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Wage Dispersion and Decentralization of Wage Bargaining*

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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 a detailed panel data set covering a period of decentralization in the Danish labor market. The decentralization process provides exogenous variation in the individual worker's wage-setting system that facilitates identification of the effects of decentralization. Consistent with predictions we find that wages are more dispersed under firm-level bargaining compared to more centralized wage-setting systems. However, the differences across wage-setting systems are reduced substantially when controlling for unobserved individual level heterogeneity.

Keywords: Wage bargaining, decentralization, panel data quantile regression

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 during the past decades. Comparing the 1970's to the 1990's not a single OECD country moved towards centralization, whereas a considerable number moved towards greater decentralization according to OECD (2004). This movement has in many countries been accompanied with 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 microeconomic evidence exist 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 for 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 decentralization

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

increases wage dispersion.

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 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 predictions concerning the impact of decentralization on wage levels are 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 industry 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 industry 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 better be in 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. The wage setting system for the individual worker may change because the labor market segment changed its system due to the decentralization process or because the worker changed job. Second, in contrast to the existing empirical evidence, longitudinal data allows us to control for unobserved heterogeneity. Our econometric approach is quantile regression, since this, in a very transparent way, illustrates the impact of wage setting systems in different quantiles of the wage distribution. However, it is only recently that quantile regression methods have been developed to better exploit the advantages of longitudinal data, see Koenker (2004) and Abrevaya and Dahl (2008). We apply the correlated random effects approach suggested by Abrevaya and Dahl (2008).

We find that decentralization of wage bargaining increases wage dispersion, i.e., wages are most dispersed under the most decentralized system – firm level bargaining. By using the panel data quantile regression approach we also find that the differences in wage dispersion between the wage setting systems are reduced substantially when unobserved individual heterogeneity is controlled for. With respect to the impact on mean wages we do not find important differences across bargaining systems after controlling for unobserved

heterogeneity.

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 1990's. 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, Lemieux and Riddell (2004) for a 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 microeconomic 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 nationally 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 per cent associated with single-employer bargaining. Interestingly, they also find that the premium is higher for more highly-paid workers using a weighted least squares approach. They take this as weak evidence for 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, Leuven and Teulings (2002) investigate the impact of bargaining regime 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 per cent. Also in terms of wage dispersion modest differences are found between 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 per cent of the contractual wages. From tobit regressions it is found that the effects of worker and firm characteristics on contractual wage 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 the higher contractual wage rate and – by interacting this bargaining power measure with worker attributes – the lower returns to these attributes. Interestingly, the higher contractual wage rate is off-set 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 sectoral level bargaining – see Fitzenberger, Kohn and Lembcke (2008) for a recent survey of these studies. One study for Germany deserves special mention as it estimates the impact of 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 the 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 regards 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. Besides this, 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 should imply 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 position to take account of unobserved heterogeneity and we may more reliably identify the effects of decentralization since the decentralization process safely may be taken to be exogenous to the individual worker.

3 The Danish wage setting system

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 per cent in the 1990s, and in 2000 more than 80 per cent 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 1980's and 1990's. 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.

Wage bargaining at the industry and firm levels depends on the wage setting system used in the industry collective agreement. In Denmark there are four different systems: 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* the collective agreements state that wages are negotiated at the plant or firm level without any centrally bargained wage rates (“uden lønsats”).

Table 1 shows the development in the use of these four wage setting systems in the private sector labor market covered by the two bargaining parties at national level; The Danish Confederation of Trade Unions (LO) and The Confederation of Danish Employers (DA). 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 segment (i.e. the firm-level bargaining segment) has grown from a coverage of 4 per cent to 22 per cent in 2004. For the two remaining decentralized wage systems – the minimum-wage and the minimum-pay systems – we also see considerable variation over time. An example of an important bargaining segment making the transition to

firm-level bargaining is the area covering office clerks. In the empirical analysis below we use data for 1994-1999, so we capture the increased importance of firm-level bargaining in particular.

Insert Table 1 about here

4 Data and descriptive statistics

We have access to information about individual characteristics for the full population of workers aged 18-65 years in the Danish labor market for the years 1994-1999.² These characteristics are extracted from the Integrated Database of labor Market Research (IDA) and the Income Registers in Statistics Denmark – see Abowd and Kramarz (1999) for a brief description. 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.

We use very detailed industry and occupation variables to determine the collective agreement to which the individual belongs. 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 – they use the codes to assess the economic implications of proposals for the

²To reduce estimation time we extract a 30 per cent random sample, which is used in the subsequent regressions unless otherwise stated. This section reports summary statistics for this subsample.

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 31 bargaining segments within the DA/LO segment, which correspond to roughly 50 per cent of workers in the organized part of the private labor market in Denmark. Coupled with information about the bargaining system each segment operates under in each year, it was straightforward to partition all workers into the four bargaining systems under consideration.

A long list of individual socio economic characteristics are used as control variables in the analysis. We use dummies for gender, the presence of children, marriage, immigrant status, city size ('Large city', and 'Rural' with 'Copenhagen' as the omitted category), education ('Unskilled', 'Short term higher education', 'Long term higher education' with 'Vocational education' as the omitted category)³ and experience (measured as actual labor market experience since 1964). There are also dummies for the size of the workplace measured in terms of the workforce. Furthermore, different industries may face different degrees of competition from abroad, which may well be reflected in both the wage level and the wage dispersion within a given industry. To avoid that wage setting dummies pick up differences in business conditions between industries we include a set of industry dummies.

In Table 2 we show some summary statistics for each of the four wage setting systems in 1997. With respect to the average wage level the unconditional evidence is mixed

³The 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 International Standard Classification of Education (ISCED), *i.e.*, the individual has a tertiary education. 'Vocational education' is defined as the final stage of secondary education encompassing programmes 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'.

since the most decentralized segment, firm-level bargaining, has the highest wage level while the standard-rate system, which is the least decentralized wage setting system, has the third highest wage level. To assess the extent of wage dispersion we have also computed the unconditional 90th/10th, 90th/50th and the 50th/10th per centile ratios for each of the wage setting systems. The wage dispersion is much higher for the workers belonging to the minimum-wage system which is particularly true for the lower end of the wage distribution. Wage dispersion under firm-level bargaining appear to be only slightly higher than the remaining two wage setting systems – the standard-rate system and the minimum-pay system. It should be noted that, since the standard-rate system typically applies for unskilled workers while many skilled workers belong to the minimum-wage system, we should not put too much emphasis on the unconditional evidence in Table 2.

Insert Table 2 about here

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 a part of the decentralization process or the worker may change job. Table 3 tracks the persons in our sample that change wage setting system in each year. The second column shows the total number of workers changing wage setting system, and it is seen that there is a transition rate of between 3 and 13 per cent each year. Column 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. Second, a worker can change occupation and/or industry and,

thereby, perhaps also bargaining segment and wage setting system (column 4-6).⁴

Insert Table 3 about here

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 people changing jobs and, thereby, wage setting system. The data still include job changers, however (see columns 4-6 in Table 3), so in the empirical analysis below we restrict the sample further to reduce potential problems with measurement error. Specifically we throw away all workers that 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 per cent.

The sample version of Table 1 is Table 4. Even though we only distinguish between 31 bargaining segments and, thus, leave out part of the DA/LO segment, the development in Table 4 resembles that of Table 1 quite closely. As described above, much of the decentralization of the bargaining level in Denmark took place before 1993, but this is not essential to the analysis as long as we still have considerable time variation in the data.

Insert Table 4 about here

⁴It should be noticed that it is only the year when a collective agreement is initiated that the wage setting system changes. For most bargaining segments this happened every second year in the early 1990s, i.e., the years 1991 and 1993. However, some collective agreements in 1995 and 1997 had a duration of three years. The 523 persons whose bargaining segment seems to have changed wage setting system because of decentralization in 1996 are persons that are in the given segment in 1994 and 1996, but out of the sample in 1995. This is also the case for the 1,396 persons in 1998 and the 725 persons in 1999.

5 Empirical framework

To assess the impact of decentralization on wage dispersion we use quantile regression. Quantile regression techniques for panel data have only recently been developed, and this section outlines the approach we follow.

The standard (cross section) quantile regression model of Koenker and Bassett (1978) is given by

$$y_i = x_i\beta + u_i \quad \text{with} \quad Q_\tau(y_i|x_i) = x_i\beta_\tau, \quad (1)$$

where $i = 1, \dots, N$ is indexing the individuals, y_i is the log of the individual hourly wage rate, β_τ is a $k \times 1$ vector and x_i is a $1 \times k$ vector of explanatory variables. $Q_\tau(y_i|x_i)$ denotes the τ th conditional quantile of y given x , $\tau \in (0, 1)$.

In the linear model the solution to endogeneity problems in presence of panel data is typically the fixed-effects estimation. Unfortunately, the usual differencing strategy does not apply here since the conditional quantiles are not linear operators, that is

$$Q_\tau(y_{it} - y_{is}|x_i) \neq Q_\tau(y_{it}|x_i) - Q_\tau(y_{is}|x_i), \quad (2)$$

where time periods $t \neq s$ and where $x_i \equiv (x_{i1}, \dots, x_{iT})$.

Abrevaya and Dahl (2008) suggest to estimate a Chamberlainian correlated random effects quantile regression model to take account of unobserved heterogeneity. Their estimator is most easily understood if we begin by considering the standard linear panel data model

$$y_{it} = x_{it}\beta + c_i + u_{it}, \quad (3)$$

where $t = 1, 2, \dots, T$, c_i is the individual specific term and u_{it} the error term.

As in Chamberlain (1982, 1984) assume that the unobservable term c_i is a linear projection onto the observables plus a disturbance v_i , that is

$$c_i = \psi + x_{i1}\lambda_1 + \dots + x_{iT}\lambda_T + v_i. \quad (4)$$

Plugging this into equation (3) gives

$$y_{it} = x_{it}\beta + \psi + x_{i1}\lambda_1 + \dots + x_{iT}\lambda_T + v_i + u_{it}. \quad (5)$$

We need to make two assumptions in order to estimate the model in equation (5):

$$(A1) \quad v_i \text{ independent of } x_i$$

and

$$(A2) \quad Q_\tau(u_{it}|x_i, v_i) = Q_\tau(u_{it}|x_{it}).$$

Assumption (A1) is also needed in the traditional random-effects probit model (see for example Wooldridge (2002)), but is stronger than the conditional mean independence needed in the linear Chamberlainian random-effects model. By assumption (A2) we assume strict exogeneity, which effectively rules out feedback-effects from current wages, y_{it} , on future values of x_{it} .

The partial derivative of the conditional quantile with respect to x_{it} is

$$\frac{\partial Q_\tau(y_{it}|x_i)}{\partial x_{it}} = \beta + \lambda_t + \frac{\partial Q_\tau(u_{it}|x_{it})}{\partial x_{it}}, \quad (6)$$

and

$$\frac{\partial Q_\tau(y_{is}|x_i)}{\partial x_{it}} = \lambda_t \quad (7)$$

for $t \neq s$. Following Abrevaya and Dahl (2008) we measure the effect of x_{it} as

$$\frac{\partial Q_\tau(y_{it}|x_i)}{\partial x_{it}} - \frac{\partial Q_\tau(y_{is}|x_i)}{\partial x_{it}} = \beta + \frac{\partial Q_\tau(u_{it}|x_{it})}{\partial x_{it}}, \quad (8)$$

which essentially reflects the desirable feature of quantile regression that x_{it} is allowed to have different effects on y_{it} in different quantiles. In other words, this is a general result of quantile regression (cf. Koenker and Bassett (1982)) and does not only pertain to the Abrevaya and Dahl (2008) estimator. For illustrative purposes Abrevaya and Dahl (2008)

assumes that $u_{it}|x_i, c_i \sim N(0, (\gamma_t x_{it})^2)$. This panel data version of the linear-scale model implies that equation (8) becomes

$$\frac{\partial Q_\tau(y_{it}|x_i)}{\partial x_{it}} - \frac{\partial Q_\tau(y_{is}|x_i)}{\partial x_{it}} = \beta + \gamma_t Q_\tau(\epsilon_{it}), \quad (9)$$

where ϵ_{it} is a standard normal random variable. It is apparent that for $\gamma_t > 0$ the effect of x_{it} is larger in the upper part of the y_{it} distribution.

One drawback is that the approach only works for balanced panels. As a consequence, we estimate the model on alternative balanced (sub-) samples. First, we construct a sample with individuals we observe twice or more in the sample and randomly select two observations for each individual from this set. Second, we extract a subsample with individuals observed at least four times and randomly select four observations per individual. Third, we use the Mundlak (1978) version of the correlated random-effects model where the unobserved part is approximated by averages of the observed covariates. In this case the unobservable term becomes

$$c_i = \psi + \bar{x}_i \lambda + v_i. \quad (10)$$

This facilitates the use of all observations, i.e. unbalanced samples, but it comes at the expense of restricting the linear projection in equation (4).

As shown by Bache et al. (2009) the correlated random effects approach works well even for very small T . However, it relies heavily on the extent to which the linear projection provides a reasonable approximation of c . For example, if c is a pure random effect then the approach is very inefficient as the included variables have poor explanatory power. Alternatively, fixed effects estimators can be applied. Koenker (2004) proposes a dummy variable based 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. However as emphasized by Bache et al. (2009) estimation for large N and small T can be a very

difficult task owing to the nature of the objective function. As in Bache et al. (2009) we were not able to obtain any precise numerical convergence for any of the subsets we considered using the dummy variable approach. Further, Bache et al. (2009) also shows that when T is relatively small (as in our application) the the Koenker (2004) fixed effects approach rarely do better than the correlated random effect approach in terms of estimating β precisely.

The correlated random effects models (in matrix notation) can be estimated straightforwardly by a 1-step multivariate quantile regression of the appropriately stacked relation

$$y = D\theta + r,$$

where $y = (y'_1, y'_2, \dots, y'_N)'$, and $r = v + u$. In the Abrevaya and Dahl (2008) model the design matrix D will contain $N \times T$ rows with a typical row given as $d_{it} = (1, x'_{it}, x'_{i1}, \dots, x'_{iT})'$ and the coefficient vector given as $\theta = (\psi, \beta', \lambda'_1, \dots, \lambda'_T)'$. In the mean-projected correlated random effects model the typical element of D will be $d_{it} = (1, x'_{it}, \bar{x}'_i)'$ with coefficient vector $\theta = (\psi, \beta', \lambda')'$.

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 individual i are not independent, the bootstrap samples should consist of "blocks" which 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 using a standard Mincer wage equation approach. This is followed by results for the impact on wage dispersion using the panel data quantile regression approach outlined in the previous section. Finally we present some robustness checks of our preferred specification.

6.1 Wage levels and wage-setting systems

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 5 reports estimation results from a pooled OLS as well as linear random-effects, fixed-effects and correlated random effects models.

It is first seen that we obtain the usual signs of the human capital and socio-demographic variables. With respect to the wage setting systems the most clean comparison is between the standard-rate system (where wages are negotiated at sector or industry level) and firm level bargaining since these systems represent the most centralized and the most decentralized systems respectively. As described in section 3 the minimum payment and minimum wage systems are intermediate cases as they both have elements of a centrally negotiated wage floor and locally negotiated wage supplements. In the following we use as the base category the standard-rate system. For the OLS regression we find that wages are 5.3 per cent higher under firm level bargaining than under the standard-rate system. However, this quite substantial wage differential vanishes if unobserved individual heterogeneity is controlled for through random effects or correlated random effects, and if the fixed effects estimator is used the effect even changes sign such that wages are 1.1 per cent lower under firm level bargaining. 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. With respect to the two intermediate systems there is also a negative effect of minimum pay once unobserved heterogeneity is accounted for, while there is no or a small positive wage differential between

the standard rate system and the minimum wage system.

Insert Table 5 about here

One might worry that the negative coefficients to the decentralized wage-setting dummies (e.g. firm-level bargaining dummy under the fixed effects specification) reflect a correlation between firm-level wage growth and the decentralization process that are not captured by our control variables. For example, one can imagine that firms that experience a negative demand shock will push for wages to be negotiated at the firm level. It is important here to note that the bargaining regime is agreed on by central unions and employers associations, so the decentralization process should be exogenous to the individual firm. Still, if entire industries are hit by negative shocks there could be a correlation. To capture such effects we have extended the models from Table 5 to include also industry specific time trends that should pick up declining wage trends. This extension had a negligible impact on the estimated coefficients to the wage-setting system dummies.⁵

To sum up, we find evidence of no wage differentials or even lower mean wages under the more decentralized bargaining systems, and this seems to be at odds with what is expected from simple rent-sharing or efficiency-wage considerations, while it is more consistent with the externality explanation of Calmfors and Driffil (1988) as argued in the introduction. Also, it is important to be able to control for unobserved heterogeneity as otherwise the wage differentials between wage-setting systems are greatly exaggerated. One important aspect which cannot be studied using the simple mean regressions is the fact that the decentralization process may have very uneven effects across the wage distribution – an issue to which we now turn.

⁵For example, the coefficient to firm-level bargaining in the fixed effects specification changed from -0.011 to -0.009 (still significant). We proceed without the industry specific time trends as the estimation time for the panel data quantile regression models in the next section increases dramatically with the number of control variables.

6.2 Wage dispersion and wage-setting systems

As a first step we will start out with a simple quantile regression without exploiting the longitudinal nature of our data. Table 6 displays the results from pooled quantile regression models for the quantiles 0.10, 0.25, 0.50, 0.75, and 0.90. 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 suggests the existence of a glass ceiling for these groups in the labor market (this is consistent with the results of Albrecht, Björklund and Vroman (2003) and Pendakur and Woodcock (2008)). Also, unskilled workers have relatively lower wages than workers with vocational education in the bottom of the wage distribution.

Of particular interest is the effect of the wage system dummies, and it is found that the coefficient on the variables for the three decentralized systems increases over almost all of the reported quantiles, so that the effects at the 90th quantile are substantially higher compared to the effects at the 10th quantile. For example the effect of working under firm-level bargaining compared to the standard-rate system almost triples from the 10th to the 90th quantile (from 4.1 per cent to 11.5 per cent). 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. However, we suspect that the coefficients on the wage system dummies are biased upwards because unobserved heterogeneity is not controlled for.

Insert Table 6 about here

The next step is to apply the panel data quantile regression techniques outlined in section 5. Table 7 shows results for estimation of the Abrevaya and Dahl (2008) correlated random-effects quantile regression model for the case where we balance the panel by randomly selecting only two observations for each individual for the reasons explained

above. It is first noted that the effects of individual level variables only change slightly. Some variables like age and experience appear to have somewhat stronger effects now, but otherwise the results are robust. However, for the wage system dummies the picture changes in important ways. For firm level bargaining we find again that wage dispersion is higher than under the standard-rate system, but the coefficients are in accordance with the fact that there is roughly no mean effects, cf. Table 5. That is, we find negative coefficients in the lower quantiles and positive coefficients in the higher quantiles such that workers under firm-level bargaining earn 2.1 per cent lower wages at the 10th quantile and 4.0 per cent higher wages at the 90th quantile compared to workers under the standard-rate system. There appears to be no significant differences between the minimum-pay system and the standard-rate system, while the minimum-wage system increases wages in the upper part of the wage distribution.

Insert Table 7 about here

To study how these results depend on the sampling scheme we also estimate the correlated random-effects quantile regression model where we randomly select four instead of two observations for each worker. This effectively corresponds to selecting stable workers in the sense that they enter the original sample at least four out of the six years in our sample window. With respect to the firm-level bargaining system the results are qualitatively similar but the effects are slightly stronger such that workers now earn 3.4 per cent lower wages at the 10th quantile and 2.4 per cent higher wages at the 90th quantile compared to workers under the standard-rate system, see Table 8. The minimum-pay system now has a negative effect in the 10th quantile but there are no changes otherwise, and the effects of the minimum-wage system are also not changed in any important way.

Insert Table 8 about here

To cast further light on the importance of the sampling scheme we also estimate a ver-

sion of the correlated random effects quantile regression model where we approximate the unobservable part with the individual means of the explanatory variables as in Mundlak (1978), see equation (10). This has the advantage that we can use all observations in our original sample and thus circumvent the requirement of a balanced sample, but it comes at the expense of a more restrictive functional form for the unobservables. The results are displayed in Table 9, and it is seen that they are very much in accordance with the two previous sets of results. At the 90th quantile the effect of firm-level bargaining lie in between the effects found for the balanced sample with two observations per worker and the balanced sample with four observation per worker. At the bottom of the wage distribution the effect is somewhat closer to zero but still significantly negative.

Insert Table 9 about here

To sum up, the three different versions of the correlated-random effects quantile regression model yield fairly robust results showing that decentralization of wage bargaining increases wage dispersion. Under the most clear cut comparison, i.e. the effect of working under firm-level bargaining (where wages are set entirely at the firm level) compared to the standard-rate system (where wages are set entirely at the sector level) negative effects are found in the lower part of the wage distribution and positive effects are found in the upper part. For the two intermediate bargaining systems – the minimum-pay and the minimum-wage systems – wages are only slightly more dispersed than under the standard-rate system.

In the following we will take the Mundlak version of the empirical model as our main specification as it yields very similar results to the more flexible models while still being based on the full sample. For illustrative purposes we have used this model to compute the coefficients for every two per centiles and plot them with 5 per cent confidence bands – see Figure 1. This shows very clearly that wage dispersion is higher under firm level bargaining.

Insert Figure 1 about here

6.3 Robustness

A major advantage of our analysis vis-à-vis the existing literature is that we exploit time variation in the wage system of the individual worker, but this also raises the question about whether wage system changes are exogenous. We argue that if the wage system change because of the decentralization process, i.e. a whole bargaining segment changes wage system, then this can safely be taken to be exogenous to the worker. The wage system may also change because workers change jobs from one bargaining segment of the labor market to another, and in this case endogeneity may be an issue as e.g. high paid workers in the standard-rate system may be inclined to change to jobs under firm-level bargaining to receive a higher wage. In traditional Mincer human capital wage equations this issue may be approached by also estimating a selection equation for the choice of wage system (see e.g. Vella and Verbeek (1998) for an application to union wage premia). However, corresponding techniques are not yet developed for the panel data quantile regression case, and in any case this approach also requires proper instruments which is not immediately available in our data. Therefore, to proceed we have to settle for more indirect evidence for exogeneity of the wage system variables.

Table 3 showed that most wage system changes are due to the decentralization process, so a straightforward sensitivity test would be to simply leave out all wage system changes that can be ascribed to job changes. However, our reference wage system is the standard-rate system because it represents the most clear-cut example of a wage system with wage determined solely at the sector level, but no bargaining segments changed to or from the standard-rate system during our sample window (see Tables 1 and 4), so we have to rely on job movers. In the following, we study whether these job changes are plagued by endogeneity.

The first step is to provide some further descriptive statistics for the wage system changes. According to Table 3, there are 45,314 wage system changes in the data, and almost two thirds of these are due to the decentralization process and the rest is job mobility. Among job changes involving the standard rate system the most frequent type

is between the standard rate system and the minimum pay system – more than one third of all job changes are in this category. In fact only very few workers change job from the standard-rate system to a job under firm-level bargaining or vice versa, but once we can identify the wage effects of changing between the standard-rate system and minimum-pay we have also identified the effects of firm-level bargaining because of sufficiently many exogenous 'decentralization' transitions between minimum-pay and firm-level bargaining.

Since most of the mobility in and out of the standard-rate system is to/from the minimum-pay system and since identification therefore relies on this transition in particular we will now study potential endogeneity of this transition only. One way to do this is to include two additional dummy variables for a change between the two wage systems, i.e. the variable 'Change standard-rate to minimum-pay' in Table 10 takes the value 1 if the worker has experienced this transition as the latest transition and 0 otherwise. If mobility is endogenous we would expect that these variables enter the model with significant effects. Wages should rise in the top end of the wage distribution if workers change to the more decentral minimum-pay system and they should fall in the bottom end. Likewise wages should fall in the top end of the wage distribution if workers change to the centralized standard-rate system and they should rise in the bottom end. However, we find no evidence for such effects – all coefficients on the change variables are insignificant in the tails of the wage distribution. At the same time the direct effects of the wage system dummies have only changed slightly.

Insert Table 10 about here

The next question is whether we would get similar results to the main results of Table 9 if in addition to the exogenous 'decentralization' transitions we rely only on job movers between the standard-rate system and the minimum-wage system, i.e. if we remove all observations involving other types of job mobility. A Comparison between the results of Table 9 and 11 shows only small changes in the coefficients on the wage system variables, so mobility between standard-rate and minimum-wage systems is sufficient to get the main

results and these job changes appear not to be driven by wage concerns. We take this as evidence for our main results not being seriously plagued by endogeneity bias through job mobility.

Insert Table 11 about here

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 increased wage dispersion.

We use a unique register-based panel data set covering a period of decentralization in the Danish labor market, and to the best of our knowledge we are the first to study these questions using longitudinal data. This is a crucial element 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. 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 important because by doing so the wage structure differences across wage-setting systems are substantially narrowed down.

We find empirical evidence in support of the predictions from theory, i.e., wage dispersion is higher under the more decentralized wage setting systems. In our main specification workers under firm-level bargaining, where wages are set entirely at the firm level, earn 1.7 per cent lower wages at the 10th quantile and 3.2 per cent higher wages at the 90th quantile compared to workers under the standard-rate system, where wages are entirely set at the sector level.

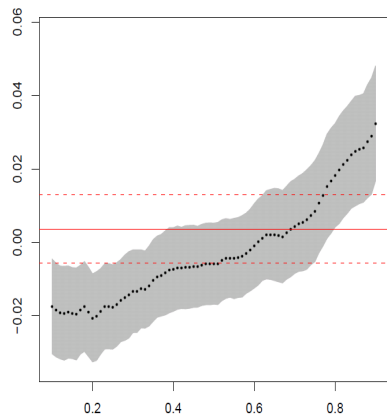
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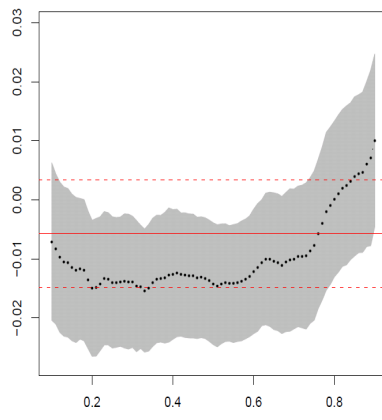
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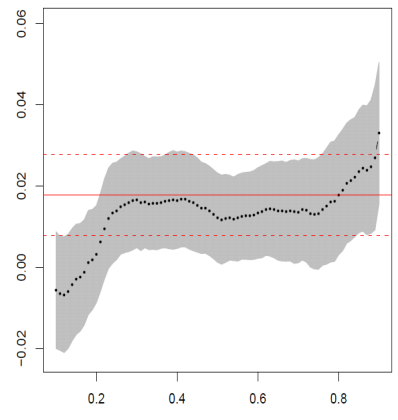
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Firm-level bargaining



Minimum pay



Minimum wage

Figure 1: Abrevaya-Dahl Mundlak quantile regression

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	4	4	4	11	17	20	22
Total	100	100	100	100	100	100	100

Source: Danish Employers' Federation (DA).

Table 2: Wage dispersion in 1997 by type of wage-setting system

	No. of obs	Mean	90th/10th	50th/10th	90th/50th
Standard-rate	15,950	150.56	1.90	1.37	1.38
Minimum wage	28,162	139.01	2.88	1.89	1.52
Minimum payment	64,578	153.43	1.90	1.33	1.42
Firm level bargaining	23,086	156.04	2.06	1.39	1.48

Notes: The numbers are based on the 30 % sample of workers.

Table 3: Transitions between wage-setting systems 1995-1999

	No. of obs.	All changes	Decentra- lization	Change in occ. and industry	Change in occupation	Change in industry
1994	123,851
1995	124,672	12,761	10,795	869	701	396
1996	126,514	3,769	523	1,611	1,047	588
1997	131,776	16,938	12,809	2,440	964	725
1998	135,355	5,863	1,396	2,839	934	694
1999	138,219	5,983	725	3,146	1,411	701
Total no. of obs.	780,387	45,314	26,248	10,905	5,057	3,104

Notes: The numbers are based on the 30 % sample of workers.

Table 4: Private sector wage-setting systems 1994-1999

	1994	1995	1996	1997	1998	1999
Standard-rate	12.6	11.6	11.9	12.1	12.0	12.3
Minimum wage	13.5	13.8	13.7	21.4	21.2	21.6
Minimum pay	73.3	62.2	62.3	49.0	49.3	48.6
Firm level bargaining	0.6	12.4	12.2	17.5	17.5	17.5
Total no. of obs.	123,851	124,672	126,514	131,776	135,355	138,219

Notes: The numbers are based on the 30 % sample of workers.

Table 5: Linear panel data models

	OLS	Random effects	Fixed effects	Correlated random effects
Firm-level bargaining	0.053 (0.002)**	-0.002 (0.002)	-0.011 (0.003)**	0.003 (0.003)
Minimum pay	0.000 (0.001)	-0.014 (0.002)**	-0.020 (0.003)**	-0.008 (0.002)**
Minimum wage	0.042 (0.001)**	0.002 (0.002)	0.005 (0.003)	0.009 (0.003)**
Age/10	0.487 (0.003)**	0.536 (0.004)**		0.753 (0.010)**
Age squared/100	-0.056 (0.000)**	-0.062 (0.000)**	-0.083 (0.001)**	-0.064 (0.001)**
Woman	-0.154 (0.001)**	-0.127 (0.001)**		-0.130 (0.001)**
Children aged 0-6 years	0.044 (0.001)**	0.011 (0.001)**	0.000 (0.001)	0.002 (0.001)
Non-western immigrant	-0.023 (0.002)**	-0.004 (0.003)		-0.017 (0.003)**
Large city	-0.07 (0.001)**	-0.059 (0.002)**	-0.020 (0.004)**	-0.058 (0.002)**
Rural	-0.077 (0.001)**	-0.066 (0.001)**	-0.051 (0.003)**	-0.063 (0.001)**
Experience/10	0.171 (0.002)**	0.153 (0.003)**	0.246 (0.008)**	0.227 (0.007)**
Experience squared/100	-0.032 (0.001)**	-0.030 (0.001)**	-0.056 (0.001)**	-0.044 (0.001)**
Unskilled	-0.113 (0.001)**	-0.277 (0.001)**		-0.276 (0.001)**
Short term higher education	0.057 (0.001)**	-0.009 (0.003)**		-0.013 (0.003)**
Long term education	0.177 (0.002)**	0.113 (0.003)**		0.105 (0.003)**
Workplace size, 16-50 workers	0.039 (0.001)**	0.032 (0.001)**	0.026 (0.001)**	0.024 (0.001)**
Workplace size, 51-200 workers	0.074 (0.001)**	0.067 (0.001)**	0.052 (0.001)**	0.048 (0.001)**
Workplace size, 200+ workers	0.107 (0.001)**	0.094 (0.001)**	0.070 (0.002)**	0.066 (0.001)**
Observations	762,211	762,211	762,211	762,211
Number of workers	240,480	240,480	240,480	240,480
R-squared	0.42	0.38	0.04	0.39

Notes: The results are based on the 30 % sample of workers. Year and industry dummies were included in all regressions. Robust standard errors in parentheses. * Significant at 5%; ** Significant at 1%. The reported R^2 s do not include the contribution of individual fixed or random effects.

Table 6: Pooled quantile regression

	Quantile Regressions					OLS
	10	25	50	75	90	
Firm-level bargaining	0.041 *** (0.003)	0.045 *** (0.003)	0.059 *** (0.002)	0.090 *** (0.003)	0.115 *** (0.004)	0.057 *** (0.003)
Minimum pay	0.002 (0.002)	-0.005 ** (0.002)	-0.003 * (0.002)	0.011 *** (0.002)	0.029 *** (0.003)	-0.001 (0.002)
Minimum wage	0.023 *** (0.004)	0.020 *** (0.003)	0.041 *** (0.002)	0.072 *** (0.003)	0.100 *** (0.004)	0.042 *** (0.002)
Age/10	0.682 *** (0.011)	0.513 *** (0.007)	0.314 *** (0.007)	0.283 *** (0.008)	0.285 *** (0.010)	0.473 *** (0.005)
Age squared/100	-0.079 *** (0.001)	-0.059 *** (0.001)	-0.037 *** (0.001)	-0.033 *** (0.001)	-0.033 *** (0.001)	-0.055 *** (0.001)
Woman	-0.123 *** (0.002)	-0.143 *** (0.002)	-0.165 *** (0.001)	-0.181 *** (0.002)	-0.196 *** (0.002)	-0.158 *** (0.001)
Children aged 0-6	0.064 *** (0.002)	0.050 *** (0.002)	0.030 *** (0.001)	0.029 *** (0.002)	0.030 *** (0.002)	0.043 *** (0.001)
Non-western immigrant	0.007 (0.005)	-0.013 *** (0.004)	-0.031 *** (0.004)	-0.047 *** (0.004)	-0.059 *** (0.005)	-0.023 *** (0.003)
Large city	-0.068 *** (0.003)	-0.078 *** (0.002)	-0.077 *** (0.002)	-0.075 *** (0.002)	-0.067 *** (0.003)	-0.072 *** (0.002)
Rural	-0.075 *** (0.002)	-0.086 *** (0.002)	-0.085 *** (0.001)	-0.082 *** (0.002)	-0.077 *** (0.002)	-0.079 *** (0.002)
Experience/10	0.260 *** (0.006)	0.202 *** (0.004)	0.147 *** (0.004)	0.114 *** (0.004)	0.097 *** (0.005)	0.178 *** (0.003)
Experience squared/100	-0.049 *** (0.002)	-0.039 *** (0.001)	-0.027 *** (0.001)	-0.018 *** (0.001)	-0.014 *** (0.002)	-0.034 *** (0.001)
Unskilled	-0.111 *** (0.002)	-0.110 *** (0.001)	-0.079 *** (0.002)	-0.067 *** (0.002)	-0.061 *** (0.003)	-0.110 *** (0.001)
Short term higher education	0.068 *** (0.003)	0.068 *** (0.003)	0.067 *** (0.003)	0.065 *** (0.003)	0.059 *** (0.005)	0.057 *** (0.003)
Long term higher education	0.121 *** (0.007)	0.156 *** (0.005)	0.187 *** (0.004)	0.204 *** (0.005)	0.230 *** (0.007)	0.174 *** (0.004)
Workplace size, 16-50 workers	0.029 *** (0.002)	0.035 *** (0.002)	0.032 *** (0.002)	0.035 *** (0.002)	0.034 *** (0.002)	0.036 *** (0.002)
Workplace size, 51-200 workers	0.061 *** (0.002)	0.063 *** (0.002)	0.057 *** (0.002)	0.061 *** (0.002)	0.062 *** (0.003)	0.069 *** (0.002)
Workplace size, 200+ workers	0.099 *** (0.003)	0.102 *** (0.002)	0.094 *** (0.002)	0.094 *** (0.002)	0.084 *** (0.003)	0.103 *** (0.002)

Notes: The results are based on the 30% sample of workers. Year and industry dummies were included in all regressions. Bootstrapped standard errors are reported in parentheses. The bootstrap uses a subsample size of 10,000 persons and 1,000 replications. * Significant at 10%; ** Significant at 5%; *** Significant at 1%.

Table 7: Abrevaya-Dahl quantile regression, 2 observations pr. individual

	Quantile Regressions					OLS
	10	25	50	75	90	
Firm-level bargaining	-0.021 ** (0.009)	-0.009 (0.007)	-0.002 (0.007)	0.017 ** (0.008)	0.040 *** (0.011)	0.008 (0.007)
Minimum pay	-0.006 (0.008)	-0.003 (0.007)	-0.006 (0.007)	0.001 (0.007)	0.018 * (0.010)	0.002 (0.007)
Minimum wage	-0.008 (0.010)	0.024 *** (0.008)	0.026 *** (0.008)	0.022 *** (0.008)	0.035 *** (0.011)	0.026 *** (0.007)
Age/10	0.858 *** (0.058)	0.901 *** (0.040)	0.570 *** (0.032)	0.488 *** (0.034)	0.494 *** (0.040)	0.778 *** (0.031)
Age squared/100	-0.126 *** (0.005)	-0.101 *** (0.003)	-0.060 *** (0.003)	-0.047 *** (0.004)	-0.043 *** (0.005)	-0.085 *** (0.002)
Woman	-0.115 *** (0.003)	-0.134 *** (0.002)	-0.161 *** (0.001)	-0.180 *** (0.002)	-0.198 *** (0.003)	-0.153 *** (0.001)
Children aged 0-6	0.065 *** (0.002)	0.054 *** (0.002)	0.033 *** (0.001)	0.029 *** (0.002)	0.030 *** (0.002)	0.044 *** (0.001)
Non-western immigrant	0.008 (0.006)	-0.007 (0.004)	-0.025 *** (0.004)	-0.042 *** (0.004)	-0.052 *** (0.006)	-0.018 *** (0.004)
Large city	-0.065 *** (0.003)	-0.074 *** (0.003)	-0.077 *** (0.002)	-0.073 *** (0.003)	-0.067 *** (0.004)	-0.070 *** (0.002)
Rural	-0.071 *** (0.003)	-0.083 *** (0.002)	-0.082 *** (0.002)	-0.077 *** (0.002)	-0.074 *** (0.003)	-0.074 *** (0.002)
Experience/10	0.839 *** (0.057)	0.434 *** (0.036)	0.217 *** (0.025)	0.133 *** (0.029)	0.082 ** (0.035)	0.330 *** (0.027)
Experience squared/100	-0.094 *** (0.006)	-0.066 *** (0.004)	-0.035 *** (0.003)	-0.022 *** (0.004)	-0.021 *** (0.006)	-0.049 *** (0.003)
Unskilled	-0.119 *** (0.002)	-0.126 *** (0.002)	-0.092 *** (0.002)	-0.074 *** (0.003)	-0.066 *** (0.004)	-0.121 *** (0.001)
Short term higher education	0.060 *** (0.005)	0.065 *** (0.003)	0.058 *** (0.003)	0.058 *** (0.004)	0.053 *** (0.005)	0.052 *** (0.003)
Long term higher education	0.119 *** (0.007)	0.162 *** (0.005)	0.181 *** (0.004)	0.199 *** (0.006)	0.223 *** (0.008)	0.172 *** (0.004)
Workplace size, 16-50 workers	0.028 *** (0.004)	0.027 *** (0.003)	0.025 *** (0.003)	0.021 *** (0.004)	0.026 *** (0.004)	0.027 *** (0.003)
Workplace size, 51-200 workers	0.055 *** (0.005)	0.053 *** (0.004)	0.047 *** (0.004)	0.045 *** (0.004)	0.053 *** (0.005)	0.056 *** (0.003)
Workplace size, 200+ workers	0.076 *** (0.006)	0.072 *** (0.005)	0.074 *** (0.004)	0.070 *** (0.005)	0.077 *** (0.006)	0.080 *** (0.004)

Notes: The results are based on the 30% sample of workers. Year and industry dummies were included in all regressions. Bootstrapped standard errors are reported in parentheses. The bootstrap uses a subsample size of 10.000 persons and 1.000 replications. * Significant at 10%; ** Significant at 5%; *** Significant at 1%.

Table 8: Abrevaya-Dahl quantile regression, 4 observations pr. individual

	Quantile Regressions					OLS
	10	25	50	75	90	
Firm-level bargaining	-0.034 *** (0.009)	-0.020 *** (0.007)	-0.008 (0.006)	0.010 (0.008)	0.024 ** (0.011)	-0.004 (0.006)
Minimum pay	-0.013 (0.009)	-0.016 ** (0.007)	-0.018 *** (0.006)	-0.008 (0.008)	0.001 (0.010)	-0.011 * (0.006)
Minimum wage	-0.011 (0.010)	0.018 ** (0.007)	0.007 (0.006)	0.014 * (0.008)	0.012 (0.011)	0.009 (0.006)
Age/10	1.010 *** (0.060)	0.752 *** (0.043)	0.556 *** (0.034)	0.506 *** (0.038)	0.501 *** (0.046)	0.821 *** (0.026)
Age squared/100	-0.117 *** (0.004)	-0.070 *** (0.002)	-0.044 *** (0.003)	-0.039 *** (0.003)	-0.038 *** (0.004)	-0.071 *** (0.002)
Woman	-0.131 *** (0.003)	-0.152 *** (0.002)	-0.176 *** (0.002)	-0.192 *** (0.003)	-0.206 *** (0.004)	-0.171 *** (0.002)
Children aged 0-6	0.047 *** (0.002)	0.031 *** (0.002)	0.024 *** (0.002)	0.025 *** (0.002)	0.026 *** (0.003)	0.035 *** (0.002)
Non-western immigrant	0.001 (0.006)	-0.019 *** (0.005)	-0.034 *** (0.005)	-0.049 *** (0.006)	-0.053 *** (0.008)	-0.029 *** (0.005)
Large city	-0.074 *** (0.003)	-0.078 *** (0.003)	-0.075 *** (0.002)	-0.072 *** (0.003)	-0.061 *** (0.004)	-0.071 *** (0.003)
Rural	-0.081 *** (0.002)	-0.086 *** (0.002)	-0.083 *** (0.002)	-0.080 *** (0.002)	-0.072 *** (0.003)	-0.078 *** (0.002)
Experience/10	0.642 *** (0.064)	0.238 *** (0.036)	0.059 *** (0.023)	0.009 (0.023)	-0.002 (0.031)	0.158 *** (0.021)
Experience squared/100	-0.098 *** (0.005)	-0.058 *** (0.002)	-0.035 *** (0.002)	-0.023 *** (0.003)	-0.018 *** (0.004)	-0.053 *** (0.002)
Unskilled	-0.095 *** (0.002)	-0.080 *** (0.002)	-0.060 *** (0.003)	-0.052 *** (0.003)	-0.050 *** (0.004)	-0.087 *** (0.002)
Short term higher education	0.063 *** (0.004)	0.065 *** (0.004)	0.066 *** (0.004)	0.062 *** (0.005)	0.055 *** (0.006)	0.057 *** (0.004)
Long term higher education	0.112 *** (0.010)	0.151 *** (0.007)	0.191 *** (0.006)	0.202 *** (0.007)	0.222 *** (0.010)	0.176 *** (0.006)
Workplace size, 16-50 workers	0.024 *** (0.003)	0.023 *** (0.002)	0.021 *** (0.002)	0.024 *** (0.003)	0.021 *** (0.004)	0.024 *** (0.002)
Workplace size, 51-200 workers	0.046 *** (0.004)	0.040 *** (0.003)	0.040 *** (0.003)	0.047 *** (0.003)	0.047 *** (0.004)	0.048 *** (0.002)
Workplace size, 200+ workers	0.060 *** (0.004)	0.058 *** (0.003)	0.060 *** (0.003)	0.062 *** (0.004)	0.051 *** (0.005)	0.063 *** (0.003)

Notes: The results are based on the 30% sample of workers. Year and industry dummies were included in all regressions. Bootstrapped standard errors are reported in parentheses. The bootstrap uses a subsample size of 10.000 persons and 1.000 replications. * Significant at 10%; ** Significant at 5%; *** Significant at 1%.

Table 9: Abrevaya-Dahl Mundlak quantile regression, all observations pr. individual

	Quantile Regressions					OLS
	10	25	50	75	90	
Firm-level bargaining	-0.017 *** (0.007)	-0.018 *** (0.006)	-0.006 (0.006)	0.008 (0.007)	0.032 *** (0.008)	0.004 (0.005)
Minimum pay	-0.007 (0.007)	-0.014 ** (0.006)	-0.014 *** (0.005)	-0.008 (0.006)	0.010 (0.007)	-0.006 (0.005)
Minimum wage	-0.006 (0.007)	0.014 ** (0.006)	0.012 ** (0.006)	0.013 * (0.007)	0.033 *** (0.009)	0.018 *** (0.005)
Age/10	1.112 *** (0.031)	1.014 *** (0.025)	0.664 *** (0.022)	0.597 *** (0.027)	0.595 *** (0.031)	0.896 *** (0.020)
Age squared/100	-0.108 *** (0.003)	-0.085 *** (0.002)	-0.051 *** (0.002)	-0.043 *** (0.002)	-0.041 *** (0.003)	-0.073 *** (0.001)
Woman	-0.126 *** (0.003)	-0.145 *** (0.002)	-0.168 *** (0.001)	-0.185 *** (0.002)	-0.199 *** (0.003)	-0.161 *** (0.001)
Children aged 0-6	0.063 *** (0.002)	0.049 *** (0.001)	0.031 *** (0.001)	0.030 *** (0.001)	0.031 *** (0.002)	0.044 *** (0.001)
Non-western immigrant	0.007 (0.005)	-0.011 *** (0.003)	-0.028 *** (0.003)	-0.044 *** (0.004)	-0.055 *** (0.005)	-0.021 *** (0.003)
Large city	-0.067 *** (0.003)	-0.076 *** (0.003)	-0.076 *** (0.002)	-0.073 *** (0.002)	-0.064 *** (0.003)	-0.070 *** (0.002)
Rural	-0.074 *** (0.002)	-0.084 *** (0.002)	-0.082 *** (0.002)	-0.079 *** (0.002)	-0.073 *** (0.003)	-0.076 *** (0.002)
Experience/10	0.542 *** (0.030)	0.308 *** (0.021)	0.153 *** (0.016)	0.092 *** (0.019)	0.046 ** (0.023)	0.244 *** (0.017)
Experience squared/100	-0.080 *** (0.003)	-0.060 *** (0.002)	-0.037 *** (0.002)	-0.024 *** (0.002)	-0.021 *** (0.003)	-0.050 *** (0.001)
Unskilled	-0.110 *** (0.002)	-0.108 *** (0.001)	-0.078 *** (0.002)	-0.066 *** (0.003)	-0.060 *** (0.003)	-0.108 *** (0.001)
Short term higher education	0.061 *** (0.004)	0.062 *** (0.003)	0.059 *** (0.003)	0.057 *** (0.003)	0.053 *** (0.005)	0.052 *** (0.003)
Long term higher education	0.120 *** (0.006)	0.154 *** (0.005)	0.180 *** (0.004)	0.193 *** (0.005)	0.216 *** (0.007)	0.169 *** (0.004)
Workplace size, 16-50 workers	0.025 *** (0.003)	0.025 *** (0.002)	0.021 *** (0.002)	0.023 *** (0.002)	0.025 *** (0.003)	0.025 *** (0.002)
Workplace size, 51-200 workers	0.048 *** (0.003)	0.047 *** (0.002)	0.041 *** (0.002)	0.045 *** (0.002)	0.050 *** (0.004)	0.050 *** (0.002)
Workplace size, 200+ workers	0.065 *** (0.003)	0.064 *** (0.003)	0.061 *** (0.003)	0.062 *** (0.003)	0.062 *** (0.004)	0.067 *** (0.002)

Notes: The results are based on the 30% sample of workers. Year and industry dummies were included in all regressions. Bootstrapped standard errors are reported in parentheses. The bootstrap uses a subsample size of 10.000 persons and 1.000 replications. * Significant at 10%; ** Significant at 5%; *** Significant at 1%.

Table 10: Abrevaya-Dahl Mundlak quantile regression with change dummies, all observations pr. individual

	Quantile Regressions					OLS
	10	25	50	75	90	
Firm-level bargaining	-0.022 ** (0.010)	-0.012 (0.008)	0.001 (0.007)	0.005 (0.008)	0.025 ** (0.011)	0.003 (0.007)
Minimum pay	-0.012 (0.010)	-0.009 (0.008)	-0.007 (0.006)	-0.011 (0.008)	0.003 (0.010)	-0.006 (0.007)
Minimum wage	-0.010 (0.010)	0.018 ** (0.008)	0.019 *** (0.007)	0.010 (0.008)	0.027 ** (0.012)	0.017 ** (0.007)
Change standard rate to minimum pay	-0.002 (0.008)	-0.011 * (0.006)	-0.014 ** (0.006)	-0.004 (0.008)	-0.001 (0.010)	0.001 (0.007)
Change minimum pay to standard rate	-0.012 (0.010)	-0.001 (0.008)	0.001 (0.007)	-0.013 ** (0.007)	-0.014 (0.011)	-0.002 (0.007)
Age/10	1.109 *** (0.030)	1.013 *** (0.024)	0.672 *** (0.021)	0.608 *** (0.026)	0.605 *** (0.032)	0.896 *** (0.020)
Age squared/100	-0.107 *** (0.003)	-0.084 *** (0.002)	-0.051 *** (0.002)	-0.044 *** (0.002)	-0.042 *** (0.003)	-0.073 *** (0.001)
Woman	-0.127 *** (0.003)	-0.146 *** (0.002)	-0.168 *** (0.001)	-0.184 *** (0.002)	-0.198 *** (0.003)	-0.161 *** (0.001)
Children aged 0-6	0.062 *** (0.002)	0.049 *** (0.001)	0.031 *** (0.001)	0.030 *** (0.001)	0.031 *** (0.002)	0.044 *** (0.001)
Non-western immigrant	0.006 (0.005)	-0.011 *** (0.003)	-0.028 *** (0.003)	-0.043 *** (0.004)	-0.054 *** (0.005)	-0.021 *** (0.003)
Large city	-0.067 *** (0.003)	-0.076 *** (0.003)	-0.075 *** (0.002)	-0.073 *** (0.002)	-0.064 *** (0.003)	-0.070 *** (0.002)
Rural	-0.074 *** (0.002)	-0.083 *** (0.002)	-0.082 *** (0.002)	-0.079 *** (0.002)	-0.073 *** (0.003)	-0.076 *** (0.002)
Experience/10	0.530 *** (0.029)	0.304 *** (0.021)	0.157 *** (0.015)	0.097 *** (0.018)	0.052 ** (0.023)	0.244 *** (0.017)
Experience squared/100	-0.079 *** (0.003)	-0.060 *** (0.002)	-0.037 *** (0.002)	-0.025 *** (0.002)	-0.022 *** (0.003)	-0.050 *** (0.001)
Unskilled	-0.110 *** (0.002)	-0.108 *** (0.001)	-0.079 *** (0.002)	-0.067 *** (0.002)	-0.061 *** (0.003)	-0.108 *** (0.001)
Short term higher education	0.061 *** (0.004)	0.062 *** (0.003)	0.059 *** (0.003)	0.056 *** (0.003)	0.052 *** (0.005)	0.052 *** (0.003)
Long term higher education	0.122 *** (0.006)	0.154 *** (0.005)	0.180 *** (0.004)	0.193 *** (0.005)	0.215 *** (0.007)	0.169 *** (0.004)
Workplace size, 16-50 workers	0.024 *** (0.003)	0.025 *** (0.002)	0.021 *** (0.002)	0.023 *** (0.002)	0.025 *** (0.003)	0.025 *** (0.002)
Workplace size, 51-200 workers	0.048 *** (0.003)	0.047 *** (0.002)	0.042 *** (0.002)	0.046 *** (0.002)	0.051 *** (0.004)	0.050 *** (0.002)
Workplace size, 200+ workers	0.065 *** (0.003)	0.065 *** (0.003)	0.062 *** (0.003)	0.062 *** (0.003)	0.062 *** (0.004)	0.067 *** (0.002)

Notes: The results are based on the 30% sample of workers. Year and industry dummies were included in all regressions. Bootstrapped standard errors are reported in parentheses. The bootstrap uses a subsample size of 10.000 persons and 1.000 replications. * Significant at 10%; ** Significant at 5%; *** Significant at 1%.

Table 11: Abrevaya-Dahl Mundlak quantile regression, exogenous changes, all observations pr. individual

	Quantile Regressions					OLS
	10	25	50	75	90	
Firm-level bargaining	-0.022 *** (0.008)	-0.014 ** (0.006)	-0.002 (0.005)	0.018 *** (0.006)	0.042 *** (0.010)	0.013 *** (0.005)
Minimum pay	-0.012 * (0.007)	-0.011 * (0.006)	-0.013 ** (0.005)	-0.003 (0.006)	0.016 * (0.010)	0.001 (0.005)
Minimum wage	-0.017 ** (0.008)	0.028 *** (0.007)	0.021 *** (0.005)	0.027 *** (0.007)	0.051 *** (0.010)	0.034 *** (0.005)
Age/10	1.154 *** (0.036)	1.047 *** (0.026)	0.674 *** (0.021)	0.602 *** (0.024)	0.589 *** (0.029)	0.921 *** (0.019)
Age squared/100	-0.109 *** (0.002)	-0.084 *** (0.002)	-0.049 *** (0.002)	-0.041 *** (0.002)	-0.037 *** (0.003)	-0.072 *** (0.001)
Woman	-0.126 *** (0.002)	-0.145 *** (0.002)	-0.169 *** (0.001)	-0.186 *** (0.002)	-0.201 *** (0.002)	-0.162 *** (0.001)
Children aged 0-6	0.064 *** (0.002)	0.051 *** (0.001)	0.031 *** (0.001)	0.029 *** (0.002)	0.031 *** (0.002)	0.044 *** (0.001)
Non-western immigrant	0.010 ** (0.005)	-0.008 * (0.004)	-0.027 *** (0.004)	-0.041 *** (0.004)	-0.054 *** (0.005)	-0.018 *** (0.004)
Large city	-0.067 *** (0.003)	-0.076 *** (0.002)	-0.075 *** (0.002)	-0.071 *** (0.002)	-0.062 *** (0.004)	-0.070 *** (0.002)
Rural	-0.074 *** (0.002)	-0.084 *** (0.002)	-0.082 *** (0.002)	-0.079 *** (0.002)	-0.073 *** (0.003)	-0.076 *** (0.002)
Experience/10	0.523 *** (0.032)	0.264 *** (0.022)	0.120 *** (0.015)	0.061 *** (0.018)	0.026 (0.019)	0.210 *** (0.014)
Experience squared/100	-0.080 *** (0.003)	-0.058 *** (0.002)	-0.035 *** (0.002)	-0.024 *** (0.003)	-0.022 *** (0.003)	-0.050 *** (0.002)
Unskilled	-0.108 *** (0.002)	-0.107 *** (0.002)	-0.077 *** (0.001)	-0.065 *** (0.002)	-0.059 *** (0.002)	-0.108 *** (0.001)
Short term higher education	0.060 *** (0.004)	0.062 *** (0.004)	0.060 *** (0.004)	0.056 *** (0.004)	0.051 *** (0.005)	0.051 *** (0.004)
Long term higher education	0.116 *** (0.007)	0.151 *** (0.006)	0.181 *** (0.005)	0.195 *** (0.006)	0.219 *** (0.007)	0.169 *** (0.005)
Workplace size, 16-50 workers	0.023 *** (0.003)	0.022 *** (0.002)	0.020 *** (0.002)	0.021 *** (0.002)	0.024 *** (0.003)	0.023 *** (0.002)
Workplace size, 51-200 workers	0.045 *** (0.003)	0.041 *** (0.003)	0.038 *** (0.002)	0.045 *** (0.003)	0.051 *** (0.004)	0.047 *** (0.002)
Workplace size, 200+ workers	0.060 *** (0.003)	0.056 *** (0.003)	0.057 *** (0.003)	0.061 *** (0.003)	0.062 *** (0.005)	0.062 *** (0.003)

Notes: The results are based on the 30% sample of workers. Year and industry dummies were included in all regressions. Bootstrapped standard errors are reported in parentheses. The bootstrap uses a subsample size of 10.000 persons and 1.000 replications. * Significant at 10%; ** Significant at 5%; *** Significant at 1%.