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High-Performance Management Practices and Employee Outcomes in Denmark

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Abstract

High-performance work practices are frequently considered to have positive effects on corporate performance, but what do they do for employees? After showing that organizational innovation is indeed positively associated with firm performance, we investigate whether high-involvement work practices are associated with higher wages, changes in wage inequality and workforce composition, using data from a survey directed at Danish private sector firms matched with linked employer-employee data. We also examine whether the relationship between high-involvement work practices and employee outcomes is affected by the industrial relations context.

JEL Classification: C33, J41, J53, L20
Keywords: Workplace practices, wage inequality, workforce composition, hierarchy

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1 Introduction

In recent years, a growing literature has been concerned with the analysis of the characteristics of so-called high-involvement and high-performance work practices (henceforth HPWP) and their impacts on firm performance.[1] The "new work organizations" originate from various intersecting managerial approaches developed in the 1980's and 1990's, the most important of which are the lean production model and Total Quality Management (TQM). Centered on the concepts of employees' involvement, empowerment and autonomy, a typical set of innovative practices includes: self managed teams, job rotation, formal arrangements to discuss production problems (e.g., quality circles), rewards for employees' suggestions, performance related pay and information sharing. According to a number of empirical works these innovative work systems are associated with higher levels of productivity (Ichniowski, Shaw and Prennushi, 1997; Greenan and Mairesse,1999; Bauer, 2003; Cristini et al., 2003; Zwick and Kuckulenz, 2004).[2] The channels through which these practices give rise to productivity improvements are, however, not well understood.[3] In particular, and this is our focus in the current paper, the ways employee outcomes contribute to the productivity effects of HPWP have received relatively little attention, thereby leaving some important questions unanswered.

First of all, there is no consensus as to the extent to which employees gain financially from HPWP.[4] This may reflect the 'a priori' theoretical ambiguity as HPWP

[1] See Bloom and van Reenen (2010) for a recent survey.

[2] The existing empirical evidence is based either on case studies or on cross-sectional data; evidence using more comprehensive data is fairly scarce. Exceptions are e.g., Black et al. (2004) and Kalmi and Kauhanen (2008).

[3] While some studies have failed to find support of HPWP as productivity enhancers (Freeman et al., 2000; Cappelli and Neumark, 2001; Godard, 2004), others have shown that the mere presence HPWP may not be sufficient to improve the firm's performance and that factors like the lack of a coherent bundle of practices, of complementary ICT investments, of adequate skills and of unions' support, may hamper a successful adoption of HPWPs (Osterman, 1994; Black and Lynch, 1998; Bresnahan, Brynjolfsson and Hitt, 2002).

[4] On the basis of a nationally representative sample of US establishments, Osterman (2000, 2006)

may have opposite impacts on wages (Handel and Levine, 2004). On the one hand, a positive relationship between pay and high-involvement management may arise if HPWP improve the firm's performance and employees can seize some of the higher rent created. A related rationale is the efficiency wage argument; in particular, a pecuniary reward may be used to overcome resistance to change; for example, supervisors may be paid a wage premium to ensure that they do not undermine organizational innovations which specifically require them to act as facilitators of groups engaged in problem solving; otherwise, these employees' groups may be viewed as a challenge to the authority and job security of a supervisor (Black et al., 2004). On the other hand, according to the theory of compensating wage differentials, high-involvement management are expected to be negatively correlated with pay as the latter can be traded off against more intrinsically rewarding jobs created by the high involvement approach.

Secondly, the impact of organizational innovation on within-firm wage inequality has only been examined in a few studies. Again, the existing evidence is ambiguous (Aghion, Caroli and Garcia-Penalosa, 1999) and mirrors a theoretical ambiguous relationship. On the one hand, the fact that HPWP are "skill biased" and associated with a lower relative demand and higher layoff rates of unskilled production workers (Caroli and van Reenen 2001; Osterman 2000; Black, Lynch, and Krivelyova, 2004) is the main reason to expect organizational changes to be positively correlated with wage inequality. On the other hand, as long as organizational changes imply delegation of decision rights to lower layers in the hierarchy, incentive considerations and skill upgrading through training may lead to wage increases in the lower part of the

finds that the introduction of high performance work systems is positively associated only with the wages of core blue collar manufacturing employees. Cappelli and Neumark (2001), using the Educational Quality of the Workforce National Employer Survey (EQW-NES), find that some workplace practices, specifically benchmarking and total quality management, are positively related to average labor costs per worker. Handel and Gittleman (2000) and Black, Lynch and Krivelyova (2004) find no wage impact of HPWP.

occupational structure, thereby narrowing wage inequality within firms.

Thirdly, regarding the interaction between industrial relations setting and the new system of work organizations, unions are generally expected to affect both the probability of adoption and the cost of adopting HPWP. Whether unions and HPWP coexist depends on two factors: the bargaining objects and the union's bargaining power (Machin and Wood, 2005). The employer's costs of adopting HPWP depend on whether the union supports or opposes the implementation of the new practices. By offering an alternative to employee exit, unions' voice helps employers retain employees, a key point for the success of high involvement practices for which employees' specific human capital is an essential contribution to the firm productivity (Freeman and Medoff, 1984). Thus, the presence of unions has a priori an ambiguous effect both on the probability and on the cost of HPWP adoption.[5]

In this paper, we use a unique 1999 survey on work practices of Danish private sector firms merged to a large matched employer-employee dataset, which provides us with a wide collection of information on firm characteristics. Our dataset allows us to overcome many limitations of the previous studies and shed some light on rather unexplored research questions. In particular, this paper contributes to the literature in several ways. First of all, it is the first comprehensive study on the effects of organiza-

[5]Only few studies have investigated the role of unions in establishing a wage premium associated with high-involvement work practices. Using a nationally representative survey of British private-sector workplaces, Forth and Millward (2004) show that high-involvement management is associated with higher pay and that the high-involvement management premium is higher where unions are involved in effective pay bargaining. However, as the data used in this study are cross-sectional, it is not possible to say whether a causal relationship exists. For the same reason, the estimates in Godard (2007) suffer from a potential endogeneity bias; Godard (2007) uses data collected in 2003 in a national survey of Canadian and English workers and finds that innovative work practices are associated with meaningful pay gains for union workers in both Canada and England. Black, Lynch and Krivelyova (2004) partly address the issue of endogeneity working with a small panel of 180 manufacturing establishments drawn from two rounds of the EQW-NES; they find a significant effect of HPWP on wages and on wage inequality among unionized employers only.

tional innovation, considering both firm performance and employees' welfare as relevant outcomes. After exploring the relationship between high-performance work practices and firm productivity, we also examine how organizational changes affect workers in terms of wages, wage inequality and workforce composition.

Secondly, the longitudinal dimension of the register data enables us to estimate the association between workplace practices and firm and employee outcomes, controlling both for time-invariant unobserved heterogeneity and for time varying variables which are not accounted for in cross section surveys. Neglecting unobserved fixed effects or time varying regressors, could bias the "true effect" of practices on firm performance and on wages (Bloom and Van Reenen, 2007). For example, if firm's decisions to adopt workplace practices are related to their business performance and the firm decides to introduce organizational innovation in troublesome period (Nickell et al., 1996), then the cross-sectionals estimated effect on productivity would be biased downward. However, the latter would be biased upward if, instead, employers are more likely to adopt new workplace practices when times are good. To address these potential biases, we first obtain accurate estimates of the coefficients of the time-varying variables using a within estimator and then regress the average residuals on an index of organizational innovation in the second stage (Black and Lynch, 2001). As a robustness check, we also calculate the same effects in one step, using a fixed effect estimator, for the subset of practices for which we can exploit a longitudinal information.

Thirdly, the possibility to precisely measure the workforce composition characteristics, such as the share of differently skilled or aged employees, allows us to examine potential omitted variables biases and to get closer to the true "average" effect of organizational innovation on the overall firm-level performance. Finally, we explicitly test whether the presence of trade unions helps employees to appropriate a greater share of

the rents associated with high-involvement practices.

According to our results organizational change is positively associated with firm level productivity and employers do appear to reward their workers for engaging in high-performance workplace practices. We also find a significant association between organizational innovation and wage inequality, as managers get a higher wage premium compared to non managerial workers. At the same time high-performance management practices are found to be associated with loss of managerial jobs. Finally we do not find significant differences in the effects of HPWP between unionized and non unionized firms.

The structure of the remainder of the paper is as follows. The data are described in more detail in Section 2. Section 3 presents the estimation strategy. Section 4 presents and discusses the findings and Section 5 concludes.

2 Data

The data set contains information about Danish private sector firms with more than 20 employees and has been constructed by merging information from two different sources. The first source is a questionnaire directed at firms that contains information about their work and compensation practices.[6] The survey was administered by Statistics Denmark as a mail questionnaire survey in May and June 1999 and was sent out to 3,200 private sector firms with more than 20 employees. The firms were chosen from a random sample, stratified according to size (as measured by the number of full time employees) and industry.[7] The survey over-sampled large and medium-sized firms: it

[6] A description of the questionnaire and the main results are given in Eriksson (2001).

[7] In the final sample, 46% of firms belong to the manufacturing sector, 10% to the construction sector, 32% to the wholesale trade sector, 4% to the transport sector and 8% to the financial sector.

included all firms with 50 or more employees and 35 per cent of firms in the 20-49 employees range. The response rate was 51 per cent, which is relatively high for the rather long and detailed questionnaire that was used.[8] The survey represents a unique source of information on Danish firms' internal labour markets and changes therein. In addition to some background information, each firm was asked about its work organization, compensation systems, recruitment, internal training practices, and employee performance evaluation. As for work design and practices, firms were asked to differentiate salaried from non managerial employees.

The second data source is the "Integrated Database for Labor Market Research" (IDA henceforth) provided by Denmark Statistics. IDA is a longitudinal employer-employee register containing relevant information (age, demographic characteristics, education, labor market experience, tenure and earnings) on each individual employed in the recorded population of Danish firms during the period 1995-1999. Apart from deaths and permanent migration, there is no attrition in the dataset. The labor market status of each person is recorded at the 30th of November each year. The retrieved information has been aggregated at the level of the firm to obtain information on the workforce composition (i.e. proportion of men, skilled employees, managers, middle managers, non managerial workers, and the proportion of employees with different tenure and age) and the mean and variance of the hourly wage.[9] Additional variables collected from firm registers are size, geographical location, industry and some financial information for the years 1995 to 1999, specifically: the value of intermediate goods or materials, fixed assets, and value added. Given our two steps estimation procedure

[8]We always take account of the complex sample design used for the survey by using the sampling weights provided in the data-set; these weights being approximately equal to the inverse of the probability of selection of each firm into the sample. The response rates by size and one-digit industry cells vary only between 47 and 53 per cent. Thus, the representativeness of the sample is of no major concern.

[9]For the empirical specification where we use different time periods, we deflate wages with the consumer price index using 2000 as base year.

explained below, we restrict our analysis to years 1997 to 1999, a compromise between having a sufficiently large number of years to identify the firm fixed effects and a short enough time period to avoid too much variation in the adoption of work practices.[10] Table 1 reports means and standard deviations of the variables of interest. At the bottom of the table, we also report the mean and standard deviation of the variables drawn from the survey, such as the dummy variable "unions" for local wage agreement.

2.1 Variables

The survey distinguishes between a few specific innovative practices: employees' involvement in self-managed teams, job rotation, quality circles, total quality management, benchmarking, project organization, financial participation schemes and on the job training. Except for training programs and different financial participation schemes[11], the survey also asked when each practice was first adopted. Table 2 provides an overview of the diffusion of the practices. Training and financial participation schemes are the most diffused practices, involving more than 50% of firms. Team working is also relatively prevalent (24%), while project organization and job rotation is used in about 15% of the firms. Finally, only a small fraction of Danish firms offer some form of employee involvement through quality circles (3%), benchmarking (4.8%) and total quality management (6%).

The least diffused practices, such as benchmarking and total quality management, have been in place for a shorter period than more diffused practices - like self-managed teams and project organization; one interpretation is that firms introduce organiza-

[10] Table 2 indicates that most practices have been in use for more than three years, which suggests that the triennium 1997-1999 is a likely period for HPWP not to change much.

[11] The questionnaire only asked firms whether they made substantial changes in their payment systems in recent years, without being more specific as to when or to which payment system. Also, there is no information regarding the proportion of employees involved in a particular work design.

tional innovation gradually and that a sequential ordering of the practices may exist so that some practices form the basis to others leading to the most advanced innovative systems, as already found by Freeman et al. (2000). Consequently it is plausible to assume that the number of practices adopted can serve as a proxy for the intensity of implementation. Hence, our main measure of organizational innovation is a single additive index of organizational innovation constructed as the sum of all HPWPs implemented by the firm.[12] We consider four outcomes: (1) the log of the firm value added; (2) the log of the firm average hourly wage, overall and by three occupational groups (managers, middle managers and non managerial workers); (3) the within firm wage inequality measured, alternatively, as: i) the ratio of the average firm wage of managers to the average wage of non managerial workers, ii) the ratio of the 90th percentile to the 10th percentile, iii) the ratio of the 90th percentile to the 50th percentile and iv) the ratio of the 50th percentile to the 10th percentile of the wage distribution; (4) the workforce composition measured by the proportions of managers, middle managers and non managerial workers of all employees in the firm.

Table 3 reports the means of the outcome variables by the number of HPWP adopted. We may notice that both the firm financial performance and the wage inequality measured by the proportion of the average wage of managers and the average wage of blue collar average hourly wages rise with the number of practices adopted. The average hourly wage, the wage of managers and middle managers and the firm's share of managers and middle managers as a proportion of all employees also rise with

[12]We also calculated two alternative indexes to measure the intensity of implementation. The first one is a weighted count index, the weights being the difficulty parameters estimated from the Rasch analysis (for more details, see Freeman et al., 2000). The difficulty parameters associated with each practice indicate that the most widely diffused practices are also the easiest to adopt. This confirms the hypothesis that workplace practices are adopted along an increasingly sequential path where the easiest practices are the first ones to be introduced, followed by more difficult ones. The second index is obtained from principal component analysis. Results obtained using these alternative indices are very similar to the ones reported in section 4 and are available on request from the authors.

the intensity of organizational innovation. However, the relation turns negative for number of practices grater than 4, suggesting the presence of non-linearities.

3 Empirical Strategy

3.1 Impact of organizational innovation on firm performance

In order to relate the firm's total factor productivity to the workplace practices, we use a two step procedure (Black and Lynch, 2001) according to which TFP is first estimated using panel information and, in the second step, the estimated time average TFP is related to the cross-sectional measure of HPWP. The use of panel information in the first step, coupled with a proper estimation technique, allows us to control for the unobservable firm characteristics and cope with both endogeneity issues and potential measurement errors.

The empirical specification of the first stage production function is then given by:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_z Z_{it} + u_{it}, \tag{1}$$

where the dependent variable is the log of the real value added, L is the log of labor, K is the log of capital stock, Z is a vector of controls including firm specific employee characteristics and a full set of size, industry and regional dummies. As pointed out by the literature on the identification of firm production functions, the major issue in the estimation of parameters is the possibility that factors influencing production are unobserved by the econometrician but observed by the firm. Specifically, firms are expected to respond to positive (negative) productivity shocks by expanding (reducing) output, which requires higher quantity/quality of variable production inputs. In order to address this endogeneity problem, Olley and Pakes (1996) (henceforth, OP)

suggested a semi-parametric estimation method that uses investment levels to proxy for time-varying productivity shocks. Their strategy is based on the assumption that future productivity is strictly increasing with respect to the investments, so firms that observe a positive productivity shock in period t will invest more in that period, for any value of capital and labor. Then, given specific assumptions about the productivity dynamics, OP suggest a two step estimation strategy whereby the coefficients of the variable inputs (labor, in the case of simple production function) are estimated semi-parametrically in the first stage and the coefficients of fixed inputs (capital) are estimated in the second stage. More recently, Levinsohn and Petrin (2003) (henceforth, LP) have argued that firm investments, because of their lumpiness due to well known adjustment costs, may not respond smoothly to the productivity shocks thereby generating inconsistent estimated parameters. Thus, they propose to use intermediate inputs to proxy productivity shocks.

Ackerberg, Caves and Frazen (2006) (ACF henceforth) have pointed out potential identification problems in LP first stage estimation and suggested an alternative two-step method that builds upon OP and LP approaches and circumvents the identification problem. Although with different specifications, all three approaches share a two-step estimation strategy which (i) ignores the potential contemporaneous correlation in the errors across the two equations and (ii) does not allow for serial correlation or heteroskedasticity in the error terms. In this regard, Wooldridge (2009) introduces a more efficient alternative based on a single-step GMM[13] estimation approach in line with the ACFs correction and dealing with the drawbacks mentioned above. This alternative implementation estimates the first and second stage conditions simultaneously, capturing de facto the identifying information for parameters on the variable inputs

[13]The GMM system estimator due to Blundell and Bond (2000) is a suitable estimation method in case of endogenous variables. It requires a long time span, since lagged values and differences are used as instruments. In practice, the presence of weak instruments is quite frequent.

like labor in the first stage (Wooldridge, 2009). Given the discussion above, Wooldridge (2009) is our preferred estimation approach to estimate equation (1).

Using the estimates of production function parameters, the firm i's TFP, at time t, is defined as

$$tfp_{it} = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it} - \hat{\beta}_z Z_{it} \tag{2}$$

Next we average the estimated *tfp* over the period 1997 to 1999 and estimate the relationship between these and the index of organizational innovation in the following equation:

$$\overline{tfp_i} = \alpha + \beta_1(index) + \beta_2(unions) + \gamma_r + \gamma_j + \xi \tag{3}$$

where β_1 and β_2 are respectively the productivity effect associated with the organizational innovation and the presence of unions; γ_t, γ_r and γ_j are regional, and industry controls.

3.2 Impact of organizational innovation on employee outcomes

In the second part of the paper we are interested in looking at the impact of organizational innovation on employees' outcomes: mean hourly wages, wage inequality and workforce composition. These variables are obtained from the register data, averaging over employees' outcomes at the firm level. As in the previous subsection, we implement a two-step strategy using the log of the employees' outcomes as dependent

variables, exploiting the fact that we observe variables obtained from longitudinal register data. In the first step we recover the firm fixed component of the residuals and we use it as dependent variable in the second step, with the organizational index as independent variable. This strategy should take care of any unobserved time-invariant firm heterogeneity that might be correlated with the firm specific characteristics. The two-step empirical specification can be written as:

$$ln(Y_{it}) = cons + \mathrm{a}(X_{it}) + u_{it}, \qquad (stage1) \tag{4}$$

$$\overline{ln(Y_{it}) - \hat{\mathrm{a}}(X_{it}) - cons} = \beta_1(index) + \beta_2(unions) + \gamma_r + \gamma_j + \xi, (stage2) \tag{5}$$

where $\overline{ln(Y_{it}) - cons - \hat{a}(X_{it})}$ is the average of the fixed component of the residual over the period 1997-1999, the vector X collects the firm specific characteristics, *index* is our count measure of organizational innovation, *unions* is the dummy variable related to the presence of the unions.[14]

4 Results

This section reports the main findings for each outcome: productivity, wages, wage inequality and workforce composition.

[14]We capture the presence of the unions by looking at whether the firm has a local collective agreement concerning wages and working hours for all employees. Note that union membership is internationally high in Denmark, as over 80 per cent of wage earners are trade union members. So the measure we use in this paper is picking up strong presence of unions at the workplace level.

4.1 Financial performance

The first column of Table 4 reports the results for TFP using the two step procedure described in section 3.1. From the first stage, labor elasticity is 0.74 and capital elasticity is 0.11, confirming previous studies (Parrotta and Pozzoli, 2010; Parrotta et al. 2010). As far as the workforce characteristics are concerned, the proportion of employees with a tenure less than two years, the proportion of employees with a tertiary and secondary education and the proportion of men are all statistically significant and carry a positive sign. The results also show that productivity is lower in firms with more young and higher with the proportion of prime age workers. When we examine the impact of HPWP on productivity in the second step, we find that the count index is positively associated with total factor productivity, suggesting that organizational innovation contribute to enhance firm performance. More specifically, a unit increase in the number of practices implies a 1% rise in total factor productivity. Interestingly, we also find that firms with strong presence of unions have higher productivity than otherwise similar firms, while the interaction between the union dummy and the index of organizational innovation is not statistically significant, implying that the presence of unions has neither a positive nor negative impact on the productivity gains from HPWPs.

Although the two-step procedure extracts the unobserved fixed effect, other biases may still arise in the second step due to the correlations of the second-stage regressors with either/both unobserved, time-invariant, firm-level characteristics or/and the average idiosyncratic shocks because the time period over which we average is relatively short. As we have information on the year of adoption for a subset of practices, we can examine how the time variation of workplace practices is related to changes in productivity. We do this by estimating in one step a production function over a longer time

period (1995-1999). Like labor input, the count index is now treated as an endogenous dynamic input and instrumented using its first lag.[15]

Results are reported in column 2 of Table 4: a lower and not statistically significant coefficient is now estimated for the number of practices adopted. This result suggests that the significance of this variable in the first column may have been driven by unobserved qualities of the firms, we cannot rule out the possibility that it may also be related to the fact that in the second column two important practices, i.e. financial participation schemes and training, are excluded from our count index. In support of this we find that the size of the coefficient of the number of practices considerably decreases also in the two-step procedure when the above mentioned practices are excluded from the count index.[16] All in all, the estimates indicate that high performance work practices are more likely to have beneficial effects on productivity when introduced in conjunction with training and financial participation programs.

4.2 Wages

After showing that organizational innovation is associated with higher firm performance, we next investigate whether innovative firms compensate employees for their increased involvement in the production process and for incurring the risk associated with financial participation schemes. To answer this question, we estimate equation 4 using the log of the average hourly wage both at firm level and by three main occupation groups (managers, middle managers, non-managerialworkers) as dependent variable. The first four columns of Table 5 presents estimates from the two-stage approach. The relationships are qualitatively close to those obtained when estimating the association between organizational innovation and productivity. An unit increase in

[15]Very similar results are obtained when the count index is not instrumented for. These results are available on request from the authors.

[16]These additional results are available on request from the authors.

the number of practices is associated with a 1.7% increase in the average wage. Hence, workplace practices that increase productivity also lead to higher average wages.[17]

When we examine the average wage in each firm by occupation group, we find that the results are relatively similar across occupations. However, it seems that the pay of managers is more affected than the pay of middle managers and non-managerialworkers. This result is consistent with the notion that innovative practices increase the demands on managers, as they are responsible for organizing the other workers and providing an environment conducive to their participation in decision making (Black et al. 2004). As in earlier studies on Danish data (see e.g., Buhai et al., 2008) we find that higher firm average education, higher proportion of male employees and of managers are associated with higher average wage. The presence of unions does not affect the average hourly wage both at firm level and by occupation groups and its interaction with our index of organizational innovation is generally negative and imprecisely estimated.

All in all, these results suggest that a wage premium is paid to managers relative to non-managerialworkers to work in an HPWP environment and that there is not a positive interaction between the union representation and HPWP. Unlike Black et al. (2004), Forth and Millward (2004) and Godard (2007) we do not find that strong presence of unions in innovative workplaces provides additional wage gains to the employees in terms of higher wages.

Again unobserved heterogeneity can potentially affect our findings, and so we estimate equation 4 in one step using a fixed effect estimator and excluding financial participation schemes and training from our count index. These results are reported in

[17]Very similar estimates are obtained when wage and productivity are simultaneously estimated using a seemingly unrelated regressions model. Results are available on request from the authors.

the last 4 columns of Table 5. Similarly to the productivity equation, the association between organizational innovation and wages gets weaker. However, the wage premium for managers remains large and statistically significant, confirming that the pay of managers is higher when they are working in a firm with some form of HPWP while the pay of production workers is affected to a smaller extent. Thus, the results concerning firm level wages show that productivity gains are shared with the employees, albeit not equally across occupational categories.

4.3 Wage inequality

In order to investigate whether organizational innovation increases within firm wage inequality, we look at: i) the ratio of the average wage of managers in a firm to the average wage of non-managerial workers in a firm, ii) the ratio of the 90th percentile to the 10th or the 50th percentile and iii) the ratio of the 50th percentile to the 10th percentile of the wage distribution. Table 6 presents results respectively from the 2-stage and the longitudinal approach. The two-step findings suggest that a higher number of workplace practices increases within-firm wage inequality: for example, an additional HPWP is associated with a slightly larger gap (0.5 per cent) between the average wage of managers and of non-managerial workers. Alternative definitions of wage inequality suggest that inequality rises more in the upper part of the distribution, confirming, once more, managerial employees' pay is affected disproportionately more than that of other employees. Union presence and its interaction with workplace practices are not statistically significant. As far as the main controls are concerned, the proportion of male workers and of workers with a secondary/vocational education reduce wage inequality while the proportion of managers and workers with a tenure of at least 10 years have a positive impact on wage inequality.

The results are, however, less robust when a one-step fixed effect approach is im-

plemented. Compared to the two-step results when the ratio of the average wage of managers to the average wage of non managerial workers is considered, the association between organizational innovation and wage inequality increases considerably. On the other hand, the same correlation loses all its significance, and even its sign changes, for the other definitions of wage inequality are examined. Overall, it appears that the estimated relationship between workplace innovation and within firm wage inequality is quite fragile, as it is highly sensitive to how inequality is measured as well to differences in estimation methods.

4.4 Workforce composition

Finally, to investigate whether innovative practices have any bearing on the firm workforce composition, we estimate equation 4 using the firm level proportion of managers, middle managers and non-managerial workers as dependent variable. The results are given in Table 7. In terms of the relationship between organizational innovation and workforce composition, there are two findings worth noting. Innovative workplaces have a lower share of middle managers and a higher share of non-managerial workers, no matter which methodological approach is implemented. These results do not support the idea that organizational change is skill biased, i.e. that a variety of workplace practices are associated with lower relative demand for unskilled production workers (Caroli and van Reenen 2001; Osterman 2000). On the other hand, the estimates are consistent with the hypothesis that organizational innovation is associated with a loss of managerial jobs (Osterman 2000), i.e. HPWPs flatten the organizational hierarchy and hence reduce the number of employees at middle managerial levels.[18]

[18]For evidence of flattening hierarchies and a discussion of possible causal factors thereof, see Rajan and Wulf (2010).

5 Conclusions

Integrating existing research on firm organizational structure and performance, this paper analyzes how the adoption of new workplace practices correlates with several firm and employee level outcomes. The analysis presented here offers several advantages over prior efforts to examine the relationship between organizational innovation and organizational outcomes. Most importantly, the availability of detailed firm-level measures together with the longitudinal nature of our data, allow to controlling for heterogeneity, thus significantly improving on prior studies relying on cross-sectional data.

The diffusion of new practices in the Danish private firms is found to vary widely depending on the type of practice: while over 50% of firms provide employees with training and financial participation schemes, less than a fourth has employees working in self managed teams, only 6% of firms follows a TQM approach and only 3% involves employees in quality circles. According to this picture, comprehensive innovative work systems are still quite uncommon in Denmark, as is the case in most European countries; nonetheless, the econometric evidence supports significant relations between some outcomes relevant to the workers and the extent of adoption of HPWP. In particular, a unit increase in the count of practices rises the average hourly wage in the range of 1%-2%. Given the weak association between practices and TFP this reward is likely attributable not to a sharing of an extra rent gained thanks to the practices, but to considerations related either/both to the risks of financial participation and layoffs or/and to resistance to change type of conducts; both cases call for some form of pecuniary compensation. Finally, the results according to which managers are those that mostly benefit in terms of wages and that middle managers are those most likely to face reduced employment opportunities as a consequence of flatter hierarchies in the workplace, suggest that the adoption of HPWP has affected the job hierarchy in firms

more than the firms' wage structures.

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Table 1: Descriptive statistics

Variables	Definition	Mean	Sd	N
IDA Variables:				
share of males	men as a proportion of all employees	0.709	0.200	4716
tenure1	employees with a tenure less than two years as a proportion of all employees	0.351	0.147	4716
tenure2	employees with a tenure between 3 and 4 years as a proportion of all employees	0.195	0.091	4716
tenure3	employees with a tenure between 5 and 8 years as a proportion of all employees	0.203	0.125	4716
tenure4	employees with a tenure more than ten years as a proportion of all employees	0.259	0.169	4716
age15-28	employees aged 15-28 as a proportion of all employees	0.262	0.152	4716
age29-36	employees aged 29-36 as a proportion of all employees	0.251	0.084	4716
age37-47	employees aged 37-47 as a proportion of all employees	0.250	0.085	4716
age47-65	employees aged 47-65 as a proportion of all employees	0.235	0.110	4716
secondary education	employees with a secondary/vocational education as a proportion of all employees	0.557	0.151	4716
tertiary education	employees with a tertiary education as a proportion of all employees	0.045	0.085	4716
share of managers	managers as a proportion of all employees	0.048	0.045	4716
share of middle managers	middle managers as a proportion of all employees	0.218	0.214	4716
share of non-managerial workers	non-managerial workers as a proportion of all employees	0.736	0.222	4716
size1	total number of employees (less than 40)	0.113	0.316	4716
size2	total number of employees (40-60)	0.246	0.430	4716
size3	total number of employees (61-120)	0.318	0.466	4716
size4	total number of employees (more than 120)	0.321	0.467	4716
average wage	mean real hourly wage of all employees	174.551	16.921	4716
wage manager	mean real hourly wage of managers	347.619	156.996	4716
wage middle manager	mean real hourly wage of middle managers	207.974	56.504	4716
wage non-managerial	mean real hourly wage of non-managerial workers	155.856	35.020	4716
Accounting Variables:				
value added	(1000 kr.)	13465.58	84525.57	4716
materials	(1000 kr.)	34409.98	290783.9	4716
capital	(1000 kr.)	16582.87	272007.9	4716
multi-establishment	(1 if multi-establishments firm; 0 otherwise)	0.131	0.337	4716
Survey variables				
count Index	number of adopted practices	1.917	1.374	1411
unions	whether the firm has a local collective agreement concerning wages	0.711	0.453	1411

Notes: IDA and accounting variables are averages from 1997 to 1999. Survey variables refer to 1999. Weighted results.

Table 2: Incidence and distribution of workplace practices.

Workplace practices	% of Firms	**Years in Use**		
		1-2	3-6	>6
Project organization	16.45	3.39	3.39	7.88
Benchmarking	4.81	1.35	1.65	1.13
Self-managed team	23.84	6.33	6.36	8.98
Quality circles	3.06	0.52	0.76	1.50
Job rotation	15.00	3.37	4.90	6.04
Total quality management	6.08	1.29	3.06	1.44
Financial participation schemes	55.01	-	-	-
Training	68.12	-	-	-

Notes: Weighted results.

Table 3: Mean of employee outcomes and value added by number of practices adopted.

Outcomes	**Number of practices adopted**			
	0	1-2	3-4	>4
Wages				
log(avg hourly wage), total	5.112	5.153	5.171	5.125
log(avg hourly wage), managers	5.648	5.782	5.808	5.825
log(avg hourly wage), middle managers	5.288	5.314	5.336	5.303
log(avg hourly wage), non-managerial workers	5.041	5.039	5.046	5.023
Wage inequality				
log((avg wage manager)/(avg wage non-managerial workers))	0.607	0.743	0.762	0.801
log((90th percentile)/(50th percentile))	0.840	0.843	0.820	0.766
log((90th percentile)/(10th percentile))	0.382	0.440	0.450	0.432
log((50th percentile)/(10th percentile))	0.458	0.403	0.369	0.333
Firm employment shares				
managers as a proportion of all employees	0.051	0.053	0.051	0.045
middle managers as a proportion of all employees	0.160	0.226	0.262	0.204
non-managerial workers as a proportion of all employees	0.590	0.551	0.524	0.607
Financial performance				
log(value added)	10.227	10.732	10.818	11.333
N	194	858	289	70

Notes: All employee outcomes (wages, wage inequality, employment shares) and value added are expressed as time averages from 1997 to 1999. Weighted results.

Table 4: The effects of workplace practices on financial performance. Two step and one step estimates.

	(1)	**(2)**
	First stage	
lnL	0.704***	0.701***
	(0.024)	(0.023)
lnK	0.115***	0.112***
	(0.017)	(0.016)
share of males	0.100**	0.085*
	(0.051)	(0.051)
tenure1	0.123**	0.123**
	(0.058)	(0.058)
tenure2	0.019	0.019
	(0.064)	(0.064)
tenure3	–0.005	–0.005
	(0.051)	(0.051)
age15-28	–0.845***	–0.855***
	(0.106)	(0.105)
age29-36	0.098	0.077
	(0.086)	(0.080)
age37-47	0.215*	0.183*
	(0.114)	(0.106)
tertiary education	0.834**	0.701**
	(0.328)	(0.319)
secondary education	0.279***	0.282***
	(0.054)	(0.052)
share of middle managers	0.230***	0.259***
	(0.069)	(0.065)
share of managers	0.276	0.254
	(0.198)	(0.167)
multi-establishment	0.023	0.024
	(0.020)	(0.019)
N	3069	
R2	0.91	
count index	0.097**	0.006
	(0.045)	(0.009)
unions	0.166*	
	(0.096)	
unions x count index	0.029	
	(0.050)	
N	1411	4007
R2	0.08	0.91

Notes: The dependent variable is the log of value added. All estimations also include a constant term, regional, size and industry dummies. For the first stage FE regression we also control for year dummies. Production function estimates obtained using the Wooldridge (2009) approach. Column 1: two-step estimates, the first-stage is estimated using panel information from 1997 to 1999. Column 2: one-step estimates using panel information from 1995 to 1999 and the count index excludes financial participation schemes and training; the estimations include a polynomial function of capital and materials and labor and the count index are instrumented for with the first lag. Weighted results. *Statistically significant at the 0.10 level, **at the 0.05 level, ***at the 0.01 level.

Table 5: The effects of workplace practices on wages. Two and one step estimates.

	First Stage, FE				One step, FE			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Average wage	Average wage (managers)	Average wage (mid managers)	Average wage (non managerial)	Average wage	Average wage (managers)	Average wage (mid managers)	Average wage (non managerial)
share of males	0.167***	0.072	0.051	0.235***	0.044	0.247*	0.035	0.123*
	(0.036)	(0.127)	(0.080)	(0.045)	(0.068)	(0.144)	(0.059)	(0.065)
tenure1	–0.007	–0.007	–0.092*	–0.026	–0.065***	–0.212**	–0.088***	–0.062*
	(0.026)	(0.077)	(0.050)	(0.031)	(0.024)	(0.088)	(0.033)	(0.034)
tenure2	–0.010	–0.074	–0.073	0.001	–0.058**	–0.098	–0.075**	–0.070**
	(0.028)	(0.080)	(0.053)	(0.033)	(0.027)	(0.089)	(0.031)	(0.035)
tenure3	–0.010	0.089	0.009	0.011	–0.054***	–0.011	–0.028	–0.060**
	(0.021)	(0.059)	(0.038)	(0.025)	(0.020)	(0.063)	(0.023)	(0.026)
age15-28	–0.547***	–0.445***	–0.281***	–0.190***	–0.448***	–0.463***	–0.490***	–0.262***
	(0.043)	(0.144)	(0.089)	(0.053)	(0.051)	(0.162)	(0.062)	(0.054)
age29-36	–0.403***	–0.485***	–0.001	–0.035	–0.165**	–0.313*	–0.149**	–0.100
	(0.041)	(0.143)	(0.088)	(0.052)	(0.072)	(0.181)	(0.066)	(0.069)
age37-47	–0.290***	–0.329**	0.070	–0.032	–0.101	–0.218	–0.090	–0.071
	(0.044)	(0.142)	(0.087)	(0.055)	(0.063)	(0.177)	(0.065)	(0.060)
tertiary education	0.680***	0.457*	0.935***	0.353***	0.840***	1.256***	0.909***	0.472***
	(0.074)	(0.263)	(0.145)	(0.104)	(0.109)	(0.291)	(0.124)	(0.178)
secondary education	0.335***	0.093	0.169**	0.318***	0.302***	0.206	0.252***	0.272***
	(0.035)	(0.119)	(0.075)	(0.043)	(0.039)	(0.133)	(0.057)	(0.056)
share of middle managers	0.098***	0.214**	–0.279***	–0.210***	0.010	0.030	–0.423***	–0.013
	(0.028)	(0.083)	(0.051)	(0.033)	(0.016)	(0.073)	(0.023)	(0.026)
share of managers	0.473***	–0.215	–1.141***	–0.574***	0.203**	–1.136***	–1.015***	–0.737***
	(0.049)	(0.149)	(0.107)	(0.065)	(0.095)	(0.249)	(0.069)	(0.068)
multi-establishment	–0.035*	–0.032	–0.038	–0.020	–0.005	0.108*	0.011	–0.020
	(0.019)	(0.054)	(0.035)	(0.023)	(0.011)	(0.056)	(0.022)	(0.017)
N	4716	4021	4449	4712				
R2	0.31	0.05	0.14	0.16				
			Second Stage, OLS					
count index	0.017***	0.022***	0.014***	0.015***	0.008***	0.025***	0.013	0.004
	(0.006)	(0.007)	(0.004)	(0.005)	(0.003)	(0.005)	(0.015)	(0.004)
unions	–0.007	–0.025	–0.004	0.005				
	(0.015)	(0.033)	(0.019)	(0.016)				
unions x count index	–0.012*	–0.003	–0.018**	–0.014**				
	(0.006)	(0.013)	(0.008)	(0.006)				
N	1348	1348	1348	1348	7621	7666	7266	7447
R2	0.17	0.10	0.12	0.09	0.16	0.03	0.14	0.05

Notes: All estimations also include a constant term, regional, size and industry dummies. For the first stage FE regression we also control for year dummies. Weighted results. *Statistically significant at the 0.10 level, **at the 0.05 level, ***at the 0.01 level. Columns 1,2,3 and 4: two-step estimates, the first-stage is estimated using panel information from 1997 to 1999. Columns 5,6,7 and 8: one-step estimates using panel information from 1995 to 1999 and the count index excludes financial participation schemes and training.

Table 6: The effects of workplace practices on wage inequality. Two and one step estimates.

	First Stage, FE				*One step, FE*			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
	wage manager/wage non-managerial	90th/50th	90th/10th	50th/10th	wage manager/wage non-managerial	90th/50th	90th/10th	50th/10th
share of males	–0.106	–0.071	–0.136***	0.065	–0.114*	0.062	–0.088	0.115*
	(0.130)	(0.082)	(0.048)	(0.065)	(0.068)	(0.059)	(0.056)	(0.066)
tenure1	–0.022	0.281***	0.105***	0.176***	–0.054	0.262***	0.023	0.160***
	(0.078)	(0.057)	(0.033)	(0.046)	(0.040)	(0.039)	(0.030)	(0.035)
tenure2	–0.060	0.229***	0.091**	0.137***	–0.002	0.187***	0.008	0.124***
	(0.082)	(0.061)	(0.036)	(0.049)	(0.041)	(0.040)	(0.030)	(0.034)
tenure3	0.100*	0.134***	0.061**	0.072**	–0.005	0.126***	0.021	0.077***
	(0.060)	(0.046)	(0.027)	(0.036)	(0.031)	(0.031)	(0.020)	(0.026)
age15-28	–0.151	–0.053	–0.139**	0.086	–0.139**	0.289***	0.130**	0.243***
	(0.150)	(0.095)	(0.055)	(0.076)	(0.068)	(0.063)	(0.052)	(0.067)
age29-36	–0.322**	–0.487***	–0.354***	–0.133*	0.005	–0.184***	–0.056	0.050
	(0.150)	(0.091)	(0.053)	(0.072)	(0.073)	(0.065)	(0.066)	(0.071)
age37-47	–0.168	–0.237**	–0.109*	–0.128*	0.040	–0.224***	–0.028	–0.063
	(0.150)	(0.097)	(0.056)	(0.077)	(0.073)	(0.066)	(0.059)	(0.068)
tertiary education	0.312	–0.289*	0.026	–0.315**	0.378**	–0.125	0.181	–0.209
	(0.272)	(0.162)	(0.094)	(0.129)	(0.148)	(0.121)	(0.124)	(0.131)
secondary education	–0.168	–0.324***	0.015	–0.339***	–0.066	–0.323***	0.010	–0.382***
	(0.122)	(0.079)	(0.046)	(0.063)	(0.060)	(0.054)	(0.049)	(0.059)
share of middle managers	0.422***	0.006	0.008	–0.002	–0.377***	0.050**	0.105***	–0.021
	(0.085)	(0.061)	(0.036)	(0.049)	(0.025)	(0.023)	(0.016)	(0.021)
share of managers	–0.197	0.159	0.180***	–0.021	–0.328***	0.195***	0.149**	0.021
	(0.172)	(0.107)	(0.062)	(0.085)	(0.083)	(0.073)	(0.066)	(0.066)
multi-establishment	–0.008	–0.032	–0.032	0.000	0.024	0.022	–0.001	0.034
	(0.055)	(0.042)	(0.024)	(0.033)	(0.027)	(0.027)	(0.014)	(0.021)
N	4008	4714	4714	4714				
R2	0.02	0.04	0.03	0.03				
	Second Stage, OLS							
count index	0.005**	0.018**	0.007**	0.005	0.021***	0.006	–0.000	–0.012**
	(0.001)	(0.007)	(0.003)	(0.008)	(0.007)	(0.007)	(0.004)	(0.006)
unions	–0.041	0.003	–0.026**	0.002				
	(0.035)	(0.026)	(0.013)	(0.022)				
unions x count index	0.013	–0.006	–0.006	–0.020				
	(0.015)	(0.011)	(0.005)	(0.010)				
N	1348	1348	1348	1348	7370	7903	7618	7618
R2	0.10	0.21	0.19	0.20	0.05	0.05	0.02	0.05

Notes: All estimations also include a constant term, regional size and industry dummies. For the first stage FE regression we also control for year dummies. Weighted results. *Statistically significant at the 0.10 level, **at the 0.05 level, ***at the 0.01 level. Columns 1,2,3 and 4: two-step estimates, the first-stage is estimated using panel information from 1997 to 1999. Columns 5,6,7 and 8: one-step estimates using panel information from 1995 to 1999 and the count index excludes financial participation schemes and training.

Table 7: The effects of workplace practices on workforce composition. Two and one step estimates.

	First Stage, FE			*One step, FE*		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	share of managers	share of middle managers	share of non-managerial	share of managers	share of middle managers	share of non-managerial
share of males	–0.017***	–0.129***	0.140***	0.011	0.038	–0.202**
	(0.004)	(0.011)	(0.015)	(0.018)	(0.069)	(0.102)
tenure1	–0.001	–0.010	–0.115***	–0.041***	0.047	–0.206***
	(0.007)	(0.018)	(0.023)	(0.010)	(0.035)	(0.051)
tenure2	–0.005	–0.048**	–0.014	–0.031***	0.008	–0.083
	(0.008)	(0.022)	(0.030)	(0.010)	(0.036)	(0.054)
tenure3	0.002	0.005	–0.057***	–0.029***	0.063***	–0.148***
	(0.006)	(0.017)	(0.022)	(0.007)	(0.023)	(0.036)
age15-28	–0.106***	–0.165***	0.369***	–0.156***	0.308***	–0.762***
	(0.008)	(0.022)	(0.029)	(0.028)	(0.083)	(0.116)
age29-36	–0.054***	0.115***	–0.074**	–0.100***	0.070	–0.189
	(0.010)	(0.026)	(0.034)	(0.034)	(0.095)	(0.133)
age37-47	–0.070***	0.143***	–0.035	–0.092***	0.071	–0.135
	(0.012)	(0.031)	(0.041)	(0.034)	(0.095)	(0.134)
tertiary education	0.065***	1.240***	–0.765***	0.164***	0.245**	0.131
	(0.012)	(0.031)	(0.041)	(0.049)	(0.122)	(0.134)
secondary education	0.035***	0.394***	0.083***	0.072***	0.088	0.172**
	(0.006)	(0.015)	(0.020)	(0.015)	(0.054)	(0.075)
multi-establishment	–0.004*	0.048***	–0.018**	0.010*	-0.072***	0.103***
	(0.002)	(0.006)	(0.008)	(0.005)	(0.024)	(0.032)
N	4716	4716	4716			
R2	0.12	0.61	0.43			
	Second Stage, OLS					
count Index	0.001	–0.013***	0.028***	0.008***	–0.049***	0.096***
	(0.001)	(0.004)	(0.006)	(0.001)	(0.005)	(0.008)
unions	–0.012***	0.046***	–0.035**			
	(0.004)	(0.017)	(0.015)			
unions x count Index	0.000	0.007	–0.025***			
	(0.002)	(0.007)	(0.007)			
N	1348	1348	1348	7621	7621	7621
R2	0.16	0.28	0.35	0.09	0.05	0.12

Notes: All estimations also include a constant term, regional, size and industry dummies. For the first stage FE regression we also control for year dummies. Weighted results. *Statistically significant at the 0.10 level, **at the 0.05 level, ***at the 0.01 level. Columns 1,2 and 3: two-step estimates, the first-stage is estimated using panel information from 1997 to 1999. Columns 4,5 and 6: one-step estimates using panel information from 1995 to 1999 and the count index excludes financial participation schemes and training.

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