeneity, we now turn to the question of how decentralization affects wage dispersion. One simple way to address this question is to study how the return to skills differs across wage-setting systems using the same job-spell fixed effects model as above. If decentralization of wage bargaining leads to

increased wage dispersion, then one would expect this is to be accomplished through a higher return to skills the more local the level of negotiations is.

In Table 9 we interact firm-level bargaining and two-tiered bargaining with dummies for educational attainment and labor market experience groups, respectively. In column 1 we find that the return to education is higher, the more decentralized the wage-setting system is. Recall that the education dummies are time invariant (a small number of switchers are dropped), so the coefficient on the interaction variable between firm-level bargaining and long-term higher education has the interpretation that workers with long-term higher education who are employed under firm-level bargaining receive a wage premium of 8.7% relative to similar workers employed under the standard-rate system. In comparison, the wage premium for long term higher educated workers employed under two-tiered bargaining is 2.9%. It is also evident that the longer the education is the higher the decentralization wage premium will be. For example, workers with vocational education have a wage premium of 5% if employed under firm-level bargaining but no wage premium under two-tiered bargaining.

In column 2 we interact the wage-setting system dummies with experience groups. The direct effects of the experience groups show the influence of experience under the standard-rate system with the reference group being between 10 and 20 years of experience. It is seen that wage differences between experience groups under the standard-rate system are very small and mostly insignificant. Experience under two-tiered bargaining also appears not to matter much for wages, with inexeperienced workers (0-3 years experience) being the exception – they earn 2.7% lower wages than similar workers under the standard-rate system. By contrast, again we find a higher return to skills under the most decentralized wage-setting systems, firm-level bargaining. Interestingly, the most inexperienced workers earn 7.4% less than under the standard-rate system, while there is a firm-level bargaining wage premium of around 5% if the worker has at least 10 years of experience.

6.3 Wage dispersion

One important aspect which cannot be studied using the simple mean regressions is the fact that the decentralization process may have uneven effects across the wage distribution – an issue to which we now turn. The results from applying the panel data quantile regression techniques outlined in section 5.2 are displayed in Table 10. The table shows results for the quantiles 0.05, 0.1, 0.25, 0.5, 0.75, 0.9 and 0.95. In general, the coefficients on the individual-level variables are fairly constant across the different quantiles, but there are also some notable exceptions. For example, women and immigrants have a higher wage penalty in the top end of the wage distribution, which is consistent with the results of, e.g., Albrecht et al. (2003) and Pendakur and Woodcock (2010). Also, the wage premium from having a long tertiary education roughly doubles from the bottom to the top of the wage distribution.

Regarding the effects of decentralization, it is found that the coefficient on the dummy for two-tiered bargaining is not significantly different from zero in any of the quantiles considered. This is consistent with the zero mean effect of two-tiered bargaining found in Table 7 and the limited interaction effects with skill variables found in Table 9. By contrast, wages under firm-level bargaining are more dispersed with the effects at the top of the wage distribution being substantially higher than at the bottom. Interestingly, there are significantly positive wage premia throughout the wage distribution. For example, the effect of working under firm-level bargaining compared to the standard-rate system more than doubles from the 5th to the 95th quantile (from 3.3% to 7.2%). For the quantiles in the middle of the wage distributions the effects of firm-level bargaining are slightly higher than the mean effect of almost 5% found in Table 7. Thus, these results support the prediction that decentralization leads to increased wage dispersion for example because firm- and individual-specific characteristics are more likely to enter wage contracts, or because egalitarian union preferences become more difficult to accomplish.

7 Conclusion

Many European labor markets have undergone a process towards more decentralized wage bargaining during recent decades. Such changes may have important welfare implications both in terms of efficiency and equity. When wages are negotiated locally at the firm level as opposed to more centralized bargaining, they are more likely to reflect individual productivity and firm-specific conditions. This should lead to higher returns to skills and increased wage dispersion. Also, according to simple rent-sharing or efficiency-wage considerations mean wages should on average increase when wage-setting is decentralized to the local level.

We use a unique register-based panel data set covering a period of decentralization in the Danish labor market. This is crucial because the time variation allows us to identify the effects of decentralization, as many workers have seen their wage-setting system change as a result of the decentralization process within job spells. In contrast, the existing literature has relied on cross section data. Also, in contrast to previous studies, the longitudinal dimension allows us to control for unobserved individual heterogeneity. This is critical because by doing so the wage structure differences across wage-setting systems are substantially narrowed down.

Several theories discussed in the introduction lead to predictions about how decentralization should affect wage levels and wage dispersion. The purpose of the paper has not been to discriminate between theories of wage formation in a unionized labor market, but we do find empirical evidence in support of the rent-sharing and efficiency wage theories. Even after controlling for observed and unobserved heterogeneity, there is still on average a 4.7% wage premium if wages are negotiated at firm-level instead of sector-level. We also provide evidence that wages are more in accordance with individual productivity under firm-level bargaining, as the return to education or labor market experience is substantially higher under the more decentralized wage-setting systems. Finally, we also use panel data quantile regression techniques to assess the impact of decentralization on the wage distribution. Again, we find that decentralization of wage bargaining increases

wage dispersion. Under the most clear-cut comparison, i.e. the effect of working under firm-level bargaining compared to the standard-rate system where wages are set entirely at the sector level, smaller wage premia are found in the lower part of the wage distribution, while larger premia are found in the upper part. For the intermediate two-tiered bargaining systems wages are not more dispersed than under the standard-rate system.

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Table 1: Private sector wage-setting systems 1989-2004

	1989	1991	1993	1995	1997	2000	2004
Standard-rate	34	19	16	16	16	15	16
Minimum-wage	32	37	13	12	21	23	27
Minimum-pay	30	40	67	61	46	42	35
Firm-level bargaining	4	4	4	11	17	20	22
Total	100	100	100	100	100	100	100

Source: Danish Employers' Federation (DA).

Table 2: Private sector wage-setting systems 1992-2001, data

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Standard-rate	16.1	13.5	13.9	12.5	12.7	12.3	11.9	12.0	11.6	11.8
Minimum-wage	30.0	17.3	18.0	18.1	18.5	24.7	25.0	25.4	24.1	23.9
Minimum-pay	53.2	68.6	67.4	55.5	55.2	42.6	42.6	42.0	44.0	44.1
Firm-level bargaining	0.8	0.7	0.7	13.9	13.6	20.5	20.6	20.6	20.3	20.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 3: Sample means by wage-setting system, 1992-2001

	All	Firm-level bargaining	Minimum-pay	Minimum-wage	Standard-rate
Age (years)	40.20	40.02	40.10	39.85	41.36
Woman	0.31	0.60	0.27	0.28	0.24
Children aged 0-6 years	0.24	0.28	0.24	0.24	0.22
Non-western immigrant	0.03	0.01	0.03	0.02	0.05
Unskilled	0.38	0.21	0.40	0.31	0.59
Vocational education	0.54	0.50	0.53	0.65	0.39
Short-term higher edu.	0.05	0.18	0.04	0.02	0.01
Long-term higher edu.	0.03	0.12	0.02	0.01	0.01
Copenhagen	0.15	0.21	0.13	0.17	0.17
Large city	0.13	0.14	0.13	0.12	0.14
Rural	0.72	0.65	0.74	0.71	0.69
Experience (years)	17.07	17.31	17.17	16.55	17.37
Tenure (years)	5.07	5.31	5.22	4.73	4.80
Plant size (employees)	308.61	386.00	420.13	119.22	114.13
No. of observations	1,137,367	155,913	580,068	256,363	145,023

Note: Samples include all 25-65-year-old full-time workers at plants with at least five employees in 36 DA/LO bargaining segments.

Table 4: Mean log wages by wage-setting system

	Mean log wage	Standard deviation	Standardized mean log wage	Standardized standard deviation
Standard-rate	5.05	0.24	5.05	0.24
	[5.03;5.06]	[0.23;0.25]	[5.03;5.06]	[0.23;0.25]
Minimum-wage	5.09	0.27	5.13	0.27
	[5.08;5.10]	[0.26;0.28]	[5.11;5.15]	[0.25;0.28]
Minimum-pay	5.11	0.23	5.12	0.25
	[5.10;5.11]	[0.23;0.24]	[5.11;5.12]	[0.24;0.26]
Firm-level bargaining	5.19	0.27	5.19	0.26
	[5.17;5.20]	[0.26;0.28]	[5.12;5.25]	[0.24;0.31]

Note: Standardized mean and standard deviation are calculated using the DiNardo et al. (1996) approach. 95% confidence intervals are reported in square brackets.

Table 5: Transitions between wage-setting systems, 1992-2001

Year	(1) No. of obs.	(2) All changes	(3) Decentra-lization	(4) Change in occ. and industry	(5) Change in occupation	(6) Change in industry
1992	101,126					
1993	102,811	12,535	10,066	1,186	45	1,238
1994	109,149	2,802	486	1,230	360	726
1995	110,158	15,027	11,978	1,693	662	694
1996	112,445	4,372	674	2,019	982	697
1997	116,105	16,001	11,821	2,369	942	869
1998	118,880	5,235	994	2,516	880	845
1999	119,909	5,273	559	2,723	1,222	769
2000	123,471	8,502	1,616	3,829	2,422	635
2001	123,313	5,996	323	3,592	1,365	716
Total	1,137,367	75,743	38,517	21,157	8,880	7,189

Table 6: Transition matrix, 1992-2001

From\To	Standard-rate	Minimum-wage	Minimum-pay	Firm-level bargaining	Total
Standard-rate	0	145	2,405	0	2,550
Minimum-wage	0	0	9,620	165	9,785
Minimum-pay	0	6,039	0	20,143	26,182
Firm-level bargaining	0	0	0	0	0
Total	0	6,184	12,025	20,308	38,517

Table 7: Linear panel data models

	(1) OLS	(2) Worker fixed effects	(3) Job-spell fixed effects	(4) Job-spell random effects Mundlak
Firm-level bargaining	0.0614***	0.0368***	0.0465***	0.0495***
	(0.0079)	(0.0069)	(0.0090)	(0.0085)
Two-tiered bargaining	-0.0014	-0.0061	0.0004	0.0007
	(0.0060)	(0.0048)	(0.0072)	(0.0052)
Woman	-0.1547***			-0.1588***
	(0.0058)			(0.0054)
Children aged 0-6 years	0.0119***	0.0050***	0.0065***	0.0079***
	(0.0012)	(0.0008)	(0.0009)	(0.0009)
Non-western immigrant	-0.0445***			-0.0526***
	(0.0047)			(0.0058)
Large city	-0.0605***	-0.0175***	-0.0033	-0.0478***
	(0.0025)	(0.0031)	(0.0030)	(0.0026)
Rural	-0.0584***	-0.0098***	0.0031	-0.0427***
	(0.0026)	(0.0019)	(0.0022)	(0.0023)
Vocational education	0.0396***			0.0546***
	(0.0020)			(0.0030)
Short-term higher education	0.0957***			0.1055***
	(0.0043)			(0.0046)
Long-term higher education	0.1806***			0.1974***
	(0.0076)			(0.0084)
Age/10	0.0916***			0.1260***
	(0.0100)			(0.0116)
Age squared/100	-0.0120***	-0.0194***	-0.0150***	-0.0126***
	(0.0010)	(0.0009)	(0.0009)	(0.0012)
Experience/10	0.0827***	0.1385***	0.0490***	0.0778***
	(0.0038)	(0.0072)	(0.0095)	(0.0093)
Experience squared/100	-0.0121***	-0.0030*	-0.0058***	-0.0078***
	(0.0009)	(0.0016)	(0.0019)	(0.0025)
Tenure	0.0426***	0.0327***		0.0363***
	(0.0046)	(0.0027)		(0.0031)
Tenure squared	-0.0136***	-0.0113***	-0.0029**	-0.0123***
	(0.0022)	(0.0016)	(0.0012)	(0.0018)
Log plant size	0.0176***	0.0210***	0.0255***	0.0247***
	(0.0013)	(0.0010)	(0.0020)	(0.0029)
Plant share, vocational education	0.0792***	0.0070**	0.0023	0.0319***
	(0.0100)	(0.0027)	(0.0021)	(0.0059)
Plant share, short-term higher education	0.0567***	0.0113**	0.0090	0.0434***
	(0.0086)	(0.0054)	(0.0056)	(0.0072)
Plant share, long-term higher education	0.1926***	0.0315***	0.0029	0.1057***
	(0.0089)	(0.0052)	(0.0069)	(0.0087)
Plant share, workers aged below 30 years	0.0084**	0.0023	0.0005	0.0040*
	(0.0039)	(0.0019)	(0.0021)	(0.0022)
Plant share, workers aged above 50 years	-0.0887***	-0.0393***	-0.0165***	-0.0425***
	(0.0083)	(0.0036)	(0.0026)	(0.0047)
Plant share, women	-0.0796***	-0.0448***	0.0036	-0.0440***
	(0.0092)	(0.0060)	(0.0028)	(0.0071)
No. of observations	1,086,114	1,072,329	1,072,329	1,086,114
No. of workers	249,546	246,710	246,710	249,546
R-squared	0.3037	0.1403	0.1369	0.2980

Note: All models include industry-year fixed effects. Standard errors are clustered at the bargaining segment-year level. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Lagged effects

	(1)	(2)
Firm-level bargaining, 1 year	0.007	0.008
	(0.009)	(0.009)
Firm-level bargaining, 2 years	0.025***	0.022**
	(0.009)	(0.009)
Firm-level bargaining, 3 years	0.033***	0.024**
	(0.010)	(0.009)
Firm-level bargaining, 4 years or more	0.058***	
	(0.010)	
Firm-level bargaining, 4 years		0.042***
		(0.009)
Firm-level bargaining, 5 years		0.047***
		(0.009)
Firm-level bargaining, 6 years		0.050***
		(0.010)
Firm-level bargaining, 7 years or more		0.050***
		(0.010)
Two-tiered bargaining, 1 year	0.006	-0.002
	(0.007)	(0.005)
Two-tiered bargaining, 2 years	0.010	0.001
	(0.008)	(0.005)
Two-tiered bargaining, 3 years	0.015*	0.010*
	(0.008)	(0.006)
Two-tiered bargaining, 4 years or more	0.015*	
	(0.008)	
Two-tiered bargaining, 4 years		0.007
		(0.006)
Two-tiered bargaining, 5 years		0.013**
		(0.006)
Two-tiered bargaining, 6 years		0.003
		(0.008)
Two-tiered bargaining, 7 years or more		-0.006
		(0.007)
Standard rate, 2 years	-0.003	
	(0.002)	
Standard rate, 3 years	-0.000	
	(0.003)	
Standard rate, 4 years or more	0.000	
	(0.003)	
No. of observations	774,422	264,567
No. of workers	208,650	65,301
R-squared	0.0954	0.1170

Note: All models include job-spell fixed effects, industry-year fixed effects and all covariates in Table 7. Standard errors are clustered at the bargaining segment-year level.
*** p<0.01, ** p<0.05, * p<0.1.

Table 9: Human capital

	(1)	(2)
Firm-level bargaining * unskilled	0.0360***	
	(0.0098)	
Firm-level bargaining * vocational education	0.0502***	
	(0.0083)	
Firm-level bargaining * short-term higher education	0.0802***	
	(0.0134)	
Firm-level bargaining * long-term higher education	0.0865***	
	(0.0133)	
Two-tiered bargaining * unskilled	-0.0053	
	(0.0081)	
Two-tiered bargaining * vocational education	0.0061	
	(0.0064)	
Two-tiered bargaining * short-term higher education	0.0263**	
	(0.0128)	
Two-tiered bargaining * long-term higher education	0.0293**	
	(0.0122)	
Experience 0-3 years		0.0052
		(0.0066)
Experience 3-5 years		0.0032
		(0.0046)
Experience 5-10 years		0.0099***
		(0.0022)
Experience 20-30 years		-0.0022
		(0.0017)
Experience 30 years or more		-0.0028
		(0.0027)
Firm-level bargaining * experience 0-3 years		-0.0741***
		(0.0144)
Firm-level bargaining * experience 3-5 years		-0.0158
		(0.0130)
Firm-level bargaining * experience 5-10 years		0.0260**
		(0.0105)
Firm-level bargaining * experience 10-20 years		0.0492***
		(0.0092)
Firm-level bargaining * experience 20-30 years		0.0548***
		(0.0091)
Firm-level bargaining * experience 30 years or more		0.0502***
		(0.0093)
Two-tiered bargaining * experience 0-3 years		-0.0266**
		(0.0120)
Two-tiered bargaining * experience 3-5 years		-0.0158
		(0.0102)
Two-tiered bargaining * experience 5-10 years		-0.0091
		(0.0085)
Two-tiered bargaining * experience 10-20 years		0.0018
		(0.0071)
Two-tiered bargaining * experience 20-30 years		0.0048
		(0.0068)
Two-tiered bargaining * experience 30 years or more		0.0102
		(0.0079)
No. of observations	1,072,329	1,072,329
No. of workers	246,710	246,710
R-squared	0.1369	0.1378

Note: All models include job-spell fixed effects, industry-year fixed effects and all covariates in Table 7. Standard errors are clustered at the bargaining segment-year level. *** p<0.01, ** p<0.05, * p<0.1.

Table 10: The quantile regression model with job spell random effects (Mundlak)

	Quantiles(τ)						
	$\tau = 0.05$	$\tau = 0.1$	$\tau = 0.25$	$\tau = 0.5$	$\tau = 0.75$	$\tau = 0.9$	$\tau = 0.95$
Firm-level bargaining	0.033***	0.039***	0.055***	0.060***	0.055***	0.062***	0.072***
	(0.007)	(0.006)	(0.004)	(0.004)	(0.003)	(0.009)	(0.012)
Two-tiered bargaining	0.006	0.004	0.002	-0.002	-0.008	-0.008	0.002
	(0.007)	(0.006)	(0.004)	(0.004)	(0.005)	(0.010)	(0.011)
Woman	-0.118***	-0.119***	-0.129***	-0.148***	-0.167***	-0.184***	-0.196***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)
Children aged 0-6 years	-0.003***	0.000***	0.005***	0.009***	0.013***	0.014***	0.013***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)
Non-western immigrant	-0.020***	-0.027***	-0.029***	-0.037***	-0.045***	-0.055***	-0.059***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.005)	(0.007)
Large city	-0.056***	-0.060***	-0.067***	-0.065***	-0.060***	-0.051***	-0.047***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)
Rural	-0.057***	-0.061***	-0.066***	-0.063***	-0.056***	-0.053***	-0.051***
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)
Vocational education	0.045***	0.040***	0.036***	0.036***	0.037***	0.039***	0.036***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Short-term higher edu.	0.096***	0.094***	0.097***	0.095***	0.093***	0.091***	0.088***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)
Long-term higher edu.	0.121***	0.128***	0.150***	0.185***	0.209***	0.218***	0.212***
	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.006)
Age/10	0.041***	0.032***	0.049***	0.081***	0.115***	0.151***	0.162***
	(0.008)	(0.006)	(0.004)	(0.003)	(0.005)	(0.008)	(0.011)
Age squared/100	-0.012***	-0.011***	-0.010***	-0.012***	-0.013***	-0.008***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Experience/10	0.120***	0.118***	0.096***	0.096***	0.090***	0.066***	0.095***
	(0.016)	(0.011)	(0.006)	(0.008)	(0.010)	(0.012)	(0.014)
Experience squared/100	-0.007***	-0.007***	-0.007***	-0.007***	-0.005***	-0.012***	-0.019***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)
Tenure	0.122***	0.089***	0.049***	0.024***	0.014***	0.005	-0.006
	(0.004)	(0.003)	(0.002)	(0.002)	(0.003)	(0.005)	(0.005)
Tenure squared	-0.038***	-0.026***	-0.013***	-0.007***	-0.006***	-0.002	-0.001
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)
Log plant size	0.021***	0.021***	0.022***	0.021***	0.020***	0.023***	0.022***
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Plant shares:							
Vocational education	0.063***	0.077***	0.087***	0.087***	0.089***	0.091***	0.088***
	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.006)	(0.007)
Short-term higher edu.	0.075***	0.074***	0.065***	0.043***	0.048***	0.044***	0.050***
	(0.008)	(0.007)	(0.005)	(0.006)	(0.010)	(0.012)	(0.018)
Long-term higher edu.	0.146***	0.156***	0.184***	0.198***	0.217***	0.232***	0.237***
	(0.006)	(0.006)	(0.004)	(0.005)	(0.007)	(0.008)	(0.010)
Age below 30 years	-0.028***	-0.017***	-0.002***	0.009***	0.021***	0.026***	0.044***
	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)	(0.005)	(0.007)
Age below 50 years	-0.067***	-0.066***	-0.069***	-0.082***	-0.105***	-0.131***	-0.142***
	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)	(0.006)
Women	-0.077***	-0.077***	-0.078***	-0.086***	-0.093***	-0.097***	-0.093***
	(0.004)	(0.003)	(0.002)	(0.001)	(0.002)	(0.004)	(0.006)

Note: The model includes industry-year fixed effects. Standard errors are block-bootstrapped at the firm-worker matched level using sub-sampling. The bootstrap uses a subsample size of 10.000 workers and 999 replications. *** p<0.01, ** p<0.05, * p<0.1.

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