Why do large firms pay higher wages? Evidence from matched worker-firm data

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Abstract

Purpose – This paper analyses the magnitude and sources of the firm-size wage premium in the Belgian private sector.

Design/methodology/approach – Using a unique matched employer-employee data set, our empirical strategy is based on the estimation of a standard Mincer wage equation. We regress individual gross hourly wages (including bonuses) on the log of firm-size and insert step by step control variables in order to test the validity of various theoretical explanations.

Findings – Results show the existence of a significant and positive firm-size wage premium, even when controlling for many individual characteristics and working conditions. A substantial part of this wage premium derives from the sectoral affiliation of the firms. It is also partly due to the higher productivity and stability of the workforce in large firms. Yet, findings do not support the hypothesis that large firms match high skilled workers together. Finally, results indicate that the elasticity between wages and firm-size is significantly larger for white-collar workers and comparable in the manufacturing and the service sectors.

Research limitation/implications – Unfortunately, we are not able to control for the potential non-random sorting process of workers across firms of different sizes.

Originality/value – This paper is one of the few to test the empirical validity of recent hypotheses (e.g. productivity, job stability and matching of high skilled workers). It is also the first to analyse the firm-size wage premium in the Belgian private sector.

Keywords Productivity rate, Pay structures, Belgium, Private sector organizations

Paper type Research paper

1. Introduction

The existence of a positive effect of firm-size on workers' wages is well documented in the economic literature (Oi and Idson, 1999a). Yet, there is little consensus about the

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particular reason why large firms pay higher wages (Winter-Ebmer and Zweimüller, 1999). Traditional explanations suggest that large firms:

- employ more qualified workers;
- compensate workers for bad working conditions;
- have more market power and share their excess profits with their workers;
- avoid or mimic unionisation; and
- substitute high monitoring costs with wage premiums.

Empirical papers offer only partial evidence for these traditional arguments. As a result, alternative hypotheses have been recently developed. Oi and Idson (1999b) suggest, for instance, that workers are more productive in large firms and, therefore, ask for higher wages. Another explanation might be that large firms prefer to match high-skilled workers together (Kremer and Maskin, 1996; Troske, 1999) and create internal labour markets in order to increase the stability of their workforce (Idson, 1996).

This study is one of the few, with Bayard and Troske (1999) and Oi and Idson (1999b), to test the validity of these recent hypotheses. Moreover, it is the first to analyse the magnitude and sources of the firm-size wage premium in the Belgian private sector. To do so, we use a unique matched worker-firm data set. This data set derives from the combination of the 1995 Structure of Business Survey (SBS) and the 1995 Structure of Earnings Survey (SES). The former provides firm-level information on financial variables and in particular on the productivity of the workforce (e.g. value added). The latter contains detailed information on individual workers (e.g. gross hourly wages, bonuses, age, education, sex, and occupation) and on firm characteristics (e.g. sector of activity, level of wage bargaining, and firm-size). Firm-size is measured by the exact number of employees. This continuous variable overcomes the potential measurement errors present in studies where the categorized employer-size data are converted into a continuous measure of firm-size (Albaek *et al.*, 1998).

The remainder of this paper is organised as follows. Section 2 reviews the literature (both theoretical and empirical) dealing with the effects of firm-size on workers' wages. Sections 3 and 4 present, respectively, the data and the empirical results. The last section concludes.

2. Review of the literature

2.1 Theoretical background

Differences in both human and physical capital investments between employers of different sizes are at the basis of various explanations for the size wage premium. According to Hamermesh (1980), large firms employ higher-quality workers due to their greater capital intensity and the capital-skill complementarity. Economies of scale and other financial advantages (e.g. lower interest rates) are often mentioned to explain why large firms might invest more in both human and physical capital. The point is that large firms can spread the fixed costs of their investments across more output and employees. Therefore, it would be relatively less costly for them to adopt advanced technologies, which in turn require more skilled labour. Black *et al.* (1999) developed a model where the size wage gap is explained by a training-size differential. They argue that cost advantages allow large firms to implement stronger formal and informal

training systems, which are essential for an efficient use of advanced technologies. A complementary argument to explain why large firms might employ more high-skilled workers has been developed by Troske (1999). Starting from the hypothesis of Kremer and Maskin (1996)[1], the author argues that if there are fixed costs associated to employing high-skilled workers, large firms should have advantages in matching them together.

Compensating wage differentials may also account for the firm-size wage premium. According to the standard competitive model of the labour market, where the equilibrium wage is determined through marginal productivity, two individuals with identical productive characteristics necessarily receive the same wages. However, compensating differences may occur between similar individuals placed in different working conditions. Indeed, the disutility undergone by one individual following the performance of a task in an unfavourable situation may lead to wage compensation. For a long time, working conditions were considered to be worse within large firms. Large firms were suspected to offer *inter alia* a more impersonal work atmosphere (Lester, 1967), to decrease the freedom of action and scheduling (Masters, 1969), and to generate longer commuting (Scherer, 1976). This perspective has been challenged by Oi and Idson (1999b). The authors argue that large firms typically offer jobs with better working conditions (e.g. cleaner and safer workplaces, generous time-off benefits, and superior fringe benefits). Moreover, they suggest for the US that observable working conditions are better within large firms and, therefore, can not contribute to the firm-size wage premium.

Job stability may also explain the existence of a firm-size wage premium. Doeringer and Piore (1971) emphasized that internal labour markets facilitate the evaluation of the worker's performance and generate higher returns to human capital investments. The point is that the internal mobility of workers tends to reduce the job turnover within junior workers and to decrease the incentives for senior workers not to share their knowledge with new workers (Criscuolo, 2000). Lower job turnover means in general lower adjustment and monitoring costs. Therefore, it can be argued that intra-firm job mobility is beneficial for a firm. The same is true for the workers since it increases job stability. To put it differently, it improves career prospects and reduces the threat of unemployment. Let us also notice that the stability of the workforce is expected to be higher within large firms because the latter provide more intensive training programs (Black *et al.*, 1999; Winter-Ebmer, 2001) and face a lower risk of bankruptcy (Idson, 1996).

Another possible explanation for the elasticity between firm-size and wages is that large employers have a greater ability-to-pay. The argument is that large firms are more likely to operate in imperfect competitive markets (Albaek *et al.*, 1998). Therefore, large firms can accumulate more monopoly rents that they may share with their workers (Slichter, 1950; Weiss, 1966; Mellow, 1982). Rent-sharing may arise for several reasons including collective wage bargaining or the firm's willingness to avoid unionisation[2]. Let us also notice that, according to Brown *et al.* (1990) and Voos (1983), large firms are more likely to be the target of union drives or to replicate union behaviour.

Efficiency wage models provide a complementary explanation of the firm-size wage premium. The point is that in general large firms face higher monitoring costs. To reduce, these costs the latter may pay efficiency wages, i.e. wages that are above the

market clearing level for a given quality of labour (Eaton and White, 1983). Indeed, efficiency wages attract workers with better skills and reduce shirking. In the Shapiro and Stiglitz's (1984) model, the level of "no shirk wage" or efficiency wage is negatively correlated with the detection rate. Since the detection rate is supposed to be lower within large firms, efficiency wages are expected to increase with firm-size[3].

Finally, Oi and Idson (1999a) argue that a worker in a large organisation can execute a more productive job than he could do elsewhere. This would be due to the fact that large firms:

- invest more in new capital goods because of lower interest rates and non-labour input costs;
- differentiate the assignment of inputs between workers; and
- attract and retain workers who are able and motivated to work harder.

In sum, the authors emphasize that the firm-size wage premium might at least partly be driven by the higher performance standards within large firms.

2.2 Empirical background

In their seminal paper, Brown and Medoff (1989) focused on the magnitude and causes of the firm-size wage premium in the US. Their results show that *ceteris paribus* working for a large firm (i.e. a firm that is double the size of another) provides a wage premium of between 1.5 and 3.8 per cent. However, they provide little evidence for traditional explanations including the labour quality hypothesis or size differences in working conditions. The study of Idson and Feaster (1990) relative to the US is the first to address the potential selectivity problem, i.e. the non-random sorting of workers across employers of different sizes. To do so, they applied the two-step estimation procedure developed by Heckman (1976, 1979) and Lee (1978). Their findings, based on a discrete measure of firm-size (five categories), show that controlling for selection effects increases the magnitude of the size wage gap.

The paper of Schmidt and Zimmerman (1991) supports the existence of a significant firm-size wage premium in West-Germany. Moreover, their results indicate that the magnitude and significance of this premium is not reduced by the addition of many control variables, including tenure, innovative activities of firms, industry dummies, demographic variables, and work characteristics. Main and Reilly (1993) focused on the UK using a discrete measure of the establishment size (three categories). Moreover, they tried to correct for the potential selection bias by adopting the same methodology as in Idson and Feaster (1990). Their results show the existence of a wage gap of around 18 per cent between large and small establishments. They also indicate that the neo-classical explanations do not much account for the size wage premium. Furthermore, in contrast to Idson and Feaster (1990), they do not support the hypothesis of a non-random assignment of workers across different size classes. The size wage differential within Italian firms has been investigated by Brunello and Colussi (1998). Using a discrete measure of firm-size (six categories) and controlling for a potential selectivity bias, the authors find that the wage differential between small and large firms is not significantly different from zero. In other words, their results suggest that any wage premium is due to differences in the observed characteristics and selection effects.

The study of Albaek *et al.* (1998) is particularly interesting because it is the first to use a continuous measure of the establishment size (i.e. the exact number of employees per establishment) and to compare the size wage elasticity across Scandinavian countries. The authors find large plant-size effects even after controlling for individual and job characteristics as well as for selection effects. They also suggest that the plant-size elasticity in the Scandinavian countries is of the same order of magnitude than in other countries with completely different wage bargaining institutions, such as the US. From a technical point of view, the authors stress the difficulty of findings good instruments to control for potential selection effects. Yet, they conclude that the sorting of workers, at the very least, is not very important for the explanation of the size wage premium in the Scandinavian countries.

More recent explanations of the size wage premium have been tested for the US by Bayard and Troske (1999). The authors use a continuous measure of the firm/establishment size and include supply-side variables directly in their wage regression. Their results show comparable, significant and positive establishment-size wage premia across industries (i.e. manufacturing, retail trade and services). Moreover, according to the theory of Oi and Idson (1999b), they suggest that productivity differences between workers in large and small firms account for half of the firm-size wage premium in the manufacturing and services sectors. However, their results do not sustain the hypothesis, developed by Kremer and Maskin (1996) and Troske (1999), that large firms match high skilled workers together.

Finally, let us notice that Abowd *et al.* (1999) used a large matched worker-firm panel date set for France and found that individual heterogeneity rather than firm heterogeneity accounts for most of the wage gap between size categories. To do so, they isolated fixed individual and fixed firm effects from workers moving between employers.

3. Data

The present study is based upon a unique combination of two large-scale data sets. The first, carried out by Statistics Belgium, is the 1995 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[4]. The survey contains a wealth of information, provided by the management of the firms, both on firm-level characteristics (e.g. sector of activity, size of the firm, and level of wage bargaining) and on the individual workers (e.g. age, education, gross hourly wages, sex, and occupation). Firm-size is measured by the exact number of employees. This continuous variable overcomes the potential measurement errors present in studies where the categorized employer-size data are converted into a continuous measure of firm-size (Albaek *et al.*, 1998). Unfortunately, the SES provides no information on the productivity of the workforce within firms. Therefore, it has been merged with the 1995 SBS. The SBS is a firm-level survey, conducted by Statistics Belgium, whose coverage differs from the SES in that it includes neither the financial sector (Nace J) nor firms with less than 20 employees. The SBS provides firm-level information on financial variables such as sales, value added, and value of production. The final sample, combining both data sets, covers 41,593 individuals working for 1,865 firms. It is representative of all firms employing at least 20 workers within sections C to K of the Nace Rev.1 nomenclature, with the exception of the financial sector.

Table I sets out the means (standard deviations) of selected variables for the overall sample as well as for small and large firms[5]. We note a significant difference between the mean characteristics of workers employed in small and large firms. The point is that on average individuals employed in large firms earn significantly higher wages, work a slightly larger number of hours, and have less (potential) experience but more seniority. Table I also shows that large firms employ a higher proportion of men, generate more value added per capita[6], and pay bonuses for overtime, shift work, night work and/or weekend work to a larger fraction of their workforce. Finally, let us notice that large firms are over-represented in the manufacturing sector (see Appendix 1 for a more detailed description of the data).

4. Empirical results

4.1 General analysis

In the remainder of this paper, we analyse the magnitude and sources of the firm-size wage premium in the Belgian private sector. Our empirical strategy is based on the estimation of a standard Mincer (1974) wage equation. To put it differently, we regress the log of individual gross hourly wages (including bonuses) on the log of firm-size

	Overall sample	Small firms[a]	Large firms[b]
Gross hourly wage (EUR)[c]	13.51 (6.52)	12.49 (6.24)	14.55 (6.63)
Prior potential experience (years)[d]	9.20 (8.14)	9.98 (8.58)	8.41 (7.57)
Seniority in the firm (years)	10.51 (9.09)	8.82 (8.39)	12.23 (9.44)
Female (yes)	27.58	30.79	24.33
Working hours[e]	161.05 (28.42)	160.14 (29.18)	161.94 (27.59)
Overtime paid (yes)	9.82	8.52	11.15
Bonuses for shift work, night work and/or weekend work (yes)	22.11	13.42	30.93
Size of the firm[f]	759.48 (1546.88)	84.38 (51.05)	1,444.57 (1971.44)
Sector			
Mining and quarrying	0.40	0.79	0.00
Manufacturing	55.99	41.27	70.94
Electricity, gas and water supply	0.42	0.35	0.50
Construction	3.93	5.46	2.37
Whole sale and retail trade; repair of motor vehicles and personal and household goods	21.94	28.08	15.70
Hotels and restaurants	1.33	2.51	0.14
Transport, storage and communication	6.32	8.49	4.11
Real estate, renting and business activities	9.67	13.05	6.24
Value added per worker (in thousands of EUR)[g]	60.19 (42.30)	55.17 (44.95)	65.31 (38.84)
Number of workers	41,593	20,826	20,767
Number of firms	1,865	1,366	499

Notes: The descriptive statistics refer to the weighted sample. [a]Number of workers in the firm ≥ 20 and <200; [b]number of workers in the firm ≥ 200; [c]includes overtime paid, premiums for shift work, night work and/or weekend work, and bonuses (i.e. irregular payments which do not occur during each pay period, such as pay for holiday, 13th month, profit sharing, etc.); [d]experience (potentially) accumulated on the labour market before the last job. It has been computed as follows: age – 6 – years of education – seniority; [e]number of hours paid in the reference period, including overtime paid; [f]number of workers in the firm; [g]firm level value added at factor costs divided by the total number of workers within the firm

Table I.
Description and means (standard deviations) of selected variables

(i.e. the exact number of workers within the firm) and insert step-by-step control variables in order to test the validity of various theoretical explanations. Regressions have been estimated by OLS with White (1980) heteroscedasticity-consistent standard errors. Moreover, to account for the potential bias stemming from the use of aggregated firm variables in an individual wage equation, we applied the correction for common variance components within groups as suggested by Greenwald (1983) and Moulton (1990)[7].

As a starting point, we estimated the elasticity between wages and firm-size controlling for basic individual characteristics, i.e. standard human capital variables, a dummy for the sex of the individual, and 19 occupational dummies. Human capital variables include five indicators showing the highest level of education; prior potential experience, its square and its cube; and seniority within the current company, and its square. The results of this specification, reported in column 1 of Table II, show the existence of a positive and significant effect of firm-size on workers' wages. Indeed, they suggest that, on average, a doubling of firm-size increases earnings by 4.8 per cent. Let us also notice that the value of the adjusted R^2 already exceeds 60 per cent.

Of course, it could be argued that the positive correlation between wages and firm-size is due to differences by size in the firm's economic and financial control, sectoral affiliation, or regional location. To investigate whether the firm-size wage premium is reflective of industry wage differentials, 182 sectoral dummies have been included in our wage regression[8]. The results of this specification are presented in column 2 of Table II. As expected, we find that sectors have a significant impact on the size wage elasticity. Indeed, the coefficient on firm-size drops from 0.048 to 0.041. However, it remains significant at the 1 per cent level and the adjusted R^2 reaches now almost 70 per cent. Next, we added to our wage regression 2 dummies for the region where the firm is located and 3 dummies for firm's economic and financial control. Results of this new regression, reported in column 3 of Table II, show that the firm-size wage effect remains unchanged when controlling for these variables.

The level of collective wage bargaining is another factor that may account for the firm-size wage premium. Collective wage bargaining in the Belgian private sector occurs at three levels: the national (inter-professional) level, the sectoral level, and the company level. In practice, the heart of the wage bargaining lies at the sectoral level. However, in certain cases, sectoral agreements are renegotiated (improved) within the individual companies. According to Rycx (2003), workers covered by a company collective agreement (CA) earn *ceteris paribus* 5.1 per cent more than their opposite numbers who are solely covered by national and/or sectoral CAs. Moreover, looking at our descriptive statistics, we find that company CAs are more frequently signed by large employers[9]. Hence, we may expect the magnitude of the firm-size wage premium to fall when controlling for the level of wage bargaining. Results, reported in column 4 of Table II, confirm this expectation. Indeed, the coefficient on firm-size drops from 0.041 to 0.037 after the inclusion of 2 dummies for the level of wage bargaining.

Another possible explanation for the size wage gap is that large employers have to compensate workers for unattractive working conditions. To test this hypothesis, the following variables have been added to our model: 3 dummies for the type of contract, the number of paid hours, a dummy for extra paid hours, and a dummy showing whether the individual is paid a bonus for shift work, night-time and/or weekend work.

Table II.
Firm-size wage premium

	(1)	(2)	(3)	(4)	(5)	(6)
Ln of firm-size	0.048** (0.004)	0.041** (0.004)	0.041** (0.004)	0.037** (0.004)	0.034** (0.004)	0.036** (0.004)
Basic variables[a]	Yes	Yes	Yes	Yes	Yes	Yes
Industry[b]	No	Yes	Yes	Yes	Yes	Yes
Region and financial control[c]	No	No	Yes	Yes	Yes	Yes
CA[d]	No	No	No	Yes	Yes	Yes
Working conditions[e]	No	No	No	No	Yes	Yes
Monitoring[f]	No	No	No	No	No	Yes
Adj. R^2	0.63	0.68	0.68	0.68	0.69	0.70
F-stat	294.95**	182.15**	437.11**	193.82**	598.04**	651.52**
Number of workers	41,593	41,593	41,593	41,593	41,593	41,593
Number of firms	1,865	1,865	1,865	1,865	1,865	1,865

Notes: The dependent variable is the ln of individual gross hourly wages including annual bonuses (i.e. irregular payments which do not occur during each pay period, such as pay for holiday, 13th month and profit sharing). Regressions have been estimated by OLS with White (1980) heteroscedasticity-consistent standard errors and with the Greenwald (1983) and Moulton (1990) correction for common variance components within firms. Robust standard errors are between brackets. **/*/***: coefficient significant at the 1, 5 and 10 per cent level, respectively; [a]basic variables: education (5 dummies), prior potential experience (in level, squared and cubed), tenure (in level and squared), occupation (19 dummies) and sex; [b]industry affiliation in Nace 3 digit (182 dummies); [c]region where the firm is located (2 dummies) and firm's economic and financial control (3 dummies); [d]level of collective wage agreement (2 dummies); [e]working conditions: type of contract (3 dummies), ln of paid hours, a dummy for extra paid hours, and a dummy for premium payments associated with shift work, night-time and/or weekend work; [f]dummy variable showing whether the individual supervises the work of his co-workers

The results relative to this new specification are presented in column 5 of Table II. We find that the size wage elasticity is still significant at the 1 per cent level and that its magnitude decreases from around 0.003 log points. Hence, it appears that working conditions only account for a small fraction of the size wage gap.

According to efficiency wage models, large firms may substitute high monitoring costs with wage premiums. To test the validity of this hypothesis, a dummy variable showing whether the individual supervises the work of his co-workers has been added to our model. Results in the last column of Table II show that the inclusion of this variable does not reduce the size wage elasticity. However, the elasticity remains significant at the 1 per cent level and results suggest that, on average, a doubling of firm-size increases earnings by 3.6 per cent. To put it differently, we find that a substantial part of the firm-size wage premium remains unexplained after controlling for a large set of individual and firm characteristics.

In order to get some additional insight into the nature of this unexplained size wage gap, three alternative explanations have been examined. The first explanation, developed by Troske (1999), is that large firms match high skilled workers together. To test this hypothesis, we controlled for the percentage of highly educated individuals within each firm (i.e. workers with long and short-type higher education) and for the workers' mean years of potential experience within each firm. Columns 2 and 3 of Table III present the results of this new specification. Findings indicate that workers within firms employing more-educated individuals receive larger wages. In contrast, the experience level of the workforce within a firm does not seem to influence the workers' wages. Also noteworthy is that the coefficient of firm-size remains almost the same when controlling for education and experience at the firm level. Hence, the hypothesis of matching high-skilled workers together within large firms does not seem to provide a valid explanation for the elasticity between firm-size and wages. A similar result has been found for the US by Bayard and Troske (1999).

Another hypothesis for the size wage gap is that jobs are more stable within large firms (Black *et al.*, 1999; Idson, 1996; Winter-Ebmer, 2001). To test this hypothesis, we included information on the workers' mean years of tenure within each firm. Results, reported in column 4 of Table III, show that workers within firms promoting job stability earn higher wages. Moreover, we find that controlling for tenure at the firm level reduces the size wage premium by around 0.004 log points. Our results thus support the hypothesis that size differences in job stability significantly contribute to the size wage gap.

Finally, we examined whether the size wage premium is due to a higher level of labour productivity within large firms. Therefore, we added to our wage regression the value added per worker within each firm. The latter is estimated by the firm's annual gross operating income per worker (plus subsidies, minus indirect taxes). Column 5 of Table III indicates that:

- workers within high-productive firms earn larger wages; and that
- the size wage premium drops from 0.031 to 0.027 when controlling for labour productivity.

Hence, according to Oi and Idson (1999b), our findings show that productivity differences between workers in large and small firms account for a substantial part of the size wage gap.

Table III.
Firm-size wage premium controlling for skills, job seniority and value added

	(1)	(2)	(3)	(4)	(5)
Ln of firm-size	0.036** (0.004)	0.035** (0.004)	0.035** (0.004)	0.031** (0.004)	0.027** (0.003)
Workers' characteristics[a]	Yes	Yes	Yes	Yes	Yes
Firms' characteristics[b]	Yes	Yes	Yes	Yes	Yes
Per cent higher education[c]	No	0.155** (0.020)	0.155** (0.021)	0.189** (0.021)	0.130** (0.021)
Mean experience[d]	No	No	0.000 (0.001)	0.003* (0.001)	0.003** (0.001)
Mean tenure[e]	No	No	No	0.007** (0.001)	0.007** (0.001)
Ln of value added per worker[f]	No	No	No	No	0.110** (0.012)
Adj. R^2	0.70	0.70	0.70	0.71	0.72
F-stat	651.52**	980.94**	869.85**	563.95**	8547.90**
Number of workers	41,593	41,593	41,593	41,593	41,593
Number of firms	1,865	1,865	1,865	1,865	1,865

Notes: The dependent variable is the ln of individual gross hourly wages including annual bonuses (i.e. irregular payments which do not occur during each pay period, such as pay for holiday, 13th month and profit sharing). Regressions have been estimated by OLS with White (1980) heteroscedasticity-consistent standard errors and with the Greenwald (1983) and Moulton (1990) correction for common variance components within firms. Robust standard errors are between brackets. **/*/***: coefficient significant at the 1, 5 and 10 per cent level, respectively; [a]basic variables: education (5 dummies), prior potential experience (in level, squared and cubed), tenure (in level and squared), occupation (19 dummies), sex, and working conditions (i.e. type of contract (3 dummies), ln of paid hours, a dummy for extra paid hours, and a dummy for premium payments associated with shift work, night-time and/or weekend work); [b]region where the firm is located (2 dummies), firm's economic and financial control (3 dummies), industry affiliation in Nace 3 digit (182 dummies), level of collective wage agreement (2 dummies), and a dummy variable showing whether the individual supervises the work of his co-workers; [c]percentage of highly educated individuals within each firm (i.e. workers with long or short-type higher education); [d]workers' mean years of potential experience within each firm; [e]workers' mean years of tenure within each firm; [f]estimated by the firm's annual gross operating income per worker (plus subsidies, minus indirect taxes)

4.2 Sensitivity analysis

So far, the existence of a significant and positive relationship between firm-size and wages has been investigated for the whole workforce. In this section, we assess the sensitivity of this relationship across occupations (i.e. white- and blue-collar workers) and industrial sectors (i.e. the manufacturing and service sectors).

Results in Table IV show, for all specifications of our wage equation, the existence of a positive and significant firm-size wage premium for both white- and blue-collar workers. Yet, regression coefficients are statistically different for both types of workers (at least at 15 per cent level, see row 1 of Table V). Indeed, results show that being employed in a large firm is more profitable for white-collar workers. On average, a doubling of firm-size increases earnings by around 1.3 percentage points more for white-collar workers. These findings are in line with the extended version of the hypothesis of Granovetter (1984)[10]. The point is that large firms offer better promotion possibilities, develop their own internal labour market, and increase workers' mobility across the firm's departments. According to Villemez and Bridges (1988), white-collar workers would be more sensitive to these elements than their blue-collar counterparts.

Finally, let us notice that results in Table VI support the dual-economy prediction about the positive firm-size wage impact within the manufacturing sector[11]. However, it is not clear whether this theory can be extended beyond the manufacturing sector (Granovetter, 1984). Actually, our findings show that there is no significant difference in the firm-size wage premium across the manufacturing and service sectors. Also noteworthy is that the productivity hypothesis, developed by of Oi and Idson (1999b), does not hold within the service sector.

5. Conclusion

This paper has investigated the magnitude and sources of the firm-size wage premium in the Belgian private sector. To do so, we used a unique matched worker-firm data set. This data set derives from the combination of the 1995 SBS and the 1995 SES. The former provides firm-level information on financial variables and in particular on the productivity of the workforce (e.g. value added). The latter contains detailed information on individual workers (e.g. gross hourly wages, bonuses, age, education, sex, and occupation) and on firm characteristics (e.g. sector of activity, level of wage bargaining, and firm-size). Firm-size is measured by the exact number of employees. This continuous variable overcomes the potential measurement errors present in studies where the categorized employer-size data are converted into a continuous measure of firm-size (Albaek *et al.*, 1998).

Our findings show the existence of a significant and positive firm-size wage premium in the Belgian private sector, even when controlling for many individual characteristics and working conditions. A substantial part of this wage premium derives from the sectoral affiliation of the firms. It is also partly due to the higher productivity and stability of the workforce in large firms. Yet, findings do not support the hypothesis that large firms match high skilled workers together. Finally, results indicate that the elasticity between wages and firm-size is significantly larger for white-collar workers and comparable in the manufacturing and the service sectors.

Unfortunately, we were not able to control for the potential non-random sorting process of workers across firms of different sizes. The point is that our data set contains no information on supply-side variables that are generally used to account for selection effects (e.g. the marital status, the household composition). This is an important

Table IV.
Firm-size wage premium across occupations

	(1)	(2)	(3)	(4)	(5)
White-collar workers					
Ln of firm-size	0.038** (0.004)	0.038** (0.004)	0.039** (0.004)	0.036** (0.004)	0.033** (0.004)
Workers' characteristics[a]	Yes	Yes	Yes	Yes	Yes
Firms' characteristics[b]	Yes	Yes	Yes	Yes	Yes
Per cent higher education[c]	No	0.175** (0.022)	0.177** (0.022)	0.204** (0.025)	0.148** (0.025)
Mean experience[d]	No	No	0.000 (0.001)	0.004* (0.001)	0.003* (0.001)
Mean tenure[e]	No	No	No	0.006** (0.001)	0.005** (0.001)
Ln of value added per worker[f]	No	No	No	No	0.094** (0.016)
Adj. R^2	0.72	0.73	0.73	0.73	0.74
F-stat	227.63**	596.71**	366.98**	486.26**	357.24**
Number of workers	22,332	22,332	22,332	22,332	22,332
Number of firms	1,657	1,657	1,657	1,657	1,657
Blue-collar workers					
Ln of firm-size	0.029** (0.005)	0.028** (0.005)	0.027** (0.005)	0.025** (0.005)	0.020** (0.004)
Workers' characteristics[a]	Yes	Yes	Yes	Yes	Yes
Firms' characteristics[b]	Yes	Yes	Yes	Yes	Yes
Per cent high education[c]	No	0.070* (0.033)	0.061*** (0.033)	0.088** (0.033)	0.043 (0.032)
Mean experience[d]	No	No	−0.002† (0.001)	0.000 (0.001)	0.000 (0.001)
Mean tenure[e]	No	No	No	0.005** (0.001)	0.005** (0.001)
Ln of value added per worker[f]	No	No	No	No	0.123** (0.011)
Adj. R^2	0.58	0.58	0.58	0.59	0.61
F-stat	139.28**	141.92**	230.06**	4630.59**	62015.5**
Number of workers	19,261	19,261	19,261	19,261	19,261
Number of firms	1,529	1,529	1,529	1,529	1,529

Notes: The dependent variable is the ln of individual gross hourly wages including annual bonuses (i.e. irregular payments which do not occur during each pay period, such as pay for holiday, 13th month and profit sharing). Regressions have been estimated by OLS with White (1980) heteroscedasticity-consistent standard errors and with the Greenwald (1983) and Moulton (1990) correction for common variance components within firms. Robust standard errors are between brackets. **/*/***/†: coefficient significant at the 1, 5, 10 and 15 per cent level, respectively. White-collar workers are workers registered within ISCO codes 12 to 52. [a] Basic variables: education (5 dummies), prior potential experience (in level, squared and cubed), tenure (in level and squared), occupation (19 dummies), sex, and working conditions (i.e. type of contract (3 dummies), ln of paid hours, a dummy for extra paid hours, and a dummy for premium payments associated with shift work, night-time and/or weekend work); [b] region where the firm is located (2 dummies), firm's economic and financial control (3 dummies), industry affiliation in Nace 3 digit (182 dummies), level of collective wage agreement (2 dummies), and a dummy variable showing whether the individual supervises the work of his co-workers.; [c] percentage of highly educated individuals within each firm (i.e. workers with long or short-type higher education); [d] workers' mean years of potential experience within each firm; [e] workers' mean years of tenure within each firm; [f] estimated by the firm's annual gross operating income per worker (plus subsidies, minus indirect taxes)

Table V.
t-Tests for the equality of regression coefficients associated to firm-size

	(1)	(2)	(3)	(4)	(5)
White vs blue collar workers	0.009 (1.41)	0.010*** (1.56)	0.012** (1.88)	0.011** (1.72)	0.013* (2.30)
Manufacturing vs services	0.006 (0.89)	0.007 (1.04)	0.008 (1.19)	0.007 (1.04)	0 (0)

Notes: t-statistics for the differences in the coefficients of firm-size are between brackets; */**/*** indicate that differences are significant at the 5, 10 and 15 per cent level, respectively

Table VI.
Firm-size wage premium across industries

	(1)	(2)	(3)	(4)	(5)
Manufacturing					
Ln of firm-size	0.040** (0.003)	0.039** (0.004)	0.040** (0.004)	0.037** (0.004)	0.031** (0.003)
Workers' characteristics[a]	Yes	Yes	Yes	Yes	Yes
Firms' characteristics[b]	Yes	Yes	Yes	Yes	Yes
Per cemt higher education[c]	No	0.145** (0.029)	0.148** (0.029)	0.168** (0.031)	0.134** (0.030)
Mean experience[d]	No	No	0.001 (0.001)	0.003** (0.001)	0.004** (0.001)
Mean tenure[e]	No	No	No	0.004** (0.001)	0.004** (0.001)
Ln of value added per worker[f]	No	No	No	No	0.112** (0.011)
Adj. R^2	0.70	0.70	0.70	0.70	0.71
F-stat	221.34**	242.81**	523.43**	487.50**	368.56**
Number of workers	27,976	27,976	27,976	27,976	27,976
Number of firms	1,165	1,165	1,165	1,165	1,165
Services					
Ln of firm-size	0.034** (0.006)	0.032** (0.006)	0.032** (0.006)	0.030** (0.006)	0.031** (0.005)
Workers' characteristics[a]	Yes	Yes	Yes	Yes	Yes
Firms' characteristics[b]	Yes	Yes	Yes	Yes	Yes
Per cent high education[c]	No	0.164** (0.026)	0.167** (0.027)	0.191** (0.028)	0.115** (0.029)
Mean experience[d]	No	No	0.001 (0.001)	0.003† (0.002)	0.003† (0.002)
Mean tenure[e]	No	No	No	0.007** (0.001)	0.006** (0.001)
Ln of value added per worker[f]	No	No	No	No	0.100** (0.020)
Adj. R^2	0.72	0.73	0.73	0.73	0.74
F-stat	268.54**	358.32**	606.37**	1170.54**	786.59**
Number of workers	13,617	13,617	13,617	13,617	13,617
Number of firms	700	700	700	700	700

Notes: The dependent variable is the ln of individual gross hourly wages including annual bonuses (i.e. irregular payments which do not occur during each pay period, such as pay for holiday, 13th month and profit sharing). Regressions have been estimated by OLS with White (1980) heteroscedasticity-consistent standard errors and with the Greenwald (1983) and Moulton (1990) correction for common variance components within firms. Robust standard errors are between brackets. **/*/***/†: coefficient significant at the 1, 5, 10 and 15 per cent level, respectively; [a]basic variables: education (5 dummies), prior potential experience (in level, squared and cubed), tenure (in level and squared), occupation (19 dummies), sex, and working conditions (i.e. type of contract (3 dummies), ln of paid hours, a dummy for extra paid hours, and a dummy for premium payments associated with shift work, night-time and/or weekend work); [b]region where the firm is located (2 dummies), firm's economic and financial control (3 dummies), industry affiliation in Nace 3 digit (182 dummies), level of collective wage agreement (2 dummies), and a dummy variable showing whether the individual supervises the work of his co-workers; [c]percentage of highly educated individuals within each firm (i.e. workers with long or short-type higher education); [d]workers' mean years of potential experience within each firm; [e]workers' mean years of tenure within each firm; [f]Estimated by the firm's annual gross operating income per worker (plus subsidies, minus indirect taxes)

limitation. However, it should not be overestimated for at least two reasons. On the one hand, several studies found no or only partial evidence for the existence of a selection bias (Albaek *et al.*, 1998; Main and Reilly, 1993). On the other, it is not clear whether the instruments used in the literature to control for the selection bias are valid. Be it as it may, the endogeneity of firm-size in the Belgian private sector remains an empirical question that should be addressed in future work. It would also be interesting to rely on matched worker-firm panel data so as to control for the non-observed characteristics of the workers and/or firms. However, at the moment such data do not exist for Belgium.

Notes

1. Following Kremer and Maskin (1996), employers prefer to match workers of similar skills together.
2. However, rent-sharing may also appear in the absence of trade unions. See the discussion in Blanchflower *et al.* (1996), Nickell (1999) and Rycx and Tojerow (2004).
3. See also the discussion in Barron *et al.* (1987), Garen (1985), Lucas (1978) and Oi (1983).
4. The following sectors are, therefore, not part of the sample: agriculture, hunting and forestry; fisheries; public administration; education; health and social action; collective, social and personal services; domestic services; and extra-territorial bodies.
5. Our sample has been split as follows: small firms employ at least 20 workers and less than 200 workers; and large firms employ 200 workers or more.
6. The firm level value added per employee is used as a proxy of the average labour productivity within the firm.
7. Therefore, we applied the "cluster" option in Stata. See StataCorp (1999, pp. 178-9) for an extended description of the estimation procedure.
8. Evidence on the existence of inter-industry wage differentials in Belgium has been provided by Rycx (2002) and Rycx and Tojerow (2002).
9. On average, firms renegotiating wages collectively at the decentralised level employ almost twice as much workers than firms solely covered by a national and/sectoral CA (1365 vs 750 workers).
10. See also the discussion in Villemez and Bridges (1988).
11. See Granovetter's (1984) dual-economy model.

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Appendix

Table A1.
Description and means (SDs) of selected variables

	Overall sample	Small firms[a]	Large firms[b]
Gross hourly wage: (in EUR) includes overtime paid, premiums for shift work, night work and/or weekend work and bonuses (i.e. irregular payments which do not occur during each pay period, such as pay for holiday, 13th month, profit sharing, etc.)	13.51 (6.52)	12.49 (6.24)	14.55 (6.63)
Education			
Primary or no degree: 0-6 years	12.48	10.71	14.11
Lower secondary: 9 years	25.31	22.64	28.02
Upper secondary (General/ Technical/Artistic/Prof): 12 years	41.23	44.67	37.72
Higher non-university short type, higher artistic training: 14 years	12.56	13.72	11.39
University and non-university higher education, long type: 16 years	7.94	7.81	8.08
Post-graduate: 17 years or more	0.48	0.45	0.50
Prior potential experience: (years) experience (potentially) accumulated on the labour market before the last job. It has been computed as follows: age − 6 − years of education − seniority	9.20 (8.14)	9.98 (8.58)	8.41 (7.57)
Seniority in the firm: (years)	10.51 (9.09)	8.82 (8.39)	12.23 (9.44)
White-collar workers (yes) [c]	52.64	52.57	52.68
Female (yes)	27.58	30.79	24.33
Hours: number of hours paid in the reference period, including overtime paid	161.05 (28.42)	160.14 (29.18)	161.94 (27.59)
Overtime paid (yes)	9.82	8.52	11.15
Bonuses for shift work, night work and/or weekend work (yes)	22.11	13.42	30.93
Type of contract	96.81	97.20	96.42
Unlimited-term employment contract	2.79	2.28	3.30
Limited-term employment contract	0.40	0.52	0.28
Apprentice/trainee contract or other contract			
Supervises the work of other workers (yes)	15.56	16.23	14.88
Size of the establishment: number of workers	759.48 (1546.88)	84.38 (51.05)	1,444.57 (1971.44)
Region: geographic location of the firm			
Brussels	12.44	13.13	11.75
Wallonia	21.31	19.36	23.28
Flanders	66.25	67.51	64.97
Sector			
Mining and quarrying	0.40	0.79	0.00
Manufacturing	55.99	41.27	70.94
Electricity, gas and water supply	0.42	0.35	0.50
Construction	3.93	5.46	2.37
Whole sale and retail trade; repair of motor vehicles and personal and household goods	21.94	28.08	15.70
Hotels and restaurants	1.33	2.51	0.14
Transport, storage and communication	6.32	8.49	4.11
Real estate, renting and business activities	9.67	13.05	6.24

(*continued*)

	Overall sample	Small firms[a]	Large firms[b]
Economic and financial control			
Fully state owned	0.16	0.00	0.32
Public firm (>50 per cent state owned)	3.83	2.05	5.64
Private firm (>50 per cent privately owned)	88.59	90.57	86.58
Other	7.42	7.38	7.46
Level of wage bargaining			
Collective wage agreement only at the national and/or sectoral level	45.55	62.33	32.69
Collective wage agreement at the firm level	47.00	27.13	47.00
Other	7.45	10.54	20.31
Value added per worker: (in thousands of EUR) firm level value added at factor costs divided by the total number of workers within the firm	60.19 (42.30)	55.17 (44.95)	65.31 (38.84)
Number of workers	41,593	20,826	20,767
Number of firms	1,865	1,366	499

Notes: The descriptive statistics refer to the weighted sample. Detailed descriptive statistics relative to the sectoral affiliation of the workers (in Nace 3 digit) and their occupations (in ISCO 2 digit) are available on request. [a] Number of workers in the firm ≥ 20 and <200; [b] number of workers in the firm ≥ 200; [c] white-collar workers are workers registered within ISCO codes 12 to 52

Table A1.