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Chapter Author: Thierry Lallemand, Robert Plasman, François Rycx

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Wage Structure and Firm Productivity in Belgium

Thierry Lallemand, Robert Plasman, and François Rycx

6.1 Introduction

Relative wages are often considered as a key determinant of the workers' effort. Indeed, because workers often compare their wages with those of their coworkers, it is argued that the intrafirm wage dispersion has an impact on the individual worker's productivity and thus on the average firm performance. However, there is no consensus regarding the precise impact of intrafirm wage dispersion on firm productivity. On the one hand, the single-period rank-order version of the tournament models (e.g., Lazear and Rosen 1981) stresses the positive influence of wage inequality within a firm on the worker's effort. This model suggests that firms should implement a differentiated prize structure and award the largest prize to the most

Thierry Lallemand is a lecturer, teaching assistant, and research fellow in the Department of Applied Economics (DULBEA) and the Center for Accounting and Management (Centre de Comptabilité et Contrôle de Gestion) at the Free University of Brussels. Robert Plasman is a professor and head of the Department of Applied Economics (DULBEA) at the Free University of Brussels. François Rycx is an associate professor of economics in the Department of Applied Economics (DULBEA) at the Free University of Brussels.

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productive worker. On the other hand, other theories argue for some wage compression within a firm by emphasizing the importance of fairness and cooperation among the workforce (e.g., Akerlof and Yellen 1990; Levine 1991).

Empirical studies, focusing on the relationship between wage disparities and firm performance, are not very numerous, and their results vary significantly. Due to a lack of appropriate data, these studies often rely on economy-wide inequality indicators or use self-constructed indicators of firm performance. Moreover, they are generally restricted to a specific segment of the labor force (e.g., the top management level) or a particular sector of the economy (e.g., the manufacturing sector, academic departments, professional team sports). In sum, the available evidence does not appear to be very compelling yet (Frick, Prinz, and Winkelmann 2003).

The aim of this chapter is twofold. First, we analyze the structure of wages within and between Belgian firms. Next, we examine how the productivity of these firms is influenced by their internal wage dispersion. Our study is based on a unique matched employer-employee data set. This data set derives from the combination of the 1995 Structure of Earnings Survey and the 1995 Structure of Business Survey. The former contains detailed information on firm characteristics (e.g., sector of activity, size of the firm, and level of wage bargaining) and on individual workers (e.g., gross hourly wages, bonuses, age, education, sex, and occupation). The latter provides firm-level information on financial variables (e.g., gross operating surplus, value added, and value of production).

To analyze the impact of wage dispersion on firm productivity, we followed the methodology developed by Winter-Ebmer and Zweimüller (1999). It rests on a two-step estimation procedure. First, we compute conditional intrafirm wage differentials by taking the standard errors of wage regressions run for each firm. Next, we use these conditional wage differentials as an explanatory variable in a firm-level productivity regression. However, as a sensitivity test, we also analyze the impact of unconditional indicators of intrafirm wage dispersion on firm productivity. These indicators include the standard deviation, the coefficient of variation, and the max-min ratio of the gross hourly wages within the firm. The productivity of a firm is measured by the value added per employee. We address the potential simultaneity problem between wage dispersion and firm productivity using information from the Belgian income tax system. More precisely, we apply two-stage least squares (2SLS) and instrument the dispersion of wages, *including* bonuses, by the intrafirm standard deviation of income taxes on gross earnings *excluding* bonuses.

To our knowledge, this chapter is one of the first to examine the effect of intrafirm wage dispersion on firm performance in the private sector using both a conditional wage inequality indicator and direct information on firm productivity. It is also one of the few, with Bingley and Eriksson (2001) and Heyman (2002), to consider potential simultaneity problems. Empirical findings, reported in this chapter, support the existence of a positive and significant relationship between wage inequality and firm productivity. Moreover, we find that the intensity of this relationship is larger for blue-collar workers and within firms with a high degree of monitoring. These results are more in line with the tournament models than with the fairness, morale, and cohesiveness models.

The remainder of this chapter is organized as follows. Section 6.2 reviews the literature (both theoretical and empirical) dealing with the impact of intrafirm wage dispersion on firm productivity. Section 6.3 summarizes the main features of the wage-bargaining process in the Belgian private sector. Sections 6.4 and 6.5 describe the data and variables as well as structure of wages within and between Belgian firms. The impact of intrafirm wage dispersion on firm productivity is analyzed in section 6.6. The last section concludes.

6.2 Review of the Literature

6.2.1 Theoretical Findings

A first interpretation of the relationship between within-firm wage dispersion and firm performance has been provided by Akerlof and Yellen (1988). On the basis of the effort version of the efficiency wage theory (Solow 1979), the authors argue that, in a firm where the workers' characteristics are not totally observable and where the monitoring of their actions is not perfect, employers have to find well-suited incentives to maximize the workers' effort. According to Akerlof and Yellen (1988), the effort function of a worker can be written as follows: $e = e[\sigma^2(w)]$, where e denotes the level of effort and $\sigma^2(w)$ the variance of wages within the firm. This expression shows that the worker's effort does not only depend on the wage level but also on the degree of salary dispersion within the firm. Using this expression, the authors argue that a compressed wage distribution improves labor relations and stimulates the average worker's effort. To put it differently, firms should achieve a greater output per worker if their wage dispersion is low.

Later, Akerlof and Yellen (1990) developed the fair wage-effort hypothesis. This hypothesis clarifies their previous reasoning by developing in greater detail the notion of fairness and introducing the concept of relative wages.[1] The basic idea is that workers often compare their wages either internally (i.e., with workers within the same firm) or externally (i.e., with

1. The fair wage-effort hypothesis is based on the social exchange theory in sociology (e.g., Blau 1955; Homans 1961) and on the equity theory in psychology (e.g., Adams 1963). Both theories show the existence of a relationship between effort and fairness.

workers in other firms or industries). Therefore, Akerlof and Yellen (1990) consider the following worker's effort function: $e = \min[(w / \hat{w}), 1]$, with w the actual wage, $\hat{w}$ the fair wage, and e equal to 1 if the level of effort is normal. This expression shows that workers reduce their effort if their actual wage falls short of the wage they regard as fair. According to the authors, a wage is generally considered as fair if the pay spread is lower than the performance differential. This means that a worker would act so as to preserve a certain equilibrium between the subjective value of input and the subjective value of return. Levine (1991) put forward this argument by stressing that pay compression within a firm where teamwork among employees is essential (i.e., participatory firms) sustains and stimulates cohesiveness, which increases the firm's total productivity.

The preceding notions of fairness, morale, and cohesiveness led Hibbs and Locking (2000) to define the following firm-level production function: $Q = \mathrm{Ef}[\sigma^2(w)]F(L, \ldots)$, with Q the real value added, Ef(.) the labor effectiveness depending on the within-firm wage dispersion, F a standard production function, and L the labor inputs to production. This expression shows that the performance of a firm depends positively upon the efficiency of labor, which is negatively correlated with the intrafirm wage dispersion (i.e., $\mathrm{Ef}' < 0$, $\mathrm{Ef}'' > 0$). As a result, this model of fairness, morale, and cohesiveness suggests that firms have a strong incentive to implement a wage distribution that is more compressed than the variation in workers' productivities.

A complementary theory promoting wage compression to increase firm performance has been developed by Milgrom (1988) and Milgrom and Roberts (1990). The authors emphasize that (white-collar) workers have incentives to (1) withhold information from managers in order to increase their influence and (2) engage in costly rent-seeking activities instead of productive work. They also argue that the implementation of some wage equity can reduce the potential tendency of workers to take personal interest decisions, which may not be profitable for the organization as a whole. Moreover, they stress that it is more costly to monitor the actions of white-collar workers. Therefore, lower levels of wage dispersion would be even more important for the latter.

In contrast to the previous literature, the relative compensation or *tournament* model, developed by Lazear and Rosen (1981), points to the benefits of a more dispersed wage structure, deriving from a performance-based pay system. This model suggests that managers should introduce a large spread in the rewards of workers in order to stimulate their effort. In other words, firms should establish a differentiated prize structure and award the largest prize to the most productive worker.[2] Formally, Lazear and Rosen

2. There is some ambiguity in the literature about the definition of a prize. It can be seen either as a promotion (i.e., to get a task with higher responsibilities and to rise in the firm hierarchy) or as a bonus.

(1981) consider two identical risk-neutral workers and a risk-neutral firm, with a compensation scheme such that the most productive worker receives a high wage (W_H) and the least productive a low wage (W_L). On the basis of these assumptions, the authors show that, ceteris paribus, workers' optimal level of effort (1) increases with prize dispersion ($W_H - W_L$) and (2) decreases with the random component of output (e.g., luck).[3] This model has been generalized by McLaughlin (1988) for *n* players. The author shows that the number of players matters and that the probability to win a game decreases with the number of contestants. Consequently, to stimulate workers' effort, there should be a positive correlation between the prize spread and the number of contestants.

Lazear (1989, 1995) argues, however, that high within-firm wage dispersion generates more competition between the workers, which may negatively affect firm performance. Indeed, considering an organization in which several workers are noncooperative or have a sabotage behavior (hawks), and others who are less aggressive (doves), the author shows that wage compression is crucial for firm performance.[4] The point is that the noncooperative activities adopted by hawks reduce the total effort level of the workers. In other words, the positive impact of an output-based pay system on firm performance may be offset by a lower level of work cohesion due to the sabotage behavior of hawks. As a result, it appears profitable for a firm to (1) adequately sort out workers before hiring them and (2) adjust the compensation scheme to the hierarchical level.

A further strand of the literature, developed by Frey (1997) and Frey and Osterloh (1997), focuses on the interplay between wage dispersion and intrinsic motivation.[5] This literature shows that the implementation of explicit incentive contracts (e.g., performance-based pay systems) can crowd out the intrinsic motivation of the workers by generating excessive external monitoring (in particular, for workers who need autonomy in their job and who have high responsibilities). However, it can also enhance intrinsic motivation by supporting the workers' own motivation, self-esteem, and feeling of competence. In sum, this literature emphasizes the importance of a correct match between the compensation scheme and the monitoring environment within a firm (Belfield and Marsden 2003).

6.2.2 Empirical Findings

Empirical studies examining the relationship between wage disparities and firm performance are not very numerous, and their results vary

3. For a discussion of Lazear and Rosen's (1981) model, see Gibbons and Waldman (1999).
4. According to Lazear (1989, 1995), hawks are often found at the top level of the organization; that is, mainly among white-collar workers. His arguments are thus in line with those of Milgrom (1988) and Milgrom and Roberts (1990). The counterproductive effect should be greatest within the higher echelons of the hierarchy.
5. It derives from the psychological literature that suggests that intrinsic motivation is the main driving force of workers' effort.

markedly. Due to a lack of appropriate data, these studies often rely on economy-wide inequality indicators or use self-constructed indicators of firm performance. Moreover, they are generally restricted to a specific segment of the labor force (e.g., the top-management level) or a particular sector of the economy (e.g., the manufacturing sector, academic departments, professional team sports). In what follows, we review the main features of these studies.[6]

A first strand of the empirical literature provides evidence in favor of the fairness, morale, and cohesiveness theory, developed by Akerlof and Yellen (1990) and Levine (1991). Cowherd and Levine (1992), for instance, examine the relationship between interclass pay equity and the performance of business units by integrating the body of equity, relative deprivation, and quality management theories.[7] Their study is based on data collected from 102 business units with more than 59 employees, in North America (72 percent) and Europe (28 percent). The performance of a business unit is measured by the quality of its production.[8] According to the authors, product quality is a good indicator of firm performance because it is (1) difficult for managers to control and (2) a function of the willingness of lower-level employees to contribute more than can formally be asked from them. Their empirical findings show the existence of a substantial positive relationship between interclass pay equity and product quality. The authors attribute this result to the impact of pay equity on three aspects of lower-level employee motivation: commitment to managerial goals, effort, and cooperation.

Pfeffer and Langton (1993) analyze how within-academic departments wage dispersion and pay schemes affect the individual's satisfaction, research performance, and cooperation, using a large sample of college and university faculty in the United Kingdom.[9] Their data set contains information on circa 17,000 college and university professors from 600 academic departments located in some 300 institutions.[10] Salary dispersion is measured by an unconditional indicator—that is, the coefficient of variation (the standard deviation divided by the mean) in salaries within a given academic department. Controlling for numerous predictors, the authors observe statistically and substantively significant negative effects of pay

6. For a summary, see appendix A.

7. Interclass pay equity is measured by the pay relation of hourly paid employees to top-three levels of management, controlling for the business size effect. A business unit is defined as any autonomous organizational unit that has top management with decision-making authority in areas like manufacturing and sales.

8. The latter is measured by customers in relative terms; that is, in comparison with the product quality of the main competitors of each business unit.

9. The data come from the Carnegie Commission's 1969 survey of college and university faculty.

10. The authors confined their attention to respondents in departments with a size of twenty or larger that had a response rate to the questionnaire greater than 50 percent.

dispersion. To put it differently, they find that, on average, people are less satisfied, do less collaboration on research, and have a lower productivity when the pay distribution is more dispersed. Moreover, results show that the extent to which wage dispersion produces adverse effects depends on one's position in the salary structure and factors such as information, commitment, consensus, and the level of certainty in the evaluation process.

A number of studies, essentially concentrated on the United States, have been devoted to the interaction between salary dispersion and performance in the team sports industry. Using mainly unconditional measures of wage inequality (e.g., the Gini index), these studies generally conclude that pay compression is beneficial for team performance (e.g., the win-loss percentage).[11] The study of Frick, Prinz, and Winkelmann (2003) is the first to attempt to measure the impact of pay inequalities on the performance of professional team sports across different leagues. Their approach enables them to implicitly control for the influence of different institutional regimes and production technologies. Using panel data from the four major North American sports leagues (i.e., baseball, basketball, football, and hockey), their study supports neither the fairness, morale, and cohesiveness hypotheses nor the tournament theories. Indeed, findings vary substantially between the four leagues. According to their estimates, a higher degree of intrateam wage dispersion is beneficial to the performance of professional basketball and hockey teams.[12] However, the reverse relationship is found for football and baseball teams; that is, a team is more successful if its pay distribution is more compressed. The authors attribute the diversity in their results to the different degrees of cooperation requirements in the four leagues.

Another strand of the empirical literature offers evidence in favor of the tournament theory developed by Lazear and Rosen (1981). Winter-Ebmer and Zweimüller (1999), for instance, investigate the impact of intrafirm wage dispersion on firm performance using panel data covering the whole Austrian workforce for the period 1975 to 1991.[13] They measure within-firm wage inequality by the standard errors of firm-level wage equations. This conditional indicator controls for the composition of the workforce within each firm.[14] Unfortunately, the authors did not observe the financial performance of the firms. As a result, they have constructed their own per-

11. For professional baseball teams, see Bloom (1999), DeBrock, Hendricks, and Koenker (2001), Depken (2000), Harder (1992), or Richards and Guell (1998). For soccer and hockey teams, see, respectively, Lehmann and Wacker (2000) and Gomez (2002).

12. For hockey teams, the coefficient is positive but not significantly different from zero.

13. Their sample is restricted to firms with more than twenty employees and with at least four data points.

14. The data report monthly earnings that are top coded. The explanatory variables in the tobit wage regressions, run separately for each firm, include age, age squared, and dummies for sex, blue-collar, foreigner, and two tenure dummies. Information on education levels is not available.

formance indicator—that is, standardized wages. Of course, this instrument is not perfectly adequate. Be it as it may, controlling for several predictors, their findings suggest the existence of a positive and hump-shaped relationship between intrafirm wage dispersion and firm performance, for both blue- and white-collar workers. Yet the overall pattern appears more monotonic for blue-collar workers. These findings are in line with the hypothesis that too little wage inequality negatively affects firm performance due to a lack of incentives. However, they also suggest that excessive wage dispersion can be harmful for productivity because of fairness effects. According to the authors, the contrasting results for blue- and white-collar workers appear to be consistent both with theories of intrinsic motivation and rent-seeking and with the prevalence of piece rates in blue-collar jobs.

Hibbs and Locking (2000) examine the effects of changes in the overall wage dispersion during the periods 1964 to 1993 and 1972 to 1993 on the productive efficiency of Swedish industries and plants. To do so, they first decompose the total variance in individual wages *within* and *between* plants (and industries). Next, they integrate the squared coefficients of variation of these components at the plant (or industry) level in an Akerlof and Yellen's (1990) type of production function. The dependent variable in this equation—that is, their performance indicator—is the log of real value added at the plant (or industry) level.[15] Their empirical findings do not confirm that wage leveling within plants and industries enhance productivity. Therefore, they do not support the fairness, morale, and cohesiveness theories.

Bingley and Eriksson (2001) analyze the impact of pay spread and skewness on two performance indicators—that is, firm productivity and employee effort. Their study uses longitudinal matched employer-employee data comprising information on Danish medium and large private-sector firms during the period 1992 to 1995. It is the first to address potential simultaneity problems using information from the income tax system. Firm productivity and employee effort are estimated by the total factor productivity and the sickness absence, respectively. Differences in firm productivity effects between the occupational groups and types of firms give support to the theories of fairness, tournaments, and tastes for skewness. In contrast, individual effort effects only back up the tournament theory.

Finally, a number of papers present evidence on the interaction between the pay structure of top executives and firm performance. Focusing on managers in large U.S. firms, Leonard (1990) finds no significant relationship between the standard deviation of pay and firm performance—that is,

15. Their production function is as follows: $\ln(Q) = \ln[\mathrm{Ef}[\sigma^2(w)]\, F(.)]$, where $\mathrm{Ef}[\sigma^2(w)] = \mathrm{Ef}[\mathrm{CV}^2(W), \mathrm{CV}^2(B)]$. In this expression, Q represent the real value-added, Ef(.) the labor effectiveness depending on $\sigma^2(w)$ (i.e., the total variation in individual wages), and $F(.)$ a standard production function (e.g., Cobb-Douglas, CES, or Translog). $\mathrm{CV}^2(W)$ and $\mathrm{CV}^2(B)$ stand, respectively, for the within and between components of the total variance of individual wages (squared coefficient of variation) among workers' assortment by plants (or industries).

the return on investment. In contrast, using respectively U.S. and Swedish data, Main, O'Reilly, and Wade (1993) and Eriksson (1999) report a positive impact of top executive pay dispersion on firm performance. The latter is measured by returns on assets and the profits-sales ratio, respectively. The paper of Heyman (2002) is the first to explicitly control for firm differences in human capital when testing several predictions from the tournament theory for white-collar workers and, in particular, managers.[16] Potential endogeneity problems are addressed using lagged predetermined values of wage dispersion. On the basis of a large matched employer-employee data set for the Swedish economy in 1991 and 1995, the author finds a positive effect of wage dispersion on profits.

6.3 Wage Bargaining in Belgium

Before describing our data set and turning to the empirical analysis, we briefly summarize the main features of the wage bargaining process in the Belgian private sector.

In the countries of North America, the legal provisions offer workers the possibility of voting for or against their companies' joining a union in elections supervised by the public authorities. This means that the union can earn the exclusive right to represent all the workers, whether union members or not, in bargaining with the employers. Yet as the majority of the collective agreements are negotiated at the level of the individual companies, the institutional system leads to a clear distinction between the unionized establishments—in other words, those that are subject to a collective agreement—and the nonunionized establishments. Hence, the rate of unionization provides a good approximation of the coverage rate or the bargaining regime.

In Belgium, as in the majority of European countries, the situation is very different. The point is that wage bargaining in the Belgian private sector occurs at three levels : the national (interprofessional) level, the sectoral level, and the company level. They generally occur every two years on a pyramidal basis. In principle, they are inaugurated by a national collective agreement defining a minimum level in wage terms. This national agreement can be improved within every sector of activity. Then we have the company negotiations, where the sectoral collective agreements may be renegotiated, except where there is a so-called imperative clause. However, these cannot give rise to a collective agreement that would run counter to the sectoral or national agreements. In other words, the wage bargained at the firm level can only be greater or equal to the wage set at the national or industry level.

16. His conditional indicator of wage dispersion is the same as in Winter-Ebmer and Zweimüller (1999).

Belgium is characterized, in addition, by a coverage rate of about 90 percent (Organization for Economic Cooperation and Development [OECD] 1997, 2002). This stems from the fact that nonunionized workers, like employers not members of an employers' organization, are generally covered by a collective labor agreement. The point is that Article 19 of the law dated 5 December 1968 specifies that a collective agreement is automatically binding on the signatory organizations, employers who are members of those organizations or who have personally concluded the agreement, employers joining those organizations after the date of the conclusion of the agreement, and finally, all workers, *whether unionized or not*, who are employed by an employer so bound. Moreover, most of the sectoral collective agreements have been rendered obligatory by Royal Decree. This means that they apply compulsorily to all companies in the sector and to their workers, *whether or not they are members* of the signatory organizations (employers' organizations or unions).[17]

To sum up, unlike in the United States or Canada, the bargaining regime in companies in the Belgian private sector does not derive directly from the latter's union membership. It is reflected more through the level of wage bargaining. The heart of the wage bargaining lies at the sectoral level in Belgium. However, in certain cases, sectoral agreements are renegotiated (improved) within individual companies.[18]

6.4 Data and Variables

Our analysis is based on a unique combination of two large-scale data sets. The first, conducted by Statistics Belgium,[19] is the 1995 Structure of Earnings Survey (SES). It covers all Belgian firms employing at least ten workers and with economic activities within sections C to K of the Nace Rev. 1 nomenclature. It thus encompasses the following sectors: mining and quarrying (C); manufacturing (D); electricity and water supply (E); construction (F); wholesale and retail trade; repair of motor vehicles, motorcycles, and personal and household goods (G); hotels and restaurants (H); transport, storage, and communication (I); financial intermediation

17. The trade union density in Belgium stands at around 54 percent (OECD 1997, 2002).

18. These institutional features are crucial to understand why Belgium has a relatively compressed wage distribution and how the wage setting system could be changed to generate more wage inequalities. Although the literature on wage dispersion and collective bargaining in corporatist countries is still limited and to some extent mixed (Dell'Aringa and Lucifora 1994; Dell'Aringa and Pagani 2007; Dominguez and Rodriguez-Gutiérrez 2004; Plasman, Rusinek, and Rycx 2007; Rycx 2003), results for Belgium suggest that company collective agreements increase (slightly) wage dispersion compared to multi-employer agreements. Hence, one way to raise intra-firm wage inequalities might be to decentralise the wage bargaining process from the sectoral to the firm level. Yet, great caution is required as results on the relationship between wage inequality and the level of collective wage bargaining are still fragile.

19. This is according to the instructions given by Eurostat (E-U regulation Nr. 2744/95).

(J); and real estate, renting, and business activities (K). The survey contains a wealth of information, provided by the management of the firms, both on the characteristics of the firms (e.g., sector of activity, number of workers, level of collective wage bargaining, type of economic and financial control, region) and on the individual employees (e.g., age, educational level, tenure, gross earnings, paid hours, sex, occupation, type of contract, annual bonuses).[20] Gross hourly wages, *without* bonuses,[21] are calculated by dividing total gross earnings (including earnings for overtime hours and premiums for shift work, night work, or weekend work) in the reference period (October 1995) by the corresponding number of total paid hours (including paid overtime hours). In contrast, gross hourly wages, *with* bonuses, are obtained by adding to the gross hourly wages (without bonuses) the annual bonuses divided by (1) the number of month to which the bonuses correspond and (2) the number of total paid hours in the reference period, respectively.

Unfortunately, the SES provides no financial information. This is why the SES has been combined with the 1995 Structure of Business Survey (SBS). It is a firm-level survey, conducted by Statistics Belgium, with a different coverage than the SES in that it includes neither the financial sector (Nace J) nor the firms with less then 20 employees. Both data sets have been merged by Statistics Belgium using the firm social security number. The SBS provides firm-level information on financial variables such as sales, value added, production value, gross operating surplus and value of purchased goods and services.

The final sample, combining both data sets, covers 34,969 individuals working for 1,498 firms.[22] It is representative of all firms employing at least twenty workers within sections C to K of the Nace Revision 1 nomenclature, with the exception of the financial sector.

20. The SES is a stratified sample. The stratification criteria refer respectively to the region (NUTS1), the principal economic activity (NACE-groups) and the size of the firm (determined by the data obtained from the Social Security Organisation). The sample size in each stratum depends on the size of the firm. Sampling percentages of firms equal respectively 10, 50, and 100 percent when the number of workers is lower than 50, between 50 and 99, and above 100. Within a firm, sampling percentages of employees also depend on size. Sampling percentages of employees reach respectively 100, 20, and 10 percent when the number of workers is lower than 50, between 50 and 99, and above 100. The consequence of these stratification criteria is that the number of data points depends upon firm size. For this reason, wage inequality indicators computed in sections 6.5 and 6.6 may be slightly biased. Finally, let us also notice that no threshold at the upper limit of wages is to be found in the SES. To put it differently, wages are not censored. For an extended description of the SES, see Demunter (2000).

21. Annual bonuses include irregular payments that do not occur during each pay period, such as pay for holiday, thirteenth month, or profit-sharing.

22. If we only consider full-time employees (i.e., individuals working a minimum thirty hours per week) and firms with at least twenty-five workers, our sample still covers 31,788 individuals working for 1,445 firms.

6.5 Structure of Wages within and between Firms

In this section, we analyze the structure of gross hourly wages, with and without bonuses, in the Belgian private sector. In particular, we focus on the dispersion of wages within and between firms. Between firms, wage dispersion is measured by the standard deviation of each firm's mean wage. Within firms, wage inequality is estimated by the mean over all firms of each firm's standard deviation, coefficient of variation, and max-min ratio of wages, respectively. As agreed, we only consider full-time employees (i.e., individuals working a minimum thirty hours per week) and firms with at least twenty-five workers. Statistics on the structure of wages have been computed for the overall sample as well as by firm size (i.e., number of employees below *or* above 100), level of collective wage agreement (i.e., only national or sectoral collective agreement *versus* firm-level collective agreement) and composition of the workforce (i.e., majority of blue- *versus* white-collar workers). Qualitative results are similar for gross hourly wages with and without bonuses. Therefore, in what follows, we solely comment on the latter.[23]

6.5.1 Overall Sample

Table 6.1 shows that, for the overall sample, the mean individual gross hourly wage stands at 12.25 EUR, with a standard deviation equal to 5.38. We also find that the dispersion of wages between firms is slightly higher than within firms (3.01 versus 2.90). Moreover, there appears to be a positive and significant correlation between the average and standard deviation of wages within firms. Thus, results suggest that high-paying firms are characterized by a more dispersed wage structure.

6.5.2 Firm Size

Besides, we see that the mean and dispersion of wages increase with firm size. We also notice that for both small and large firms (1) the correlation between the average and standard deviation of wages within firms remains positive and significant, and (2) the wage inequality between firms is slightly larger than the wage inequality within firms. However, wage dispersion within and between firms rises with firm size.

The positive relationship between wages and firm size is in line with neoclassical and institutional arguments supporting the existence of a positive size-wage premium. These arguments suggest inter alia that large employers (1) hire more qualified workers (e.g., Hamermesh 1980; Kremer and Maskin 1996; Troske 1999), (2) compensate for bad working conditions, (3) have more market power and share their excess profits with their workers (e.g., Mellow 1982; Slichter 1950; Weiss 1966), (4) avoid or mimic

23. Statistics on the structure of gross hourly wages with bonuses are reported in appendix B.

Table 6.1 **Structure of wages (without bonuses) within and between firms, 1995**

		Firm size		Level of wage bargaining			Workforce composition	
	Overall sample[a]	Small firms (25–99 workers)	Large firms (≥ 100 workers)	CA only at national and/or sectoral level	Firm level CA	Other or no CA	Majority blue-collar workers	Majority white-collar workers
Average wages[c]	12.25	11.03	12.77	11.67	12.88	11.75	n.a.	n.a.
SD[b]	5.38	4.80	5.53	5.65	5.00	5.56	n.a.	n.a.
25th percentile	9.10	8.45	9.50	8.62	9.88	8.58	n.a.	n.a.
75th percentile	13.52	11.82	14.12	12.59	14.24	12.63	n.a.	n.a.
No. of workers	31,788	9,450	22,338	14,123	15,713	1,952	n.a.	n.a.
Average of firm average wage[d]	11.10	10.80	11.91	10.93	11.60	10.68	9.92	12.22
SD	3.01	2.83	3.33	3.06	2.76	3.21	1.73	3.51
25th percentile	9.16	9.08	9.68	9.10	9.88	8.90	8.70	9.69
75th percentile	12.47	12.07	13.38	12.11	12.91	12.08	10.87	13.80
No. of firms	1,445	590	855	795	530	120	760	685
Average of SD[b] of wage[d]	2.90	2.79	3.21	2.87	2.96	2.94	1.80	3.95
SD	2.53	2.38	2.88	2.61	2.36	2.46	1.33	2.92
25th percentile	1.19	1.15	1.27	1.12	1.44	1.02	0.82	1.82
75th percentile	4.03	3.76	4.45	4.04	3.93	4.28	2.30	5.20
No. of firms	1,445	590	855	795	530	120	760	685
Average CV of wage[d]	0.24	0.24	0.24	0.24	0.24	0.25	0.17	0.30
SD	0.14	0.14	0.15	0.15	0.14	0.15	0.11	0.15
25th percentile	0.13	0.13	0.13	0.12	0.14	0.11	0.09	0.19
75th percentile	0.33	0.32	0.34	0.33	0.32	0.33	0.23	0.38
No. of firms	1,445	590	855	795	530	120	760	685

(*continued*)

Table 6.1 (continued)

		Firm size		Level of wage bargaining			Workforce composition	
	Overall sample[a]	Small firms (25–99 workers)	Large firms (≥ 100 workers)	CA only at national and/or sectoral level	Firm level CA	Other or no CA	Majority blue-collar workers	Majority white-collar workers
Average max.-min. ratio of wage[d]	2.61	2.63	2.58	2.56	2.62	2.99	2.04	3.16
SD	1.58	1.62	1.45	1.44	1.64	2.13	1.06	1.78
25th percentile	1.54	1.56	1.50	1.54	1.54	1.46	1.39	1.91
75th percentile	3.16	3.14	3.22	3.15	3.12	3.37	2.36	3.76
No. of firms	1,445	590	855	795	530	120	760	685
Correlation (average wage, SD of wage)[d]	0.820***	0.812***	0.840***	0.832***	0.800***	0.832***	0.630***	0.821***

Notes: CA = collective agreement on wages; SD = standard deviation; CV = coefficient of variation of wage (SD of wage/average of wage); n.a. = not applicable.

[a]These statistics refer to the weighted sample only covering full-time workers in firms employing at least twenty-five employees.

[b]Individual gross hourly wages (in EUR) include overtime paid, premiums for shift work, night work, and/or weekend work.

[c]Observation = a person.

[d]Observation = a firm.

***Indicates that the Pearson correlation coefficient is significant at the 1% level.

unionization (e.g., Brown, Hamilton, and Medoff 1990; Voos 1983), and (5) substitute high monitoring costs with wage premiums (e.g., Eaton and White 1983; Garen 1985; Lucas 1978; Oi 1983; Stigler 1962).[24] How are we to explain that both within- and between-firms wage dispersion increases with firm size? Davis and Haltiwanger (1996) argue that because large firms are more technologically diversified (horizontally and vertically), their workforce is more heterogeneous. Hence, within-firms wage dispersion is likely to rise with employer size. However, in contrast to our findings, the authors expect between-firms wage dispersion to fall with firm size (due to the life-cycle dynamics of firms). Another factor that can explain higher wage dispersion within large firms is linked to the tournament theory (Lazear and Rosen 1981). The tournament theory points to the benefits of a more dispersed wage structure, deriving from a performance-based pay system. In other words, this theory suggests that firms should establish a prize structure and award the largest prize to the most productive worker. Moreover, according to McLaughlin (1988), to stimulate the workers' effort, there should be positive correlation between the prize spread and the number of contestants. Because the number of contestants is likely to rise with firm size, one may expect a more dispersed wage structure within large firms.[25]

6.5.3 Level of Wage Bargaining

As expected, table 6.1 indicates that, on average, workers, whose wages are renegotiated collectively at the firm level, earn higher wages. This result is in line with earlier findings for Belgium. Using the Oaxaca-Blinder decomposition, Rycx (2003) reports indeed that, ceteris paribus, workers covered by a company collective agreement (CA) earn 5.1 percent more than their opposite numbers who are (solely) covered by the national or sectoral CAs. A similar finding is found by Plasman, Rusinek, and Rycx (2007). Table 6.1 also shows that while within-firms wage dispersion is higher when wages are renegotiated collectively in house, between-firms wage dispersion is larger when wages are solely covered by a national or sectoral CA. Although caution is required, these findings suggest that the bargaining regime has a significant impact on the structure of wages even in a corporatist country like Belgium.[26]

24. Empirical evidence on the firm-size wage premium in Belgium and across European countries is provided by Lallemand, Plasman, and Rycx (2005a, b).

25. Davis and Haltiwanger (1996) for the United States and Lallemand and Rycx (2006) for European countries provided empirical evidence on how and why the wage distribution differs among firms of different sizes.

26. For more evidence on this issue, see, for example, Card and de la Rica (2006), Dell'Aringa and Pagani (2007), Dominguez and Rodriguez-Gutiérrez (2004), Rodriguez-Gutiérrez (2001).

6.5.4 Composition of the Workforce

Finally, let us also note that (1) the mean wage is around 2.3 EUR higher within firms employing a majority of white-collar workers, and (2) the structure of wages is more compressed when blue-collar workers compose the majority of the workforce.

6.6 Wage Inequality and Firm Productivity

In this section, we analyze the impact of intrafirm wage dispersion on firm productivity in the Belgian private sector.

6.6.1 Methodology and Indicators

There are several ways to compute intrafirm wage inequality. On the one hand, wage dispersion can be measured between unequal workers by unconditional indicators (e.g., the Gini index, the white-collar–blue-collar wage ratio, or the pay gap between managers and the rest of the workforce). On the other hand, it can be defined for workers with similar observable characteristics. In this case, wage dispersion is measured by the residual inequality, after controlling for human capital variables.

Although unconditional indexes may have appeal if the analysis focuses on the effect of the chief executive officer's (CEO) pay on firm performance, many theories like tournaments or hawks and doves refer to wage differentials between similar workers (Winter-Ebmer and Zweimüller 1999). As a result, a conditional indicator appears more appropriate for our study. Hence, we follow the methodology developed by Winter-Ebmer and Zweimüller (1999). However, as a sensitivity test, we also analyze the impact of three unconditional indicators of intrafirm wage dispersion on firm productivity. These indicators include the standard deviation, the coefficient of variation, and the max-min ratio of the gross hourly wages within the firm.

The methodology of Winter-Ebmer and Zweimüller (1999) rests upon a two-step estimation procedure. In the first step, we estimate by ordinary least squares (OLS) the following wage equation for each firm:

$$\ln W_{ij} = \alpha_0 + \alpha_1' \mathbf{Y_{ij}} + \varepsilon_{ij}, \tag{1}$$

where W_{ij} is the gross hourly wage (with bonuses) of worker i in firm j; $\mathbf{Y_{ij}}$ is a vector of individual characteristics including age, age squared, sex, education (two dummies), and occupation (one dummy); and ε_{ij} is the usual error term. The standard errors of these regressions (σ_j) are used as a measure of conditional intrafirm wage dispersion.

In the second step, we estimate by OLS the following firm-level performance regression:

$$\ln P_j = \beta_0 + \beta_1'\sigma_j + \beta_2'X_j + \beta_3'Z_j + \upsilon_j, \tag{2}$$

where P_j is the productivity of firm j, σ_j is the conditional indicator of the intrafirm wage dispersion, X_j contains aggregated characteristics of workers, Z_j includes employer characteristics, and υ_j is the usual error term. The productivity of a firm (P_j) is measured by the value added (at factor costs) per employee. It is obtained by dividing the firm annual gross operating income (plus subsidies, minus indirect taxes) by the number of workers in the firm. The main explanatory variable in equation (2) is the conditional intrafirm wage dispersion (σ_j) estimated in step 1. Equation (2) contains numerous control variables for the composition of the workforce (X_j) as well as for firm characteristics (Z_j). These control variables include the share of the workforce that (1) at most has attended lower secondary school, (2) has more than ten years of tenure, and (3) is younger than twenty-five and older than fifty years, respectively. The share of women, the share of blue-collar workers, the share of workers supervising coworkers, sectoral affiliation (five dummies), the size of the firm (the number of workers), and the level of wage bargaining (two dummies) are also included.

An important problem to consider is the potential simultaneity between productivity and wage dispersion. Indeed, it may be argued that highly productive firms pay larger bonuses, which in turn leads to more wage inequality. We address this issue using information from the income tax system. More precisely, we use two-stage least squares (2SLS) and instrument the dispersion of wages *including* bonuses by the intrafirm standard deviation of income taxes on gross earnings *excluding* bonuses. Of course, it is very difficult to find an appropriate instrument for intrafirm wage inequality. However, we believe that our instrument is of potential interest for breaking the simultaneity problem between productivity and wage dispersion because it is less affected by rent sharing. In other words, we expect the intrafirm standard deviation of income taxes on gross earnings *excluding* bonuses to be uncorrelated (or at least less correlated) with the error term and highly correlated with the endogenous variable (i.e., wage dispersion). Statistics on workers' income taxes, available in our data set, have been estimated by Statistics Belgium. To do so, Statistics Belgium relied on individual gross annual earnings, excluding bonuses and social security contributions (13.07 percent). After deduction of professional costs, they obtained the assessable income. From this, they derived the base income tax (seven different scales), the municipality taxes (7 percent),[27] the supplementary crisis contribution (3 percent), and the special social security contribution (six different scales). The sum of these four elements provides an estimation of the individual income taxes.[28]

27. Statistics Belgium had no information on the workers municipality of residence. Therefore, they applied the average municipality tax (7 percent) to all employees.

28. The most important restriction of these estimates is that they do not consider the specific situation of the employee, for example, composition of the family. For more information, see Demunter (2000).

6.6.2 Descriptive Statistics

The first step of our estimation procedure requires a large number of data points per firm. Therefore, our sample has been restricted to firms with at least 200 workers. This restriction guarantees a minimum of ten observations per firm. Our definitive sample is representative of all firms employing at least 200 workers within sections D to K of the Nace Rev. 1 nomenclature, with the exception of hotels and restaurants (H) and the financial sector (J).[29] It covers 17,490 individuals working for 397 firms. The mean number of data points per firm is forty-four, and for 75 percent of the firms, there are between ten and forty-one observations.

Table 6.2 depicts the means and standard deviations of selected variables.[30] We note that, on average, the value added per employee amounts to 61,344 EUR and that the residual pay inequality is equal to 0.17. Moreover, we find that the estimated intrafirm wage dispersion is highest when measured by the max-min ratio, that the mean age is around thirty-seven years, and that, on average, approximately 26 percent of the workers are women, 48 percent are blue collar, and 42 percent have a low level of education (i.e., lower secondary school at most). Finally, table 6.2 shows that, on average, firms employ 480 workers and are essentially concentrated in the manufacturing sector (64 percent); wholesale and retail trade, repair of motor vehicles (19 percent); and real estate, renting, and business activities (11 percent).

6.6.3 Empirical Analysis

Basic Specification

Table 6.3 reports our estimates of the effect of wage dispersion on firm productivity. These estimates are obtained by applying respectively OLS and 2SLS, with White (1980) heteroscedasticity consistent standard errors, to equation (2).

Findings, obtained from OLS regressions, emphasize the existence of a positive and significant relationship between intrafirm wage dispersion and firm productivity. Overall, the point estimates range between 1.25 and 0.08, which yields an elasticity of between 0.25 and 0.14 at sample means. These results suggest that, on average, a rise of 10 percent in wage inequal-

29. Our sample is representative of all firms employing at least 200 workers within the following sectors: (1) manufacturing (D), (2) electricity, gas, and water supply (E), (3) construction (F), (4) wholesale and retail trade; repair of motor vehicles, motorcycles, and personal and household goods (G), (5) transport, storage, and communication (I), and (6) real estate, renting, and business activities (K). The mining and quarrying sector (C) and the hotels and restaurants (H) are not part of our final sample because almost all firms in these sectors employ less than 200 workers.

30. For a detailed description, see appendixes C and D.

Table 6.2 **Means and standard deviations of selected variables**

	Mean	SD
Value-added per employee at factor costs[a] (in thousands of EUR)	61.34	1,618.9
Residual pay inequality[b]	0.17	0.07
Standard deviation of wages[c]	0.24	0.10
Coefficient of variation of wages[c]	0.29	0.14
Max.-min. ratio of wages[c]	3.17	1.60
Age (years)	37.2	9.6
Female	25.9	
Education		
No degree, primary/lower secondary	41.5	
General upper secondary, technical/artistic/prof. upper secondary	38.8	
Higher nonuniversity, university, and post graduate	19.7	
Blue-collar workers	48.4	
Size of the firm (no. of workers)	480.4	621.1
Sector		
Manufacturing (D)	63.5	
Electricity, gas, and water supply (E)	0.2	
Construction (F)	3.6	
Wholesale and retail trade; repair of motor vehicles (G)	18.6	
Transport, storage, and communication (I)	3.7	
Real estate, renting, and business activities (K)	10.6	
No. of employees	17,490	
No. of firms	397	

Notes: The descriptive statistics refer to the weighted sample.

[a]Estimated by the firm annual gross operating income per worker (plus subsidies, minus indirect taxes).

[b]Conditional measure of the intrafirm wage dispersion (i.e., standard errors of wage regressions run for each firm separately).

[c]Individual gross hourly wages include overtime paid, premiums for shift work, night work, and/or weekend work and bonuses (i.e., irregular payments that do not occur during each pay period, such as pay for holiday, 13th month, and profit sharing).

ity increases firm productivity by between 2.5 and 1.4 percent.[31] Yet it could be argued that because of the potential simultaneity between productivity and wage dispersion, OLS estimates are not only biased but also inconsistent.[32] To account for this problem, we run 2SLS regressions instrumenting the dispersion of wages *including* bonuses by the intrafirm standard deviation of income taxes on gross earnings *excluding* bonuses. Results from these regressions, presented in table 6.3, confirm the positive

31. Similar positive and significant results have been found for the unconditional indicators when we extended our sample to all firms with twenty workers or more. These results are available on request. Yet due to a limited number of data points within small firms, we were not able to determine whether this is also the case using a conditional indicator.

32. Hausman's (1976) specification error tests, reported in table 6.3, support the existence of a simultaneity problem.

Table 6.3 Effect of wage inequality on firm productivity, OLS versus 2SLS

	Value added per employee[a] (ln)							
	OLS				2SLS			
Intercept	7.22***	7.20***	7.27***	7.49***	6.92***	7.05***	7.12***	7.60***
	(0.27)	(0.27)	(0.27)	(0.26)	(0.26)	(0.27)	(0.28)	(0.27)
RPI[b]	1.25***				4.38***			
	(0.45)				(0.72)			
SD of wages[c]		1.03***				2.09***		
		(0.27)				(0.36)		
CV of wages[c]			0.48***				1.47***	
			(0.20)				(0.27)	
Max.-min. ratio of wages[c]				0.08***				0.13***
				(0.02)				(0.02)
Worker characteristics[d]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm characteristics[e]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.53	0.54	0.53	0.55	0.44	0.52	0.48	0.53
F-stat	130.43***	136.62***	126.69***	134.75***	138.59***	145.04***	132.77***	143.03***
Hausman test: p-value					0.00	0.00	0.00	0.00
No. of employees	17,490	17,490	17,490	17,490	17,490	17,490	17,490	17,490
No. of firms	397	397	397	397	397	397	397	397

Notes: Dependent variable = value added per employee (ln). RPI = residual pay inequality; SD = standard deviation; CV = coefficient of variation. White (1980) heteroscedasticity consistent standard errors are reported in parentheses.

[a]Estimated by the firm annual gross operating income per worker (plus subsidies, minus indirect taxes).

[b]Conditional measure of the intrafirm wage dispersion (i.e., standard errors of wage regressions run for each firm separately).

[c]Individual gross hourly wages include overtime paid, premiums for shift work, night work, and/or weekend work and bonuses (i.e., irregular payments that do not occur during each pay period, such as pay for holiday, 13th month, and profit sharing).

[d]Share of the workforce that (1) at most has attended lower secondary school, (2) has more than ten years of tenure, and (3) is younger than twenty-five and older than fifty years, respectively. The share of women, the share of blue-collar workers, and the share of the workers supervising coworkers are also included.

[e]Sectoral affiliation (five dummies), size of the firm (number of workers), and level of wage bargaining (two dummies).

***Significant at the 1 percent level.

and significant impact of wage dispersion on productivity. Moreover, we find that the elasticity between wage dispersion and productivity is significantly larger when using 2SLS. At sample means, the elasticity now stands at between 0.75 and 0.43. This means that, on average, when wage dispersion increases by 10 percent, firm productivity rises by between 7.5 and 4.3 percent.[33]

How are we to interpret these results? The positive impact of wage dispersion on firm productivity tends to support the tournament models (Lazear and Rosen, 1981). Indeed, these models demonstrate that if the workforce is relatively homogeneous, wage differentials stimulate workers' effort and their productivity. To put it differently, these models suggest that firms should establish a differentiated prize structure and award the largest prize to the most productive workers. Lazear's model (1989, 1995) of hawks and doves suggests that it is profitable for a firm to (1) adequately sort out workers at the hiring stage and (2) adjust the compensation scheme to the characteristics of the workforce (i.e., the hierarchical level). This model shows that if the majority of the workforce adopts a sabotage or noncooperative behavior, a more compressed wage structure should be preferred. According to this theory, our sample is essentially composed of doves. To put it in another way, it is because the majority of the workforce adopts a cooperative behavior that firms can achieve a higher productivity by implementing a more dispersed wage structure. However, our findings offer no support to the fairness, morale, and cohesiveness theories (Akerlof and Yellen 1990; Levine 1991). Indeed, these theories suggest a negative relationship between intra-firm wage dispersion and firm productivity.

Composition of the Workforce

According to the "new economics of personnel" (Lazear 1995), we should expect the elasticity of firm productivity with respect to pay inequality to be influenced by the composition of the workforce. In particular, various theories suggest that the relationship between pay dispersion

33. To test for a hump-shaped relationship, three methods have been used. Firstly, we added within-firm wage inequality indicators in quadratic form to our regression model. Results obtained with OLS were inconclusive because of a strong multicollinearity between indicators in level and squared. However, 2SLS estimates showed a significant positive and hump-shaped pattern for three instrumented wage inequality indicators, that is, the standard deviation, the coefficient of variation, the max-min ratio of wages. Next, we divided our sample into two homogeneous parts containing low and high inequality firms, respectively. The idea was to test whether the impact of wage inequality on firm productivity is larger in low inequality firms. Using OLS, we found no significant differences in the elasticities for both subsamples (with the exception of the max-min ratio of wages). In contrast, 2SLS estimates supported, for all instrumented wage inequality indicators, the existence of a positive and hump-shaped relationship between wage dispersion and firm productivity. Finally, we tested for a nonlinear relationship using dummy variables (two or more) indicating the magnitude of the intrafirm wage inequality. This methodology led to insignificant results using both OLS and 2SLS regressions. In sum, we found some evidence in favor of a hump-shaped relationship. However, results (available on request) were not very robust.

and firm productivity depends upon the proportion of white- and blue-collar workers within the firm. In this section, we test this hypothesis by letting our intrafirm wage dispersion indicators interact with a dummy variable that is equal to 1 if the share of white-collar workers within the firm is larger than 50 percent and zero otherwise. The results of this new specification are presented in table 6.4.

Whatever the indicator used for intrafirm wage dispersion, OLS estimates show that the intensity of the relationship between pay dispersion and productivity is significantly lower in firms that are essentially composed of white-collar workers. Indeed, the point estimates vary between 1.70 and 0.09 for blue-collar workers and between 0.79 and 0.05 for white-collar workers. At sample means, this yields an elasticity of between 0.39 and 0.26 for blue-collar workers and of between 0.14 and 0.06 for white-collar workers. In sum, results suggest that following a 10 percent rise in wage inequality, productivity increases by approximately 2.1 percentage points more within firms that are essentially composed of blue-collar workers. The 2SLS estimates, reported in table 6.4, confirm that the elasticity between wage dispersion and productivity is positive and substantially larger within firms with a majority of blue-collar workers. Yet caution is required because regression coefficients associated to the interaction variables are only significant at the 15 percent level. As in the basic specification, 2SLS point estimates are larger than those obtained by OLS. Using 2SLS, the elasticity, at sample means, ranges between 0.57 and 0.30 for white-collar workers and between 0.91 and 0.55 for blue-collar workers, respectively. These findings suggest that if wage dispersion rises by 10 percent, productivity increases by approximately 2.9 percentage points more in firms essentially composed of blue-collar workers.

Why is the effect of pay dispersion on firm performance different for blue- and white-collar workers? As suggested by Winter-Ebmer and Zweimüller (1999), a first possible explanation is that piece rates are more frequently used in firms with a majority of blue-collar workers. The point is that the implementation of piece rates increases wage dispersion but also productivity because, in general, workers will put in more effort, and top performers will stay in these firms. Another argument may be that, on average, white-collar workers have a higher degree of autonomy in their jobs, more responsibilities, and superior career prospects (Winter-Ebmer and Zweimüller 1999). Therefore, their level of effort is thought to be more determined by their intrinsic motivation. To put it differently, strong incentive schedules such as pay-for-performance, which in general need more monitoring, could be seen as a threat to their autonomy by white-collar workers and, as such, crowd out their intrinsic motivation and reduce the intensity of their effort (Frey 1997). Our findings can also be interpreted on the basis of the theory of Milgrom (1988) and Milgrom and Roberts (1990). Indeed, monitoring costs are likely to be higher for white-collar workers.

Table 6.4 **Effect of wage inequality on firm productivity—interaction with the composition of the workforce, OLS versus 2SLS**

	Value added per employee[a] (ln)							
	OLS				2SLS			
Intercept	7.32***	7.30***	7.35***	7.61***	7.00***	7.13***	7.20***	6.71***
	(0.26)	(0.26)	(0.26)	(0.26)	(0.26)	(0.26)	(0.26)	(0.67)
RPI[b]	1.70***				4.53***			
	(0.50)				(0.72)			
RPI · white-collar[c]	–0.91**				–0.61†			
	(0.40)				(0.41)			
SD of wages[d]		1.36***				2.20***		
		(0.30)				(0.35)		
SD · white-collar[c]		–0.69***				–0.41†		
		(0.24)				(0.26)		
CV of wages[d]			0.79***				1.56***	
			(0.24)				(0.25)	
CV · white-collar[c]			–0.55***				–0.34†	
			(0.20)				(0.21)	
Max.-min. ratio of wages[d]				0.09***				0.14***
				(0.02)				(0.02)
Max.-min. · white-collar[c]				–0.04**				–0.03*
				(0.02)				(0.02)
Worker characteristics[e]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm characteristics[f]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(*continued*)

Table 6.4 (continued)

	Value added per employee[a] (ln)							
	OLS				2SLS			
Adjusted R^2	0.53	0.54	0.53	0.55	0.57	0.57	0.57	0.57
F-stat	126.89***	131.88***	123.69***	132.05***	136.48***	137.15***	137.11***	137.49***
Hausman test: p-value					0.00	0.00	0.00	0.00
No. of employees	17,490	17,490	17,490	17,490	17,490	17,490	17,490	17,490
No. of firms	397	397	397	397	397	397	397	397

Notes: See table 6.3 notes.

[a]Estimated by the firm annual gross operating income per worker (plus subsidies, minus indirect taxes).

[b]Conditional indicator for within-firm wage dispersion (i.e., standard errors of wage regressions run for each firm separately).

[c]"White-collar" is a dummy variable that is equal to 1 if the share of white-collar workers within the firm is larger than 50 percent and 0 otherwise.

[d]Individual gross hourly wages include overtime paid, premiums for shift work, night work, and/or weekend work and bonuses (i.e., irregular payments that do not occur during each pay period, such as pay for holiday, 13th month, and profit sharing).

[e]Share of the workforce that (1) at most has attended lower secondary school, (2) has more than ten years of tenure, and (3) is younger than twenty-five and older than fifty years, respectively. The share of women, the share of blue-collar workers and the share of the workers supervising coworkers are also included.

[f]Sectoral affiliation (five dummies), size of the firm (number of workers), and level of wage bargaining (two dummies).

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

†Significant at the 15 percent level.

Therefore, white-collar workers may have more incentives to (1) withhold information from managers in order to increase their influence and (2) engage in costly rent-seeking activities instead of productive work. This could be an additional reason explaining why the elasticity between wage dispersion and productivity might be lower for white-collar workers.

Monitoring Environment

Another important question is whether the relationship between wage dispersion and firm productivity is affected by the degree of monitoring within the firm. To address this question, we have let our intrafirm wage dispersion indicators interact with a dummy variable that is equal to 1 if the share of the workforce with supervising authority over coworkers is lower than or equal to 20 percent and zero otherwise.

The OLS estimates relative to this new specification, presented in table 6.5, show that the elasticity of productivity to pay dispersion is positive and significantly higher among firms with a high degree of monitoring (supervising firms). At sample means, the elasticity of productivity to intrafirm pay dispersion ranges between 0.37 and 0.23 in firms with a high degree of monitoring and between 0.20 and 0.10 in firms with a low degree of monitoring. The 2SLS estimates also show a positive and significant effect of wage dispersion on firm productivity. However, while coefficients associated to the interaction variables remain negative, none of them are significantly different from zero. This result suggests that findings from OLS regressions have to be interpreted with care. Yet it should be noted that our instrumenting procedure may have led to some loss of information.

Overall, findings reported in table 6.5 emphasize the importance of a correct match between the compensation scheme and the monitoring environment within a firm. To put it differently, results appear to be consistent with the hypothesis that "it is not so much the choice of pay system that drives the organisational outcomes, but the combination of pay system and monitoring environment" (Belfield and Marsden 2003, 469). It is also noteworthy that our descriptive statistics indicate that supervising firms have a greater proportion of blue-collar workers (66 percent versus 43 percent) and that their mean conditional pay inequality is larger (0.20 versus 0.15). Hence, our findings seem to be consistent with Milgrom (1988) and Milgrom and Roberts (1990), who suggest a lower pay spread within firms that are mainly composed of white-collar workers.

6.7 Conclusion

The objective of this chapter is twofold. First, we analyze the structure of wages within and between Belgian firms. Next, we examine how the productivity of these firms is influenced by their internal wage dispersion. To do so, we rely on a unique combination of two large-scale data sets (i.e., the

Table 6.5 **Effect of wage inequality on firm productivity—interaction with the monitoring environment, OLS versus 2SLS**

	Value added per employee[a] (ln)							
	OLS				2SLS			
Intercept	7.27***	7.23***	7.29***	7.50***	6.95***	7.07***	7.13***	7.60***
	(0.26)	(0.27)	(0.27)	(0.26)	(0.26)	(0.26)	(0.26)	(0.26)
RPI[b]	1.66***				4.42***			
	(0.47)				(0.71)			
RPI * low monitoring[c]	–0.71**				–0.26			
	(0.32)				(0.33)			
SD of wages[d]		1.21***				2.12***		
		(0.30)				(0.93)		
SD * low monitoring[c]		–0.29†				–0.09		
		(0.17)				(0.21)		
CV of wages[d]			0.64***				1.48***	
			(0.22)				(0.24)	
CV * low monitoring[c]			–0.25†				–0.04	
			(0.16)				(0.18)	
Max.-min. ratio of wages[d]				0.09***				0.14***
				(0.02)				(0.02)

Max.-min. * low monitoring[c]				–0.03*				–0.01
				(0.01)				(0.02)
Worker characteristics[e]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm characteristics[f]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.54	0.54	0.53	0.55	0.57	0.57	0.57	0.57
F-stat	128.41***	129.52***	120.02***	130.51***	136.29***	135.21***	134.89***	135.31***
Hausman test: *p*-value					0.00	0.00	0.00	0.00
No. of employees	17,490	17,490	17,490	17,490	17,490	17,490	17,490	17,490
No. of firms	397	397	397	397	397	397	397	397

Notes: See table 6.3 notes.

[a]Estimated by the firm annual gross operating income per worker (plus subsidies, minus indirect taxes).

[b]Conditional indicator for within-firm wage dispersion (i.e., standard errors of wage regressions run for each firm separately).

[c]"Low monitoring" is a dummy variable that is equal to 1 if the share of the workforce with supervising authority over coworkers is lower than or equal to 20 percent and 0 otherwise.

[d]Individual gross hourly wages include overtime paid, premiums for shift work, night work, and/or weekend work and bonuses (i.e., irregular payments that do not occur during each pay period, such as pay for holiday, 13th month, and profit sharing).

[e]Share of the workforce that (1) at most has attended lower secondary school, (2) has more than ten years of tenure, and (3) is younger than twenty-five and older than fifty years, respectively. The share of women, the share of blue-collar workers and the share of the workers supervising coworkers are also included.

[f]Sectoral affiliation (five dummies), size of the firm (number of workers), and level of wage bargaining (two dummies).

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

†Significant at the 15 percent level.

1995 Structure of Earnings Survey and Structure of Business Survey). The former contains detailed information on firm-level characteristics (e.g., sector of activity, size of the firm, and level of wage bargaining) and on individual workers (e.g., gross hourly wages, bonuses, age, education, sex, and occupation). The latter provides firm-level information on financial variables (e.g., gross operating surplus, value added, and value of production).

Our methodology is consistent with that of Winter-Ebmer and Zweimüller (1999). It rests on a two-step estimation procedure. First, we compute conditional intrafirm wage differentials by taking the standard errors of wage regressions run for each firm separately. Next, we use these conditional wage differentials as an explanatory variable in a firm-level productivity regression. As a sensitivity test, we also analyze the impact of unconditional indicators of intrafirm wage dispersion on firm productivity. These indicators include the standard deviation, the coefficient of variation, and the max-min ratio of gross hourly wages within the firm. The productivity of a firm is measured by the value added per employee. The potential simultaneity problem between wage dispersion and firm productivity is addressed using information from the Belgian income tax system. More precisely, we apply two-stage least squares (2SLS) and instrument the dispersion of wages *including* bonuses by the intrafirm standard deviation of income taxes on gross earnings *excluding* bonuses.

To our knowledge, this chapter is one of the first to examine the effect of intrafirm wage dispersion on firm performance in the private sector using both a conditional wage inequality indicator and direct information on firm productivity. It is also one of the few, with Bingley and Eriksson (2001) and Heyman (2002), to consider potential simultaneity problems. Empirical findings, reported in this chapter, support the existence of a positive and significant relationship between wage inequality and firm productivity. Moreover, we find that the intensity of this relationship is stronger for blue-collar workers and within firms with a high degree of monitoring. These findings are more in line with the tournament models (Lazear and Rosen 1981) than with the fairness, morale, and cohesiveness models (Akerlof and Yellen 1990; Levine 1991).

Future research in this area should rely on matched employer-employee panel data so as to control for the nonobserved characteristics of the workers or firms. Unfortunately, at the moment, such data do not exist for Belgium. It would also be interesting to extend the analysis to small firms using a conditional measure of intrafirm wage dispersion. However, this option requires a rich data set with a larger number of observations per firm.

Appendix A

Table 6A.1 **Intrafirm wage dispersion and firm performance—some empirical results**

Study	Countrie(s)	Data/Coverage	Wage dispersion	Firm performance	Methodology	Results
Cowherd and Levine (1992)	North America, Europe	OASIS program: 102 business units ≥ 59 workers	Semiunconditional: pay of employees relative to top 3 management level	Product quality	Cross-section (OLS)	Negative relationship between wage spread and firm performance → fairness and cooperation theory + relative deprivation theories
DeBrock, Hendricks, and Koenker (2001)	United States	Professional baseball teams, 1985–1998	Several unconditional measures and standard error of earnings regression	Win-loss percentage by team	Cross-section (OLS) and fixed effects	Negative impact of wage dispersion on team performance → fairness theory
Eriksson (1999)	Denmark	2,600 managers from 210 Danish firms, 1992–1995	Unconditional: coefficient of variation	Profits/sales ratio	Cross-section (OLS) and fixed effects	Weak positive relationship between these variables among executives → tournament theory
Frick, Prinz, and Winkelman (2003)	United States	Professional baseball, basketball, football, and hockey teams, data for min. 7 years in each league	Unconditional: GINI index of wage inequality	Win-loss percentage by team	Cross-section (OLS), fixed effects or random effects	Ambiguous result. For basketball and hockey teams, a higher degree of wage dispersion is beneficial for team performance but the reverse is found for football and baseball teams.
Gomez (2002)	United States	Professional hockey teams, 1993–1998	Unconditional: GINI coefficient	Win-loss percentage by team and season-ending point totals	Cross-section (OLS) and fixed effects	Negative relationship between these variables → fairness theory
Harder (1992)	United States	Professional baseball teams, data for 4 seasons (1976, 1977, 1987, 1988). Professional basketball (1987)	Two separate continuous measures of inequity (% overrewarded and % under-rewarded players)	Technical measures for baseball (e.g., runs created, total average) and for basketball (e.g., points scored)	Cross-section (OLS) and lagged dependent values as explanatory variables	Negative relationship between these variables for basketball, results less clear for baseball → partial support of pay equity theory (underreward leads to selfish behavior, overreward to cooperative behavior)

(*continued*)

Table 6A.1 (continued)

Study	Countrie(s)	Data/Coverage	Wage dispersion	Firm performance	Methodology	Results
Heyman (2002)	Sweden	Panel data for white-collar workers and approximately 10,000 managers in 1991 and 1995	Conditional: standard error of wage regression	Profits	Cross-section (OLS) and fixed effects (lagged value of wage spread as instrumental variable)	Positive relationship between these variables among white-collar workers and managers → tournament theory
Hibbs and Locking (1995)	Sweden	Aggregated individual wage data, 1974–1993	Unconditional: squared coefficient of variation	Real value added	Cross-section (OLS) and instrumental variable (lagged value of output)	Positive relationship between these indicators → tournament theory
Leonard (1990)	United States	439 large corporations, 1981–1985	Unconditional: standard deviation of pay	Return on investment	Cross-section (OLS) and fixed effects	No significant relationship between these indicators for top executives
Main, O'Reilly, and Wade (1993)	United States	Executives in 210 firms, 1980–1984	Unconditional: coefficient of variation	Return on assets	Cross-section (OLS)	Positive relationship between these indicators for executives → tournament theory
Pfeffer and Langton (1993)	United Kingdom	17,000 college and university professors from 600 academic departments	Unconditional: coefficient of variation	Workers' satisfaction, productivity, and cooperation	Cross-section (OLS)	Negative relationship between wage spread and (1) satisfaction, (2) productivity, (3) cooperation → fairness and cooperation theory
Richards and Guell (1998)	United States	Professional baseball teams, 3 seasons (1992, 1993, 1995)	Unconditional: variance of team salaries	Win-loss percentage by team	Cross-section (OLS) and fixed effects	Negative effect of wage spread on the win percentage but not on the probability to win a title → partial support of fairness theory
Winter-Ebmer and Zweimüller (1999)	Austria	Panel of Austrian firms (≥ 20 workers with at least 4 data points), 1975–1991	Conditional: standard error of wage regression	Standardized wage for white- and blue-collar workers	Cross-section (OLS) and fixed effects	Positive relationship between these variables. Stronger for blue-collar workers → results more in line with tournament theory

Note: OLS = ordinary least squares.

Appendix B

Table 6B.1 Structure of wages (with bonuses) within and between firms, 1995

		Firm size		Level of wage bargaining			Workforce composition	
	Overall sample[a]	Small firms (25–99 workers)	Large firms (≥ 100 workers)	CA only at national and/or sectoral level	Firm level CA	Other or no CA	Majority blue-collar workers	Majority white-collar workers
Average wage[b,c]	13.85	12.36	14.49	13.14	14.63	13.21	n.a.	n.a.
SD[b]	6.67	6.01	6.83	7.10	6.08	6.90	n.a.	n.a.
25th percentile	9.94	9.17	10.43	9.27	10.92	9.22	n.a.	n.a.
75th percentile	15.39	13.43	16.11	14.31	16.21	14.45	n.a.	n.a.
No. of workers	31,788	9,450	22,338	14,123	15,713	1,952	n.a.	n.a.
Average of firm average wage[d]	12.46	12.11	13.44	12.25	13.11	11.94	10.81	14.04
SD	3.80	3.59	4.16	3.89	3.35	4.15	2.08	4.35
25th percentile	9.98	9.82	10.58	9.80	10.83	9.40	9.45	10.91
75th percentile	14.02	13.74	15.41	13.80	14.75	13.47	11.89	16.03
No. of firms	1,445	590	855	795	530	120	760	685
Average SD[b] of wage[d]	3.52	3.38	3.89	3.51	3.53	3.50	2.14	4.83
SD	3.20	3.08	3.48	3.35	2.83	3.12	1.63	3.73
25th percentile	1.40	1.39	1.48	1.29	1.64	1.17	0.99	2.16
75th percentile	4.80	4.60	5.36	4.81	4.75	5.00	2.80	6.38
No. of firms	1,445	590	855	795	530	120	760	685
Average CV of wage[d]	0.25	0.25	0.26	0.25	0.25	0.26	0.19	0.32
SD	0.15	0.15	0.16	0.16	0.14	0.15	0.12	0.16
25th percentile	0.13	0.13	0.13	0.13	0.14	0.11	0.10	0.19
75th percentile	0.34	0.34	0.35	0.34	0.33	0.35	0.25	0.40
No. of firms	1,445	590	855	795	530	120	760	685

(*continued*)

Table 6B.1 (continued)

		Firm size		Level of wage bargaining			Workforce composition	
	Overall sample[a]	Small firms (25–99 workers)	Large firms (≥ 100 workers)	CA only at national and/or sectoral level	Firm level CA	Other or no CA	Majority blue-collar workers	Majority white-collar workers
Average max.-min. ratio of wage[d]	2.79	2.81	2.74	2.76	2.76	3.11	2.14	3.42
SD	1.80	1.88	1.59	1.74	1.79	2.22	1.09	2.11
25th percentile	1.63	1.64	1.56	1.64	1.58	1.46	1.43	2.03
75th percentile	3.27	3.26	3.45	3.31	3.18	3.53	2.49	4.04
No. of firms	1,445	590	855	795	530	120	760	685
Correlation (average wage, SD of wage)[d]	0.831***	0.829***	0.839***	0.844***	0.800***	0.866***	0.642***	0.825***

Notes: CA = collective agreement on wages; SD = standard deviation; CV = coefficient of variation of wage (SD of wage/average of wage); n.a. = not applicable.

[a]These statistics refer to the weighted sample only covering full-time workers in firms employing at least twenty-five employees.

[b]Individual gross hourly wages (in EUR) include overtime paid, premiums for shift work, night work, and/or weekend work.

[c]observation = a person.

[d]observation = a firm.

***Indicates that the Pearson correlation coefficient is significant at the 1 percent level.

Appendix C

Table 6C.1 Means and standard deviations of variables—workers' level (first step)

	Mean	SD
Gross hourly wage (in EUR)	13.5	262.6
Age (years)	37.2	9.6
Female	25.9	
Education		
No degree, primary/lower secondary	41.5	
General upper secondary, technical/artistic/prof. upper secondary	38.8	
Higher nonuniversity, university, and postgraduate	19.7	
Blue-collar workers	48.4	
No. of employees	17,490	
No. of firms	397	

Notes: The descriptive statistics refer to the weighted sample. Gross hourly wage includes overtime paid, premiums for shift work, night work, and/or weekend work, and bonuses (i.e., irregular payments that do not occur during each pay period, such as pay for holiday, 13th month, profit sharing, etc.).

Appendix D

Table 6D.1 Means and standard deviations of variables—firm level (second step)

	Mean	SD
I. Firm productivity[a]	61.34	1,618.89
II. Intrafirm wage dispersion		
Residual pay inequality[b]	0.17	0.07
SD of wages[c]	0.24	0.10
CV of wages[c]	0.29	0.14
Max.-min. ratio of wages[c]	3.17	1.60
III. Control variables		
A) Share of the workforce		
Age $<$ 25 years	10.2	11.5
Age $>$ 50 years	9.3	8.5
Female	30.1	27.0
Low educated (no degree, primary, or lower secondary)	40.6	31.0
Blue-collar workers	52.4	34.2
Tenure $>$ 10 years	42.2	23.4
Supervising their coworkers (monitoring)	15.1	13.4
B) Firm characteristics		
Size (no. of workers)	480.4	621.1
Level of wage bargaining		
CA only at national and/or sectoral level	41.7	
CA at the company level	53.5	
Other	4.8	

(*continued*)

Table 6D.1 (continued)

	Mean	SD
Sector		
Manufacturing (D)	63.5	
Electricity, gas, and water supply (E)	0.2	
Construction (F)	3.6	
Wholesale and retail trade; repair of motor vehicles (G)	18.6	
Transport, storage, and communication (I)	3.7	
Real estate, renting, and business activities (K)	10.6	
No. of employees	17,490	
No. of firms	397	

Notes: The descriptive statistics refer to the weighted sample. CA = collective labor agreement; SD = standard deviation; CV = coefficient of variation.

[a]Firm productivity is estimated by the value added per worker (in thousands of EUR). The value added is approximated by the firm annual gross operating income per worker (plus subsidies, minus indirect taxes).

[b]Intrafirm wage dispersion is the conditional measure of the intrafirm wage dispersion (i.e., standard errors of wage regressions run for each firm separately)

[c]Individual gross hourly wages include overtime paid, premiums for shift work, night work and/or weekend work and bonuses (i.e., irregular payments that do not occur during each pay period, such as pay for holiday, 13th month, and profit sharing)

References

Adams, J. 1963. Toward an understanding of inequity. *Journal of Abnormal and Social Psychology* 517:422–36.

Akerlof, G. A., and J. L. Yellen. 1988. Fairness and unemployment. *American Economic Review* 78 (Papers and Proceedings): 44–49.

———. 1990. The fair wage-effort hypothesis and unemployment. *Quarterly Journal of Economics* 105:255–83.

Belfield, R., and D. Marsden. 2003. Performance pay, monitoring environments, and establishment performance. *International Journal of Manpower* 24:452–71.

Bingley, P., and T. Eriksson. 2001. Pay spread and skewness, employee effort and firm productivity. Department of Economics, Faculty of Business Administration. Working Paper no. 01-2. Aarhus, Denmark: University of Aarhus.

Blau, P. M. 1955. *The dynamics of bureaucracy: A study of interpersonal relations in two government agencies.* Chicago: Cambridge University Press.

Bloom, M. 1999. The performance effects of pay dispersion on individuals and organizations. *Academy of Management Journal* 42:25–40.

Brown, C., J. Hamilton, and J. Medoff. 1990. *Employers large and small.* Cambridge, MA: Harvard University Press.

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

Cowherd, D. M., and D. I. Levine. 1992. Product quality and pay equity between lower-level employees and top management: An investigation of distributive justice theory. *Administrative Science Quarterly* 37:302–20.

Davis, S. J., and J. Haltiwanger. 1996. Employer size and the wage structure in U.S. manufacturing. *Annales d'Economie et de Statistique* 41/42:323–67.
DeBrock, L., W. Hendricks, and R. Koenker. 2001. Pay and performance: The impact of salary distribution on firm-level outcomes in baseball. University of Illinois, Urbana-Champaign, Department of Economics. Unpublished Manuscript.
Dell'Aringa, C., and C. Lucifora. 1994. Wage dispersion and unionism: Do unions protect low pay? *International Journal of Manpower* 15:150–70.
Dell'Aringa, C., and L. Pagani. 2007. Collective bargaining and wage dispersion. *British Journal of Industrial Relations* 45:29–54.
Demunter, C. 2000. Structure and distribution of earnings survey: Analysis 1995. *Statistics Belgium Working Paper.* Brussels, Belgium: Statistics Belgium.
Depken, C. A. 2000. Wage disparity and team productivity. Evidence from major league baseball. *Economics Letters* 67:87–92.
Dominguez, J., and C. Rodriguez-Gutiérrez. 2004. Collective bargaining and within firm wage dispersion in Spain. *British Journal of Industrial Relations* 42:481–506.
Eaton, B. C., and W. D. White. 1983. The economy of high wages: An agency problem. *Economica* 50:175–81.
Eriksson, T. 1999. Executive compensation and tournament theory: Empirical tests on Danish data. *Journal of Labor Economics* 17:262–80.
Frey, B. S. 1997. *Not just for the money: An economic theory of personal motivation.* Cheltenham, UK: Edward Elgar.
Frey, B. S., and M. Osterloh. 1997. *Sanktionen oder seelenmassage? Motivationale grundlagen der unternehmesführung* (Sanctions or gentle persuasion? Foundations of incentives for firm management). *Die Betriebswirtschaft* 57:307–21.
Frick, B., J. Prinz, and K. Winkelmann. 2003. Pay inequalities and team performance: Empirical evidence from the North American major leagues. *International Journal of Manpower* 24:472–88.
Garen, J. 1985. Worker heterogeneity, job screening, and firm size. *Journal of Political Economy* 93:715–39.
Gibbons, R., and M. Waldman. 1999. Careers in organizations: Theory and evidence. In *Handbook of labor economics.* Vol. 3, ed. O. Ashenfelter and D. Card, 2373–2437. Amsterdam: North-Holland.
Gomez, R. 2002. Salary compression and team performance: Evidence from the National Hockey League. *Zeitschrift für Betriebswirtschaf: Ergänzungsheft 'Sportökonomie'* 72:203–20.
Hamermesh, D. S. 1980. Commentary. In *The economics of firm size, market structure, and social performance,* ed. J. Siegfried, 383–88. Washington, DC: Federal Trade Commission.
Harder, J. W. 1992. Play for play: Effects of inequity in a pay-for-performance context. *Administrative Science Quarterly* 37:321–35.
Hausman, J. A. 1976. Specification tests in econometrics. *Econometrica* 46:1251–71.
Heyman, F. 2002. Pay inequality and firm performance: Evidence from matched employer-employee data. FIEF Working Paper no. 186. Stockholm, Sweden: Trade Union Institute for Economic Research.
Hibbs, D. A., and H. Locking. 2000. Wage dispersion and productive efficiency: Evidence for Sweden. *Journal of Labor Economics* 18:755–82.
Homans, G. C. 1961. *Social behavior: Its elementary forms.* New York: Harcourt Brace Jovanovich.
Kremer, M., and E. Maskin. 1996. Segregation by skill and the rise in inequality. NBER Working Paper no. 5718. Cambridge, MA: National Bureau of Economic Research.

Lallemand, T., R. Plasman, and F. Rycx. 2004. Intra-Firm wage dispersion and firm performance: Evidence from linked employer-employee data. *Kyklos* 57:541–66.
———. 2005a. The establishment-size wage premium: Evidence from European countries. IZA Discussion Paper no. 1569. Bonn, Germany: Institute for the Study of Labor.
———. 2005b. Why do large firms pay higher wages? Evidence from matched worker-firm data. *International Journal of Manpower* 26:705–23.
Lallemand, T., and F. Rycx. 2006. Establishment size and the dispersion of wages: Evidence from European countries. *Applied Economics Quarterly* 52:309–36.
Lazear, E. P. 1989. Pay equality and industrial politics. *Journal of Political Economy* 97:561–80.
———. 1995. *Personnel economics.* Cambridge, MA: MIT Press.
Lazear, E. P., and S. Rosen. 1981. Rank-order tournaments as optimum labor contracts. *Journal of Political Economy* 89:841–64.
Lehmann, E., and U. Wacker. 2000. *Messung und steuerung von einkommensungleichheiten in organisationen* (Measurement and management of income inequalities in organization). In *Flexibilisierungstendenzen in der betrieblichen personalpolitik,* ed. U. Backes-Gellner, 109–28. Munich: Hampp.
Leonard, J. 1990. Executive pay and firm performance. *Industrial and Labor Relations Review* 43:13–29.
Levine, D. I. 1991. Cohesiveness, productivity and wage dispersion. *Journal of Economic Behavior and Organization* 15:237–55.
Lucas, R. E. 1978. On the size distribution of business firms. *Bell Journal of Economics* 9:508–23.
Main, B. G., C. A. O'Reilly, and J. Wade. 1993. Top executive pay: Tournament or teamwork? *Journal of Labor Economics* 11:606–28.
McLaughlin, K. 1988. Aspects of tournaments models: A survey. *Journal of Labor Economics* 15:403–30.
Mellow, W. 1982. Employer size and wages. *Review of Economics and Statistics* 54:495–501.
Milgrom, P. 1988. Employment contracts, influence activities and efficient organisation design. *Journal of Political Economy* 96:42–60.
Milgrom, P., and J. Roberts. 1990. The efficiency of equity in organisational decision processes. *American Economic Review* 80 (Papers and Proceedings): 154–59.
Oi, W. Y. 1983. The fixed employment costs of specialized labor. In *The measurement of labor cost*, ed. J. Triplett, 63–116. Chicago: University of Chicago Press.
Organization for Economic Cooperation and Development (OECD). 1997. *Employment Outlook.* Paris: OECD.
———. 2002. *Employment Outlook.* Paris: OECD.
Pfeffer, J., and N. Langton. 1993. The effect of wage dispersion on satisfaction, productivity, and working collaboratively: Evidence from college and university faculty. *Administrative Science Quarterly* 38:382–407.
Plasman, R., M. Rusinek, and F. Rycx. 2007. Wages and the bargaining regime under multilevel bargaining: Belgium, Denmark and Spain. *European Journal of Industrial Relations* 13:161–80.
Richards, D. G., and R. C. Guell. 1998. Baseball success and the structure of salaries. *Applied Economics Letters* 5:291–96.
Rodriguez-Gutiérrez, C. 2001. Wage dispersion within firms and collective bargaining in Spain. *Economics Letters* 72:381–86.
Rycx, F. 2003. Industry wage differentials and the bargaining regime in a corporatist country. *International Journal of Manpower* 24:347–66.

Slichter, S. H. 1950. Notes on the structure of wages. *Review of Economics and Statistics* 32:80–91.
Solow, R. 1979. Another possible source of wage stickiness. *Journal of Macroeconomics* 1:79–82.
Stigler, G. J. 1962. Information in the labour market. *Journal of Political Economy* 70:94–105.
Troske, K. R. 1999. Evidence on the employer-size wage premium from worker-establishment matched data. *Review of Economics and Statistics* 81:1–12.
Voos, P. 1983. Union organizing: Costs and benefits. *Industrial and Labor Relations Review* 36:576–91.
Weiss, L. 1966. Concentration and labour earnings. *American Economic Review* 56:96–117.
White, H. 1980. A heteroscedasticity-consistent covariance matrix estimator and a direct test for heteroscedasticity. *Econometrica* 48:817–30.
Winter-Ebmer, R., and J. Zweimüller. 1999. Intra-firm wage dispersion and firm performance. *Kyklos* 52:555–72.