CEB Working Paper

Centre Emile Bernheim
Research Institute in Management Sciences

Solvay Brussels School
Economics & Management

Productivity and wage effects of firm-level collective agreements: Evidence from Belgian linked panel data

Andrea Garnero, François Rycx and Isabelle Terraz

How do firm-level collective agreements affect firm performance in a multi-level bargaining system? Using detailed Belgian linked employer-employee panel data, our findings show that firm agreements increase both wage costs and productivity (with respect to sector-level agreements). Relying on a recent approach developed by Bartolucci (2014), they also indicate that firm agreements exert a stronger impact on wages than on productivity, so that profitability is hampered. However, this rent-sharing effect only holds in manufacturing. In private sector services, the raw wage premium associated to firm agreements is entirely driven by compositional effects. Furthermore, estimates show that firm agreements lead to significantly more rent-sharing among firms operating in less competitive environments. Firm agreements are thus mainly found to raise wages beyond productivity when the rents to be shared between workers and firms are relatively big. Overall, this suggests that firm-level agreements benefit to both employers and employees – through higher productivity and wages – without being very detrimental to firms' performance.

Keywords: Collective bargaining, productivity, labour costs, linked panel data.

JEL Classifications: C33, J24, J31.

CEB Working Paper N° 18/020
May 2018

Université Libre de Bruxelles - Solvay Brussels School of Economics and Management
Centre Emile Bernheim
ULB CP114/03 50, avenue F.D. Roosevelt 1050 Brussels BELGIUM
e-mail: ceb@admin.ulb.ac.be Tel.: +32 (0)2/650.48.64 Fax: +32 (0)2/650.41.88

ULB

Productivity and wage effects of firm-level collective agreements: Evidence from Belgian linked panel data*

Andrea Garnero
OECD, Université libre de Bruxelles (CEB and DULBEA), and IZA

François Rycx
Université libre de Bruxelles (CEB and DULBEA),
Université catholique de Louvain (IRES), Université de Mons (humanOrg), GLO, and IZA

Isabelle Terraz
Université de Strasbourg (BETA, OPEE)

Abstract

How do firm-level collective agreements affect firm performance in a multi-level bargaining system? Using detailed Belgian linked employer-employee panel data, our findings show that firm agreements increase both wage costs and productivity (with respect to sector-level agreements). Relying on a recent approach developed by Bartolucci (2014), they also indicate that firm agreements exert a stronger impact on wages than on productivity, so that profitability is hampered. However, this rent-sharing effect only holds in manufacturing. In private sector services, the raw wage premium associated to firm agreements is entirely driven by compositional effects. Furthermore, estimates show that firm agreements lead to significantly more rent-sharing among firms operating in less competitive environments. Firm agreements are thus mainly found to raise wages beyond productivity when the rents to be shared between workers and firms are relatively big. Overall, this suggests that firm-level agreements benefit to both employers and employees – through higher productivity and wages – without being very detrimental to firms' performance.

JEL classification: C33, J24, J31.
Keywords: Collective bargaining, productivity, labour costs, linked panel data.

* We are grateful to the OECD (Directorate for Employment, Labour and Social Affairs) for financial support and Statistics Belgium for giving access to the data. E-mails: andrea.garnero@oecd.com, frycx@ulb.ac.be, terrazi@unistra.fr

1. Introduction

Despite an extensive theoretical and empirical literature, the impact of unions and collective bargaining on firm performance is still an open debate. Since the seminal works of Freeman (1976) and Freeman and Medoff (1984), the 'two faces of unionism' have been put forward. The latter refer respectively to 'union rent seeking behaviour' and 'union voice'. On the one hand, acting as a 'monopoly', unions can raise wages, restrict employment flexibility and distort labour supply by standardizing wages across regions and industries (Addison and Belfield, 2004). On the other hand, they provide an institutionalised mechanism by which labour and management can communicate and bargain without fear of major repercussions (Gomez et al., 2008). Unions and collective bargaining institutions thus enable workers to express their voice which in turn may improve efficiency notably through job and organisational changes. In sum, whether unions are detrimental to firm performance or not depends on their respective impact on wage costs and productivity. If the union wage premium originates from higher productivity, then both workers and firms can benefit. However, "*if raised wages come at the expense of normal profits, this can damage the prospects of firms and employment growth - to the long term detriment of all*" (Bryson, 2014: 1).

In many European countries, wages are determined by multi-employer collective agreements (at the national, industry or regional levels) and are often complemented by single-employer agreements (at the firm level). The existing literature has shown that firm-level agreements generally yield higher wages and foster rent-sharing, i.e. strengthen the wage-profit elasticity (Gürtzgen, 2010; Rycx and Rusinek, 2013). This is an expected outcome since in many countries firm-level agreements can only improve wages and working conditions. In contrast, very little is known regarding the consequences of firm-level agreements on productivity (Doucouliagos et al., 2017; Gürtzgen, 2010; Magda et al., 2012). This is somehow surprising since decentralisation of collective bargaining was mainly pushed in order to better align wages with productivity and to enhance productivity by promoting incentive schemes that can only be implemented at the decentralized level, such as performance-related pay schemes (OECD, 2018).

Our paper provides one of the first attempts at measuring the impact of collective bargaining levels on wages and productivity. More precisely, we rely on detailed matched employed-employee panel data for Belgium, covering all years from 1999 to 2010, to investigate the consequences of firm-level collective agreements (with respect to multi-employer agreements) on wage costs and productivity-wage gaps, i.e. profits. Our data offer

several advantages. The panel covers a large part of the private sector, provides accurate information on average productivity and wages within establishments and allows us to control for a wide range of worker, job and establishment characteristics. It also enables us to address important econometric issues that are often not accounted for in this literature, such as establishment-level fixed effects and endogeneity. Belgium is one of the OECD countries in which collective bargaining is most centralised and coordinated. A central level of negotiation at the top covers the entire private sector, while sector-level negotiations cover specific industrial branches. Company-level negotiations at the bottom can only improve wages and working conditions set in higher-level agreements (i.e. at the national and industry level).

In order to estimate the impact of firm-level collective agreements on wages and productivity-wage gaps, we rely on a recent approach developed by Bartolucci (2014). This approach is an extension of the Hellerstein et al. (1999) framework. It has been shown to be more flexible than the latter notably because it doesn't impose that the elasticity of wages with respect to productivity is equal to 1. Moreover, it avoids the estimation of a production function and hence the choice of an appropriate functional form for the latter. Practically, it boils down to estimate a wage equation at the firm level and to control for a large set of covariates, including firm-level productivity. Three types of outcomes can be obtained using Bartolucci's (2014) approach. First, results might show that firm-level agreements have a significant positive effect on wage costs, conditional on productivity and other covariates. In this case, results imply that firm-level agreements are mainly a tool for rent-sharing (i.e. that their impact on wages is stronger than on productivity, so that profits are hampered). In contrast, if the presence of firm-level agreements is found *ceteris paribus* to depress wage costs, it means that firms' profitability is fostered by firm-level agreements (i.e. that the latter are more beneficial for firms' productivity than for workers' wages). Finally, if wage costs are not found to depend significantly on firm-level agreements, then the interpretation is that firms' profitability is not affected by firm-level agreements (i.e. that the latter's impact is alike on productivity and wage costs).

Economic theory suggests that trade unions' ability to bargain higher wages depends on their strength and on the size of the rents that are to be shared between workers and firms (Boeri and van Ours, 2014; Bryson, 2007). We also contribute to the existing literature by testing the accurateness of these predictions. To do so, we investigate whether the consequences of firm-level collective agreements on wages and productivity-wage gaps depend on establishments' sectoral affiliation and on the degree of competition that they face on their product market. Given that trade unions are generally found to be stronger in the manufacturing industry

(notably due to higher union membership) than in private sector services, a stronger wage premium could be expected in the former sector. More rent-sharing is also anticipated among establishments operating is less competitive environments, where the size of the rents to be shared are typically larger.

The remainder of this paper is organised as follows. The next section provides a brief review of the literature regarding 'union effects' on wages and productivity. Section 3 summarizes the main features of collective bargaining in the Belgian private sector. The dataset and descriptive statistics are presented in Section 4. Our methodology and empirical results are shown in Sections 5 and 6. The last section concludes.

2. Background

What is meant by 'union effects' varies markedly across countries and depends crucially on the institutions in place within those countries. In the Anglo-American world, most of pay bargaining occurs at the firm or establishment level. Moreover, union membership is often a reasonable proxy of union coverage. Hence, 'union effects' traditionally refer to the consequences of union membership (Bryson, 2007).

In Western Continental Europe, focusing on the effects of union membership is less relevant (or at least not enough) since the vast majority of workers are covered by collective agreements, whether they are union members or not (OECD, 2017). Due to the existence of *erga omnes* clauses and extension mechanisms[1], the coverage rate in those countries is indeed generally much higher than the trade union density. Accordingly, the debate does not focus on the effects of union membership but rather on the most appropriate bargaining level. This debate has been triggered by the hump-shaped hypothesis, supported by Calmfors and Driffill (1988), suggesting that sector-level bargaining leads to higher wage increases and unemployment compared to firm-level or national bargaining. It has also been prompted by the OECD (1994) recommending advanced economies to decentralise wage bargaining to improve labour market performance.

While these recommendations have since been amended (OECD, 2004, 2006, 2018), many Western European countries opted in recent years for more decentralised wage bargaining (OECD, 2018). This decentralisation notably involved a shift in the prevailing bargaining level

[1] *Erga omnes* clauses extend an agreement to all workers in a signatory company. Administrative extensions extend the terms of a collective agreement at sectoral level also to workers in firms which have not signed the agreement or are not affiliated to an employer organisation which signed the agreement.

(e.g. from national or sector-level to firm-level), and/or the addition of a supplementary layer of bargaining at the firm level (i.e. the implementation of a two-tier system in which wages are not solely bargained at the industry and/or national level but also at the firm level). Despite this decentralisation trend, employment conditions in Western Europe remain largely determined by multi-employer collective agreements (at the national, industry and/or regional levels). Accordingly, 'union effects' in Western Europe generally refer to the consequences of firm-level collective agreements with respect to multi-employer agreements.[2]

a. 'Union effects' on wages

Empirical evidence shows that workers covered by a firm-level agreement generally earn higher wages than their opposite numbers solely covered by sectoral agreements. Several arguments support this outcome (Dahl et al., 2013): i) decentralisation enables to better reward individual performance (Lucifora and Origo, 2015); ii) it can foster rent-sharing (Gürtzgen, 2010; Rusinek and Rycx, 2013); and iii) lead to higher wages due to efficiency wage considerations (Cahuc and Zylberberg, 2014) or iv) because trade unions and employers are less likely to fully internalize the macroeconomic consequences of their agreements (Calmfors, 1993).

Dell'Aringa and Lucifora (1994) are among the first to estimate 'union wage effects' in the Western European context. Their results, based on Italian data, show that union recognition for local bargaining leads to a significant wage gain for both white- and blue-collar workers. Since then, the existence of a positive wage premium associated to firm-level collective agreements has been confirmed for other countries, including Belgium (Rycx, 2003), Denmark (Plasman et al., 2007), France (Leclair et Petit, 2004), Greece (Daouli et al., 2013), Portugal (Cardoso and Portugal, 2005), Spain (Card and de la Rica, 2006; Dell'Aringa and Pagani, 2007) and Sweden (Granqvist and Regner, 2008). The wage premium associated to firm-level collective agreements (with respect to higher-level agreements) is generally estimated at between 3 and 7%. Yet, some studies find a more limited effect: it would be around 0.5% in the Netherlands (Hartog et al., 2002) and close to zero in Germany (Antonczyck, 2011).

Whereas aforementioned papers are mainly based on cross-sectional data, more recent studies rely on longitudinal datasets. Gürtzgen (2016), for instance, shows with German linked

[2] Notwithstanding institutional diversity, two groups of countries can be distinguished in Western Europe: one where sector- and firm-level agreements can be combined, and a smaller one (notably including Germany and Britain) where sector- and firm-level agreements are alternatives to one another (Bryson, 2007; Schnabel. et al., 2006).

panel data that transiting from no coverage to firm-level bargaining leads to a wage premium, while transiting from sector- to firm-level bargaining yields a wage penalty. This outcome could result from the fact that decentralisation of wage bargaining has been mainly initiated by employers and that unions are no longer in a position to secure a wage premium when bargaining occurs at the firm level, especially given that sector- and firm-level bargaining are mutually exclusive in Germany. In Sweden, bargaining occurs at the firm level (decentralised system), at the sector level (centralised system) or at both levels (two-tier system). Relying on longitudinal data for this country and using a fixed effects model, Andreasson (2014) finds a wage gain of 6% for firm bargaining and of 1.7% for a two-tier system compared to a centralised one. Using similar longitudinal data for Denmark, Dahl et al. (2013) also focus on the wage effects of bargaining changes and, more precisely, of bargaining decentralisation. Their results reveal a wage premium of 4.7% for firm bargaining relative to sector bargaining (and no significant effect associated to two-tiered bargaining) using a job-spell-fixed effects model.

b. 'Union effects' on productivity

While 'union effects' on productivity and productivity-wage gaps (i.e. profitability) have been widely studied for Anglo-American countries (Doucouliagos et al., 2018), surprisingly little is known for Western Europe. From a theoretical perspective, decentralisation of bargaining may enable firms to better reward individual skills and to adopt more appropriate incentive practices, notably for performing a mix of tasks (Lindbeck and Sower, 2001). According to efficiency wage arguments, this could in turn improve workers' motivation and productivity. However, decentralisation can also increase firms' transaction costs. Moreover, by raising wage demands after contract negotiation, it can seize returns on capital, slow investments in physical capital and R&D, and hence impede firms' performance (Acemoglu and Pischke, 1999; Cardullo, 2015; Haucap and Wey, 2004). On the opposite, by compressing the wage structure, a more centralised bargaining system can force unproductive companies to exit the market faster (Braun, 2011).

Theoretical predictions in the Anglo-American context are better documented. The voice effect/institutional response model (Freeman, 1976; Freeman and Medoff, 1984) highlights three main channels by which unions may lift productivity. Unions may improve communication between workers and management and provide a way for workers to express their discontent which saves turnover costs by reducing quit rates. Moreover, facing higher costs due to union presence, firms may be triggered to reorganise their production process,

leading to higher productivity. However, unions may also hamper productivity by depressing physical capital formation and favouring shirking due to a lower risk of dismissal.

On the empirical side, meta-analyses of existing studies (Doucouligos et Laroche, 2003; Doucouliagos et al., 2017; Doucouliagos et al., 2018) suggest that union effects on productivity in Anglo-American economies and other countries are quite small on average.[3] However, the magnitude of estimates varies widely across countries, periods, industries and product market structures. Moreover, evidence for Western Continental Europe remains very scarce and existing studies essentially focus on the consequences of union membership (instead of bargaining levels) on productivity. A recent study by Barth et al. (2017), for instance, investigates this relationship using longitudinal firm-level data for Norway. Accounting for the endogeneity of unionization, they find that increases in union density have a sizeable positive effect on both productivity and wages. When adding productivity as an additional covariate in their wage regression, they also show that the impact of union density on earnings decreases by a third. This outcome is consistent with a rent-sharing explanation, i.e. that the wage-profit elasticity gets larger as union density increases. The study of Hibbs and Locking (2000) is the only one so far to investigate in depth the effect of collective bargaining decentralisation on productivity. Their estimates for Sweden show that the possibility to renegotiate sector-level agreements at company level hampers aggregate productivity growth by slowing down the exit of inefficient firms. In contrast, Andreasson (2014) provides some preliminary descriptive results suggesting that firm-level agreements are associated to higher productivity in Sweden.

Our paper is one of the first to estimate the effect of firm-level agreements on both wages and productivity in a Western European context. More precisely, we rely on detailed matched employed-employee panel data for Belgium, covering more than a decade, to investigate the consequences of firm-level collective agreements (in addition to industry and national agreements) on wage costs and productivity-wage gaps. Put differently, we investigate whether firm-level agreements have a similar effect on wages and productivity. Last but not least, we investigate the role of two important moderating factors, namely establishments' sectoral affiliation and the degree of product market competition.

3. Wage Bargaining in the Belgian private sector

[3] In contrast, meta-studies show a clear negative relationship between unions and investments.

As in many Western European countries, wage bargaining in Belgium 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 minimum wages and a margin for wage increases that may be bargained at lower levels.[4] Next, this national agreement is improved within every sector of activity. Sector-level agreements are concluded within Joint Committees that bring together employer and union representatives. They set sector-wide standards for all workers covered by the Joint Committee. Then we have the firm negotiations where the sectoral collective agreements may be renegotiated. However, these cannot give rise to a collective agreement which would run counter to the sectoral agreement. In other words, the wage bargained at the firm level can only be greater or equal to the wage set at the sectoral level (i.e. the so-called "favourability principle").

Belgium is characterised, in addition, by a coverage rate of more than 90% (OECD, 2004).[5] This stems from the fact that non-unionised workers and the employers who are not members of an employers' organisation are generally covered by a collective labour agreement. Article 19 of the law dated 5 December 1968 specifies that a collective agreement is automatically binding upon the signatory organisations, employers who are members of those organisations or who have personally concluded the agreement, employers joining those organisations after the date of the conclusion of the agreement, and finally, all workers, *whether unionised or not*, who are employed by an employer so bound. Moreover, all sectoral collective agreements are 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 organisations (employers' organisations or unions). This extension mechanism aims to reduce differences in working conditions among workers within sectors and more generally to foster social cohesion.

To sum up, 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.

[4] Every year the Central Economic Council produces a technical report on the maximum available nominal wage cost increase margin that is compatible with the objectives of the July 1996 legislation on the promotion of employment and the competitiveness of the Belgian economy. This margin depends essentially on forecast pay trends in the three reference countries (Germany, France and the Netherlands). It is used by the social partners every two years when bargaining the interprofessional (i.e. national) collective agreement and fixing the 'wage norm', i.e. the theoretical maximum margin for wage costs growth. The objective of the wage norm is to make sure that all parties to the negotiations take on board the need for wage restraint in an open economy with a high unemployment rate. Though not legally binding, the wage norm has thus been implemented to guarantee a sufficiently high degree of coordination among the social partners and to avoid excessive wage increases.

[5] Only self-employed workers may not be covered by a collective agreement. These workers are not included in our sample.

4. Data and descriptive statistics

Our empirical analysis is based on a combination of two large data sets covering the period 1999-2010. The first, carried out by Statistics Belgium, is the 'Structure of Earnings Survey' (SES). It covers all establishments operating in Belgium which employ at least 10 workers and with economic activities within sections C to K of the NACE Rev.1 nomenclature.[6] The survey contains a wealth of information, provided by the management of establishments, both on the characteristics of the latter (e.g. level of collective wage bargaining, sector of activity, number of employees, region where the establishment is located) and their workers (e.g. age, education, sex, tenure, gross earnings, working hours, occupations).[7] The SES provides no financial information. It has therefore been merged with a firm-level survey, the 'Structure of Business Survey' (SBS). The SBS, also conducted by Statistics Belgium, provides information on financial variables such as investments, value added and gross output. The coverage of the SBS differs from that of the SES in that it does not cover the whole financial sector (NACE J) but only Other Financial Intermediation (NACE 652) and Activities Auxiliary to Financial Intermediation (NACE 67). The merger of the SES and SBS datasets has been carried out by Statistics Belgium using firms' social security numbers.

[6] It thus covers the following sectors: (i) mining and quarrying (C), (ii) manufacturing (D), (iii) electricity, gas and water supply (E), (iv) construction (F), v) wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods (G), (vi) hotels and restaurants (H), (vii) transport, storage and communication (I), (viii) financial intermediation (J), and ix) real estate, renting and business activities (K).

[7] The SES is a stratified sample. The stratification criteria refer respectively to the region (NUTS-groups), the principal economic activity (NACE-groups) and the size of the establishment. The sample size in each stratum depends on the size of the establishment. Sampling percentages of establishments are respectively equal to 10, 50 and 100 percent when the number of workers is lower than 50, between 50 and 99, and above 100. Within an establishment, sampling percentages of employees also depend on size. Sampling percentages of employees reach respectively 100, 50, 25, 14.3 and 10 percent when the number of workers is lower than 20, between 20 and 50, between 50 and 99, between 100 and 199, and between 200 and 299. Establishments employing 300 workers or more have to report information for an absolute number of employees. This number ranges between 30 (for establishments with between 300 and 349 workers) and 200 (for firms with 12,000 workers or more). To guarantee that establishments report information on a representative sample of their workers, they are asked to follow a specific procedure. First, they have to rank their employees in alphabetical order. Next, Statistics Belgium gives them a random letter (e.g. the letter O) from which they have to start when reporting information on their employees (following the alphabetical order of workers' names in their list). If they reach the letter Z and still have to provide information on some of their employees, they have to continue from the letter A in their list. Moreover, firms that employ different categories of workers, namely managers, blue- and/or white-collar workers, have to set up a separate alphabetical list for each of these categories and to report information on a number of workers in these different groups that is proportional to their share in the firm's total employment. For example, a firm with 300 employees (namely, 60 managers, 180 white-collar workers and 60 blue-collar workers) will have to report information on 30 workers (namely, 6 managers, 18 white-collar workers and 6 blue-collar workers). For more details see Demunter (2000).

The computation of our explanatory variables (especially, those reflecting the composition of the labour force) requires a sufficient number of individual observations per establishment. We therefore eliminate (a very small number of) establishments with less than 10 observations in a given year.[8] We also exclude workers and/or establishments for which data are missing or inaccurate.[9] Next, the estimation of capital stock through the 'perpetual inventory method' (OECD, 2009) requires to have information on investments for minimum two successive periods. This restricts our sample to establishments that are observed in at least two consecutive years. It leads to the over-representation of medium-sized and larger establishments since sampling percentages of establishments in our sample increase with the size of the latter.[10] Finally, we restricted our sample to single-establishment firms (SEF). The rationale for doing this is that information on dependent variables (taken from the SBS) is at the level of the firm, while explanatory variables (taken from the SES) are measured at the establishment level. Put differently, the dependent variable takes the same value for all establishments belonging to the same multi-establishment firm (MEF). To avoid this aggregation bias, we focus on SEF only.[11] Our final sample consists of an unbalanced panel of 7,419 establishment-year observations from 2,439 establishments. It is representative of all medium-sized and large establishments employing at least 10 employees in the Belgian private sector, with the exception of large parts of the financial sector (NACE J) and the electricity, gas and water supply industry (NACE E).

[Include Table 1 about here]

As shown in Table 1, around 28 percent of establishments in our final sample (i.e. 700 out of 2,439) are covered by a firm-level collective agreement.[12] We note a clear-cut difference between the characteristics of firms[13] covered by a company collective agreement and those not

[8] Theoretically, the characteristics of the SES data set should guarantee that the minimum number of individual observations per establishment and per year is equal to 10 (see footnote 7). However, in practice, in less than 2 percent of cases this minimum number of data points is not reached. This could be explained for instance by the fact that some establishments did not fill in the questionnaire for a sufficient number of their employees or because some questionnaires have been lost or not encoded by the administration. The average number of observations per establishment in each year is equal to 34 in our final sample.

[9] For instance, we eliminate a (very small) number of establishments for which the recorded value added was negative.

[10] See footnote 7.

[11] This restriction reduces the number of establishments by approximately 24% (from 3,225 to 2,439 establishments). Yet, it is unlikely to generate a significant selection bias. Descriptive statistics for SEF are indeed very similar to those obtained for our initial sample (including both single- and multi-establishment firms). The average values for hourly productivity and wage costs are for instance almost the same in both samples. SEF are however found to be somewhat smaller and more concentrated in the manufacturing and construction industries. As a result, the share of blue-collar workers is also found to be slightly bigger in SEF.

[12] This is in line with previous evidence on this issue (see e.g. du Caju et al., 2012).

[13] Given our focus on SEF, in the remainder of this paper, the terms 'establishments' and 'firms' will be used as synonymous.

so covered. The point is that establishments within which wages are collectively renegotiated are more capital intensive, productive and profitable (though wage costs are also higher here), larger and more concentrated in manufacturing. They also employ workers that are somewhat more educated, with more years of seniority. Conversely, the shares of women and part-timers are slightly lower among those establishments. As regards establishments solely covered by national and sectoral collective agreements, they are more often found in construction, wholesale and retail trade, and real estate, renting and business activities. Finally, descriptive statistics show that the degree of product market competition is somewhat stronger among firms that are not covered by a firm-level collective agreement. Indeed, the mean Herfindahl-Hirschman index is found to be lower among those firms (0.04 vs 0.06).[14]

5. Methodology

Our empirical approach is based on the wage-setting equation proposed by Bartolucci (2014). It is similar to the wage equation in Hellerstein et al. (1999) but directly estimates a parameter for the logarithm of average firm-level productivity. Accordingly, the three following equations have been estimated:

$$\log\left(\frac{Wage\ Cost}{Hours}\right)_{j,t} = \alpha_j + \beta\, Firm\ Agreement_{j,t} + \sum_{t=1}^{T-1}\rho_t YEAR_t + \varepsilon_{j,t} \tag{1}$$

$$\log\left(\frac{Wage\ Cost}{Hours}\right)_{j,t} = \alpha_j^* + \beta^*\, Firm\ Agreement_{j,t} + \sum_{t=1}^{T-1}\rho_t^* YEAR_t + \lambda^* X_{j,t} + \varepsilon_{j,t}^* \tag{2}$$

$$\log\left(\frac{Wage\ Cost}{Hours}\right)_{j,t} = \alpha_j^{**} + \beta^{**}\, Firm\ Agreement_{j,t} + \sum_{t=1}^{T-1}\rho_t^{**} YEAR_t + \lambda^{**} X_{j,t} + \delta^{**}\log\left(\frac{Value\ Added}{Hours}\right)_{j,t} + \varepsilon_{j,t}^* \tag{3}$$

The dependent variable in equations (1) to (3) is the average wage bill (including payroll taxes and variable pay components, such as wage premia for overtime, weekend or night work, performance bonuses and other premia) in firm *j* at time *t*. It is obtained by dividing the firm's

[14] To compute these estimates, we relied on NACE 3 digit Herfindahl-Hirschman indices provided by Statistics Belgium for each year from 1999 to 2010 (Statistics Belgium, 2016).

total wage cost by the total number of hours worked. The main explanatory variable (*Firm Agreement*$_{j,t}$) in all three equations is a dummy taking the value 1 if the firm is covered by a firm-level collective agreement, and 0 otherwise (i.e. if the firm is solely covered by a national and sectoral collective agreement).

Equation (1) only controls for year dummies. The parameter β thus captures the raw wage differential between firms solely covered by a national and sector-level collective agreement and those in which working conditions are collectively renegotiated in house, after controlling for annual changes in the business cycle. Equation (2) also includes $X_{j,t}$, i.e. a vector containing a set of variables controlling for observable worker, job and firm characteristics. More precisely, it comprises the share of the workforce in firm *j* at time *t* that: (i) has at most a degree from lower secondary education and tertiary education, respectively; (ii) is younger than 30 and older than 49 years, respectively; (iii) has at least 10 years of tenure; (iv) is female; (v) works part-time; (vi) occupies blue-collar jobs; (vii) has a fixed-term contract; and (viii) is apprentice or under contract with a temporary employment agency. $X_{j,t}$ also includes 8 industry dummies, the logarithm of firm size, 2 dummies for the region in which the firm is located, and the logarithm of the capital stock per worker in firm *j* at time *t*. Hence, the parameter β* measures the average wage effect of being covered by a firm-level collective agreement after controlling for a large set of covariates. Equation (2) corresponds to the traditional wage-setting regression run in the literature to estimate the impact of a firm-level collective agreement on workers' wages. Yet, it is aggregated at the level of the firm. Indeed, most previous studies use the individual worker as statistical unit. This aggregation enables us to control for firm time-invariant unobserved characteristics and to test for potential endogeneity (see below). It also makes it possible to follow Bartolucci's (2014) approach, i.e. to include firm-level average productivity as an additional control variable. This is done in equation (3). The parameter β** in this equation measures the impact *ceteris paribus* of a firm-level collective agreement on the gap between wage costs and productivity. The interpretation of β** is as follows. If the estimate of β** is found to be significantly positive (negative), it implies that firm-level agreements are harmful (beneficial) for profitability, i.e. they are more (less) beneficial for workers' wages than for firms' value added. If the estimate of β** is found to be insignificant, it implies that firm-level agreements leave firms' profitability unaffected, i.e. their impact is alike on wage costs and productivity. Despite the difficulties highlighted by Bartolucci (2014) to estimate accurately a production function, we complement our analysis by directly estimating the impact

of firm-level collective agreements on firms' productivity. To do so, we rely on equation (2) using as dependent variable the hourly productivity of a firm (instead of the hourly wage cost).

6. Results

a. Benchmark estimates

We first estimated equation (1) with pooled OLS. Results, presented in column (1) of Table 2, show the impact of being covered by a firm-level agreement on firms' average hourly wage bill, while controlling solely for year dummies. The regression coefficient associated to the firm-level agreement dummy is highly significant and equal to 0.141. It means that the hourly wage cost is on average 14% higher among firms in which wages are collectively renegotiated in house, after controlling for annual business cycle effects. If we include additional covariates for worker, job and firm characteristics (as specified in equation (2)), this wage cost differential drops to around 5% but remains significant at the 1% probability level (see column (2)). Interestingly, the magnitude of this premium is coherent with previous estimates obtained for Belgium using cross-sectional data at the worker level. It is also in the range of estimates reported for other Western European countries with multi-tier bargaining regimes, such as France, Italy and Spain.

b. Endogeneity

Firms in the Belgian private sector cannot choose by which sector-level agreement they will be covered. Indeed, it is the Ministry of Employment, Labour and Social Dialogue that decides to which Joint Committee (JC) a firm belongs. The decision of the Ministry is based on the principal economic activity of the firm. Within JCs, firms can choose whether or not they want to renegotiate wages collectively 'in house'. This choice could lead to an endogeneity problem, especially if the latter is not independent of firms' average productivity and wage cost. However, as highlighted by Rusinek and Rycx (2013), the probability that a firm opts for an 'in house' agreement is contingent on the JC to which it belongs.[15] An additional feature likely to

[15] Three groups of industries (i.e. JCs) can be identified according to the prevailing level at which job classifications and regular wage premia are bargained (Verly, 2003): (a) industries where such norms are mostly defined at the sector level and applied as such in companies. These are mainly manufacturing industries and sectors essentially employing blue-collar workers such as the textile, food, construction, wood and transport industries. (b) Industries where such norms exist at the sector level but are often considered as a minimum that has to be

mitigate endogeneity is that the level of wage bargaining is highly persistent over time. Firms covered by an 'in house' collective agreement are indeed very unlikely to change bargaining status, i.e. to become solely covered by a sector-level agreement (and vice versa). Accordingly, within-firm changes in wages/productivity are expected to have little impact on a company's likelihood to renegotiate wages collective 'in house'.

To examine whether our results are affected by a potential endogeneity issue, we re-estimated equation (2) using two-stage least-squares (2SLS). We use as an instrument for firm agreement, the incidence of firm-level collective agreements by industry and firm size cells at each period. More precisely, for each firm *i*, we computed the percentage of firms (excluding firm *i*) belonging to the same industry-size cell covered by a firm-level collective agreement.[16] The rationale for using this IV is that the mean hourly wage cost within a firm is unlikely to be correlated to whether or not many firms in the same industry and size class are covered by a firm agreement. Moreover, we expect the likelihood of a firm to be covered by a firm-level collective agreement to be higher when a larger share of firms belonging to the same industry/size cell renegotiates wages collectively in house. First-stage estimates (reported in Appendix 1) suggest that a 10 percentage points increase in the industry-size coverage raises a firm's probability to be covered by a firm-level agreement by 5 percent on average. These estimates suggest that our IV is not weak, which is also corroborated by the Cragg-Donald Wald F statistic for weak identification. The latter is indeed much bigger than 10.[17] Moreover, we can reject the null hypothesis that our first-stage equation is under-identified. The Kleibergen-Paap rk LM statistic is indeed found to be highly significant. As regards the endogeneity test[18], the p-value associated to the Chi-squared statistic is equal to 0.60. This outcome suggests that the null hypothesis of no endogeneity should not be rejected. Estimates thus indicate that our main explanatory variable, i.e. firm agreement, is not endogenous and that OLS estimates (reported in Table 2) should be preferred to those obtained by 2SLS.

c. Establishment fixed unobserved heterogeneity

improved at the firm level. This is mostly the case for industries mainly employing white-collar workers. (c) Industries where such norms are mostly defined at the company level. These are mainly industries consisting of larger firms: steel, non-ferrous metals, glass, chemicals, papers and electricity.

[16] We considered five sectors (i.e. NACE categories C&D, F, G&H, I&J, and K) and four size classes (i.e. [10, 58], [59, 129], [130-253] and 254 workers and more).

[17] We rely on the standard 'rule of thumb' that weak identification is problematic for F statistics smaller than 10 (as suggested by van Ours and Stoeldraijer, 2011).

[18] The test is based on the difference of two Sargan-Hansen statistics: one for the equation in which the firm-level collective agreement variable is treated as endogenous, and one in which it is treated as exogenous. If the null hypothesis of this test cannot be rejected, then instrumentation is actually not necessary.

Another potential issue that has not been tested so far is the presence of establishment fixed effects. Indeed, pooled OLS estimates might suffer from a potential heterogeneity bias because firm wages can be related to establishment-specific, time-invariant characteristics (such as the quality of management, the culture of the firm, the ownership of a patent or other firm idiosyncrasies) that are not measured in micro-level surveys. To examine whether we should address this issue, we applied a Breusch-Pagan LM test. The later clearly supports the existence of establishment fixed effects.

The traditional way to control for this is by estimating a fixed effects (FE) model. This boils down to estimate a within differentiated model, i.e. a model where the mean of each variable has been subtracted from the initial values. Given that our variable of interest, i.e. firm agreement, is (almost) time-invariant, this approach cannot be applied. Hence, we re-estimated equation (2) with the system generalized method of moments (SYS-GMM), proposed by Arellano and Bover (1995) and Blundell and Bond (1998). This estimator is widely used in the literature to obtain consistent estimates of time-invariant regressors while controlling for firm fixed effects (Roodman, 2009). It implies to simultaneously estimating a system of two equations (one in level and one in first differences) and to use 'internal instruments' to control for endogenous regressors. All explanatory variables, except the level of collective wage bargaining, the region where the firm is located, the sectoral affiliation and time, have been considered as endogenous in our SYS-GMM regressions. Put differently, variables showing very little or no variability over time have not been instrumented so as to avoid inconsistent estimates due to weak instrumenting. SYS-GMM estimates thus control for firm fixed effects as well as for the endogeneity of time-varying explanatory variables (in addition to a large set of covariates).

SYS-GMM estimates associated to equation (2) are reported in column (4) of Table 2. To examine their reliability, we applied the Hansen's (1982) and Arellano-Bond's (1991) tests. The first is a test of over-identification which allows to test the validity of the instruments. The second is a test for autocorrelation, where the null hypothesis assumes no second order autocorrelation in the first differenced errors. On the basis of these tests, we do not reject respectively the null hypotheses of valid instruments and of no second order auto-correlation in first differenced errors. SYS-GMM estimates thus appear to be reliable. The regression coefficient obtained by SYS-GMM for our main explanatory variable (see column (4)) is slightly smaller than that estimated by OLS (see column (2)), which means that part of previous estimated wage cost gaps were due to establishment-level fixed unobserved heterogeneity. Yet,

the wage premium in companies covered by a firm-level collective agreement still stands at 4.6%.

d. The impact on productivity-wage gaps

To examine whether firm-level collective agreements have a stronger impact on wages than on productivity, we first followed the methodology developed by Hellerstein et al. (1999). Hence, we estimated equation (2) by SYS-GMM using as dependent variable firm-level average hourly productivity (instead of the firm-level average hourly wage cost). Results are reported in Appendix 2. They show that firm-level agreements foster productivity. More precisely, the productivity premium in companies covered by a firm-level collective agreement is estimated at 2.1%. This productivity premium appears to be smaller than the corresponding wage cost differential (estimated at 4.6%) reported in column (4) of Table 2. Hence, estimates suggest that firm-level agreements are detrimental to profitability. Yet, to test the robustness of this conclusion, we adopted the more reliable approach suggested by Bartolucci (2014). To do so, we estimated equation (3) by SYS-GMM. Put differently, we add average firm-level productivity among regressors of the wage-setting equation (2). Results are reported in the last column of Table 2. Estimates show that productivity is strongly and positively related to wage costs. They also indicate that a wage premium of 3.7% is still recorded in companies covered by a firm-level collective agreement, after controlling for productivity. This result suggests that firm-level agreements generate some rent-sharing, i.e. they lead to higher wages at given level of productivity. More precisely, given that the coefficient associated to firm-level agreements is larger in column (4) than in column (5) of Table 2, estimates support the conclusion that firm-level agreements are more beneficial for workers' wages than for firms' productivity. In sum, SYS-GMM estimates suggest that firm-level agreements are *ceteris paribus* detrimental to profitability.[19]

e. The moderating role of sectors

[Include Table 3 about here]

[19] Note that we also estimated equation (3) by OLS. Results, reported in column (3) of Table 2, support the conclusion that firm agreements have a stronger positive effect on wage costs than on productivity.

As a sensitivity test, we first investigated whether our benchmark results are influenced by establishments' sectoral affiliation. To do so, we re-estimated equations (2) and (3) separately for manufacturing and services.[20] OLS and SYS-GMM estimates, reported in Table 3, are quite interesting. They basically show that previous results only hold in manufacturing. For services, regression coefficients associated to the presence of a firm-level collective agreement all become statistically insignificant once covariates, i.e. individual, job and firm characteristics, are controlled for (see columns (1') to (5')). In manufacturing, results are quite different. Before controlling for productivity (see column (4)), SYS-GMM estimates show the existence of a wage premium *ceteris paribus* of 5% among firms in which wages are collectively renegotiation 'in house'. After controlling for productivity (see column (5)), this premium drops to around 3%. As in our benchmark specification (see Table 2), these estimates suggest that firm-level agreements foster wage costs proportionally more than productivity. They thus support the hypothesis that firm-level agreements are mainly a tool for rent-sharing in manufacturing.[21]

f. The moderating role of product market competition

Bargaining models suggests that trade unions' ability to negotiate higher wages depends on their strength but also on the size of the rents that are to be split between workers and firms. Economic theory thus predicts that the wage premium associated to firm-level collective agreements should be higher when the price-elasticity of demand for products or services in the sector is lower, i.e. in the case of monopolistic or oligopolistic competition. The argument goes that employers in less competitive environments can more easily pass wage increases on to consumers, without fearing of being undercut by other producers, or meet additional costs from above-normal profits (Boeri and van Ours, 2014). To investigate the accurateness of this prediction, we relied on NACE 3 digit Herfindahl-Hirschman indices of product market concentration computed by Statistics Belgium. More precisely, for each year, we split firms according to whether or not they were operating in an industry (at the NACE 3 digit level) with a product market competition index below the median sample value of that year, i.e. with a Herfindahl-Hirschman index above the median value. We thus created a dummy variable, set

[20] Industry sectors refer to NACE codes C (Mining and quarrying), D (Manufacturing), E (Electricity, gas and water supply) and F (Construction). Services sectors include NACE codes G (Wholesale and retail trade; repair of motor vehicles, motorcycles and household goods), H (Hotels and restaurants), I (Transport, storage and communication), J (financial intermediation) and K (Real estate, renting and business activities).

[21] A similar conclusion is obtained when estimating Equation (3) by sector of activity with the OLS estimator (see columns (2) and (3) of Table 3).

equal to one, for firm operating in less competitive environments. This dummy has been included in our benchmark equations as an additional control variable and in interaction with our main variable of interest ('firm-level agreement').

[Include Table 4 about here]

As expected, SYS-GMM estimates reported in columns (4) and (5) of Table 4 first show that mean hourly wage costs are significantly higher in less competitive environments. The wage differential stands at between 6.5 and 4% depending on whether or not firm-level productivity is controlled for. Interestingly, results also show that the wage premium associated to firm-level collective agreements is systematically higher when product market competition is weaker.[22] More precisely, GMM-SYS estimates (reported in column (4)) suggest that the wage premium in companies covered by a firm-level collective agreement is *ceteris paribus* twice as big when competition is lower (6.5 instead of 3.2%). After controlling for productivity, these wage premia drop respectively to 5.1 and 2.5% in more and less competitive environments (see column (5)). These findings suggest that firm-level agreements are mainly a tool for rent-sharing in both types of environments (i.e. their impact on wages is stronger than on productivity, so that profits are hampered). However, results also support the prediction that firm-level agreements lead to significantly less rent-sharing when product market competition is fiercer, i.e. when the rents to be split between workers and firms are smaller. OLS estimates reported in columns (1) to (3) lead to the same conclusion.

7. Conclusion

This article contributes to the literature on the wage and productivity effects of different collective bargaining regimes. Our analysis is focused on Belgium, a country where, like in several other European countries, multi-employer bargaining (at the national and sector level) can be complemented by single-employer bargaining. Using matched employer-employee panel data covering the years 1999-2010, we distinguish firms solely covered by multi-employer agreements from the ones covered by an additional 'in house' agreement. We rely on

[22] Differences in regression coefficients associated to firm-level collective agreements in low- and high-competitive environments are statistically significant at the 1% level in the OLS regressions (columns (1) to (3)) and at the 10% level in the GMM-SYS regressions (columns (4) and (5)).

a recent approach developed by Bartolucci (2014) that enables us to estimate the wage differential associated to firm-level collective agreements but also to test whether this wage differential is in line with the corresponding productivity differential. Our paper is one of the first to investigate this research question. We also add to the literature by investigating the role of two potentially important moderators: establishments' sectoral affiliation and product market competition. According to bargaining models, these moderators are likely to affect the size of the rents that are shared between workers and firms.

A large literature, though essentially based on cross-sectional data, found that firm bargaining yields higher wages. Using the system generalized method of moments (SYS-GMM) estimator which accounts for firm fixed effects, we find a wage premium of between 4 and 5% after controlling for individual, job and firm characteristics. This effect is coherent with the Belgian bargaining system in which only upward flexibility is allowed at the firm level. However, we show that firm bargaining also fosters productivity. While a rather large literature has focused on the impact of union membership on productivity in Anglo-American countries, this paper is among the first to investigate the effect of firm-level agreements (beyond the mere presence of a union on the workplace) on productivity at firm level. Using the SYS-GMM estimator, we obtain a productivity premium associated to firm bargaining of around 2%. This result is confirmed using Bartolucci's approach which consists in adding firm-level productivity as an additional covariate in the wage equation. The wage and productivity estimates also indicate that firm agreements generate some rent-sharing, i.e. they lead to higher wages at given level of productivity. Firm agreements are thus found to be more beneficial for workers' wages than for firms' productivity, so that profitability is hampered. Yet, our findings highlight that firm agreements are mainly a tool for rent-sharing in manufacturing. In private sector services, the raw wage premium associated to firm-level bargaining appears to be entirely driven by compositional effects differences (i.e. heterogeneity in individual, job and firm characteristics). This is not surprising as trade unions are generally found to be stronger in manufacturing (notably due to higher union membership) than in private sector services.[23] In addition, our findings show that firm-level agreements lead to significantly more rent-sharing when competition on the firms' product market is weaker. Put differently, firm agreements are mainly found to raise wages beyond productivity when the rents to be shared between workers and

[23] This is even more likely to be the case in our setup given that two services sectors with strong unions, i.e. the financial sector (NACE J) and the electricity, gas and water supply industry (NACE E), are largely under-represented in our data (see section 4).

firms are higher. This finding, in line with theoretical predictions, has so far never been shown in the European context.

Overall, what are the implications of our estimates for firm performance? On the one hand, findings show that firm agreements are detrimental to profitability. Referring to the 'two faces of unionism' (Freeman and Medoff, 1984), one might conclude that the 'rent-seeking behaviour of unions' dominates their 'voice effect'. However, our findings also show that firm bargaining is mainly a tool for rent-sharing when competition is low. This suggests that firm agreements are probably not very detrimental for firm performance in the Belgian context. In the presence of weaker competition, firms can indeed meet additional costs from above-normal profits. And when competition is fiercer, results show that the wage premium associated to firm bargaining primarily originates from higher productivity, so that – as highlighted by Bryson (2014: 1) – both workers and firms can actually benefit.

References

Acemoglu, D. and J. Pischke (1999), "The Structure of Wages and Investment in General Training", *Journal of Political Economy,* 107/3: 539-572.

Addison, J and Belfield, C. (2004), "Unions voice", *Journal of Labor Research,* 25 (4): 563-597.

Andreasson, H. (2014), "The effect of decentralized wage bargaining on the structure of wages and firm performance", Ratio Working Papers 241, Ratio Institute, Stockholm.

Antonczyk, D. (2011), "Using social norms to estimate the effect of collective bargaining on the wage structure", unpublished manuscript, University of Freiburg, Freiburg.

Arellano, M. and Bond, O. (1991), "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations", *Review of Economic Studies,* 58: 277-297.

Arellano, M. and Bover, O. (1995), "Another look at instrumental variable estimation of error-component models", *Journal of Econometrics,* 68: 28-51.

Barth, E., Bryson, A. and Dale-Olsen, H. (2017), "Union density, productivity and wages", IZA Discussion Paper 11111, Bonn.

Bartolucci, C. (2014), "Understanding the native-immigrant wage-gap using matched employer-employee data: Evidence from Germany", *Industrial and Labor Relations Review,* 67 (4): 1166-1202.

Blundell, R. and Bond, S. (1998), "Initial conditions and moment restrictions in dynamic panel data models", *Journal of Econometrics,* 87 (1): 115-43.

Boeri, T. and van Ours, J. (2014), *The Economics of Imperfect Labor Markets*, Princeton University Press, Princeton, 434p.

Braun, S. (2011), "Unionisation structures, productivity and firm performance: New insights from a heterogeneous firm model", *Labour Economics,* 18/1: 120-129,

Bryson, A. (2014), "Union wage effects", *IZA World of Labor,* 35.

Bryson, A. (2007), "The effect of unions on wages", *Reflets et Perspectives de la vie économique,* 2-3: 33-45.

Cahuc and Zylberberg (2014), *Labor Economics,* MIT Press, Cambridge (Ma.), 844p.

Clamfors, L. (1993), "Centralisation des négociations de salaires et performances macro-économiques – une analyse", *Revue économique de l'OCDE,* 21:172-206.

Calmfors, L. and Driffill, J. (1988), "Bargaining structure, corporatism and macroeconomic performance", *Economic Policy,* 3 (6): 13-61.

Card, D. and de la Rica, S. (2006), "Firm-level contracting and the structure of wages", *Industrial and Labor Relations Review*, 59 (4): 573-593.

Cardoso, A. and Portugal, P. (2005), "Contractual wages and the wage cushion under different bargaining settings", *Journal of Labor Economics*, 23 (4): 875-902.

Cardullo, G., Conti, M. and Sullis, G. (2015), "Sunk capital, unions and the hold-up problem: Theory and evidence from cross-country sectoral data", *European Economic Review*, 76: 253-274.

Checchi, D. and Pagani, L. (2004), "The effects of unions on wage inequality. The Italian case in the nineties", PIEP Working Paper, Centre for Economic Performance, London.

Dahl, C., le Maire, D. and Munch, J. (2013), "Wage dispersion and decentralisation of wage bargaining", *Journal of Labor Economics*, 31 (3): 501-533.

Daouli, J. Demoussis, M. Giannakapoulos, N. and Laliotis, I. (2013), "Firm-level collective bargaining and wages in Greece: A quantile decomposition analysis", *British Journal of Industrial Relations*, 51 (1): 80-103.

Dell'Aringa, C. and Lucifora, C. (1994), "Collective bargaining and relative earnings in Italy", *European Journal of Political Economy*, 10 (4): 727-747.

Dell'Aringa, C. and Pagani, L. (2007), "Collective bargaining and wage dispersion in Europe", *British Journal of Industrial Relations*, 45(1): 29-54.

Demunter, C. (2000), "Structure and dispersion of earnings survey", Statistics Belgium Working Paper, Brussels.

Doucouliagos, C. and Laroche, P. (2003), "What do unions do to productivity? A meta-analysis", *Industrial Relations*, 42: 650-691.

Doucouliagos, H., Freeman R. and Laroche P. (2017), *The Economics of Trade Unions: A Study of a Research Field and its Findings*, Routledge, London, 280 p.

Doucouliagos, H., Freeman, R., Laroche, P. and Stanley, T. (2018), "How credible is trade union research? Forty years of evidence on the monopoly-voice trade-off", *Industrial and Labor Relations Review*, 71 (2): 287-305.

du Caju, P., Rycx, F. and Tojerow, I. (2012), "Wage structure effects of international trade in a small open economy: The case of Belgium", *Review of World Economics*, 148 (2): 297-331.

Freeman, R. (1976), "Individual mobility and union voice in the labor market", *American Economic Review*, 66 (2): 361-368.

Freeman, R. and Medoff, J. (1984), *What Do Unions Do?*, Basic Books, New York.

Gomez, R., Bryson, A. and Willman, P. (2008), "From the two faces of unionism to the facebook society: Union voice in a 21st century context", MHRL Discussion Paper 6, London School of Economics, London.

Granqvist, L. and Regner, H. (2008), "Decentralized wage formation in Sweden", *British Journal of Industrial Relations*, 46 (3): 500-520.

Gürtzgen, N. (2010), "Rent-sharing and collective wage contracts: Evidence from German establishment-level data", *Applied Economics*, 42 (22): 2835-2854.

Gürtzgen, N. (2016), "Estimating the wage premium of collective wage contracts: Evidence from longitudinal linked employer-employee data", *Industrial Relations*, 55 (2): 294-322.

Hansen, L. (1982), "Large sample properties of generalized method of moment estimators", *Econometrica*, 50: 1029-1054.

Hartog, J., Pereira, P. and Vieira, J. (2002), "Bargaining regimes and wages in Portugal", *Portuguese Economic Journal*, 1: 237-268.

Haucap, J. and C. Wey (2004), "Unionisation structures and innovation incentives", *Economic Journal*, 114/494: C149-C165.

Hellerstein J., Neumark D. and Troske, K. (1999), "Wages, productivity and workers characteristics: Evidence from plant-level production functions and wage equations", *Journal of Labor Economics*, 17: 409-446.

Hibbs Jr., D. and H. Locking (2000), "Wage Dispersion and Productive Efficiency: Evidence for Sweden", *Journal of Labor Economics*, 18/4: 755-782.

Leclair, M. and Petit, P. (2004), "Présence syndicale dans les établissements: Quel effet sur les salaires masculins et féminins?", *Économie et Statistique*, 371: 23-47.

Linbeck, A. and Snower, D. (2001), "Centralized bargaining and reorganized work: Are they compatible?", *European Economic Review*, 45: 1851-1875.

Lucifora, C. and Origo, F. (2015), "Performance-Related Pay and Firm Productivity: Evidence from a Reform in the Structure of Collective Bargaining" *Industrial and Labor Relations Review*, 68: 1-27.

Magda, I., Marsden, D. and Moriconi, S. (2012), "Collective agreements, wages and firms' cohorts: Evidence from Central Europe", *Industrial and Labour Relations Review*, 65 (3): 607-629.

OECD (1994), *The OECD Jobs Study, Evidence and Explanation - Part II: The Adjustment Potential of the Labour Market*, OECD Publishing, Paris.

OECD (2004), "Wage setting institutions and outcomes." In OECD *Employment Outlook 2004*, OECD Publishing, Paris, pp.127-181.

OECD (2006), "Reassessing the role of policies and institutions for labour market performance: A quantitative analysis." In OECD *Employment Outlook 2006*, OECD Publishing, Paris, pp.207-23.

OECD (2009), *Measuring Capital*, OECD Publishing, Paris.

OECD (2017), "Collective bargaining in a changing world of work." In *OECD Employment Outlook 2017*, OECD Publishing, Paris.

OECD (2018), "The role of collective bargaining systems for good labour market performance." In *OECD Employment Outlook 2018*, OECD Publishing, Paris.

Palenzuela, D. and Jimeno, J. (1996), "Wage drift in collective bargaining at the firm level: Evidence from Spain", *Annales d'Economie et de Statistique*, 41/42: 187-206.

Plasman, R., Rusinek, M. and Rycx, F. (2007), "Wages and the bargaining regime under multi-level bargaining: Belgium, Denmark and Spain", *European Journal of Industrial Relations*, 13 (2): 161-180.

Roodman, D. (2009), "How to do xtabond2: an introduction to difference and system GMM in Stata", *Stata Journal*, 9 (1): 86-136.

Rycx, F. (2003), "Industry wage differentials and the bargaining regime in a corporatist country", *International Journal of Manpower*, 24 (4): 347-66.

Rycx, F. and Rusinek, M. (2013), "Rent sharing under different bargaining regimes: Evidence from linked employer-employee data", *British Journal of Industrial Relations*, 51 (1): 28-58.

Schnabel, C., Zagelmeyer, S. and Kohaut, S. (2006), "Collective bargaining structure and its determinants: An empirical analysis with British and German establishment data", *European Journal of Industrial Relations*, 12(2):165-188.

Statistics Belgium (2016), "Fonctionnement du marché du travail: screening horizontal des secteurs - Database", Brussels.

Van Ours, J. and Stoeldraijer, L. (2011), "Age, wage and productivity in Dutch manufacturing", *De Economist*, 159: 113-137.

Verly, J. (2003), "La decentralisation des relations collectives de travail", *Reflets et Perspectives de la vie économique*, XLII: 23-34.

Table 1: Descriptive statistics at the firm level, overall and by level of collective bargaining

	All		Firm-level agreement		No firm-level agreement[d]	
Variables	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Value-added per hour (ln)	3.79	0.54	3.90	0.50	3.72	0.57
Wage cost per hour (ln)	3.39	0.35	3.48	0.31	3.32	0.37
Gross profit per hour (ln) [a]	2.34	1.19	2.48	1.15	2.23	1.21
Share of workers with primary or lower secondary education	0.33	0.31	0.31	0.28	0.34	0.33
Share of workers with higher secondary education	0.42	0.29	0.43	0.26	0.42	0.30
Share of workers with tertiary education	0.25	0.26	0.27	0.40	0.24	0.27
Share of workers with 10 years of tenure or more	0.38	0.23	0.44	0.23	0.33	0.22
Share of workers < 30 years	0.21	0.14	0.20	0.12	0.22	0.15
Share of workers > 49 years	0.17	0.12	0.17	0.12	0.17	0.13
Share of women	0.24	0.22	0.23	0.20	0.25	0.23
Share of part-time workers (less than 30 hours per week)	0.10	0.13	0.10	0.12	0.11	0.15
Share of blue-collar workers	0.58	0.33	0.59	0.31	0.58	0.34
Share of workers with fixed-term contacts	0.03	0.08	0.03	0.08	0.03	0.08
Share of apprentices	0.00	0.01	0.00	0.00	0.00	0.01
Share of temporary agency workers	0.00	0.04	0.00	0.05	0.00	0.03
Industry:						
Mining and quarrying (C)	0.01	0.08	0.01	0.10	0.00	0.06
Manufacturing (D)	0.58	0.49	0.70	0.46	0.48	0.50
Electricity, gas and water supply (E)	0.00	0.03	0.00	0.02	0.00	0.03
Construction (F)	0.12	0.32	0.04	0.21	0.17	0.38
Wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods (G)	0.11	0.31	0.08	0.28	0.13	0.34
Hotels and restaurant (H)	0.01	0.11	0.01	0.08	0.02	0.14
Transport, storage and communication (I)	0.06	0.23	0.06	0.24	0.06	0.23
Financial intermediation (J)	0.02	0.12	0.02	0.14	0.01	0.11
Real estate, renting and business activities (K)	0.10	0.30	0.07	0.26	0.12	0.33
Employment (ln)	4.81	1.07	5.35	0.93	4.38	0.97
Capital stock per worker (ln)	10.78	1.53	10.96	1.50	10.54	1.54
Herfindahl-Hirschman index[c]	0.04	0.07	0.06	0.07	0.04	0.06
Number of establishment-year observations	7,419		3,267		4,152	
Number of establishments	2,439		700		1,739	

Notes: [a] Measured as follows: ln(value added per hour – wage cost per hour). [b] All variables measured in monetary terms have been deflated to constant prices of 2004 by the consumer price index taken from Statistics Belgium. [c] Based on NACE 3 digit Herfindahl-Hirschman indices (HHI) provided by Statistics Belgium for each year from 1999 to 2010 (Statistics Belgium, 2016). Descriptive statistics based on 7,370 establishment-year observations and 2,424 establishments. [d] 'No firm-level agreement' identifies firms that are solely covered by national and sectoral-level collective agreements.

Table 2: The impact of firm-level collective agreements on labour costs

Dependent variable = log average hourly wage cost[a]	OLS	OLS	OLS	SYS-GMM	SYS-GMM
	(1)	(2)	(3)	(4)	(5)
Log average labour productivity[b]			0.397***		0.280***
			(0.031)		(0.050)
Firm-level collective agreement[c]	**0.141*** **	**0.051*** **	**0.025*** **	**0.046*** **	**0.037*** **
	(0.008)	(0.007)	(0.005)	(0.011)	(0.009)
Year dummies	YES	YES	YES	YES	YES
Individual and job characteristics[d]	NO	YES	YES	YES	YES
Firm characteristics[e]	NO	YES	YES	YES	YES
Arellano-Bond test for AR(2), p-value				0.67	0.51
Hansen over-identification test, p-value				0.48	0.54
R-squared (adjusted)	0.04	0.45	0.68		
Number of firm-year observations	7,419	7,419	7,419	7,419	7,419

Notes: ***, **, * significant at 1, 5 and 10 percent levels, respectively. Robust standard errors are reported between parentheses. [a] The dependent variable is the natural logarithm of the firm-level average hourly wage cost. [b] The natural logarithm of the firm-level average hourly labour productivity. [c] Dummy equal to one if the firm is covered by a firm-level collective agreement. [d] Individual and job characteristics include the: % workers with at most a degree from lower secondary education and tertiary education, respectively; % workers with 10 years of tenure or more; % workers younger than 30 and older than 49 years, respectively; % women; % part-time workers; % blue-collar workers; % workers with fixed term employments contracts; % apprentices; and % temporary agency workers. [e] Firm characteristics include: 8 industry dummies; the natural logarithm of firm size; 2 dummies for the region where the firm is located; the natural logarithm of capital stock per worker. AR(2) refers to second-order autocorrelation in first-differenced errors. GMM-SYS specifications include first and second lags of explanatory variables (except time dummies) as instruments.

Table 3: Estimates according to firms' sectoral affiliation[#]

Dependent variable = log average hourly wage cost[a]	Manufacturing					Services				
	OLS	OLS	OLS	SYS-GMM	SYS-GMM	OLS	OLS	OLS	SYS-GMM	SYS-GMM
	(1)	(2)	(3)	(4)	(5)	(1')	(2')	(3')	(4')	(5')
Log average labour productivity[b]			0.290***		0.230***			0.513***		0.356***
			(0.016)		(0.055)			(0.057)		(0.065)
Firm-level collective agreement[c]	**0.147*** **	**0.065*** **	**0.041*** **	**0.050*** **	**0.034*** **	**0.150*** **	0.033	0.005	0.027	0.021
	(0.008)	(0.007)	(0.005)	(0.011)	(0.009)	(0.024)	(0.020)	(0.013)	(0.020)	(0.015)
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Individual and job characteristics[d]	NO	YES	YES	YES	YES	NO	YES	YES	YES	YES
Firm characteristics[e]	NO	YES	YES	YES	YES	NO	YES	YES	YES	YES
Arellano-Bond test for AR(2), p-value				0.30	0.35				0.44	0.76
Hansen over-identi-fication test, p-value				0.35	0.11				0.62	0.50
R-squared (adjusted)	0.07	0.46	0.65			0.01	0.46	0.74		
Number of firm-year observations	5,199	5,199	5,199	5,199	5,199	2,219	2,219	2,219	2,219	2,219

Notes: ***, **, * significant at 1, 5 and 10 percent levels, respectively. Robust standard errors are reported between parentheses. [#] Manufacturing refers to NACE codes C (Mining and quarrying), D (Manufacturing), E (Electricity, gas and water supply) and F (Construction). Services sectors include NACE codes G (Wholesale and retail trade; repair of motor vehicles, motorcycles and household goods), H (Hotels and restaurants), I (Transport, storage and communication), J (Financial intermediation) and K (Real estate, renting and business activities). [a] The dependent variable is the natural logarithm of the firm-level average hourly wage cost. [b] The natural logarithm of the firm-level average hourly labour productivity. [c] Dummy equal to one if the firm is covered by a firm-level collective agreement. [d] Individual and job characteristics include the: % workers with at most a degree from lower secondary education and tertiary education, respectively; % workers with 10 years of tenure or more; % workers younger than 30 and older than 49 years, respectively; % women; % part-time workers; % blue-collar workers; % workers with fixed term employments contracts; % apprentices; and % temporary agency workers. [e] Firm characteristics include: 8 industry dummies; the natural logarithm of firm size; 2 dummies for the region where the firm is located; the natural logarithm of capital stock per worker. AR(2) refers to second-order autocorrelation in first-differenced errors. GMM-SYS specifications include first and second lags of explanatory variables (except time dummies) as instruments.

Table 4: Estimates according to the degree of product market competition[d,e]

Dependent variable = log average hourly wage cost[a]	OLS	OLS	OLS	SYS-GMM	SYS-GMM
	(1)	(2)	(3)	(4)	(5)
Log average labour productivity[b]			0.390***		0.281***
			(0.031)		(0.050)
Firm-level collective agreement[c] * strong competition[d]	**0.106*** **	**0.038*** **	**0.012** **	**0.032*** **	**0.025*** **
	(0.010)	(0.008)	(0.006)	(0.011)	(0.009)
Firm-level collective agreement[c] * weak competition[e]	**0.164*** **	**0.077*** **	**0.038*** **	**0.065*** **	**0.051*** **
	(0.015)	(0.013)	(0.009)	(0.016)	(0.012)
Weak competition (dummy)[d]	0.086***	0.035***	0.009	0.065***	0.041***
	(0.012)	(0.009)	(0.008)	(0.016)	(0.013)
Year dummies	YES	YES	YES	YES	YES
Individual and job characteristics[f]	NO	YES	YES	YES	YES
Firm characteristics[g]	NO	YES	YES	YES	YES
Arellano-Bond test for AR(2), p-value				0.784	0.494
Hansen over-identification test, p-value				0.528	0.428
R-squared (adjusted)	0.06	0.44	0.68		
Number of firm-year observations	7,370	7,370	7,370	7,370	7,370

Notes: ***, **, * significant at 1, 5 and 10 percent levels, respectively. Robust standard errors are reported between parentheses. [a] The dependent variable is the natural logarithm of the firm-level average hourly wage cost. [b] The natural logarithm of the firm-level average hourly labour productivity. [c] Dummy equal to one if the firm is covered by a firm-level collective agreement. [d] Dummy equal to one if the firm at time *t* belongs to an industry (at the NACE 3 digit level) with a degree of product market competition index above the median sample value, i.e. with Herfindhal-Hirschman index below the median sample value. [e] Dummy equal to one if the firm at time *t* belongs to an industry (at the NACE 3 digit level) with a degree of product market competition index below the median sample value, i.e. with Herfindhal-Hirschman index above the median sample value. [f] Individual and job characteristics include the: % workers with at most a degree from lower secondary education and tertiary education, respectively; % workers with 10 years of tenure or more; % workers younger than 30 and older than 49 years, respectively; % women; % part-time workers; % blue-collar workers; % workers with fixed term employments contracts; % apprentices; and % temporary agency workers. [g] Firm characteristics include: 8 industry dummies; the natural logarithm of firm size; 2 dummies for the region where the firm is located; the natural logarithm of capital stock per worker. AR(2) refers to second-order autocorrelation in first-differenced errors. GMM-SYS specifications include first and second lags of explanatory variables (except time dummies) as instruments.

Appendix 1: First and second-stage estimates of 2SLS regression

First-stage regression Dependent variable = being covered by a firm-level collective agreement[a]	
Instrumental variable :	
Coverage rate by industry-size cell[b]	0.499*** (0.067)
Other covariates[c]	YES
Sanderson-Windmeijer F-test of excluded instruments:	54.91***
Number of firm-year observations	7,419
Second-stage regression Dependent variable = log average hourly wage cost[d]	
Firm-level collective agreement[f]	0.102 (0.090)
Year dummies	YES
Individual and job characteristics[g]	YES
Firm characteristics[h]	YES
Under-identification (p-value of Kleibergen-Paap rk LM statistic)[i]	0.00
Weak identification (Cragg-Donald Wald F statistic)[j]	54.91
Endogeneity (p-value associated to Chi-squared statistic)[k]	0.60
R-squared (adjusted)	0.43
Number of firm-year observations	7,419

Notes: ***, **, * significant at 1, 5 and 10 percent levels, respectively. Robust standard errors are reported between parentheses. [a] The dependent variable is a dummy equal to one of the firm is covered by a firm-level agreement and zero otherwise. [b] Incidence of firm-level collective agreements by industry and firm size cells at each period. More precisely, for each firm *i*, we computed the percentage firms (excluding firm *i*) belonging to the same industry-size cell at each period covered by a firm-level collective agreement. We considered five sectors (i.e. NACE categories C&D, F, G&H, I&J, and K) and four size classes (i.e. [0, 58], [59, 129], [130-253] and 254 workers and more). [c] Other covariates include all explanatory variables of equation (3), except firm agreement. [d] The dependent variable is the natural logarithm of the firm-level average hourly wage cost. [e] The natural logarithm of the firm-level average hourly labour productivity. [f] Dummy equal to one if the firm is covered by a firm-level collective agreement, and zero otherwise. [g] Individual and job characteristics include the: % workers with at most a degree from lower secondary education and tertiary education, respectively; % workers with 10 years of tenure or more; % workers younger than 30 and older than 49 years, respectively; % women; % part-time workers; % blue-collar workers; % workers with fixed term employments contracts; % apprentices; and % temporary agency workers. [h] Firm characteristics include: 8 industry dummies; the natural logarithm of firm size; 2 dummies for the region where the firm is located; the natural logarithm of capital stock per worker. [i] The Kleibergen-Paap rk LM statistic for under-identification tests whether the equation is identified, i.e. whether the excluded instruments are all relevant. The null hypothesis in this test is that the equation is under-identified. [j] The Cragg-Donald statistic for weak identification is a Wald F statistic testing whether the excluded instruments are sufficiently correlated with the endogenous regressor. The null hypothesis is that the instruments are weak. According to the standard 'rule of thumb', weak identification is problematic for F statistics smaller than 10 (as suggested by van ours and Stoeldraijer, 2011). [k] The endogeneity test is based on the difference of two Sargan-Hansen statistics: one for the equation in which firm-level collective agreement is treated as endogenous, and one in which it is treated as exogenous. If the null hypothesis of this test cannot be rejected, then instrumentation is actually not necessary, i.e. 'being covered by a firm-level collective agreement' can actually be considered as exogenous.

Appendix 2: The impact of firm-level collective agreements on productivity

Dependent variable = log average hourly productivity[a]	SYS-GMM
Firm-level collective agreement[c]	**0.021****
	(0.011)
Year dummies	YES
Individual and job characteristics[f]	YES
Firm characteristics[g]	YES
Arellano-Bond test for AR(2), p-value	0.191
Hansen over-identification test, p-value	0.584
Number of firm-year observations	7,419

Notes: ***, **, * significant at 1, 5 and 10 percent levels, respectively. Robust standard errors are reported between parentheses. [a] The dependent variable is the natural logarithm of the firm-level average hourly value added at factor costs. [c] Dummy equal to one if the firm is covered by a firm-level collective agreement. [f] Individual and job characteristics include the: % workers with at most a degree from lower secondary education and tertiary education, respectively; % workers with 10 years of tenure or more; % workers younger than 30 and older than 49 years, respectively; % women; % part-time workers; % blue-collar workers; % workers with fixed term employments contracts; % apprentices; and % temporary agency workers. [g] Firm characteristics include: 8 industry dummies; the natural logarithm of firm size; 2 dummies for the region where the firm is located; the natural logarithm of capital stock per worker; the lagged dependent variable. AR(2) refers to second-order autocorrelation in first-differenced errors. GMM-SYS specifications include first and second lags of explanatory variables (except time dummies) as instruments.