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WORKING PAPER

"Ménage à trois" in a globalizing world: bargaining between firms, low-skilled and high-skilled workers. *

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"Ménage à trois" in a globalizing world: bargaining between firms, low-skilled and high-skilled workers.[1]

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Abstract

This paper extends the assessment of the impact of globalization on the bargaining power of employees by taking worker heterogeneity into account. In contrast with previous studies, two separate unions - representing low-skilled and high-skilled workers respectively - are considered. Using Belgian firm-level data, labour bargaining power and relative wage preference have been estimated by skill level. Subsequently regressing these estimates on a set of potential determinants, the bargaining power of low-skilled workers appears to fall with imports and offshoring, whereas the bargaining power of high-skilled workers remains unaffected. In addition, a significant effect of globalization is found on the relative preference of unions for wages over employment, indicating that the effect of globalization on the behaviour of labour unions is more encompassing than frequently assumed. A positive impact of R&D intensity on the bargaining power of low-skilled workers is the only effect related to technological change that is found to be statistically significant.

[1] We would like to thank Bernhard Michel and Maritza López-Novella for the data they kindly provided.

1. Introduction.

In most industrialized countries, the labour market position of low-skilled workers appears to have deteriorated over the most recent decades, whether in terms of falling relative wages (rising skill premium) or unfavourable job opportunities. The early empirical research in the 1990s resulted in the consensus opinion that this evolution could predominantly be explained by skill-biased technological change (SBTC) whereas increasing imports from emerging low-wage countries were only a minor determinant. However, more recent studies indicate that international trade, especially in intermediate inputs (i.e. foreign outsourcing), can explain a relatively substantial part of the labour market experience of low-skilled workers. Moreover, by assuming perfect (labour market) competition, the early studies ignored the role of labour market institutions. Accounting for the latter complicates the analysis, as they imply that a shift in relative labour demand may have an impact on wages as well as on employment. Considering interactions between globalization, technological change and labour market institutions further complicates the framework but is also likely to provide a more balanced assessment of the respective roles played by the potential determinants (see surveys by Autor, Katz and Kearney 2008; Chusseau, Dumont and Hellier 2008).

This paper aims at assessing the effects of globalization and technological change on the labour market position of workers, through their impact on the bargaining position of workers.

Although the conclusions on their overall impact are not unambiguous (e.g. Agell, 1999; Aidt and Tzannatos, 2002), the role of labour unions in many industrialised countries, in particular in the EU, is well established. If unions have some bargaining power with respect to employers, they can claim part of the rents that result from imperfect product market competition. If globalization is likely to provide firms with an increasingly credible threat to relocate activities abroad, union bargaining power may be weakened (Bhagwati, 1995; Leahy and Pavelin, 2004). As unions are reported to focus on low-paid workers and to reduce wage inequality between low-skilled and high-skilled workers (e.g. Freeman, 1980; Blau and Kahn, 1996; Aidt and Tzannatos, 2002 and Card et al., 2003) a negative impact of globalization on the bargaining power of unions could explain rising wage inequality. Alternatively, globalization could imply a change in the labour union's relative preference of wages over employment. If, for instance, unions would become more employment-oriented in response to intensified import penetration, the rise in the skill premium due to a decrease in bargaining power may be counterbalanced by an increase in the employment of (low-skilled) workers.

The number of contributions that assess the impact of globalization on unions is growing steadily (e.g. Abowd and Lemieux, 1993; Borjas and Ramey, 1995; Gaston and Trefler, 1995; Gaston, 1998; Harrison, 2002; Brock and Dobbelaere, 2006; Dumont et al., 2006; Boulhol et al., forthcoming; Dreher and Gaston, 2007; Abraham et al., 2009). Using different methodological approaches and data sources, most of these studies conclude that globalization tends to reduce the bargaining power of unions.

Fewer studies have considered the impact of technological change on unions, although Acemoglu et al. (2001) have argued that skill-biased technological change may weaken the position of unions and the coherence within unions between low-skilled and high-skilled workers, by improving the outside option of the latter. Brock and Dobbelaere (2006), Dumont et al. (2006) and Boulhol et al. (forthcoming) included a variable related to R&D expenditures in their regressions but to our knowledge no paper has tried to estimate the impact of ICT investment on the bargaining position of unions.

Given that a breakdown of labour by skill is central in the literature on wage inequality, considering heterogeneity of workers seems self-evident when analysing the labour market effects of globalization and technological change. Yet, Fitzenberger (1999) is one of the few to relax the assumption of homogenous labour in a bargaining framework.

There are some obvious explanations for this shortcoming. From a theoretical perspective, Horn and Wolinsky (1988) already pointed out that modelling bargaining between two groups of workers tends to be cumbersome. When a firm is assumed to bargain simultaneously with separate unions, it is not possible to rely on standard Nash concepts (Horn and Wolinsky, 1988: p. 485). Therefore, most theoretical models of bargaining with two unions consider sequential or independent bargaining (e.g. Manning, 1987; Cardona and Sanchez-Losada, 2006)[2]. With respect to empirical work, proxies of labour union bargaining power in general (e.g. bargaining coverage or union membership) are rarely available (and even then of varying accuracy), and data differentiated by skill level even less so. Moreover, the bargaining power proxies are not always informative. For example, while the union membership rate in the private sector in France and the US is comparable, there is a clear difference in bargaining power. To circumvent the problems of data availability and quality, Brock and Dobbelaere (2006), Dumont et al. (2006) and Boulhol et al. (forthcoming) use a model to estimate bargaining power. An additional advantage of this method is that the model-based approach provides direct estimates of bargaining power. As a consequence, it is possible to obtain a measure of the bargaining power of high-skilled workers

2 There is so far no fully developed theory to model simultaneous bargaining between three players. We would like to thank John F. Nash Jr. and Asher Wolinsky for their useful comments as to the difficulties in applying bargaining theory in games with three players.

even when they are not formally unionized (in which case a proxy like union membership would clearly break down). However, an estimation of bargaining power by skill level requires wage and employment data broken down by skill level, which are often not available, certainly not at the firm level.

The main contribution of this paper is to provide estimates of the bargaining power and preference of unions by skill level, using Belgian firm-level data. A theoretical framework is proposed in which two separate unions, one for low-skilled (manual) workers and one for high-skilled (non-manual) workers, bargain independently with the firm over wages and employment. From this theoretical model an econometric specification is derived that permits to estimate the bargaining power and relative wage preference of both groups of workers. Subsequently, skill-specific bargaining power and relative wage preference are regressed on a set of potential explanatory variables in order to determine to what extent a skill-specific effect of globalization and technological change can be identified.

In the period considered (2000-2008), the bargaining power of low-skilled workers in Belgium declined, on average, whereas that of the high-skilled increased. There is a significant negative effect of import competition from low-wage countries as well as from offshoring, on the bargaining power of low-skilled workers. As the bargaining power of the high-skilled is unaffected by globalization, results show that the effect of globalization on labour unions is skill-specific. In addition, globalization seems to affect the preferences of both types of unions. In broad lines, imports of goods and offshoring of activities that can be considered of comparable skill intensity, weaken the wage orientation of the unions, whereas imports and offshoring that are complementary in skill characteristics strengthen the wage orientation of the unions.

In the following section, the theoretical framework, from which the econometric specification is derived, is presented. In the third section, the bargaining power and the wage preference, relative to employment, of low-skilled and high-skilled workers are estimated. In the fourth section, the extent to which there is a skill-specific effect of globalization and technological change on the bargaining power and relative wage preference is analyzed. Conclusions are drawn in the final section.

2. Theoretical framework

A representative firm is assumed to earn revenue $R=R(x,Z)$ from selling a final good, x denotes the volume of the final good sold by the firm. Z represents other determinants of revenue that will be assumed exogenous and hence omitted to simplify notation. As in Acemoglu (1998), Aghion (2002) and Cardona and Sànchez-Losada (2006), the final good is assumed to be produced using two intermediate components:

$$x = x_{HS}^{\alpha} x_{LS}^{(1-\alpha)}. \quad (1)$$

x_{HS} (x_{LS}) is produced using high- (low-) skilled labour, fixed capital and intermediate inputs. The intermediate components are the outputs of two separate business units (HS and LS). Workers are represented by a skill-specific union at the business unit level. Hence, bargaining over wages and employment occurs at this level.

There is mounting evidence of segregation of workers by skill level to motivate this set-up. Kremer and Maskin (1996) point out that rising wage inequality in France, Great Britain and the US is accompanied by segregation of high-skilled and low-skilled workers into separate plants. Indications of increasing workplace segregation are provided for Spain by Gavilán Gonzales (2006); for Sweden by Nordström Skans et al. (2007) and for the United States by Hellerstein et al. (2007). Dunne and Troske (2005) consider the role of computer networks in enabling manufacturing plants to outsource skilled tasks. They argue that, by allowing engineers and managers to monitor activities at a production plant and transfer information, computer investment may result in deskilling of production plants.

Total revenue is allocated to the two business units, with each business unit being paid the value of its marginal product[3]. This implies that the business units are characterized by a revenue function $R_i = R_i(x_{HS}, x_{LS})$, ($i$ = HS, LS), with:

$$R_i = x_i p \frac{\partial x}{\partial x_i}, \quad (2)$$

[3] This can be motivated in a principal-agent setting, where the principal (shareholders) wants to maximize total rents, subject to positive and increasing costs of management rivalry when the units' revenue fall below their "fair" level (i.e. the participation constraint of the agent is that the intermediate good produced by the business unit should at least be paid the value of its marginal product). The incentive compatibility constraint is that the agent (management) is fired if it does not maximize the firm's rents.

$$R_{i,x_i} = \frac{\partial R_i}{\partial x_i} > 0 \; ; \; R_{i,x_i,x_i} < 0 \tag{3}$$

Given (2), the profits of business unit *i* of the firm, producing in the home country, are determined by:

$$\Pi_i \left(x_{HS}, x_{LS}\right) = R_i \left(x_{HS}, x_{LS}\right) - w_i \ell_i - \sum_{v \neq l} p_v v_i \quad , \tag{4}$$

where w_i indicates the (bargained) wage and p_v the (competitively determined) price of other production factors *v*. A Stone-Geary utility function of the wage and employment level represents union preferences (e.g. Mezzetti and Dinopoulos, 1991):

$$U_i \left(w_i, \ell_i\right) = \left(w_i - \overline{w}_i\right) \ell_i^{\gamma_i} \quad , \tag{5}$$

where $\overline{w}_i$ represents the outside wage option for the skill level *i* and γ_i the union's relative preference of employment over wages. If $\gamma_i < 1 \; (\gamma_i > 1)$, the union is wage- (employment-) oriented, $\gamma_i = 1$ applies to a risk-neutral union. In the absence of an agreement, the supply of each domestic business unit is zero, but the firm may switch the production of the intermediate component abroad, if profits outweigh relocation costs. In that case union's *i* utility is assumed to be zero, whereas the profits of the business unit *i* equal the cost of the capital domestically engaged and the net profits of producing abroad (i.e. the outside option of the business units) Ψ_i, $\Psi_i \geq 0$. The generalized Nash product can be written as:

$$G_i \left(w_i, \ell_i\right) = \left(R_i - w_i \ell_i - \sum_{v \neq l,k} p_v v_i - \Psi_i\right)^{\left(1-a_i\right)} \left(\left(w_i - \overline{w}_i\right) \ell_i^{\gamma_i}\right)^{a_i} \qquad i = HS, LS, \tag{6}$$

where a_i ($0 \leq a_i \leq 1$) denotes the bargaining power of the union in business unit *i*. As pointed out by Binmore et al. (1986), if there is an exogenous risk of breakdown of the bargaining process, bargaining power is determined by the probability that such a breakdown will occur. Teulings and Hartog (1998) link the perceived probability of a breakdown to labour market tightness, i.e. the tighter the labour market the greater the bargaining power of unions will be. Import competition, foreign outsourcing, offshoring and labour-saving technological change can reduce domestic employment opportunities and thereby labour market tightness. To the extent that an increase in foreign competitiveness or technological change increases the fear of unions that firms will actually withdraw from bargaining they will reduce the bargaining strength of

unions. This reasoning is similar to the argument of Bhagwati (1995) that the bargaining position of employers will improve if they can threaten to relocate production to low-wage countries. The bargaining power parameters a_{LS} and a_{HS} can be interpreted as measures of the credibility of the outside options of the respective business units (Ψ_{LS} and Ψ_{HS}). Assuming that unions and business units bargain over wages and employment, the first order conditions for the maximization of G_i (6) are:

$$\frac{\partial G_i}{\partial w_i}=0 \;\Leftrightarrow\; (1-a_i)\left(w_i-\overline{w}_i\right)=a_i\left(\frac{VA_i-\Psi_i}{\ell_i}-w_i\right), \tag{7}$$

$$\frac{\partial G_i}{\partial \ell_i}=0 \;\Leftrightarrow\; a_i\,\gamma_i\left(\frac{VA_i-\Psi_i}{\ell_i}-w_i\right)+(1-a_i)\left(R_{i,\ell_i}-w_i\right)=0 \tag{8}$$

VA denotes value added of the respective business unit: $VA_i=R_i-\sum_{v\neq l,k}p_v v_i$.

Substituting (8) in (7) and rearranging, provides the expression for the contract curve (CC):

$$\gamma_i\left(w_i-\overline{w}_i\right)=w_i-R_{i,\ell_i}. \tag{9}$$

In addition to the contract curve, the Nash bargaining curve is derived from (9) in order to solve for the wage and the employment level. Grouping all the terms in w_i gives:

$$w_i=\frac{a_i\,\gamma_i}{(1-a_i+a_i\gamma_i)}\frac{(VA_i-\Psi_i)}{\ell_i}+\frac{(1-a_i)}{(1-a_i+a_i\gamma_i)}R_{i,\ell_i}. \tag{10}$$

From the total differentiation of (9) and (10), it can be shown that under fairly general conditions[4]:

$$\frac{dw_i}{da_i}>0;\frac{dl_i}{da_i}<0\,|_{\gamma<1};\frac{dl_i}{da_i}>0\,|_{\gamma>1};\frac{dw_i}{d\gamma_i}<0;\frac{dl_i}{d\gamma_i}>0 \tag{11}$$

3. The estimation of union power

In section 3.1, the empirical specification used for the estimation of the bargaining power of low-skilled and high-skilled workers is derived from the first order conditions of the maximisation of the generalized Nash product presented in section 2. In section 3.2, the results of

[4] Available upon request from the authors.

the estimation of the bargaining power are reported, as well as the parameters reflecting relative wage preferences.

3.1. The empirical specification

First, under efficient bargaining, equation (10) can be rewritten:

$$w_i = g_i \frac{\left(VA_i - \Psi_i\right)}{\ell_i} + \left(1 - g_i\right)\frac{\partial R_i}{\partial x_i}\frac{\partial x_i}{\partial \ell_i} \quad , \tag{12}$$

with $g_i = \frac{a_i \gamma_i}{\left(1 - a_i + a_i \gamma_i\right)}$. Assuming that the outside option for each business unit can be written as:

$$\Psi_i = \Omega_i p_i x_i \tag{13}$$

and value added as:

$$VA_i = R_i - p_m m_i \tag{14}$$

with m_i denoting the intermediate inputs used in business unit *i*, priced at p_m. Denoting the share of intermediate inputs used by the high-skilled labour business unit by φ_m, m_{HS} and m_{LS} take the following form:

$$m_{HS} = \varphi_m m; \qquad m_{LS} = \left(1 - \varphi_m\right) m \tag{15}$$

In the same vein, the share of capital used by the high-skilled labour business unit is denoted by φ_k, such that:

$$k_{HS} = \varphi_k k; \qquad k_{LS} = \left(1 - \varphi_k\right) k \tag{16}$$

From the upper-tier production function (1), the revenue of the respective business units is given by:

$$R_{HS} = \alpha p x; \qquad R_{LS} = \left(1 - \alpha\right) p x \tag{17}$$

Inserting (13)-(15) and (17) in (12) and multiplying the left and right hand side by $\frac{\ell_i}{px}$:

$$\frac{w_{HS}\ell_{HS}}{px} = g_{HS}\left(\left(1-\Omega_{HS}\right)\alpha - \phi_m\frac{p_m m}{px}\right) + \left(1-g_{HS}\right)\alpha\frac{\partial R_{HS}}{\partial x_{HS}}\frac{x_{HS}}{R_{HS}}\frac{\partial x_{HS}}{\partial \ell_{HS}}\frac{\ell_{HS}}{x_{HS}} \tag{18}$$

$$\frac{w_{LS}\ell_{LS}}{px} = g_{LS}\left(\left(1-\Omega_{LS}\right)\left(1-\alpha\right) - \left(1-\phi_m\right)\frac{p_m m}{px}\right) + \left(1-g_{LS}\right)\left(1-\alpha\right)\frac{\partial R_{LS}}{\partial x_{LS}}\frac{x_{Ls}}{R_{Ls}}\frac{\partial x_{Ls}}{\partial \ell_{LS}}\frac{\ell_{LS}}{x_{Ls}} \tag{19}$$

Equations (18)-(19) are fully specified from (16) assuming translog production functions in both business units.

To identify union bargaining power and union preferences, the first order condition of the maximization of the Nash product with respect to wages (8), is included in the system of equations of the empirical model, provided by (18)-(19):

$$w_i - \overline{w}_i = a_i\left(\frac{VA_i - \Psi_i}{\ell_i} - \bar{w}_i\right) \tag{20}$$

Using (13)-(15) and (17), these wage equations can be rewritten as:

$$w_{HS} = a_{HS}\left(\left(1-\Omega_{HS}\right)\alpha\frac{px}{\ell_{HS}} - \varphi_m\frac{p_m m}{\ell_{HS}}\right) + \left(1-a_{HS}\right)\bar{w}_{HS} \tag{21}$$

$$w_{LS} = a_{LS}\left(\left(1-\Omega_{LS}\right)\left(1-\alpha\right)\frac{px}{\ell_{LS}} - \left(1-\varphi_m\right)\frac{p_m m}{\ell_{LS}}\right) + \left(1-a_{LS}\right)\bar{w}_{LS} \tag{22}$$

In order to improve the efficiency of the estimates, the empirical model is extended with two more equations. First, an equation for the intermediate inputs used in the business units, assumed to be competitively priced (an equation for physical capital is redundant in the system of equations because of the sum restriction on the factor shares):

$$\begin{aligned} &\frac{p_m m}{px} = \frac{p_m m_{HS}}{px} + \frac{p_m m_{LS}}{px} = \alpha\frac{\partial R_{HS}}{\partial m_{HS}}\frac{m_{HS}}{R_{HS}} + \left(1-\alpha\right)\frac{\partial R_{LS}}{\partial m_{LS}}\frac{m_{LS}}{R_{LS}} \\ &\Leftrightarrow \\ &\frac{p_m m}{px} = \alpha\frac{\partial R_{HS}}{\partial x_{HS}}\frac{x_{HS}}{R_{HS}}\frac{m_{HS}}{x_{HS}}\frac{\partial x_{HS}}{\partial m_{HS}} + \left(1-\alpha\right)\frac{\partial R_{LS}}{\partial x_{LS}}\frac{x_{LS}}{R_{LS}}\frac{m_{LS}}{x_{LS}}\frac{\partial x_{LS}}{\partial m_{LS}} \end{aligned}, \tag{23}$$

Second, an equation for total production, which is given by the upper-tier production function (1):

$$\ln x = \alpha\ln x_{HS} + \left(1-\alpha\right)\ln x_{LS} \tag{24}$$

in which (15) and (16) are substituted and the assumption of translog production functions at the business unit level is used. This results in the following system of simultaneous equations for each firm[5] that is estimated in order to identify union bargaining power a_i and relative wage preference γ_i:

$$
\begin{aligned}
&\ln\left(w_{HS}-\bar{w}_{HS}\right)=b_{0HS}+\ln\left(\left(1-\Omega_{HS}\right)\alpha\frac{px}{\ell_{HS}}-\varphi_m\frac{p_m m}{\ell_{HS}}-\bar{w}_{HS}\right)+\varepsilon_1\\
&\ln\left(w_{LS}-\bar{w}_{LS}\right)=b_{0LS}+\ln\left(\left(1-\Omega_{LS}\right)\left(1-\alpha\right)\frac{px}{\ell_{LS}}-\left(1-\varphi_m\right)\frac{p_m m}{\ell_{LS}}-\bar{w}_{LS}\right)+\varepsilon_2\\
&\frac{w_{HS}\ell_{HS}}{px}=b_{1HS}\left(\left(1-\Omega_{HS}\right)\alpha-\varphi_m\frac{p_m m}{\ell_{HS}}\right)+\\
&\quad b_{2HS}b_{3HS}\alpha\left(a_{\ell_{HS}}+a_{\ell_{HS}\ell_{HS}}\ln\ell_{HS}+a_{\ell_{HS}mHS}\ln\varphi_m m+a_{\ell_{HS}kHS}\ln\varphi_k k\right)+\varepsilon_3\\
&\frac{w_{LS}\ell_{LS}}{px}=b_{1LS}\left(\left(1-\Omega_{LS}\right)\left(1-\alpha\right)-\left(1-\varphi_m\right)\frac{p_m m}{\ell_{LS}}\right)+\\
&\quad b_{2LS}b_{3LS}(1-\alpha)\left(a_{\ell_{LS}}+a_{\ell_{LS}\ell_{LS}}\ln\ell_{LS}+a_{\ell_{LS}mLS}\ln\left(1-\varphi_m\right)m+a_{\ell_{LS}kLS}\ln\left(1-\varphi_k\right)k\right)+\varepsilon_4\\
&\frac{p_m m}{px}=\alpha b_{3HS}\left(a_{mHS}+a_{\ell_{HS}mHS}\ln\ell_{HS}+a_{mHSmHS}\ln\varphi_m m+a_{mHSkHS}\ln\varphi_k k\right)+\\
&\quad\left(1-\alpha\right)b_{3LS}\left(a_{mLS}+a_{\ell_{LS}mHS}\ln\ell_{LS}+a_{mLSmLS}\ln\left(1-\varphi_m\right)m+a_{mLSkLS}\ln\left(1-\varphi_k\right)k\right)+\varepsilon_5\\
&\ln x=\alpha\left(a_{oHS}+\sum_{j=l,m,c}a_{jHS}\ln j_{HS}+\frac{1}{2}\sum_{j=l,m,c}\sum_{j^*=l,m,c}a_{jj^*HS}\ln j_{HS}\ln j^*_{HS}\right)\\
&\qquad+\left(1-\alpha\right)\left(a_{oLS}+\sum_{j=l,m,c}a_{jLS}\ln j_{LS}+\frac{1}{2}\sum_{j=l,m,c}\sum_{j^*=l,m,c}a_{jj^*LS}\ln j_{LS}\ln j^*_{LS}\right)+\varepsilon_6
\end{aligned}
\tag{25}
$$

with $\varepsilon_j \sim N(0, \sigma_{\varepsilon j})$ j = 1, ...6.

From the first two equations of (25), an estimate of the bargaining power of non-manual (HS) and manual (LS) workers is obtained: $\hat{a}_i=e^{\hat{b}_{0i}}, i=HS,LS$, which, substituted in $\hat{b}_{1j}$ and taking account of the definition of g_i, gives an estimate of union preference $\hat{\gamma}_i$.

The empirical evidence on union bargaining regimes is not conclusive. However, in addition to wages, working conditions seem to be subject to bargaining (e.g. Ulph and Ulph, 1990; Layard et al., 1991; Booth, 1995). Haskel and Martin (1992) formalize this in a labour hoarding model, where unions and employers bargain over wages and overhead labour. It can be shown that in such a regime the system of equations (25) remains valid to estimate the bargaining power and the relative wage[6].

[5] The index denoting the firm is omitted for simplicity.
[6] The demonstration is available from the authors upon request.

3.2 The bargaining power estimation results

The system of equations (25) is estimated using firm-level data, e.g. on wages and employment of manual and non-manual workers and on average profitability of foreign subsidiaries of Belgian firms (proxy for the outside option of firms) and industry-level data for price deflators of output, capital goods and raw materials and intermediate goods.

Appendix 1 provides a more detailed description of the definition of the variables and data sources. The breakdown of the wage and employment data (i.e. manual/non-manual) is obviously not a perfect proxy for a breakdown by skill level. However, the distinction is appropriate from a labour market perspective, as in Belgium manual and non-manual workers are actually represented by separate unions.

The system of equations (25) is estimated with maximum likelihood at the two-digit ISIC level (manufacturing) for each year of the period 2000-2008[7]. Details about the econometric issues with the estimation of (25) are explained in Appendix 2.

The average bargaining power and the relative wage preference of high-skilled and low-skilled workers by industry, as well as their change over the period, are reported in Table 1[8].

The estimated bargaining power parameters are all highly significant. The estimates of the relative wage preference of both types of unions are less accurate, with 15% of the estimates statistically insignificant at the 10% level and some 15% significant between the 10% and 5% error level. The average bargaining power level of low-skilled workers unions exceeds that of high-skilled workers unions in the majority of sectors. However, in the period considered, the bargaining power of high-skilled workers increased in all but three sectors whereas the opposite occurred for low-skilled workers. Hence, the average bargaining power (across industries) of the high-skilled worker unions increased between 2000 and 2008, while that of the low-skilled worker unions fell. As regards the unions' preferences, all unions without exception appear to be wage-oriented. There is no clear pattern according to skill in the level or first difference of the relative wage preference.

[7] See Appendix 1 for a definition of the industries.
[8] The annual estimates are available upon request.

Table 1: Average bargaining power and relative wage preference (2000-2008)

Sector (ISIC)	Average bargaining power		Change 2000-2008		Average wage preference		Change 2000-2008	
	High-skilled	Low-skilled	High-skilled	Low-skilled	High-skilled	Low-skilled	High-skilled	Low-skilled
10-12	0.54	0.75	0.04	0.09	0.48	0.29	0.22	-0.12
13-15	0.49	0.86	0.00	0.05	0.75	0.19	0.10	-0.06
16/31	0.58	0.68	0.03	-0.13	0.51	0.64	-0.07	0.26
17-18	0.61	0.68	0.02	0.03	0.53	0.78	0.14	-0.42
19-22	0.67	0.62	0.04	-0.03	0.25	0.51	-0.06	0.02
23	0.64	0.68	-0.03	-0.06	0.49	0.60	-0.13	0.06
24-25	0.69	0.74	0.04	-0.10	0.42	0.56	0.08	0.27
26-27	0.63	0.66	-0.05	-0.14	0.83	0.60	0.02	0.29
28	0.65	0.86	-0.04	-0.03	0.81	0.27	-0.02	0.02
29-30	0.65	0.65	0.03	-0.07	0.82	0.84	0.20	0.27
Average	0.62	0.72	0.01	-0.04	0.59	0.53	0.05	0.06

Note: The change over the period is the change between the average of the last three years and the average of the first three years of the period. See Appendix 1 for the description of the sector aggregates.

4. The determinants of union bargaining power by skill level

In this section, the extent to which the bargaining position of the skill-specific unions is determined by internationalization and technological change is analyzed, by regressing the bargaining power and relative wage preference of Belgian labour unions – as estimated in the first step- on a set of potential determinants. The same set of explanatory variables is used in each estimated equation, though the model specification differs. As union bargaining power, being the share of rents captured by the union, lies within the [0,1] range, the following general logit specification is used to model bargaining power (a) of the union of skill level i in industry s at time t:

$$\ln\left(\frac{a_{i,s,t}}{1-a_{i,s,t}}\right) = \beta_i + \beta_{1i} IMP_{OECD,t-2} + \beta_{2i} IMP_{NOECD,t-2} + \beta_{3i} OUTS_{DOM,t-2} + \beta_{4i} OFF_{HWAG,t-2} + \beta_{5i} OFF_{LWAG,t-2} + \beta_{6i} OFFBS_{HWAG,t-2} + \beta_{7i} OFFBS_{LWAG,t-2} + \beta_{8i} EMPFA_{EUHW,t-2} + \beta_{9i} EMPFA_{EULW,t-2} + \beta_{10i} RDI_{s,t-2} + \beta_{11i} ICT_{s,t-2} + \beta_{11i} SR_{s,t-2} + \beta_{11i} HHI_{s,t-2} + \varepsilon_{t,i} + \varepsilon_{s,i} + \varepsilon_{s,i,t} \quad (26)$$

For the relative wage preference (μ) a double-log model is specified:

$$\ln\left(\mu_{i,s,t}\right) = \beta_i^* + \beta_{1i}^* \ln(IMP_{OECD,t-2}) + \beta_{2i}^* \ln(IMP_{NOECD,t-2}) + \beta_{3i}^* \ln(OUTS_{DOM,t-2}) + \beta_{4i}^* \ln(OFF_{HWAG,t-2}) + \beta_{5i}^* \ln(OFF_{LWAG,t-2}) + \beta_{6i}^* \ln(OFFBS_{HWAG,t-2}) + \beta_{7i}^* \ln(OFFBS_{LWAG,t-2}) + \beta_{8i}^* \ln(EMPFA_{EUHW,t-2}) + \beta_{9i}^* \ln(EMPFA_{EULW,t-2}) + \beta_{10i}^* \ln(RDI_{s,t-2}) + \beta_{11i}^* \ln(ICT_{s,t-2}) + \beta_{12i}^* \ln(SR_{s,t-2}) + \beta_{13i}^* \ln(HHI_{s,t-2}) + \delta_{t,i} + \delta_{s,i} + \delta_{s,i,t} \quad (27)$$

To assess the impact of globalization, different mechanisms are considered. First, import competition, in line with the increasing number of papers that seem to corroborate the so-called imports-as-market-discipline hypothesis, i.e. the competitive pressure of rising imports results in a decrease in mark-ups and in the bargaining power of labour (e.g. Kramarz 2003; Boulhol et al. forthcoming; Abraham et al. 2009; Moreno and Rodriguez 2010). However, whereas Boulhol et al. (forthcoming) find support for market discipline when considering imports from developed countries (Western Europe, North America, Japan, Australia and New Zealand), Abraham et al. (2009) only find a negative impact on bargaining power for imports from new EU countries and low-wage countries (non-EU and non-OECD). In the regressions, import penetration (as defined in Abraham et al., 2009) is included for two groups: OECD and non-OECD countries respectively (IMP_{OECD} and IMP_{NOECD}).

Second, early studies on the labour market effects of international trade focused on trade in final goods. In later studies, the rising importance of trade in intermediate goods was acknowledged and assessed. Theoretical models on international trade in intermediate inputs (foreign outsourcing or offshoring) are more ambiguous than models on trade in final goods as to the impact on low-skilled and high-skilled workers (e.g., Arndt 1997, Venables 1999, Jones and Kierzkowski 2001). In some empirical studies the impact of outsourcing on the bargaining position of workers is found to be positive (e.g. Kramarz 2003; Abraham et al. 2009). Belgian data on outsourcing, as described in Michel (2009), are used, distinguishing domestic outsourcing

($OUTS_{DOM}$) and foreign outsourcing (offshoring), the latter broken down between high-wage and low-wage countries (OFF_{HWAG} and OFF_{LWAG}). In addition, the distinction between offshoring of material inputs and business services is taken into account by also including two variables for the latter: $OFFBS_{HWAG}$ and $OFFBS_{LWAG}$.

Third, another type of globalization variable concerns foreign affiliate activity. Data by sector at the world level are not available. However, the company data used in the estimation of the bargaining power also contain information on the affiliates of Belgian companies within Europe, which dominates Belgian firm presence abroad. Data on the number of employees in foreign affiliates in Europe relative to the number of employees in the domestic industry are used to reflect the intensity of foreign production facilities, distinguishing between affiliates in high-wage European countries (mainly the EU15) and in low-wage European countries (mainly the Central and Eastern European countries), denoted $EMPFA_{EUHW}$ and $EMPFA_{EULW}$ respectively.

Most studies that try to explain changes in union bargaining power tend to focus on globalization and less on technological change, although the latter is often considered as a more important determinant of rising labour market inequality. However, if technological change is skill-biased, it may reduce the bargaining power of employees by raising the credibility of a firm to substitute high-skilled workers for low-skilled workers. Acemoglu et al. (2001) have argued that skill-biased technological change may undermine the coalition among low-skilled and high-skilled workers as it improves the outside option of the latter. In their view, the deunionization that resulted from this may have amplified the direct effect of SBTC on inequality. This calls for the inclusion of variables related to technological change in a regression of workers' bargaining power on potential determinants. Two variables are considered: R&D intensity in terms of turnover (RDI) and ICT capital services per hour worked (ICT). R&D expenditures have been used by Brock and Dobbelaere (2006), Dumont et al. (2006) and Boulhol et al. (forthcoming) but to our knowledge this is the first paper to assess the impact of ICT investment.

Finally, to control for the potential omission of relevant determinants of union bargaining power, in addition to industry and year dummies, two variables are included in the specification, as used in previous empirical work (e.g. Freeman 1980, Veugelers 1989, Blau and Kahn 1996, Aidt and Tzannatos 2002, Card et al. 2003): industry concentration and the skill ratio. Industry concentration is measured by the Herfindahl-Hirschman (HHI) index computed for each industry with the firm-level data that were used to estimate union bargaining power. The skill ratio (SR) is measured as the number of non-manual workers relative to the number of manual workers.

Table 2: Estimation of the determinants of bargaining power (2000-2006).

	Dependent variable	
	$\ln\left(\frac{a_{HS}}{1-a_{HS}}\right)$	$\ln\left(\frac{a_{LS}}{1-a_{LS}}\right)$
Imports (OECD)	-0.10 (0.31)	-0.12 (0.32)
Imports (non-OECD)	0.80 (0.80)	-3.40 (1.14)***
Domestic Outsourcing	-0.22 (1.75)	-0.82 (1.99)
Offshoring materials (high-wage countries)	-1.13 (2.31)	3.68 (3.01)
Offshoring materials (low-wage countries)	7.19 (5.18)	-23.3 (8.09)***
Offshoring business services (high-wage countries)	-36.4 (27.9)	35.1 (35.5)
Offshoring business services (low-wage countries)	762.0 (963)	-885.0 ($0.12*10^4$)
Employment in foreign affiliates (high-wage EU)	-0.37 (0.60)	-0.39 (0.83)
Employment in foreign affiliates (low-wage EU)	-1.16 (0.70)	-1.82 (0.28)***
Skill ratio	0.18 (0.93)	-2.93 (1.26)**
ICT capital services per hour worked	0.02 (0.03)	0.01 (0.03)
R&D expenditures/turnover	2.96 (2.38)	6.30 (2.07)***
Herfindahl-Hirschman index	0.12 (2.71)	4.18 (2.97)
Sector dummies	Yes	Yes
Time dummies	Yes	Yes
LM test heteroscedasticity	1.34 (0.25)	6.36 (0.01)
Adjusted R^2	0.78	0.84

Note: Heteroscedasticity consistent standard errors are reported in brackets and have been corrected to account for the generated regressand problem as explained in appendix 2. *, ** and *** denote significance at respectively 10%, 5 % and 1 %.

The equations were estimated for a panel of ten industries over the period 2000-2006. The independent variables were lagged two years, in order to limit the loss of degrees of freedom due to data availability. This also improves the identification of the causal direction[9]. Because of the availability of the offshoring variables until 2004, the estimations cannot cover the whole period

[9] A number of papers argue for an impact of (changes in) union bargaining power on the decisions of firms. E.g. Lommerud et al. (2009) and Bognetti and Santoni (2010) suggest that offshoring may depend on the power and preference of unions whereas Menezes-Filho et al. (1998) and Lommerud et al. (2006), among many others, consider the impact of unions on the investment of firms in R&D and in (labour-saving) technology respectively.

for which we have bargaining power and relative wage preference estimates. For each estimated equation, an F-test on the significance of the time and sector specific effects determines the preferred model specification. In addition, though a number of arguments can motivate the choice for sector-specific fixed effects, this choice is controlled by means of a Hausman test (which was never in favour of the random effects assumption). Finally, the fact that bargaining power and relative wage preference are estimated in a previous step is taken into account in the computation of standard errors as explained in Appendix 2. The estimation results are reported in Tables 2 and 3.

As regards the bargaining power of the non-manual (high-skilled) workers, none of the considered determinants is found to be individually significant. Hence the bargaining power of non-manual workers does not appear to be affected by internationalization. On the other hand, import competition by non-OECD countries as well as offshoring to low-wage countries and foreign affiliate activity in low-wage European countries, have a negative effect on the bargaining power of low-skilled workers. The skill ratio of the industry is also significant and negative as expected (a higher skill ratio implies less demand for low-skilled labour and hence a less favourable bargaining position). All the coefficients of the technology variables (ICT and R&D) are positive but only the impact of R&D expenditures on the bargaining power of low-skilled workers is statistically significant. Though somewhat surprising, this result may be explained by the fact pointed out by Dowrick and Spencer (1994) that, in contrast with employment-oriented unions, wage-oriented unions may actually favour (labour-saving) innovation whereas Menezes-Filho et al. (1998) pointed out that the assessment of the relationship between unions and R&D investment does not allow for straightforward conclusions.

The estimation results for relative wage preference indicate that the effect of internationalization on unions may be more complex than commonly assumed. Unions may adjust their preference of wages over employment because of internationalisation or technological change. As regards the relative wage preference of the non-manual workers, there is little evidence of sector-specific effects, in line with the inter-sector organisation and structure of unions representing non-manual workers in Belgium. The unions' preference of wages over employment significantly increases (i.e. a negative coefficient) with offshoring (irrespective of the destination category), domestic outsourcing and the skill ratio in the industry. However, import competition from OECD countries causes an almost proportionate drop in relative wage preference. The wage orientation of the low-skilled, which shows more sector heterogeneity (in line with the industry-specific structure of these unions in Belgium) compared to the high-skilled,

increases significantly with offshoring of business services to high-wage countries (which can be assumed to be skill-intensive) but falls (significantly) with import competition from non-OECD countries as well as offshoring of business services to low-wage countries. Hence, the relative wage preference of the unions is affected by more than one internationalization mechanism as well. Increased competition of similar production or close substitutes (intra-sector imports for high-wage or low-wage countries respectively) weakens the wage orientation of the unions. Higher complementary production activities strengthen the wage orientation of the unions. Again, technological change does not seem to affect the unions' preferences.

Table 3: Estimation of the determinants of relative wage preference (2000-2006).

	Dependent variable			
	$\ln \mu_{HS}$		$\ln \mu_{LS}$	
Imports (OECD)	0.95	(0.15)***	0.56	(0.76)
Imports (non-OECD)	0.01	(0.05)	0.90	(0.13)***
Domestic Outsourcing	-1.82	(0.41)***	-2.33	(2.37)
Offshoring materials (high-wage countries)	-0.77	(0.11)***	-0.82	(1.49)
Offshoring materials (low-wage countries)	-0.33	(0.03)***	0.77	(0.29)***
Offshoring business services (high-wage countries)	-0.22	(0.67)	-6.49	(1.23)***
Offshoring business services (low-wage countries)	0.14	(0.70)	6.63	(1.19)***
Employment in foreign affiliates (high-wage EU)	-0.11	(0.08)	-0.001	(0.12)
Employment in foreign affiliates (low-wage EU)	-0.004	(0.04)	-0.02	(0.09)
Skill ratio	-0.57	(0.12)***	0.37	(1.27)
ICT capital services per hour worked	-0.11	(0.10)	0.33	(0.27)
R&D expenditures/turnover	-0.07	(0.05)	0.26	(0.17)
Herfindahl-Hirschman index	-0.20	(0.07)**	-0.09	(0.19)
Sector dummies	No		Yes	
Time dummies	Yes		Yes	
LM test heteroscedasticity	3.00	(0.08)	3.82	(0.05)
Adjusted R2	0.69		0.67	

Note: Natural logs have been taken of all explanatory variables. Heteroscedasticity consistent standard errors are reported in brackets and have been corrected to account for the generated regressand problem as explained in Appendix 2. *, ** and *** denote significance at respectively 10%, 5 % and 1 %.

VI. Conclusions

This paper introduces skill heterogeneity into a union bargaining framework. Using firm-level data, the bargaining power and the relative wage preference of high-skilled and low-skilled workers is estimated for ten Belgian manufacturing industries. In most sectors the estimated bargaining power of high-skilled workers increased between 2000 and 2008 whereas the bargaining power of low-skilled workers fell. In all industries considered both unions appear to be wage-oriented.

In a second step, the estimated bargaining power and relative wage preference by skill level are regressed on a number of potential determinants such as internationalization and technological change. There are indications of a skill-specific impact of globalization on the bargaining position of labour unions. In particular, as regards bargaining power, globalization seems to affect low-skilled workers' unions negatively through several mechanisms: imports of final goods from and offshoring to as well as the presence of foreign subsidiaries in low-wage countries. R&D intensity appears to have a positive impact on the bargaining power of low-skilled workers. This is the only coefficient of a variable related to technological change that is found to be statistically significant. There are no indications that the bargaining power of high-skilled workers is affected by globalization or technological change. The estimation results concerning the relative wage preference of the unions show that the impact of globalization on the position of unions is more complex than is commonly assumed. By and large, increased competition of similar products or production activities in terms of skill characteristics weakens the wage orientation of the unions. Higher complementary production activities, however, strengthen the wage orientation of unions. Hence, the effect of globalization on relative wage preference is less differentiated by skill level and is, taken as a whole, more ambiguous.

The significant effects reported in this paper, suggest that through its effect on the bargaining position of low-skilled and high-skilled workers, globalization has led to an increase in the skill premium (wage inequality) whereas little evidence is found of a significant impact of technological change.

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Appendix 1

Data sources and list of ISIC two-digit manufacturing industries.

Breakdown of wages by skill level and estimation of union bargaining power:

Annual account and balance sheet data of Belgian companies are retrieved from BELFIRST (Bureau van Dijk Electronic Publishing) for the period 1997-2008.

Labour (employment level) is provided with a breakdown for manual workers and non-manual workers. Firm-level data on wages, broken down by manual and non-manual workers, are provided by the Belgian National Office for Social Security.

For the estimation of the union bargaining power and relative wage preference, the current values of turnover; raw materials and intermediary goods; and the capital stock (taken from BELFIRST) are deflated, respectively, by the production deflator and the intermediate goods deflator taken from EU KLEMS[10], and by the gross fixed capital formation price index for capital goods, derived from the current and constant value time series of investment goods of the OECD STAN database.

As empirical proxies for the outside options of the firm, the average profitability of the subsidiaries of Belgian firms for the period 1997-2005 is computed from AMADEUS (Bureau van Dijk Electronic Publishing): on the one hand in the Central and East European countries, Portugal, Greece, Cyprus and Malta, and in the EU-15 (less Portugal and Greece), Norway and Switzerland, on the other hand. The first was used as proxy for the outside option of the low-skilled business unit, the second as proxy for the outside option of the high-skilled business unit.

The outside option (wage) of unions is computed as in Layard et al. (1991)

$$\bar{w} = (1 - 2 * unemployment\ rate) * wage^{0} + 2 * unemployment\ rate * gross\ replacement\ rate * wage^{a}$$

$wage^{o}$ and $wage^{a}$ are, respectively, the minimum wage and the average wage in the sector considered. Data on the unemployment rate and the gross unemployment benefit replacement rate are provided by the OECD.

Industry-level data from EU KLEMS and STAN (OECD) are used for price deflators of output, capital goods and raw materials and intermediate goods.

[10] EU KLEMS is a database created with support from the European Commission which contains measures of economic growth, productivity, labour and capital at the industry level for all European Union member states from 1970 onwards (see www.euklems.net).

Determinants of bargaining power.

Data international trade (STAN)

Import penetration is computed using data on international trade from the OECD STAN database.

Outsourcing is determined as the share of intermediate goods in total turnover and is computed from the EU KLEMS database.

Data on foreign offshoring were kindly provided by Bernard Michel (see Michel 2009 for details)

Data on foreign (European) affiliates activities (turnover and employment) of Belgian companies are taken from AMADEUS (Bureau Van Dijk). The same distinction between countries is adopted as the one used for the computation of the outside option of the firms.

Research and Development expenditures at the sector level are available from the OECD ANBERD statistics.

Information and communications technology (ICT) capital services per hour is taken from EU KLEMS.

The skill ratio was computed from the sector employment data of the Belgian National Office for Social Security. The Herfindahl-Hirschman index was computed at the sector level from the BELFIRST company account data.

List of the two-digit manufacturing industries (NACE Revision 3)

10-12	Food, Beverages and Tobacco
13-15	Textiles, Footwear and Leather
16/31	Wood, Wood Products and Furniture
17-18	Paper, Printing and Publishing
19-22	Chemicals, Rubber, Plastics and Fuel
23	Non-metallic Mineral Products
24-	Fabricated Metal Products
26-27	Machinery and Equipment n.e.c.
28	Electrical and Optical Equipment
29-30	Transport Equipment

Appendix 2

Parameter estimation with variance correction

The estimation of the empirical model presented in this paper is a two-step procedure in which estimates obtained in the first step are used as variables in the subsequent step. The estimation steps are:

1) The estimation of union power by skill level (section 3.1, equations (25))
2) The estimation of the determinants of union bargaining power and wage preference by skill level (section 4, equations (26) and (27)).

Due to the large number of parameters in the first step and their highly nonlinear combination in the set of equations (25), it was impossible to find a stable solution for the optimization problem. The optimization algorithm either failed to converge or led to imprecise and/or theoretically impossible estimates, depending on the starting values of some of the parameters. Given these problems, a different estimation strategy was adopted, partially based on simulated maximum likelihood. The estimation problems occurred mainly with the φ_m and φ_c parameters that determine the allocation of intermediate and capital inputs over the business units. While in principle these parameters could have been estimated separately at the firm level, the very limited number of observations precluded this as a practical alternative. Another approach, which turned out to be a feasible one, was to estimate their values by simulation.

Starting from the observation that both parameters are bounded between zero and one, and without any prior knowledge of their distribution, it is reasonable to draw their values from a uniform distribution. The value of $\tilde{\alpha}$ can then be retrieved from (parameters with ~ denote simulated values):

$$R_{HS} = \tilde{\alpha}\, px = w_{HS} L_{HS} + \tilde{\varphi}_K K + \tilde{\varphi}_m M \qquad \text{(A 2.1)}$$

Given simulated values for α, φ_m and φ_c, the system of equations (25) can be estimated with sufficient precision. The maximum likelihood estimate of the three parameters is defined as the set of values that maximizes the estimated log-likelihood of (25) over all replications. In effect, this approach amounts to a random grid search over the parameter space (φ_M, φ_K).

The variance of the parameters has to take the simulating of α, φ_m and φ_c into account. This was done in the following way. Each replication of α, φ_M and φ_K results in one estimate of

the parameters of system (26), conditional on the simulated input values. Five thousand replications were performed to ensure sufficient coverage of the simulated parameter space. The estimated conditional variances of the parameters can be 'unconditioned' using

$$\mathrm{var}(\beta) = E\left[\mathrm{var}\left(\beta_j \mid \theta_j\right)\right] + \mathrm{var}\left[E\left(\beta_j \mid \theta_j\right)\right] \qquad \text{(A 2.2)}$$

where β is any parameter of interest and θ_j represents the set of values of the conditioning parameters in the j-th replication. The expectations and variance operators in (A2.2) were replaced by their sample counterparts in the calculations. To summarize, the system of equations (25), which constitutes the first step in the full empirical model, was estimated by simulated maximum likelihood as follows:

The estimated union power and preference parameters, together with their corrected estimated variances, were used as dependent variables in the second step of the model, as explained in section 4. The variance of these estimates had to be taken into account to correct the estimated parameter variances in this step. This was a straightforward application of the correction procedure described in Dumont et al. (2005, 2006), to which the reader is referred.