The Dispersion of Employees' Wage Increases and Firm Performance

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Abstract

In this contribution we examine the interrelation between the distribution of intra-firm wage increases and firm performance. Previous studies have focused on the dispersion of wage levels in order to examine for the empirical dominance of positive monetary incentive effects compared to adverse effects due to fairness considerations. We argue that the dispersion of wage increases rather than wage levels is a crucial measure for monetary incentives in firms. The larger the dispersion of wage increases the higher the amount of monetary incentives in firms. However, increasing the differences may also hamper fairness considerations. Evidence from a unique Danish linked employer employee data shows that large dispersion of wage growth within firms is generally associated with low firm performance. The results are mainly driven by white collar rather than blue collar workers.

Key words: Fairness, Firm Performance, Inequality, Monetary Incentives, Wage Increases, Wage Dispersion

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In recent years, the fundamental debate has been ongoing, whether the distribution of monetary incentives has a positive impact on organizations. Both theoretical arguments and empirical evidence are ambiguous. Probably, it is unchallenged that monetary incentives affect individuals' behavior. However, individual monetary incentives often lead to uneven outcomes among the affected individuals and this may in turn have a negative impact on motivation due to equity or fairness considerations.

Knowledge about the interaction of these two effects is very important when creating an efficient compensation policy in firms. A beneficial policy will always depend on the relative relevance of the two effects. We can make use of a unique data set. In contrast to most other studies — which in most cases have somewhat crude measures for firm performance or wage dispersion, or analyze only a small number of firms and/or a small fraction of the workforce — we are able to examine a large proportion of the whole Danish labor market. We have linked information for all employees and all larger private sector firms with at least 20 employees for a six year observation period. Our findings provide insights of the relative importance of fairness considerations resulting from monetary inequality in firms compared to incentive effects**.** The results can be considered to generate recommendations for firms' wage policy.

Prior studies argue that the dispersion of wage levels in firms represents the amount of monetary incentives. In this contribution we want to address an important additional aspect, which has been neglected in the literature so far. The previous studies argue that large dispersion coincides with large (tournament) incentives in firms. However, it is

important to note that this is not automatically the case. If there are hardly any promotional possibilities and eminent glass ceilings, employees do not face significant monetary incentives regardless of the amount of intra-firm wage inequality. In contrast to previous studies, we therefore also analyze the interrelation between the dispersion of wage *increases* next to the dispersion of wage *levels* and firm performance. For example, a firm can definitely implement monetary incentives if two colleagues are aware of the fact that one will get a 20 percent raise at the end of the year, whereas the other misses out.

Theoretical Considerations and Earlier Empirical Studies

Some previous studies argue that the dispersion of wages in firms acts as a proxy for the amount of monetary incentives and may influence firm performance in terms of profit or value added. This is particularly the case in tournament structures, where individuals are necessarily divided into winners and losers (see Lazear & Rosen 1981, Rosen 1986). Tournaments are automatic ingredients of common internal labor markets.[1] While the winner of a promotional tournament is promoted and receives a wage increase, for example, other employees miss out. Several approaches argue that this inequality can lead to some kind of opposed effects besides to the positive incentive effect, e.g. because of equity or fairness considerations. Not surprisingly, there is explicit evidence for both: On the one hand, monetary incentives matter (Lazear 2000) and individual efforts are affected by the prize structure of tournaments (Abrevaya 2002, Becker & Huselid 1992, Bull, Schotter & Weigelt 1987, Ehrenberg & Bognanno 1990, Main, O'Reilly & Wade 1993). On the other hand, fairness considerations influence human behavior as well (Camerer/Thaler 1995, Cowherd/Levine 1992,

[1] Lazear (1992), Baker, Gibbs & Holmstrom (1994a, 1994b), Dohmen, Kriechel & Pfann (2004), Grund (2005) and Treble, van Gameren, Bridges & Barmby (2001) provide evidence for single firms.

Güth/Schmittberger/Tietz 1990).[2] In a series of experiments on different incentive schemes Harbring (2004) provides evidence for both.

Some contributions examine the link between wage dispersion and firm performance.[3] In default of direct productivity information, Winter-Ebmer & Zweimüller (1999) argue in a neoclassical sense that a high wage level in a firm reflects high firm performance. For white collar employees they find an inversely u-shaped interrelation between wage dispersion and the level of wages in Austrian firms. Lallemand, Plasman & Rycx (2004) and Heyman (2005) study the link between the dispersion of intra-firm wage levels and firm performance for Belgium and Sweden, respectively. Both find a positive relationship. Bloom (1999) uses data from the major league baseball and shows that the level of wage dispersion among team members is negatively related to several measures of individual and team performance. Pfeffer & Langton (1993) find decreasing research productivity and collaboration among college and university faculty with increasing wage dispersion. Some contributions focus on wage dispersion among the managers of firms only. Eriksson (1999) finds evidence for a positive relationship between the pay spread among managers and firm profitability in Denmark. However, O'Reilly, Main & Crystal (1988) and Leonard (1990) do not confirm this result for large U.S. firms. Due to lack of information on individual wages Beaumont & Harris (2003) use the ratio of non-manual and manual labor costs per employee as a proxy for wage dispersion in firms. This somewhat rough measure is positively related to value added per employee in the majority of manufacturing sectors in the UK. Using Swedish aggregate time-series data Hibbs and Locking (2000) find more positive than negative effects of wage dispersion on firms' real value added. Bingley & Eriksson (2001) concentrate on the

[2] Recent contribtions, which focus on multiple agent gift-exchange experiments, include Güth et al. (2001), Maximiano, Sloof & Sonnemans (2004) and Rossi & Warglien (2001).
[3] Turnover, tenure and job satisfaction are also affected by the dispersion of wages (see Pfeffer & Davis-Blake 1992, Pfeffer & Langton 1993, Bloom & Michel 2002). Already Simon (1957) argues that wage policy has an impact on employee behavior.

skewness of intra-firm wage distribution, which is found to be u-shaped related to firm productivity in Denmark.

This brief overview shows that the evidence is mixed. It is not possible to demonstrate a clear interrelation (neither positive nor negative) in general. Indeed, there are considerable differences in the investigated specific labor markets and the authors use different measures of both wage dispersion and firm performance. We therefore revisit this question in our empirical study making use of unique linked employer employee data of the whole Danish labor market.

However, it is important to note that the presumed coherence of dispersion of wages and monetary incentives is not automatically true. Employees do not face significant monetary incentives even at a huge amount of intra-firm wage dispersion, if they have hardly any promotion possibilities. Indeed, Leonard (1990) provides evidence for the U.S. that steeper pay differentials across hierarchies are associated with lower promotion rates. Employees realize the possibility of lacking extraordinary wage increases as well. For example, the U.S. pharmaceutical company Merck & Co., Inc. has had an absolute performance evaluation system until the mid 80s of the last century, which lead to strong managerial tendencies to assign uniform ratings, which again have been responsible for uniform pay increases. Thus, employees were complaining about missing incentives. When asked to judge the performance evaluation system: “What’s the use of killing yourself [… if] you still get the same 5% increase. It’s demoralizing and demotivating” (Murphy 1992, p. 39).

Hence, what really matters in terms of monetary incentives is not only the simple dispersion of wages but also the possibility of receiving extraordinary wage *increases*. First, there might be some kind of pay for performance contracts, which reward employees with respect to firm performance. But then, automatically the free riding problem occurs if employees have to bear their cost of effort, but only receive a small

fraction of the surplus. From a strict economic point of view, it is rather the dispersion of wage increases which is supposed to induce additional monetary incentives to exert effort.

Tournament theory (Lazear & Rosen 1981, Rosen 1986) predicts increasing effort levels with increasing wage premiums for winners of rank-order tournaments. Hence, incentives are induced rather by differences in wage increases than by differences in wage levels in the sense of tournament theory. This argument suggests a positive link between the inequality of wage increases and individual performance. In this case, firm performance should also be affected positively. However, one drawback of tournaments is that participants have usually two possibilities to increase their individual winning probabilities. They can either exert a high productive effort or a counterproductive effort (e.g. by withholding important information). If the problem of counterproductive effort or sabotage is relevant, a somewhat compressed wage structure is beneficial for the firm (see Lazear 1989). Drago & Garvey (1998) find support for Australia that helping on the job among employees is reduced with increasing monetary incentives in tournament structures. From a tournament perspective the dispersion of wage increases – measured with the standard deviation – is maximized, when half of the contestants receive the winner prize. Indeed, experimental evidence hints that employees' maximal efforts occur at a fraction of winner prizes of 0.5 compared to tournaments with only few winner or loser prizes (Orrison, Schotter & Weigelt 1997, Harbring & Irlenbusch 2004).[4]

Other theories warn explicitly about too much inequality inside firms. More specifically, there are equity theory (Adams 1963), relative deprivation theory (Martin

[4] Note that this is not automatically the result of tournament *theory*. From a theoretical point of view, the marginal probability to win a promotion tournament is the decisive factor to determine the effort choice of the employee. Orrison et al. (1997), as well as Harbring & Irlenbusch (2002) derive for a tournament model with identically distributed individual error terms that effort choice is even independent of the fraction of winner prizes in a symmetric equilibrium.

1981), distributional justice theory (Cowherd and Levine 1992) and fairness (Akerlof 1984, Akerlof and Yellen 1990) or cohesiveness considerations (Levine 1991) as well as the possible reduction of intrinsic motivation (Deci et al. 1999, Frey and Jegen 2001). In the following they are summarized by the term *fairness approaches* without neglecting their differences in detail. These fairness approaches point out that many employees are unmotivated and reduce effort or even quit their jobs if they perceive to be paid unfairly or inequitably.[5] For example, equity theory states that employees evaluate the relation of their own labor input (e.g. effort) and labor output (e.g. wages or wage increases) compared to colleagues. If this relationship is perceived to be unfair, individuals will reduce effort in order to adjust this imbalance. Even having accepted a certain wage inequality as equitable because of different task requirements, for example, it might very well be the case that employees judge very uneven wage increases as unfair. Differences in effort or performance may be observed concordantly across employees in some cases. However, the vast majority of employees consider themselves as top performers (Meyer 1975, Taylor and Brown 1988). That is why large differences of wage increases are often hard to communicate to the employees. Possible reactions are reducing future effort or quitting due to destroyed motivation.

As a consequence performance is argued to be negatively correlated with the dispersion of wage increases among employees of a firm. Levine (1993) provides a first hint for empirical relevance by asking real world compensation executives about recommendations for wage changes in a hypothetical company and certain scenarios. Indeed, the managers were concerned about giving employees different relative wage increases due to fairness aspects. Concordantly, the interviews conducted by Bewley (1999) reveal that internal equity, internal harmony and fairness are the main reasons for a fixed formal wage structure inside firms.

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[5] Fehr & Schmidt (1999) integrate fairness considerations – in particular other-regarding preferences – in a theoretical economic analysis.

The two strands of the literature obviously predict contradicting results for the interrelation between the dispersion of wage increases and firm performance. However, the different temporal perspectives of tournament and fairness approaches are usually not mentioned. Tournament theory focuses on incentives at the beginning and during the tournament. Nothing is said explicitly about things going on after the winner is found.[6] Standard economic theory would state that there are simply no monetary incentives any more, if no further tournament follows directly. In contrast, equity approaches highlight the situation, when employees are already treated differently. This is the case, for instance, subsequent to a promotion tournament. The winner then receives the prize, and the loser receives nothing, although having possibly both exerted the same amount of effort. Hence, the two approaches are not mutually exclusive.[7] Both effects are likely to be relevant in common corporate compensation policies.

The exact impact of these effects on individual effort is not clear, though. One may argue that both effects are linear in the amount of monetary incentives. Then, a first possibility is that the composite effect is also linear. However, this is not the only possibility. Interpreting the negative effect as a reduction of intrinsic motivation, it seems plausible that motivation cannot become negative.[8] Therefore, the negative effect will only be relevant up to a certain point of monetary incentives (or dispersion of wage increases) in firms. From this point there will be only the incentive at work. If the negative effect dominates the positive one, we get an overall v-shaped effect of monetary incentives on individual efforts. However, the slopes of the effects will differ across employees in different situations in different firms, which will lead to different perception thresholds of fairness and

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[6] Waldman (2003) is an exemption. He focuses on the time inconsistency problem. In promotion tournaments it might ex post be rational to hire an outsider. However, this will destroy ex ante incentives for incumbents.

[7] Besides, recent economic approaches try to incorporate sentiments like relative deprivation, envy and compassion in tournament models as well (see Kräkel 2000, Grund & Sliwka 2005). They again choose an ex ante view and argue that employees anticipate the uneven outcomes in the future with the associated perceptions. Then the effort choice is made taking into account their anticipated inequity aversion.

[8] This is also a underlying assumption of models on intrinsic motivation such as offered by James (2005).

motivation crowding out. Deci et al (1999) surveys the literature and identify situations such as different kind of rewards and tasks, in which intrinsic motivation is more likely reduced by monetary incentives. By aggregating the individual v-curves, we will then get to an overall u-shaped interrelation between wage increase dispersion and overall effort.

The effect of monetary incentives on firm productivity depends on the kind of relevant production function transforming effort to production. Adams (2006) suggests a function

$$F(e_1, e_2, e_3, \ldots\ldots) = \left(\sum_{i=1}^{N} e^{\rho} \right)^{1/\rho} \quad \text{with } \rho = (0,1],$$

in which the effort of individual workers (e_i) are aggregated to the productivity of the firm (F). This aggregation function allows for an additive aggregation for $\rho = 1$. For smaller values of ρ we get that the team production is bigger than the sum of the effort. The latter situation is of course most likely if people work together. This kind of production function implies that the observed productivity effect is expected to be increasing in the overall effort level for complementarities in production functions.

Gneezy & Rustichini (2000) show in a series of experiments, where people have to solve IQ-tests or collect monetary donations, that pay for performance does only pay off, if monetary incentives are large enough. Hence, they observe a kind of u-shaped effect. Applying these results to the present study we can presume that some kind of fairness norm can be destroyed by inequality of wage increases. Thus, it is at least arguable, whether we shall expect a linear relationship on effort or firm performance.

As argued above, there are arguments for different possible shapes. It is, however, an empirical question, which effect dominates in practice. Until now, there is no definite empirical evidence about this issue. We will study this interrelation in the following empirical examination. Regressing the dispersion of wage increases and its square on firm performance, we can examine the empirical shape of the relationship and calculate a possible minimum (or maximum) of the function. Then we can check, whether there is a positive or negative relationship between the dispersion of wage increases and firm performance for the majority of firms.

Data, Variables, and Methods

The data used in this study originates from two sources: The first is the Statistics Denmark IDA (Integrated Database for Labour Market Research) Register. IDA contains information on labour market conditions for persons and workplaces in Denmark over the years 1980-1998. This data originates from various administrative registers. The important feature of IDA is that it is possible to associate workplaces with the identity of all employees at a specific day in November each year. Employers are defined by their employer identification number, which is changed if ownership changes in a strictly legal sense.[9] We have corrected for those cases where more than 50% of all employees are taken over by the new legal employer. In these cases, the work place is said to continue.

Data on workplaces are subsequently aggregated to firms by Statistics Denmark for Center for Corporate Performance. For a subsample of firms with more than 20 employees these data have been merged with data on financial information concerning profit, total revenue, total costs, investments and capital. These data cover the period 1992-1997.

[9] A detailed description of the data is given at http://data.ccp.asb.dk.

The individual data includes information on gender, age, education, occupational status and wage. For each firm and year we are able to calculate descriptive statistics (means and standard deviations) of these variables. Thus, the great advantage of our data is that we can observe not only a sample of firms and/or employees, but the whole population of both the demand and supply side of the labor market. Furthermore, it is possible to follow firms and employees over time. By aggregating the information of the employees and matching it to the firms, we construct an unbalanced panel data set where the firm/year is the unit.

It is argued above that wage increases of employees and especially the dispersion of wage increases are the crucial objects of investigation in this study. In order to analyze wage increases, we have to restrict our data set to employees who stay in a firm for two consecutive years or more. A second restriction applies to the firm size. It is not very meaningful to calculate dispersions of wages and wage growth for firms with very few employees. Hence, we restrict our data set to firms with at least 20 employee observations in a certain year.

We measure firm performance with the log of value added per employee. Value added is thereby defined as net revenue (after rebates and after tax) less purchase of goods (freight, raw and auxiliary materials and external wages).[10] The central aim of this contribution is to analyze the link between the dispersion of wage increases ($wage_t$ / $wage_{t-1}$) and firm performance (log of value added (t)). We take the coefficient of variation – which is the standard deviation divided by the mean – of individual wage increases in firms as a measure for wage increase dispersion.[11] We use hourly gross wages as our wage variable. All values for value added and wages are deflated with the Danish Consumer Price Index with basis year 1997. In order to examine possible non-linear effects of the dispersion of wage increases on firm performance, which were

[10] See Hibbs and Locking (2000) as well as Beaumont and Harris (2001) for studies which also use value added as a performance indicator.
[11] Allison (1978) discusses several measures of wage inequality and finds that the coefficient of variation is advantageous in many situations.

suggested by the considerations of section 2 and Figure 1, we also make use of the square of the coefficient of variation.

Other variables are supposed to affect value added as well. Wages have still to be paid by value added. Therefore, high wage are supposed to come along with high value added. In order to have a link to previous studies, we also include the dispersion of the firms' wage level next to the dispersion of wage increases. Additionally, the average age of employees and the dispersion of the ages of employees might have an effect. Lazear (1998, pp. 169ff) argues that there are usually complementarities among the different kinds of human capital of young and old workers. Young employees have new ideas and skills on new technologies, whereas the elderly have knowledge about the intra-firm structures and the relevant markets and networks. Usually both kinds of human capital are necessary for firm productivity.[12] Hence, a mixture of age groups seems to be beneficial, although communication problems among the age groups might arise. Organizational demography (Pfeffer 1981, 1983, 1985) argues that dissimilarities among persons lead to problems in communication, integration and cohesion. Additional control variables are education level of the workforce, percentage females, percentage blue collars, firm size and branch of industry.

We have deleted some outliers with extremely high, respectively low (negative) value added per employee to make sure that the results do not depend on a few extreme observations. Also firms with extreme variations in the numbers of employees and extreme fraction of leavers are not taken into account.[13] Additionally, we delete the top managers of the firms since we also want to examine the influence of the subgroups of blue collar and white collar workers. The results are robust with respect to all of these restrictions. The resulting data set has some 22,000 observations. During the six year

[12] A second argument for having different age groups in a company comes from overlapping generations models. Cremer (1986) shows that an overlapping generations structure with several age cohorts can be a decisive factor to induce cooperation among employees who forbear from shirking in prisoner dilemma situations.

[13] Note that we analyze the dispersion of wage increases and, therefore, need information of two consecutive years of each employee. By restricting the sample the number of observations is reduced by about 4 per cent mainly due to firms reporting more than doubled or halved workforces. Deletions of firms with extremely high or low value added account for only 0.5 percent of observations. None of our result is affected by these restrictions.

period (1992 – 1997) there is information about 5,736 different firms. Some descriptive statistics are given in Table 1. The mean value added per employee amounts to some 400,000 DKK, which equates with around 80,000 US $ or 58,000 €. The descriptive statistics are reasonably stable over the observation period 1992 to 1997. In particular, the dispersion of wage levels and wage increases in firms does not deviate very much.

Insert Table 1 about here

Referring to the previous studies, we start our multivariate analysis by regressing only the dispersion of the wage levels next to the control variables on the log of value added. First, we use simple OLS to examine differences between firms. Taking into account unobserved heterogeneity, we continue to estimate fixed effects panel regressions. In a second step we include the dispersion of wage increases and its square as explanatory variables. Further on, we split the firms' workforce and examine whether unequal wage increases among blue and/or white collar workers are interrelated to firm performance. In addition to other robustness checks, we also take a look on lead effects.

Results

First of all, it is not surprising that the mean wage in firms is positively related to value added since wages are still to be paid from value added. The regression models (1) and (2) of Table 2 provide additional evidence on the link between wage dispersion and firm performance. As mentioned earlier, there is some evidence in the literature for both a positive and negative context. In contrast to most other studies our study is not limited to certain firms or certain individuals (e.g. executives). The OLS regression (model 1) shows an inversely u-shaped interrelation between the dispersion of wage levels and firm performance across firms. In general, firms with a larger dispersion of wages have higher levels of value added though. Therefore, this result is in line with previous

studies with somewhat crude measures for the dispersion of wages or firm performance (Beaumont & Harris 2003, Winter-Ebmer & Zweimüller 1999).

However, there might be differences across firms – e.g. differences in product markets or the production technology – that are not captured by the control variables and that affect value added and the wage dispersion simultaneously. This may lead to biased and inconsistent parameter estimates. The firm fixed effects estimation (model 2), indeed, reveals that there is no causal effect of wage dispersion per se that is not explained by firm specific factors. That does not mean that we repudiate possible effects – neither positive nor negative – for clear delimited parts of the labor market, which has been shown by previous studies. However, on aggregate we cannot find a significant interrelation of wage dispersion and firm performance.

Insert Table 2 about here

Models (3) and (4) integrate the dispersion of wage growth and its square. The results with respect to the other independent variables are not affected dramatically. There is a u-shaped link between wage growth dispersion and firm performance across firms. This result also holds for the fixed effects estimation (model 4). Up to a minimum for the coefficient of variation of wage growth at about 0.6 the interrelation is negative. Hence, in this range the effect of increasing incentives is dominated by fairness considerations. However, after fairness considerations have been crowded-out and monetary incentives become stronger and stronger, we may find a positive link to value added from a certain point of wage increase dispersion onwards as Gneezy & Rustichini (2000) do observe in their – already cited – experiments. Indeed, for values greater than 0.6 we find a positive link. However, the vast majority of firms (98 %) have dispersions of wage increases of less than 0.6. Hence, marginal increases in wage growth dispersion are associated with reductions of value added for the majority of firms. This is in line with the above cited results from interviews with managers (see Levine 1993, Bewley 1999) that inequality aversion among individuals reduces the attraction of performance related pay.

Revisiting Figure 1, the u-shaped relationship is confirmed instead of the other possible patterns. The supposed fairness effect is thereby dominating the opposed competition effect for the vast majority of firms (see Figure 1).

Insert Figure 1 about here

The results for the control variables show that there is inverse u-shaped interrelation for the percentage of female employees, the mean age and the dispersion of employees' age. In contrast, the effect for firm size is u-shaped. The percentage of blue collar workers and the education level is negatively related to value added for given wages.

These results are robust to different specifications of the regressions and sub samples of the data. We have found the same interrelations for single industries (e.g. manufacturing, construction, and retail) and for a more expanded classification of industries and different categories of firm size. Including the mean wage growth of firms does not change the results, either. One can argue that it is not value added, but profit (defined as value added minus wage cost), what matters. Regressions on profits lead to comparable results though. Using the standard deviation or the gini coefficient instead of the coefficient of variation as the dispersion measure does not change the results, either. Furthermore, the results are robust to inserting the lag of value added as an additional independent variable. Doing this we loose about 5,500 observations, though.

Our data covers the years 1992 to 1997. Therefore, it is worth analysing differences or developments over years. Estimating OLS regressions for each year, the u-shaped interrelation of wage growth dispersion and firm performance is also confirmed (see Table 3). Our main results include that marginal increases in wage growth dispersion are associated with reductions of value added for the vast majority of firms. Now we can revisit this issue by calculating the minimum of the u and the fraction of firms to the right of the minimum for each year. The results confirm that the positive interrelation

between wage growth dispersion and value added (the right hand side of the u) is relatively unimportant. However, it is becoming more and more relevant over time. The fraction of affected firms has been tripled from 1% to 3% over the observation period.[14] One might speculate that we observe a change of spirit if this development has been going on until the present.

Insert Table 3 about here

Often, the production process of firms is organizationally strictly separated from the administration. That is why it seems to be meaningful to look at blue collar and white collar workers separately and compute mean wages, wage dispersion and wage increase dispersion for these two groups of employees individually. In addition we check the possible interrelation of differences in the wages between both groups by taking into account their relative wage.[15] Many firms are characterized by either a majority of blue collar or white collar employees. To get meaningful results we limit the data set to firms with at least 10 blue collar and 10 white collar observations in a particular year. Hence, the sample size is reduced to 11,000 observations and about 3,500 different firms.

It turns out that the wage policy of firms does not play that crucial role for blue collar workers (see Table 4). There are no significant effects for the mean wage of blue collars, the wage dispersion among blue collars or the dispersion of blue collar workers' wage increases. Apparently, for this group of employees other aspects such as monitoring or technological conditions are more important in order to influence firm performance. The wage of white collar workers exceeds the wage of blue collars by around 20 percent on average. The amount of this wage differential has no significant effect on firm performance. In contrast to the blue collar workers, the results for white collar employees show the same patterns as in Table 2 and thereby confirm the overall

[14] The average coefficient of variation of firms remains constant over time (0.18). The standard deviation of the coefficient of variation (0.13) does not change, either.
[15] Note that this was the only measure of firms' wage dispersion of the study by Beaumont and Harris (2003).

results. The effects of the dispersion of wage levels are only significant in the OLS but not in the fixed effect regression. Looking at the dispersion of wage increases among white collars, we again find a u-shaped interrelation to firm performance. Therefore, the overall results are driven by significant effects among the white collar workers.

Insert Table 4 about here

One can argue that the presented effects might be superposed by opposite effects in subsequent years. For example, less capable employees faced by increased wage growth dispersion may first reduce effort and quit their job only after a while. Firms with high wage growth dispersion may benefit from this sorting effect in the long run. To examine possible effects on longer periods, we run the same specification as model (4) of Table 2 with the value added of the subsequent year as the dependent variable. Afterwards we do it also for the second subsequent year. Doing this we loose a considerable number of observations, because information for value added is only available until 1997. It is shown that possible opposed effects such as sorting of employees across firms do not play a crucial role for the results. Again, there is a u-shaped relationship of the dispersion of wage increases on firm performance of the next period as well (see Table 4). One additional year ahead we see there is no significant interrelation any more. Results for regressions on differences of log value added over consecutive years also support our results, although the level of significance decreases.

Insert Table 5 about here

Previous evidence suggests that task interdependence in firms is a key characteristic with regard to the question on how inequality among employees affect individual, group or firm performance (Siegel & Hambrick 2005 and the there cited literature). We have

no information on firms' task interdependence or necessity of cooperation among employees, though. Instead, we have looked at differences across industries, but find no substantial differences. However, task interdependence is likely to differ also across firms within industries.

It is worth mentioning that the wage dispersion over years in firms is also affected by leavers and individuals who join the company. We are aware of the fact that our study is restricted to incumbents, because we want to focus on wage increases in firms. The current wage policy of a firm is also supposed to affect the selection process of people joining and leaving the firm. Implementing an additional control variable that indicates the annual fraction of leavers of the firms do not change the results, though. We leave these two aspects for additional future work.

Discussion and Conclusion

Our study extends previous contributions on the interaction of incentive and fairness effects with respect to the wage policy of firms in at least two ways. First, we can make use of a linked employer-employee data set, which covers all employees and firms of the Danish private sector labor market. Therefore, our results do not depend on specific characteristics of a particular employment relationship like in sports, for example. Second, contrary to previous studies, we focus on the relationship between the dispersion of wage increases (next to levels) and firm performance, because this measure is argued to be a better proxy for the amount of monetary incentives in firms. The cross section analysis of the link between the dispersion of wage *levels* and firm performance shows a positive correlation. This result does not hold, however, when we control for unobserved heterogeneity in a firm fixed effects panel approach.

Our main and robust finding is a u-shaped interrelation between wage increase dispersion in firms and firm performance, where the vast majority of the firms are on

the decreasing part of the U-curve. Therefore, fairness considerations are argued to be more important than competition effects in general. The results are primarily driven by white collar rather than blue collar workers.

Based on our results, recommendations for the wage policy of firms have to include that the management has to be extremely cautious when deviating from the established distribution of wages between employees, because financial losses may occur. Although a certain dispersion of wage levels is possibly perceived as fair (e.g. because of differences in human capital or tasks), increases in the existing wage dispersion will lower the value added because the sense of (un-)fairness dominates the competitive effect of more differential pay. Employees seem to react extremely sensitively to the amount of wage increase dispersion. Fehr and Rockenbach (2003) report evidence from an abstract experiment that people usually cooperate to a certain extent. The degree of cooperation is affected by the possibility that certain incentives can be implemented, which are perceived as a fine. If the fine is imposed, the degree of cooperation decreases. However, the degree of cooperation is even strengthened if a fine is possible, but not imposed. These results may be applied to the 98 percent of firms where we have found that there is a negative correlation between changes in wage dispersion and value added by assuming that a high amount of wage increase dispersion can be perceived as a fine by inequality averse employees. Although increasing the wage growth dispersion leads to a positive incentive or competition effect, cooperation among employees as well as between employees and management may be destroyed. In contrast, cooperation of employees seems to be highest if management consciously abstains from – principally possible – extraordinary dispersion of wage increases and communicates this to the employees in the right way. In this sense, the degree of cooperation seems to be highly correlated with firm performance. Our results also show that these considerations are strongest within the white collar group. The reason can be that blue collar wages are to a much higher degree regulated according to contracts and to union rules so that the fairness consideration is already built into the permissive wage changes.

We have not found differences between industries and firm size categories. However, the effect of the dispersion of wage increases on firm performance might depend on other used features of human resource management in firms or corporate culture. Often, the relevance of monetary incentives is associated with a high degree of monitoring in firms. In contrast, monetary incentives might be unnecessary, if the corporate culture is stamped by trust between management and subordinates (Deckop, Mangel & Cirka 1999). Falk & Kosfeld (2004) find corresponding evidence that trust pays off in a stylized experiment with monetary payoffs. Unfortunately, we are not able to distinguish firms in terms of their corporate culture explicitly. However, our results also suggest that rather firms with trust than monitoring cultures are the successful ones. Corporate culture also differs across countries. Following the cultural dimensions of Hofstede (2006), Denmark can be characterized as a country with a high degree of individualism and a low degree of masculinity, for instance. Being part of the huge international GLOBE project on culture Gelfand et al. (2004) split the one dimensional individualism-collectivism scale into two dimensions: The degree of collectivism at the institutional and the in-group level. Denmark has a collectivistic culture at the institutional level indicating that individuals are integrated into strong cohesive groups and are likely to engage in group activities, for instance. However, it ranks first out of 62 countries among the most individualistic countries at the in-group or firm level, which often comes along with less organizational citizenship behaviour and an equity model, in which an individual is rewarded in direct relationship to his or her contribution to task success. One may speculate that the interrelation of these two types of collectivism and individualism may partly cause our results. Comparable studies of other countries would be interesting to investigate, whether the results hold also for other cultures and which are the crucial elements of a societal culture with respect to this research question.

The results may also be interpreted in the way that extraordinary high wage increases (e.g. based on top past performance) is not associated with a further increase in individual productivity in general. In contrast, these high wage increases in connection with promotions may lead to an inefficient employee-job-allocation, where the Peter Principle occurs (Peter & Hull 1969, Lazear 2004).

Wage increases for employees are often based on some kind of performance appraisal (Fletcher 2001). Possibly, the design of a firm's appraisal scheme acts as a mediator to the link between wage growth dispersion of employees and firm performance. Unfortunately, we have no information on performance appraisals on the individual or firm level. Fletcher (1997) points out that many firms express dissatisfaction with their appraisal schemes. If an appraisal scheme is not transparent or too complicated, employees may not react on monetary incentives by exerting effort. Therefore, firms have to be aware of implementing a transparent appraisal scheme and minimizing rating errors (Delery et al. 1998) in order to convince employees of different wage increases. Many firms have implemented new forms of performance appraisal such as the balanced scorecard (Kaplan & Norton 1996) since the observation period of our study (1992-1997). Hence, a re-examination of our study seems to be interesting, when data from the 21st century are also available.

Future research is also supposed to analyze, whether our findings are robust for other institutional environments as well. It may well be the case that fairness considerations are less or even more important in other countries. The dispersion of wage increases and the perceived fairness are influenced by unions in many countries to some extent, which may influence the results. The main problem is that appropriate data sets such as the Danish one are necessary in order to make meaningful evaluations.

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Table 1: Descriptive statistics

	Whole Sample	
	Mean	**Standard deviation**
Value added per employee (in 1,000 DKK) [a]	436.22	331.87
Percentage blue collar workers	0.652	0.247
Percentage females	0.269	0.213
Mean hourly wage (in DKK) [a]	155.73	28.77
Wage dispersion [b]	0.330	0.153
Dispersion of wage growth [b]	0.177	0.164
Mean education (in months)	142.98	12.77
Dispersion of education [b]	0.202	0.053
Mean age (in years)	37.68	3.892
Dispersion of age [b]	0.283	0.046
Firm size (# employees)	123.04	447.90
Number of observations	22,178	

Note: [a] In prices of 1997. [b] Dispersion measured by coefficient of variation (= standard deviation / mean).

Table 2: Regressions on firm performance
[Dependent variable: log (value added per employee)] [a]

	OLS	Fixed effects	OLS	Fixed effects
	(1)	(2)	(3)	(4)
Mean wage [b]	0.006**	0.002**	0.006**	0.002**
	(40.43)	(8.15)	(41.25)	(8.33)
Wage dispersion [c]	0.393**	-0.038	0.498**	-0.021
	(7.78)	(1.09)	(9.76)	(0.58)
Wage dispersion squared	-0.333**	-0.018	-0.358**	-0.026
	(9.39)	(0.81)	(10.08)	(1.18)
Wage growth dispersion [c]	----	----	-0.728**	-0.121**
			(11.79)	(3.36)
Wage growth dispersion squared	----	----	0.480**	0.102**
			(8.53)	(3.22)
Percentage blue collars	-0.614**	-0.068**	-0.591**	-0.067**
	(29.33)	(3.88)	(28.23)	(3.83)
Percentage females	0.882**	0.303**	0.866**	0.305**
	(15.95)	(3.39)	(15.72)	(3.40)
Percentage females squared	-1.305**	-0.417**	-1.275**	-0.419**
	(20.19)	(3.70)	(19.80)	(3.72)
Mean education (in months)	-0.005**	-0.002**	-0.005**	-0.002**
	(9.37)	(2.78)	(9.40)	(2.88)
Dispersion of education [c]	0.287*	-0.207	0.311**	-0.205
	(2.49)	(1.55)	(2.71)	(1.54)
Mean age (in years)	0.058**	0.027*	0.047**	0.025
	(5.16)	(2.06)	(4.18)	(1.93)
Mean age squared	-0.001**	-0.0003*	-0.001**	-0.0003
	(5.87)	(2.01)	(5.09)	(1.91)
Dispersion of age [c]	1.682**	0.894	1.747**	0.925
	(2.90)	(1.79)	(3.02)	(1.85)
Dispersion of age squared	-4.734**	-1.571	-4.658**	-1.591
	(4.81)	(1.84)	(4.75)	(1.86)
Firm size (# employees) * 100	0.007**	-0.030**	0.009**	-0.029**
	(6.17)	(6.73)	(7.32)	(6.59)
Firm size squared * 1,000,000	-0.003**	0.009**	-0.004**	0.009**
	(3.48)	(5.53)	(4.29)	(5.43)
Industry dummies (5)	Yes	Yes	Yes	Yes
Year dummies (6)	Yes	Yes	Yes	Yes
Intercept	4.756**	5.500**	5.013**	5.540**
	(22.52)	(21.38)	(23.73)	(21.52)
R^2	0.269 [d]	0.035 [e]	0.275 [d]	0.036 [e]
Number of observations	22,178	22,178	22,178	22,178

Note: Absolute t-values in parentheses-. * and ** indicate significance at the 0.05 and 0.01 level. [a] value added in 1,000 DKK. [b] hourly gross wage in DKK. [c] Dispersion measured by coefficient of variation (= standard deviation / mean). [d] Adjusted R^2 is reported. [e] Within R^2 is reported.

Figure 1: The link between wage increase dispersion in firms and value added per employee

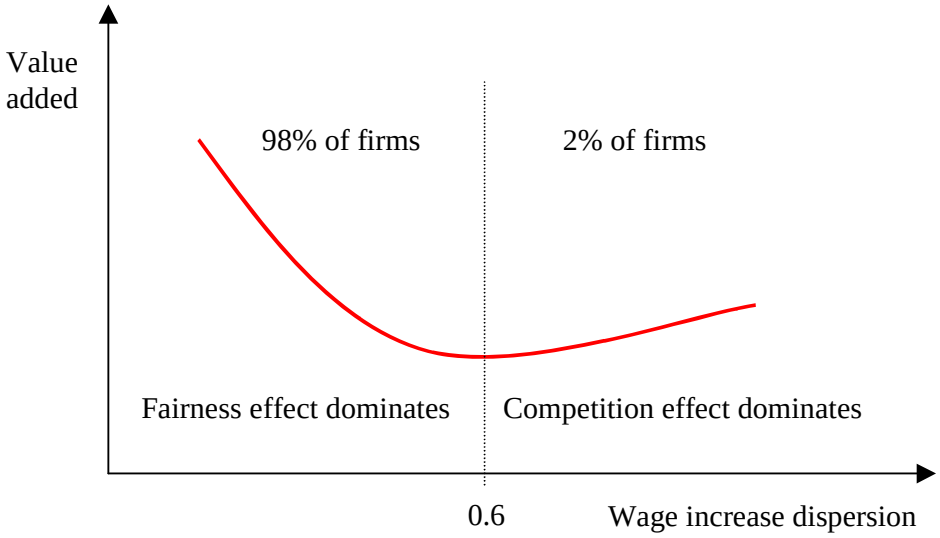

Table 3: Cross section regressions on firm performance
[Dependent variable: log (value added per employee)]

Year		OLS	Minimium	Fraction of firms right of the minimum
1992	Wage growth dispersion	-0.653** (4.12)	0.899	0.9%
	Wage growth dispersion squared	+0.363* (2.47)		
1993	Wage growth dispersion	-0.936** (6.75)	0.771	1.3%
	Wage growth dispersion squared	+0.607** (5.05)		
1994	Wage growth dispersion	-0.516** (3.50)	0.753	1.5%
	Wage growth dispersion squared	+0.343* (2.11)		
1995	Wage growth dispersion	-0.718** (5.48)	0.719	1.6%
	Wage growth dispersion squared	+0.499** (4.49)		
1996	Wage growth dispersion	-0.631** (3.93)	0.659	2.1%
	Wage growth dispersion squared	+0.479** (3.05)		
1997	Wage growth dispersion	-0.999** (4.52)	0.518	3.0%
	Wage growth dispersion squared	+0.965** (4.01)		

Notes: Control for mean wage, wage dispersion and its square, percentage blue collars, percentage females, percentage females squared, mean education, dispersion of education, mean age, mean age squared, dispersion of age, dispersion of age squared, firm size, firm size squared, industry dummies (5) and year dummies (6) as in regressions of Table 2. Absolute t-values in parentheses. * and ** indicate significance at the 0.05 and 0.01 level.

Table 4: Regressions on firm performance
Blue collar and white collar workers divided
[Dependent variable: log (value added per employee / 1000)][a]

	OLS	Fixed effects
	(1)	(2)
Mean blue collar wage [b]	0.003**	0.0002
	(3.57)	(0.32)
Blue collar wage dispersion [c]	0.068	0.067
	(0.87)	(1.18)
Blue collar wage dispersion squared	-0.029	-0.062
	(0.45)	(1.48)
Blue collar wage growth dispersion [c]	-0.343**	-0.020
	(4.70)	(0.44)
Blue collar wage growth dispersion squared	0.179**	0.010
	(3.30)	(0.32)
Mean white collar wage [b]	0.004**	0.001*
	(6.25)	(1.99)
White collar wage dispersion [c]	0.668**	0.073
	(8.30)	(1.19)
White collar wage dispersion squared	-0.457**	-0.083
	(7.33)	(1.95)
White collar wage growth dispersion [c]	-0.443**	-0.155**
	(5.51)	(3.10)
White collar wage growth dispersion squared	0.302**	0.127**
	(4.63)	(3.28)
Mean white collar wage / mean blue collar wage	-0.223*	-0.079
	(2.34)	(1.08)
Control for percentage blue collars, percentage females, percentage females squared, mean education, dispersion of education, mean age, mean age squared, dispersion of age, dispersion of age squared, firm size, firm size squared, industry dummies (5) and year dummies (6)	Yes	Yes
Intercept	5.858**	5.559**
	(15.97)	(10.04)
R^2	0.210 [d]	0.027 [e]
Number of observations	11,134	11,134

Note: Firms with at least 10 blue collar and 10 white collar employees in data. Absolute t-values in parentheses-. * and ** indicate significance at the 0.05 and 0.01 level. [a] value added in 1,000 DKK. [b] hourly gross wage in DKK. [c] Dispersion measured by coefficient of variation (= standard deviation / mean). [d] Adjusted R^2 is reported. [e] Within R^2 is reported.

Table 5: Wage growth dispersion and value added in t, t+1 and t+2

	Fixed effects estimations		
	Value added (t)	**Value added (t+1)**	**Value added (t+2)**
Wage growth dispersion	-0.121**	-0.171**	-0.007
	(3.36)	(4.15)	(0.14)
Wage growth dispersion squared	0.102**	0.132**	0.014
	(3.22)	(3.74)	(0.34)
Within R^2	0.036	0.013	0.012
Number of observations	22,178	17,689	13,002

Note: Same specification as reported in Table 2 (model (4)). Absolute t-values in parentheses-. ** indicate significance at the 0.01 level.