Imperfect Goods and Labor Markets, and the Union Wage Gap*

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Abstract

Existing theoretical literature fails to explain satisfactorily the differences between the pay of workers that are covered by collective agreements and others who are not. This study aims at providing a model framework that is amenable to an analysis of this issue. Our general-equilibrium approach integrates a dual labor market and a two-sector product market. The results suggest that the so-called 'union wage gap' is largely determined by the degree of centralization of the bargains, and, to a somewhat lesser extent, by the expenditure share of the unionized sector's goods.

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1 Introduction

In this contribution, we present a theoretical model designed to explain differences in the union wage gap (i.e. wage differences between otherwise identical workers who are or are not covered by union bargaining). The empirical literature on the union wage gap or union wage premium is largely controversial. Due to different data sources, different periods of time under consideration, and different methodologies, estimated wage gaps vary significantly. For instance, Blanchflower (1999) reports a union wage gap of 15.5% for the USA, which he finds to be remarkably stable from 1983-1993.[1] In the same time span the estimations of Hirsch and Schumacher (2004) fall from 25.5% to 23.5%. Bratsberg and Ragan (2002) report increasing union wage gaps in some industries of the USA and decreasing union wage gaps in other industries. A rather extreme example is Canada. Here, Blanchflower (1996)'s estimation is 4.8% (insignificant), while Robinson (1989) obtains union wage gaps from 20% up to 43%, depending on the methodology employed. One major reason why estimations of the wage premium may not be very reliable is that simultaneously positive and negative selection into unions occurs, which differs, for example, depending on the skill level (Hirsch, 2004).

Blanchflower and Bryson (2004) summarize and compare estimates of the wage gap they obtained using data from the Matched Outgoing Rotation Group (MORG) files of the Current Population Survey (CPS) 1996–2001 for the USA. with those reported by Freeman and Medoff (1984) who used data from the 1979 May CPS file. They gathered that the union wage gap is higher for men, old workers, lowly educated individuals, nonwhites and manual workers. In addition, the wage differential depends on the region and the industry. Freeman and Medoff (1984) gathered that the wag gap depends "on the extent to which the firm bargains for an entire sector rather than for individual plants within a sector."

The puzzling diversity of the empirical work accompanies and amplifies the helplessness of the economic theory in explaining the causes of the union wage gap. Usually the issue of the wage premium is not addressed directly. Instead, the bulk of the theoretical literature considers union wage effects independently of nonunion wages. Frequently, the argumentation refers to the unions' "bargaining power"

[1] Blanchflower and Bryson (2003) uses more recent data and adjusts for the bias due to earnings imputations (see Hirsch and Schumacher, 2004). Their results suggest that the union wage gap has declined from 22.4% in 1984 to 15,1% in 2001 (private sector).

(Hirsch, 2004, p. 4). But since the latter cannot be measured directly, and indirect measures often use the union wage rate as an explanatory variable, it is difficult to verify how the bargaining power evolves and to which extent it impacts on the wage rate. If union density is taken as an explanatory variable (or as a proxy for the bargaining power), there is no problem in obtaining the necessary data. Because union density and coverage have declined dramatically in the USA during the last 30 years (Blanchflower, 1996), whereas no such change has been recognized for the wage gap, union density obviously does not suffice to explain differences in the latter, however.

Another strand of the literature, which builds up on the famous Calmfors and Driffill (1988) paper, focuses on the role of the bargaining structure for the outcome of the wage bargaining (for a short overview see Boeri, Brugiavini and Calmfors, 2001). In this literature, a more central wage bargaining has two controversial effects on the wage level. Firm-specific characteristics are taken into account to a lesser extent, which causes higher wage demands. On the other hand, unions recognize the impact that higher wages have on prices, which reduces the incentive to go for high wages. The latter effect is relevant in this contribution, too.

In comparison with related literature, we are able to calculate this wage gap directly through the inclusion of a secondary, nonunionized sector of the labor market. To illustrate why the secondary sector is important, consider the case where unionized firms are able to shift wage rises to higher prices completely. In this case, one would wrongly come to the conclusion that unions have no effect on real wages if the model neglects that in reality some workers are not covered by union wage bargaining, whereas the inclusion of a secondary sector would show that the consumers' price index rises less than that commensurate to the negotiated wage rate. A dual labor market increases realism given that, in reality, labor markets are segregated into a large number of sectors. Empirical evidence supports the simplifying assumption of only two sectors (see the survey in Saint-Paul (1996)).

Our approach is closely related to the general-equilibrium model by Blanchard and Giavazzi (2003). This model framework allows the analysis of cross-market effects between the labor and the product markets, whose relevance has recently been stressed by a number of researchers (see e.g. Boeri, Nicoletti and Scarpetta (2000), Nicoletti, Bassanini, Ernst, Jean, Santiago and Swaim (2001), Jean and Nicoletti (2002), and Bertrand and Kramarz (2002)). The most important differences in the

Blanchard-Giavazzi approach are the inclusion of a nonunionized sector of the labor market, which renders it possible to derive the union wage premium and the way market entry is modeled. In this model and its numerical specifications, we are able to show that (1) the union wage gap largely depends on the degree of centralization of the bargains and, to a lesser extent, on the expenditure share of the unionized sector's goods; and (2) the bargaining power of unions turns out to have only a limited influence on the union wage premium.

Section 2 develops the theoretical model. Section 3 derives the results numerically. Section 4 summarizes the results and concludes.

2 The model

Imagine a two-sector economy: one monopolistic competitive sector, producing heterogeneous goods with increasing returns to scale, and one perfectly competitive sector producing a homogeneous good with constant returns to scale. This setup has recently been supported by empirical work on scale elasticities. After an examination of trade data from 71 countries, Antweiler and Trefler (2002) conclude: "Our results point to the importance of integrating constant- and increasing-returns-to-scale industries within a single general-equilibrium framework."

The market for labor is dichotomized as well. Some workers receive the competitive wage rate, and some workers receive the (higher) union wage rate. While firms in the homogeneous sector exclusively employ workers from the competitive labor market, production in the heterogeneous sector requires unionized labor as an input. Since there is no surplus to be shared in the competitive sector, the union wage in this sector would coincide with the competitive wage rate, anyway. Although, in reality, labor markets consist of more than only two sectors, the simplifying assumption of two sectors is supported by empirical evidence (see the survey in Saint-Paul (1996)).

Firms in the heterogeneous sector also each employ a fixed amount of nonunionized labor. Wages paid to these workers have the character of fixed costs, because the competitive wage rate is determined by the technology of the homogeneous sector. Assuming fixed costs is the simplest way to generate increasing returns to scale in the heterogeneous sector. In our interpretation these costs arise e.g. due to the assignment of security agents, cleaner, gate keeper, and all other employees, who are

essential for the firm to produce goods, but whose number is yet independent of the amount produced. Equivalently, the fixed input may be seen as the corresponding amount of the homogeneous good itself.

2.1 Workers

There are N homogeneous workers, indexed by j. Utility of a worker depends on the consumption of homogeneous and heterogeneous goods ($x_{0,j}$, and $x_{i,j}$ with $i \in \{1, 2, \ldots, n\}$, respectively). The utility function of a representative worker is

$$u_j = u(x_{0,j}, x_{1,j}, \ldots, x_{n,j}) = x_{0,j}^{1-\beta} \cdot X_j^{\beta} \tag{1}$$

with

$$X_j \equiv \left(n^{-(1-\rho)} \sum_{i=1}^{n} {x_{i,j}}^{\rho} \right)^{\frac{1}{\rho}} \quad 0 < \rho < 1$$

where $x_{0,j}$ stands for consumption of the homogeneous good, n gives the number of heterogeneous firms/ varieties, β symbolizes the expenditure share, and X_j is a composite index of the consumed varieties (see Blanchard and Giavazzi, 2003). ρ corresponds with the elasticity of substitution, σ, according to the definition $\sigma \equiv 1/(1-\rho) > 1$. In comparison to the original Dixit and Stiglitz-approach, ρ is derived endogenously through the assumed relationship

$$\rho = 1 - 1/(\zeta n),\ \zeta n = \sigma > 1$$

where the exogenous parameter ζ determines how strong ρ and the elasticity of substitution between any two varieties depend on the number of firms.[2] One possible interpretation why a higher number of firms increases the elasticity of substitution is that the varieties become closer substitutes. We see ζ as a proxy for the degree of transparency on the products market. It is necessary that changes of the supply structure be transparent to the consumers for market entry to have an impact on consumer behavior.

Apart from ρ being endogenous the main difference to the Dixit-Stiglitz framework is the term $n^{-(1-\rho)}$ in the definition of the composite index X. The effect of this term becomes clear when we assume for the moment that consumption of each heterogeneous variety is the same, i.e. $x_{1,j} = x_{2,j} = \ldots = x_j$. In this case we get $X_j = n \cdot x_j$. Hence, utility depends only on the total amount of consumption. In the

[2] For a more general formulation see Blanchard and Giavazzi (2003, p. 881).

Dixit-Stiglitz framework, in contrast, there is a direct utility gain from an increase of the number of firms/ varieties. Here, consumers profit from an increase of the number of firms only through the reduction of mark-ups by lower market power. We follow Blanchard and Giavazzi (2003, p. 882) in considering this effect of market entry to be the most important.

Maximizing the utility function (1) under a budget constraint yields the demand functions

$$X_j = \frac{\beta y_j}{P} \quad \text{and} \quad x_{0,j} = \frac{(1-\beta)y_j}{p_0} \tag{2}$$

where y_j denotes the income of worker j, p_0 is the price of the homogeneous good, and P is the price index of the heterogeneous goods, defined by

$$P = \left(\frac{1}{n} \sum_{i=1}^{n} p_i^{\frac{\rho}{\rho-1}} \right)^{\frac{\rho-1}{\rho}} \tag{3}$$

(see Blanchard and Giavazzi, 2003, p. 882). Income y_j of a worker is either the union wage rate w_i or the competitive wage rate w_0. Minimizing the expenditures for a given value of X_j yields the following individual demand function for variety x_i:

$$x_{i,j} = \left(\frac{P}{p_i} \right)^{\frac{\rho}{1-\rho}} \frac{\beta y_j}{n p_i} \tag{4}$$

Hence, aggregate demand for this good is

$$x_i = \left(\frac{P}{p_i} \right)^{\frac{\rho}{1-\rho}} \frac{\beta}{n p_i} Y \tag{5}$$

and depends linearly on the total income of workers $Y \equiv \sum_{j=1}^{N} y_j$.

2.2 Firms

Firms in both sectors maximize profits. The homogeneous good x_0 is produced employing exclusively labor from the competitive labor market. The good serves as a numeraire. Technology is assumed to be linear (no fixed costs), and standardized without loss of information to $x_0 = L_0$. Market entry occurs until firms just break even. This implies together with the assumed production function that the competitive wage rate is unity: $w_0 = p_0 \equiv 1$. The number of firms in the perfectly competitive sector is undetermined, but must be large enough to guarantee perfectly competitive behavior.

Each heterogeneous good is produced by a different firm employing, respectively, a fixed amount of Δ units of labor from the competitive labor market. The amount of unionized labor input can be derived from the technology constraint

$$L_i(x_i) = \frac{x_i}{\alpha} \tag{6}$$

where the constant α symbolizes exogenous variable output per unionized worker. Profit π of a representative firm reads

$$\pi_i = x_i \cdot p_i - L_i \cdot w_i - \Delta$$

After substituting L_i by the technology constraint and p_i by the inverse demand function, maximization of π_i yields the optimum price

$$p_i = \frac{w_i}{\alpha\rho} \quad \text{or} \quad p_i = \frac{w_i}{\alpha}\frac{\sigma}{\sigma - 1} \tag{7}$$

The mark-up over marginal costs is a negative function of n, since ρ depends positively on the number of firms n.

Market entry is free and costless. Firms enter/ exit the market until the profits of an additional firm would be negative, and profits of all incumbent firms are strictly nonnegative. In a symmetric equilibrium all firms $i \neq 0$ are equal ($x_i = x$, $p_i = p$, $L_i = L$, $w_i = w$ and $\pi_i = \pi = 0$).

2.3 Unions

Assuming that workers are distributed evenly across all firms in the heterogeneous sector,[3] the probability of a worker to get employed there is nL/N. Those who do not become employed in the primary labor market must work for the competitive wage rate. Each trade union maximizes the expected utility of a representative worker, and bargains with a fraction γ of firms in the unionized sector of the economy over the wage rate w ("right-to-manage model"). The number of unions is thus $1/\gamma$.

Given our assumptions the expected utility of a representative worker is

$$U^+ = \frac{nL}{N}u_j(w, P^+) + \left(1 - \frac{nL}{N}\right)u_j(1, P^+)$$

if there is an agreement with the firms and

$$U^- = u_j(1, P^-)$$

[3]If workers were distributed unevenly, some of them could increase the probability of an employment by reallocating themselves to a firm where less workers are attached.

if there is no agreement.[4] P^+ and P^- represent the price index of the heterogeneous goods, respectively in the cases of an agreement and of no agreement. The bargaining parties thus take into account that the price index differs in these two cases.

2.4 Timing of the model

Since our model is static, there is no chronological order of decisions, actions, and reactions. But, by assuming a specific informational status of the workers, firms and unions, we determine what may be called a logical order.

One of the main differences to Blanchard and Giavazzi (2003) is the way market entry is modelled. In their paper, firms face entry costs, which play a role similar to that of fixed costs in our study. But since these costs are sunk costs, it is difficult to explain why the number of firms should shrink after a marginal deterioration of their economic situation. Blanchard and Giavazzi (2003, p. 891) argue that "firms which die are not replaced". But it remains open why these firms should die in the model as long as profits are strictly positive. In our model all firms that enter the market actually have to bear the fixed costs. Thus, starting from a zero-profit equilibrium, a deterioration of the firms' situation leads to losses, pushing some firms out of the market. But, as entry costs in the Blanchard and Giavazzi framework, fixed costs do not affect the wage bargain, if they arise independently of whether or not there is an agreement.

From these considerations, the following logical order results: (1) First market entry/ exit decisions are taken. (2) Fixed costs arise for those firms that have entered the market. (3) Wage bargains take place independently of each other. It must be assumed that the unions and the corresponding firms know the resulting wages, prices, and employment from all other bargaining units in the economy (e.g. through a heuristic process, which is terminated in the long-run equilibrium we look at). This common assumption allows us to abstract from the strategic interplay between different bargains. Even though this assumption may be grossly unrealistic, we prefer to employ it, too, in order to maintain comparability and simplicity. Once wages are determined, (4) goods are produced, sold, and consumed. However, in a long-run equilibrium only those firms that can actually cover fixed costs enter the market.

[4] Since all agents fare better in the case of an agreement, this second term serves only as the 'conflict point' during the bargain, but is never realized.

2.5 The wage bargain

Both, unions and firms, take into account the aggregate demand functions the firms face. They are equally aware of the responses of employment, workers' income and prices regarding changes of the wage rate. In contrast, they take the number of firms in the heterogeneous sector as given, because it is determined "before" the bargaining.

The Nash product describing the asymmetric bargaining problem is

$$NP = \gamma n(px - Lw) \cdot (U^{+} - U^{-})^{\delta} \tag{8}$$

where δ denotes the relative bargaining power of the union (Nickell, 1999, p. 3). Constraints of the maximization are: the demand function (5), the technology of the firm (6), the optimum price of the good (7), the definition of the price index (3), and the composition of the total income. The two latter equations have to be modified to take into account whether or not workers are covered by the agreement.[5]

From the union's and the corresponding γn firms' point of view, the heterogeneous goods' price index depends on the agreed wage because the goods prices depend on the wage rate and the number of firms is not negligible relative to the entire economy. If we differentiate between firms that are covered and not covered (in the latter case p_i, L_i and w_i carry a bar, symbolizing that these values are regarded as being given), definition (3) becomes

$$P = \left[\frac{1}{n}\left(\sum_{i=1}^{\gamma n} p_i^{\frac{\rho}{\rho-1}} + \sum_{i=\gamma n+1}^{n} \overline{p_i}^{\frac{\rho}{\rho-1}}\right)\right]^{\frac{\rho-1}{\rho}} \tag{9}$$

Since workers are distributed evenly across all firms, the number of workers per firm is N/n. The probability of an employment at the union wage rate is thus $L_i/(N/n)$ for workers who are member of the considered union, and $\overline{L_i}/(N/n)$ for all other workers. Hence, the expected income of a worker equals $(nL_i/N)w_i + [1 - (nL_i/N)]$ for members of this union and $(n\overline{L_i}/N)\overline{w_i} + [1 - (n\overline{L_i}/N)]$ for all workers that are members of other unions (notice that the competitive wage rate is unity). Total income from the point of view of the bargaining parties is

$$Y = \sum_{j=1}^{\gamma N}\left[\frac{nL_i}{N}w_i + \left(1 - \frac{nL_i}{N}\right)\right] + \sum_{j=\gamma N+1}^{N}\left[\frac{n\overline{L_i}}{N}\overline{w_i} + \left(1 - \frac{n\overline{L_i}}{N}\right)\right]$$

[5] As noted earlier, wages, demand, labor input etc. are the same for all firms in a symmetric equilibrium. Nevertheless, the bargaining parties consider these variables to depend on the result of the bargain if they are related to them, and as exogenous if they are related to other firms/ workers.

$$= \sum_{j=1}^{\gamma N} \left[\frac{nL_i}{N}(w_i - 1) \right] + \sum_{j=\gamma N+1}^{N} \left[\frac{n\overline{L_i}}{N}(\overline{w_i} - 1) \right] + N \tag{10}$$

The resulting wage rate is not amenable to a formal representation in general. Only in the benchmark case of decentralized bargaining ($\gamma \to 1/n$) a closed form can be found, which is

$$w_i|_{\gamma \to \frac{1}{n}} = \frac{\delta + \rho}{\rho(1 + \delta)}$$

All other variables follow from the wage rate in a straightforward manner. Except from the special case of decentralized bargaining, numerical methods are appropriate to solve for the wage rate and all other endogenous variables. This exercise is carried out in section 3 Since ρ depends on the number of firms n, the latter has to be derived before we can determine the wage rate. Other variables that are related to the macro level are the price index P and total income Y.

2.6 The macro level

For the aggregation of the variables that are determined at the level of the bargain, we assume symmetry. In a symmetric equilibrium the price index (3) becomes

$$P = p_1 = p_2 = \ldots = p$$

The cost-of-living price index $\hat{P}$ can be derived by a weighting of the prices in both sectors with the respective expenditure shares:

$$\hat{P} = P^{\beta} \cdot 1^{1-\beta} = p^{\beta} \tag{11}$$

In the symmetric case, aggregate income (10) becomes

$$Y = nL(w - 1) + N$$

As in the Dixit-Stiglitz framework the number of firms/ heterogeneous goods is determined through the assumption that firms' profits are zero in equilibrium. Since there are fixed costs, this does not imply a breakdown of the wage bargains because of absent rents. In comparison with Blanchard and Giavazzi (2003), a small deterioration of the firms' economic situation, e.g. higher fixed costs, unambiguously leads to a decrease of the number of firms. Setting $\pi_i = 0$, making use of equations (6) and (7), we get $(1 - \rho)px - \Delta = 0$. In a symmetric equilibrium, market demand for

each variety is $x = \beta Y/(np)$ (equation (5)), and from the definition of ρ, we know that $1 - \rho = 1/(\zeta n)$. Employing this information, the zero-profit condition yields:

$$n = \sqrt{\frac{\beta Y}{\Delta \zeta}}$$

The three equations for the price index P, total income Y and the number of firms n determine - together with the results and definitions derived before - the simultaneous long-run equilibrium. The following variables are endogenous: wage rate w, variable employment per firm L, product price p, demand x, number of firms n, total income Y, price index P, and elasticity of substitution σ. Other variables, like the demand for the homogeneous good may be deduced from them. The results depend on the number of workers N, output per unionized worker α, the expenditure share of the heterogeneous goods β, the unions' relative bargaining power δ, the fixed labor input Δ, the degree of centralization of the bargain γ, and on the parameter ζ, which indicates how strong competition on the goods market is affected by market entry. It is possible to verify the correctness of the model's outcome by the redundant equilibrium condition of the homogeneous market: $x_0^{demand} = (1-\beta)Y = N - n(L + \Delta) = x_0^{supply}$.

3 Numerical analysis

The first goal of the numerical specification is to derive an exemplary equilibrium. Analyzing the properties of this equilibrium may help to understand the complex interactions between the endogenous variables. If we would restrict the analysis to decentralized bargaining ($\gamma \to 1/n$), it could also be executed analytically. Yet, this parameter turns out to be a crucial one. In addition, the numerical analysis renders possible to compare quantitatively the comparative-static effects of different exogenous variables.

Second, the numerical analysis allows to tailor the parameters to the situation of a specific country. A comparison of the model's results with empirical data may give some guidance as to the extent of the model's predictive power. Finally, the application to a country's particular economic situation permits to derive what policy suits best for any given pursued objective.

A lack of data and the objective to work out differences between countries in a stylized and focused fashion forced us to restrict the numerical analysis to

seven countries: The United States, the United Kingdom, West Germany, Denmark, Canada, Italy and Japan. These countries have been chosen because the necessary data have been available at least for some years, and because they are quite different from each other with regard to the degree of centralization of the wage bargains and the union coverage rate. If the data were available, we specified the parameters for the years 1980, 1985, 1990 and 1994.

3.1 The data

The following parameters are chosen to distinguish a country's specific situation at different points in time: union coverage, the size of the workforce, and "the degree of centralization of the wage bargains", which correspond with the expenditure share of the heterogenous good (β), the number of workers (N), and the fraction of covered workers who are member of one union (γ). Although the latter is relatively stable over time (Kenworthy, 2003, p. 13), we account for variations of it because the considered time span is fairly long, and because γ affects the endogenous variables strongly. It is needless to say that these three parameters cannot give a sound impression of a country's economic situation. Yet, it turns out that they suffice to explain much of the differences in the union wage gap between the included countries.

We adjust β until the share of workers that are covered coincides with the bargaining coverage rate, taken from Traxler (1996, p. 274), supplemented by OECD (1997, p. 71), whenever the records were comparable.[6] That is to say, we derive the decrease of union coverage in many countries from an assumed relative decrease of the consumers' valuation of goods produced in the unionized sector. This means that we abstract from many causes that may have influenced the coverage rates, too, e.g. the political environment, legislative measures etc. Examples for the shift of preferences away from the unionized sector's goods are common and include sectors like 'steel' and 'public transports'. There are several reasons why we draw on union coverage rather than union membership (density). First, recent evidence suggests

[6]Unfortunately, the definition and measurement of bargaining coverage is not unambiguous. One difference between the reported coverage rates is that some of them adjust for the fact that in several countries not all workers have the legal right to bargain. From the role of the parameter in the model is is clear that we must take the unadjusted coverage rate. Therefore, the OECD data were only viable for those countries where all workers have the right to bargain, so that both rates coincide. For instance, this is the case in Italy.

that there is no union membership non-membership wage gap among the covered employees. Measured differences between the pay of trade union members and non-members seem to be caused by various unobservable variables, which cause e.g. a concentration of members in high paying workplaces (see (Booth and Bryan, 2004)). Second, the figures for coverage account for all sort of institutional and legislative differences between the countries in the sample. For instance, in Germany all workers whose employer is member of the employers' association are covered, regardless whether they are member of a union or not. In many countries, union wages are legally extended to cover nonunion firms. In these cases union density would not reflect the number of workers who are affected by collective contracts. Therefore, union coverage is the proper concept if one wishes to measure the true impact of unionism across different countries.

The most difficult decision is regarding the appropriate measure of γ, the degree of centralization. There is an abundance of qualitative indicators designed to describe it (for a comprehensive survey see Kenworthy, 2003). In addition, some authors claim that coordination rather than centralization would be the appropriate measurement (Soskice, 1990). For several reasons, we chose to take Iversen (1998)'s indicator of wage bargaining centralization. First, it is available annually for all countries that we included.[7] Second, the Iversen indicator takes account of small changes towards a more centralized or decentralized wage setting. In comparison, other indicators, like the one published by the OECD, are much more abrasive. It must not be concealed, however, that (with the exception of Canada and the USA) there are considerable differences between the alternative indicators (Kenworthy, 2003). Therefore, our results are not robust to the choice of indicator. We displaced the origin of the Iversen indicator such that the smallest value, corresponding with firm-level bargaining, is zero.[8] N is civilian employment, taken from the US Department of Labor (2002, p. 11).[9] The 1980 value is standardized to unity, respectively. It should be noted that this parametrization does not account for variations in the number of hours worked per employee.

Why have these three parameters been chosen to characterize the countries in

[7]The 1994 value has to be taken from 1993, which is the last one published.

[8]To avoid computational problems, a value of 0.0001 rather than literally zero is the minimum (employed for the USA and for Canada).

[9]This source converts the national data such that they approximate US concepts. The Danish values stem from OECD (2001, p. 20f.).

the sample? First, it turns out that one parameter does not suffice to describe the bargaining setting adequately. For instance, bargaining takes place at the firm level in the USA as well as in Canada. But union coverage is significantly higher in Canada, which yields a different outcome. The same applies if one compares the situation of the USA with Japan. Union coverage is roughly comparable, but bargaining is more centralized in Japan, leading to a noticeable lower union wage gap. Second, this paper sets out to derive the union wage gap from features of labor markets *and* product markets. Therefore, it is desirable that at least one parameter is included, which is also related to the product markets (i.e. N, the 'number of workers/ consumers'). This permits to examine if and to which extent the size of the markets has an impact on the wage rate for a given structure of the labor markets.

In contrast, we chose not to vary the production technology across countries and time (parameters α and Δ in the model). Even though these parameters play an important role for the level and dynamics of real wages and income, we abstract from variations in them because our focus is on the comparative-static effects of the bargaining structure and the size of the unionized sector. In addition, it is difficult to obtain reliable data on costs. The latter is equally valid for the parameters δ (relative union bargaining power) and ζ (determining how strong the number of varieties affects the elasticity of substitution). We chose to employ the same parameter values for ζ and δ for each point in time and country because a lack of data would otherwise make the results additionally arbitrary.

Table 1 specifies the parameter values employed, where union coverage, symbolized by ψ, is given in addition to the corresponding values of β. α is standardized to unity for the ease of computation. Fixed labor input Δ is 0.002, which causes a ratio of fixed costs to total costs (cost disadvantage ratio, CDR) within the range 13.6%–24.5%.[10] Furthermore, we specify the parameters δ and ζ as 1 and 0.1, respectively, implying symmetric bargaining and a relatively weak responsiveness of the elasticity of substitution with regard to market entry.

3.2 The model's results

Figure 1 shows the relative differences between the union wages and the competitive wage rates in the model. The highest wage gap is found in the USA, where it equals 14.7% in 1980, increases to 16.3% in 1985 and then decreases to 15.9% in 1994.

[10] These values are comparable with those of Elbehri and Hertel (1999).

Table 1. Parameter specification

	Canada			Denmark			Germany			Italy		
year	1985	1990	1994	1980	1990	1994	1980	1985	1990	1980	1990	1994
β	0.491	0.494	0.472	0.823	0.823	0.824	0.901	0.882	0.897	0.996	0.972	0.965
ψ	0.37	0.38	0.36	0.69	0.69	0.69	0.76	0.74	0.76	0.85	0.83	0.82
γ	0.000	0.000	0.000	0.404	0.257	0.329	0.242	0.243	0.249	0.071	0.071	0.194
N	1.061	1.194	1.200	1.000	1.068	1.015	1.000	0.982	1.055	1.000	1.044	0.987

	Japan		UK			USA				Each country/ year	
year	1980	1990	1980	1990	1994	1980	1985	1990	1994	α	1.000
β	0.352	0.293	0.842	0.595	0.598	0.372	0.298	0.270	0.268	Δ	0.002
ψ	0.25	0.21	0.70	0.47	0.47	0.26	0.20	0.18	0.18	δ	1.000
γ	0.160	0.265	0.052	0.052	0.052	0.000	0.000	0.000	0.000	ζ	0.100
N	1.000	1.130	1.000	1.084	1.043	1.000	1.079	1.196	1.239		

Canada features the second highest value, which is roughly 11.5%. The UK wage gap increases from 8.2% in 1980 to 9.7% in 1994. In contrast, the union wage gap decreases in Japan from about 10.5% in 1980 to 7.2% in 1990. In the time span, the Danish union wage gap increases from 3.0% to 5.2%, and then decreases to 4.2% in 1994. The German and Italian values remain nearly constant from 1980 to 1990 (5.4% and 7.1%, respectively). In 1994 the Italian wage gap falls to 5.9%, whereas the German value could not be calculated because of missing data.

Decentralized wage bargaining explains apparently the high wage gap in Canada and the USA. Unions disregard the negative effect higher wages have on the aggregate price level, since the number of represented workers is small relative to the total workforce. The inverse accounts for Denmark, where wage bargains concern a large fraction of the workforce, and the wage gap is the lowest. Danish unions internalize the negative effect higher wages have to a great extent. This effect is well explored in the literature (for a short summary of different external effects that may be internalized see e.g. Boeri et al., 2001), and it causes much, yet not all of the differences between the countries' development of the wage gap.

Since Canada and the USA both have decentralized bargaining, and the relative variations of the total workforce are similar, differences in union coverage explain why Canada's wage gap is roughly four percentage points lower. But why should a

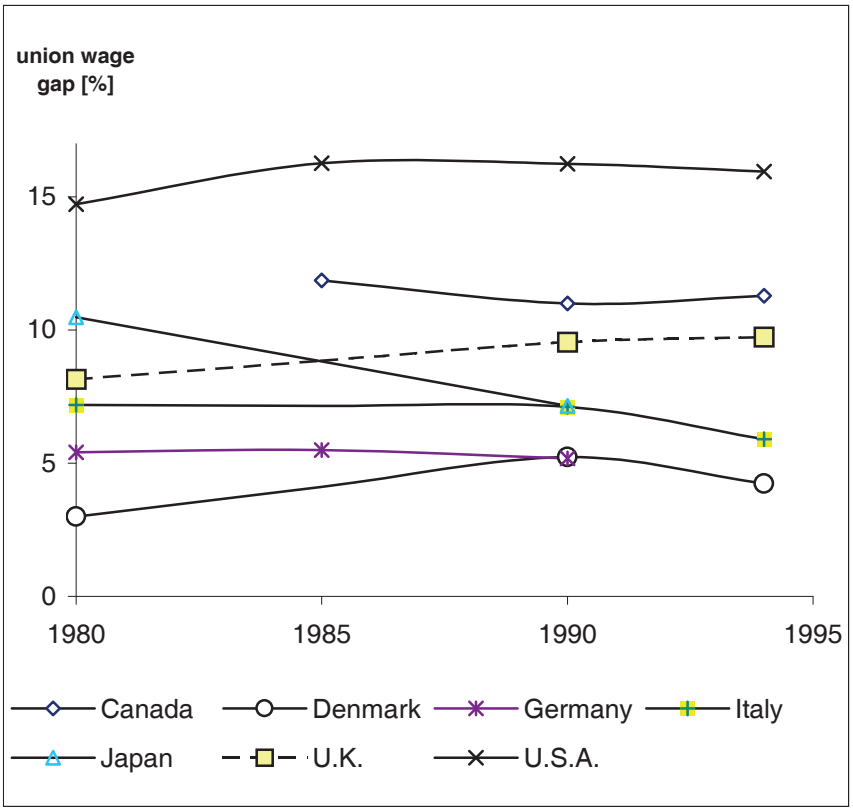

Fig. 1: The union wage gap

higher union coverage rate yield a lower wage? Usually, it is taken for given that coverage is a proxy for a union's bargaining power, which is supposed to have a positive effect on the negotiated wage rate. In our framework, in contrast, a higher coverage rate is caused by a higher expenditure share of the unionized sector of the economy, so that there are more monopolistically competitive firms. This implies that the heterogeneous goods become closer substitutes (ρ increases) so that the optimum prices and the firms' ability to accrue rents diminish. Therefore, union wages decrease. The moderate increase of the wage gap in the UK can also be explained by changes of the expenditure share. In all other countries the expenditure shares remained relatively stable.

The decrease of the unionized sector in the USA in the considered time span did not lead to a relevant modification of the wage gap, however, because the relatively strong increase of the total workforce worked against this effect. More workers lead to a higher number of firms, which enhances competition in the goods markets. This

reduces rents and union wages. In Canada, this effect yields a moderate decrease of the wage gap from 1985 to 1990. For all other countries, the variations of the total workforce are small relative to the variations of union coverage and the degree of centralization.

What do our results imply for real income? If we deflate wages by the consumer price index (11), we find that the highest real wages in the primary sector occur in the USA. Here and in the UK, we also observe the strongest increase of the real wage rate during the 1980s. The reason is, besides the modest increases of the union wages in these countries, that the expenditure share β of the goods produced by firms that face union wage bargaining has dramatically declined in the considered time span. This lowers the cost-of-living price index (11) and raises real wages. In the USA and in the UK ever less workers profited ever more from the existence of trade unions. Why this happens seems a question worth being researched.

3.3 Comparison with empirical evidence

There is no lack of empirical work on the union wage gap. The problem is rather that the existing empirical literature is in part inconsistent because of differences with regard to the employed data and methodology. Therefore, it is advisable to keep at one source to increase comparability. We chose Blanchflower (1996), supplemented by Blanchflower and Bryson (2003), since it is the only study we found that includes nearly all countries for which we parametrized the model in the considered time span (except from Denmark). The underlying data from the International Social Survey Programm Series (ISSP, 1985–1993) does not allow to control for important variables such as industry, which is likely to bias the estimations upwards. More reliable are the results in Blanchflower and Bryson (2003), using the MORG files of the CPS for the USA and the British Social Attitudes Surveys (BSAS) for the UK, which we averaged for the time span 1985–1993 to make them comparable. Table 2 contrasts the estimates of Blanchflower and Bryson (2003) for the U.K and the USA, and Blanchflower (1996) for the rest of the countries with our model's results. For Italy, the UK and the USA the differences appear small. The estimated wage gap for Japan (47.8%) is much higher than what the model predicts (and also much higher than what we think is plausible). The estimates for Germany (3.4%) and Canada (4.8%) are lower than what our model predicts. However, Blanchflower and Freeman (1992) find a wage gap of 6% for West Germany, which again is near the model's

result. Blanchflower (1996, p. 23, footnote 17) cites several studies that estimate wage gaps for Canada which are similar to the outcome of our model. Altogether the model's results seem to be relatively close to the estimated wage gaps, in particular in those cases where the latter are reliable.

Table 2. Union wage gap in the model and empirical evidence

	Model				Estimates
	1980	1985	1990	1994	85–93
Canada		11.9	11.0	11.3	4.8[a]
Denmark	3.0	4.1	5.2	4.2	
Germany	5.4	5.5	5.2		3.4
Italy	7.2	7.2	7.1	5.9	7.2
Japan	10.5	8.8	7.2		47.8
UK	8.2	8.9	9.6	9.7	7.3
USA	14.7	16.3	16.2	16.0	19.2

[a] not significantly different from zero

Sources: Blanchflower (1996), Blanchflower and Bryson (2003), own calculations

One reason why estimated wage gaps may not be reliable is that empirical studies frequently use union density (membership) as a measure of union influence. This may be reasonable for the USA, Japan and Canada, where union density and coverage are roughly equivalent. In Continental Europe substantial gaps between union density and coverage prevail, however. An extreme case is France, where union membership is about 10%, and where coverage of collective agreements is about 95% (see Visser (2003)). This biases the estimated union-nonunion wage gap downwards, which may explain partially the difference between the simulated and the estimated wage gap for Germany.[11] Another important reason for differences between our results and some estimations is selection. Longitudinal evidence has shown that there is positive selection into unions among low-skilled workers and negative selection among high-skilled workers (Hirsch, 2004), which biases the measured effect of unions on wages. In some countries, however, the results of the bargains

[11] I would like to thank one anonymous referee for making this point.

are de facto or even legally extended to workers who are not members of a union. In these cases selection can only have a very limited impact.

How robust are our results? First, we checked the sensitivity of the results with respect to variations of the exogenous parameters α, Δ, δ and ζ. None of them has a strong impact on the union wage gap. Therefore, we conclude that the parameters that describe the countries in the numerical analysis (β, γ and N) are indeed decisive for the union wage gap. In contrast, employment, elasticity of substitution, prices, and the number of firms depend more on the choice of the former parameters, which determines, for example, real income. Therefore, an analysis aiming at explaining the course of real income would have to account for their role more accurately than this study.

A second possibility to check our results is to compare computed values of endogenous variables (other than the wage gap) with estimates in the literature. We perform such a comparison with respect to the markup of prices on marginal costs, taken from Oliveira Martins, Scarpetta and Pilat (1996). Before we turn to the results of this comparison, some words of caution are in order, however. First, the employed method of estimation, put forward by Roeger (1995), produces a downward bias with increasing returns to scale. Thus, the estimates are likely to represent a lower bound. Second, the estimated markups are the average of sectoral markups in the period 1980-1992, weighted by 1990 production shares in manufacturing. Therefore, they can only be used to give a rough impression of the differences between countries.

Table 3. Markups on prices in the model and empirical evidence

	Model	Estimates
Canada	23	20
Denmark	18	15
Germany	17	21
Italy	16	19
Japan	32	26
UK	20	15
USA	32	14

Source: Oliveira Martins et al. (1996), own calculations

The third column of table 3 stems from Oliveira Martins et al. (1996, p. 25). The second column averages the markups we obtain in the numerical analysis for the respective countries at different points in time. Taking into account that the estimated markups are probably biased downward because of the implicitly assumed constant returns to scale, the results for Canada, Denmark, Japan, and the UK are supported by proving. The computed markups for Germany and Italy are quite close to the estimated values but are smaller than the latter. The ranking of the US values is as supposed, but they display the largest differences. One possible explanation as to why the computed markup for the USA is too high is that, here, the neglected perfectly competitive sector with zero markup is the largest.

4 Summary and conclusions

The theoretical model developed in the first part of this study is designed to analyze the causes of the union wage premium. It captures some of the most important channels by which labor and goods markets interact. Subsequently, we derive numerical results by adjusting the model for seven countries that are characterized by their expenditure shares of the unionized sector, degrees of centralization of the bargains, and growth rates of civilian employment. Although the analysis is based on a limited number of countries and points in time, the following results seem to be fairly stable:

- The union wage gap largely depends on the degree of centralization of the bargains, and, to a somewhat lesser extent, on the expenditure share of the unionized sector's goods and on the size of the employed labor force. At odds with a widely held view, the latter two have a negative effect on the wage gap because competition on the goods market is reinforced, which reduces the bargained wage rate.

- In contrast, the bargaining power of unions, commonly regarded as important explanatory factor, turns out to have only a limited influence on the union wage premium.

- Differences between countries with respect to real income per worker can partially be explained by the expenditure share of the unionized sector.

Our results highlight the importance of spillovers between labor and product markets (see also Boeri et al. (2000), Nicoletti et al. (2001), and Jean and Nicoletti (2002)). As an example, more central bargaining causes lower wages because less of the negative effect of high wages is external to the bargaining units. This impacts positively on the number of firms and negatively on price markups, which in turn reduces the number of firms. Market entry increases competition on the product markets, which lowers price markups and rents. Consequently, wages decrease, too. These mutual dependencies between the outcome of labor and product markets are central for an understanding of the role of unions.

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