WAGE INTERDEPENDENCE THROUGH DECENTRALIZED BARGAINING

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Abstract. The idea that sector-specific unions are influenced by the wages obtained by other unions has mainly been used to support the empirical observation that wages are highly correlated among industries. The sources of wage interdependence can mainly be found in unions' preferences, in the nature of technology and in price and demand determination. The presence of externalities and of strategic complementarity among unions leads to suboptimal equilibria, which generates non-desired inflation, unemployment and possibly also trade balance deficit. This enforces the idea that part of current unemployment can be eliminated by improving the cooperation between social actors.

Keywords. Envy; externalities; strategic complementarities; unemployment; unions.

Introduction

The observation that wages which are negotiated at the sectorial or firm level depend on the wage of other firms or sectors has long been treated in both empirical studies and theoretical analysis. This observation has led to the concepts of 'wage imitation effect' (Michell (1980)), 'envy effect' (Gylfason and Lindbeck (1984a), (1984b)), 'wage rivalry' (Oswald (1979)), 'jealousy effect' (Calmfors and Driffill (1988)), 'spillovers in wage determination' (Mehra (1976)), or, more simply, 'wage-wage' spirals. We think that it is time to clarify the links between the various branches of this literature which are generally unknown to each other. In this survey, we try to make some links between wage rivalry, coordination failures, Scandinavian models and empirical studies of wage formation.[1] Their common point is that they deal with bargaining between unions and firms[2] at the sectoral or firm level.[3] The general aim of this survey is to synthesize the results about the implications of 'wage-wage' spirals on economic activity.

In a first section, we investigate the sources of wage interdependence (or the way of modelling wage interdependence). These can mainly by found in unions' preferences, in the nature of technology and in price and demand determination. The analysis of the sources of wage interdependence allows us to make the link with some recent investigations dealing with the role of externalities (or spillovers) among players and their consequences on the allocation of resources (Cf. Cooper and John (1988)). In this first section, we also distinguish between

two main frameworks of interdependence: (a) The multi-causal framework where the sectors are equally treated with causality links in all directions, and (b) the one-way causal framework where some leading sectors give the pace for the wages of the following sectors.

Secondly, we analyze the effect of the 'wage-wage' spirals on economic performance, looking at the sub-optimality of decentralized wage setting. The sub-optimality can be analyzed in terms of non-desired inflation, unemployment or trade deficit. As illustrated by Mitchell (1980) for the case of unwanted inflation, changes in wage structure, sparked by some initial cause, could continue to produce wage inflation long after the spark had gone out. This leads to the idea of *wage explosion* that can be at the root of the explanation of the important wage increases that have occurred in Europe around 1975. The question can also be treated in an open economy perspective, considering the Scandinavian model as a special branch of the sectoral wage setting theory. We use this framework to analyze the implications on the trade balance surplus or deficit. We will ask how wage interdependence can affect the profitability of the tradeables sector and the competitiveness of the economy.

In a third section, some aspects of empirical analysis about wage spillovers are studied. The policy conclusions implied by wage interdependence are reviewed in section 4. Section 5 concludes by identifying the difficulties and interests of the various approaches surveyed in the paper, and proposes some points left for future researches.

1. Modelling wage interdependence

The dependence between the negotiated wages of different sectors is generally expressed by the concept of wage reaction function. This says simply that the wage of a sector i is a (positive or negative) function of the wage in the other sector(s) j:

$$w_i = w_i(w_j, \dots) \qquad i \neq j$$

The shape of this reaction function depends on the source of wage interdependence. The reaction function is derived by maximizing the bargaining function which is generally approximated by the Nash product of the objective functions of the union and of the firm. In the case of a non-cooperative set-up, which is dominant in the literature about wage interdependence, the Nash product can be seen as an approximation of the outcome of a sequential bargaining if the reaction speed of both players to other player's proposals tends to infinity (cf. Binmore *et al.* (1986)). A general maximization problem for the agents of sector i can be written as:

$$\max_{w_i} \left[U_i\left(\frac{w_i}{p}, n_i, \frac{w_j}{p}, t\right) - \bar{U}_i\left(\frac{w_j}{p}\right) \right]^{\beta} \left[\Pi_i\left(E\left(\frac{w_i}{w_j}\right), \frac{w_i}{p}, n_i\right) - \tilde{\Pi}_i \right]^{1-\beta}$$

$$s.t. \qquad n_i = n_i\left(\frac{w_i}{p}, E\left(\frac{w_i}{w_j}\right)\right)$$

where U_i is the utility of the union and $\bar{U}_i$ is its fall-back utility level, which is the utility in case of disagreement. p is the price level, t is taxes, β is union power.[4] Π_i is the profit of firm i, E is workers' effort, $\bar{\bar{\Pi}}_i$ is fall-back profit, and n is labour demand.

This maximization programme allows to determine an optimal wage for a given labour demand schedule (Right-to-manage model). If $\beta = 1$, the union determines alone the optimal wage (Monopoly union model). The various arguments of utility, profit and labour demand will be explained in the following sections. The above maximization programme puts together all the channels that will be discussed later on.

Using partial equilibrium analysis (1.1), the sources of wage interdependence can be found directly in the utility of the union $U_i(w_i/p, n_i, w_j/p, t)$ (1.1.1), in the production function of the firm $n_i = n_i(w_i/p, E(w_i/w_j))$ (1.1.2), in the effort function of workers $E(w_i/w_j)$ (1.1.3) or in the specification of fall-back utility levels of unions $\bar{U}_i(w_j)$ (1.1.4). Indirect links between sectors are also found in general equilibrium frameworks (1.2), mainly through demand structure and aggregate price level p (1.2.1) and through an endogenous tax system t (1.2.2). Finally, a last subsection is devoted to the specific (uni-directional) interdependence between leading and following sectors (1.3).

1.1. *Partial equilibrium analysis*

In this subsection, we analyze the models dealing with wage interaction across different sectors, considering only the maximization programme of unions and firms. The channel of interdependence passes through wages and employment. Demand and prices are kept exogenous.

1.1.1. *Unions' utility function and relative wage*

Let us consider an economy with a number of different labour groups. These groups may correspond to economic sectors (Gylfason and Lindbeck (1984a), (1984b)) or to different types of labour (Oswald, (1979)). In each group, there is one trade union which determines the wage, constrained by the firm's labour demand curve. The utility of each union is defined over the real wage of the representative member and over the employment level in its sector or group. It could also be defined over the *relative* wage level, formalizing the original idea of Keynes (1936, p. 14) that unions care about some fairness between the workers:

> In other words, the struggle about money wages primarily affects the distribution of the aggregate real wage among labour groups and not its average amount per unit of employment, which depends, as we shall see, on a different set of forces. The effect of combination on the part of a group of workers is to protect their relative wage. The general level of real wages depends on the real forces of the economic system.

The concept of 'social transference' proposed by Dunlop (1944) is similar: 'Wage increases originating in one sector may be diffused because wage earners are determined to fare just as well as their associates. (...) The community of housewives, with the inevitable "you are as good as the next fellow," is not to be underestimated.' This story about the existence of a wage norm could also be applied to individual behaviour without implying unionization (as in Kolm (1988)).

Accordingly, unions base their claim partly on the wages received by other groups of workers. This framework allows to analyze a series of topics which is impossible to treat in a centralized bargaining framework. Gylfason and Lindbeck (1984a), (1984b) and Dixon (1988) use a two-sector model and include the wage of the other sector as a third argument in the utility function of each union. Let us call this assumption the *rivalry* assumption:

$$U_i = U_i\left(\frac{w_i}{p}, n_i, \frac{w_j}{p}\right) \quad i \neq j$$

w_i is the wage paid in sector i, p is the expected price and n_i is employment of sector i.

The fact that the wage of the other sector is included in the utility of the union can be seen as an externality (or spillover) among players. This is defined as the interaction between agents at the level of payoffs or objective functions (Cf. Cooper and John (1988)). In the model of Gylfason and Lindbeck, the externality is negative since a rise in the alternative wage w_j decreases the utility of union i.

There is no negotiation. the sector-specific union is assumed to maximize its utility function subject to the labour demand constraint (monopoly union model):

$$\max_{w_i} U_i \qquad s.t. \qquad n_i = n_i\left(\frac{w_i}{p}\right)$$

Consequently, the wage of one sector is dependent on the age of the other sector, leading to the notion of wage reaction function. Using strongly simplifying assumptions about the form of the utility and production functions, the model of Gylfason and Lindbeck implies that the wage of one sector is a loglinear homogeneous function in wages and prices, showing that rational behaviour does not force union i to require full compensation for expected inflation ($\eta_{w_i,p} = 1 - a < 1$ for a given w_j) unless it assumes union j to be fully compensated ($\eta_{w_i,p} + \eta_{w_i,w_j} = 1$).

$$\ln(w_i) = a \ln(w_j) + (1 - a)\ln(p) + c \qquad 0 < a < 1 \tag{1}$$

$$\ln(w_j) = b \ln(w_i) + (1 - b)\ln(p) + d \qquad 0 < b < 1 \tag{2}$$

This two-union model using Cournot-type reaction functions leads to a Cournot-Nash equilibrium whose macroeconomic implications will be discussed. This framework can be extended to the n-union case (cf. Oswald (1979)) and to a

world with imperfect information (cf. Andersen and Christensen (1989)). The fact that the wage of one sector is a positive function of the wage in the other sector introduces a strategic complementarity among unions which is increasing in the parameters a and b. This is defined as the interaction between agents at the level of strategies. Cooper and John (1988) show that the presence of both externalities and strategic complementarities (here, among unions) generates sub-optimal equilibria and possibly also coordination failures. This sub-optimality is thy subject of the next section.

A recent version of the model of Gylfason and Lindbeck is presented by Bhaskar (1990), who makes an additional assumption on the derivative of the unions' utility functions. These utility functions are defined over employment, the real wage and the wage relative to the expected aggregate wage w^e:

$$U_i = U_i\left(\frac{w_i}{p}, n_i, \frac{w_i}{w^e}\right)$$

Following the argument of Keynes, assuming that workers are concerned with fair treatment, Bhaksar supposes that the dissatisfaction of being paid less than the workers of the other sector is greater than the benefit from being paid more. He thus assumes a discontinuity of the derivative at the point $w_i = w^e$: the left-hand side derivative of the utility function with respect to relative wage at the point $w_i = w^e$ is greater than the right-hand side derivative. This discontinuity results from the existence of a minimum acceptable social norm in the mind of each worker.[5] Consequently, the wage setting rule (which results from union's utility maximization) defines, at a given employment level, an *interval* for the real wage, instead of a unique level.[6]

Envy and distributive justice
The assumption that the utility of unions are defined, a.o., over alternative wages is a very crude way to incorporate envy considerations. Another route to introduce interdependence among unions through envy is to use the social choice criterion of envy-freeness. According to it, an envy-free allocation (defined among unions) is characterized by the fact that no union should prefer any of other unions' basket (defined over a pair wage-employment) to his own. The various formulations of this idea are surveyed in Arnsperger (1994). Such criteria have never been applied to wage-employment allocation across sectoral unions.

Envy and family
Envy-like behaviour could also be micro-founded on specific human structure like the family. Manning (1994) studies a model with skilled and unskilled labour and argues that 'the value attached to leisure by an unskilled worker who lives with a skilled worker is likely to be higher than one who does not because consumption is, to some extent, spread even over the household.' This argument could be generalized to households composed of workers from different sectors and could explain the existence of externalities.

1.1.2. *Interdependence in the production function*

Another modified version of the model of Gylfason and Lindbeck is presented
in Risager (1990). He applies the wage rivalry framework to the competing wage
claims of skilled and unskilled workers groups. The idea is to test the wage
interdependence across skills in Denmark.[7] According to this set-up, the
production function of each firm includes in its arguments the two types of
labour. When the firm maximizes its profit, it determines labour demands as
functions of the wages of both labour groups:

$$n_i = n_i\left(\frac{w_i}{p}, \frac{w_j}{p}\right) \qquad i = 1, 2 \qquad i \neq j \qquad (3)$$

The sign of the derivative of labour demands with respect to the wage of the
other group depends on the nature of the technology: if the two labour types are
substitutes (complements), this derivative is positive (negative).[8]

Contrary to the previous model, each wage is *negotiated* between the firm and
each union given the labour demand functions (3) and (4) (right-to-manage
model). The outcome of the non-cooperative bargaining game is approached by
the maximization of the following Nash product:

$$\max_{w_i} \ U_i\left(\frac{w_i}{p}, n_i, \frac{w_j}{p}\right)^{\beta} \ \Pi\left(\frac{w_i}{p}, n_i, \frac{w_j}{p}\right)^{(1-\beta)}$$

$$s.t. \qquad n_i = n_i\left(\frac{w_i}{p}, \frac{w_j}{p}\right)$$

The wage reaction function is derived from the first-order condition of the Nash
product. The influence of a change in w_j on w_i is determined as the combination
of three effects:

- Income effect: the rise in the other wage increases the wage bill paid by the
  firm and reduces its profit, forcing the firm to be more aggressive in the
  negotiation over w_i (negative effect on w_i).
- Substitution effect:[9] if the two types of labour are substitutes, the rise in w_j
  increases the input of labour n_i, increasing the benefit to the firm of a fall
  w_i (negative effect on w_i). If the factors are complements, the effect on w_i
  is positive. A time dimension is present in this effect: in the short run (at
  given technology), we may assume that the two labour groups are
  complements while they could be substitutes in the long run.[10]
- Rivalry effect: the rise in w_j reduces the utility of the union and forces it
  to claim an increase in w_i.

The net effect is uncertain.

With respect to the model of Gylfason and Lindbeck, the two first effects are
new, but they are dependent on the particular bargaining structure which
assumes that *the negotiation is specific to the labour type*. Moreover, it should
be interesting to treat the same problem in an efficient bargaining framework[11]

rather than in a right-to-manage framework, since the aptitude of the union to bargain also over employment should be crucial in this type of model.

1.1.3. *The role of the effort function*

In addition to the introduction of the wages of the other sector(s) in the utility of the union and of the substitution possibilities between different types of labour, the alternative wages may play a role through the efficiency wage phenomenon.[12] The combination of the bargaining framework with efficiency wages and the discussion of the role of the alternative wage (mainly in determining the employment level) are found in Nickell and Wadhwani (1988) and Urga (1990). The main idea is the following: workers' productivity depends on workers' effort, which is linked to the ratio between the wage and the alternative wage; this ratio measures the cost to be paid by the worker if being laid off in case of shirking.[13] In that case, the profit of the firm is a function of workers' effort. $E(w_i/w^e)$. The Nash product becomes:

$$\max_{w_i} \; U\left(\frac{w_i}{p}, n_i, \frac{w^e}{p}\right)^{\beta} \Pi\left(E\left(\frac{w_i}{w^e}\right), \frac{w_i}{p}, n_i\right)^{(1-\beta)}$$

$$s.t. \qquad n_i = n_i\left(\frac{w_i}{p}, E\left(\frac{w_i}{w^e}\right)\right)$$

The influence of a change in w^e on w_i is determined as the combination of three effects:

- The direct negative externality of w^e on U_i which is the usual rivalry effect (positive effect on w_i).
- The direct effect on profit: on the one hand, the reduction in workers' effort increases the unit cost for the firm, decreases profit and forces the firm to be more aggressive in the bargaining process (negative effect on w_i). On the other hand, reducing w_i during the bargaining process will reduce w_i/w^e still more: the firm could have advantage to increase its wage in order to boost the effort of the workers. Therefore, the net effect through profit is uncertain.
- The indirect effect through the demand for labour: as emphasized by Nickell and Wadhwani, a rise in the alternative wage has two effects on employment. It implies a fall in labour productivity since the cost of the punishment of being laid off if shirking is reduced. The same output is produced with more workers, employment rises, increasing the utility of the union, allowing for a reduction in the current wage. However, since the unit costs are increased, a lower level of output is produced so that employment could be reduced, having a negative impact on the union's utility.

The inclusion of efficiency wage theory (using the shirking approach) in rivalry models considerably complicates the story by enriching the nature of externalities. It increases the role played by the firm in the treatment of wage

externalities. This approach seems promising and has not yet been fully treated in the theoretical literature.

1.1.4. *Alternative wages and the outside option*

As we have seen, the bargaining set-up used to model wage interdependence is generally the simple monopoly union model which assumes that the union maximizes its utility to determine the wage, being constrained by the firm's labour demand.[14] This framework is useful to derive easily interpretable wage equations; however, the framework where the union bargains *with the firms' representative organization* to determine the wage and possibly also the employment level is closer to the practice of social negotiations in many countries. If we specify the model as a 'true' bargaining process between two agents, we have to introduce fall-back positions (or minimum acceptable levels for union utility and firm profit) corresponding to the income stream obtained by the players during the delay of agreement.

   If we assume that there exists a point in time at which it is credible for the workers to leave and look for a job in other firms or sectors, the *outside option* must be included in the fall-back position of the firm.[15] This outside option includes two elements through which the wages of the other sectors intervene:

- the probability, with which leaving workers can find employment in other firms or sectors.[16]
- the income paid in other firms or sectors.

In that case, following Barth's (1989) argument, the wage equation is (to be compared with equation (1)):

$$w_i = (1 - \beta)[\phi s + (1 - \phi)(\lambda w^e + (1 - \lambda)w^u] + \beta \frac{R - \pi^0}{n_i} \qquad (4)$$

The parameters β and ϕ are functions of the size of strike funds, of the number of proposals made by the firm during the period in which strike payments are positive and of the length of the total bargaining period. s is the strike allowance, λ is the probability of finding a job elsewhere, w^e is the expected wage in the other sectors, w^u is the unemployment allowance and $R - \pi^0/n_i$ is the net profit per worker. We see that wage interdependence arises directly through the expected wage w^e. The derivative of w_i with respect to w^e is a function of the probability of finding a job.[17] Equation (4) is derived by Barth using a sequential bargaining set-up, but can also be generated by the maximization of the asymmetric Nash product

$$[w_i - (\phi s + (1 - \phi)(\lambda w^e + (1 - \lambda)w^u))]^\beta \; [R - w_i n_i - \pi^0]^{(1 - \beta)}.$$

1.2. *General equilibrium analysis*

As emphasized by Cahuc (1990), the main problem of rivalry models is that the

union's utility function is postulated: the inclusion of the alternative wage is ad hoc. We may add that it is not derived from the utility of the households; for instance, Dixon (1988) postulates a Stone–Geary utility function defined over employment and relative wages, while the households have a Cobb–Douglas utility function.[18]

The inclusion of the relative wage as an externality in the objective of the union is not necessary to have 'wage-wage' spirals and to define wage reaction function. In the absence of direct externalities between unions, the interdependence may pass through the aggregate price level and the composition of demand (1.2.1) or through the modelling of government behaviour with endogenous taxes (1.2.2).

1.2.1. *Demand and prices*

The externalities between two different labour groups due to aggregate demand are treated in Jacobs and Janssen (1990): they assume two types of households, the firm owners and the wage earners, with different utility functions. The economy is divided into two productive sectors, each producing one good. If the wage is modified in one sector, the income allocation between the two types of household changes and the demand addressed to each sector is modified.[19] This is the *demand composition* effect. A second effect passes through the aggregate price: a rise in the wage of one sector reduces the real wage of the other sector through its influence on the output price and therefore on the aggregate consumption price index. Two cases may arise:

- In case I, a rise in the wage of sector 1 decreases the demand for sector 2 through the demand composition argument, and hence lower employment in sector 2. This reduces the utility level of union 2 and modifies the outcome of the bargaining process. This is called a *negative externality* of the alternative wage on the union utility.
- In case II, a rise in the wage of sector 1 increases the employment of sector 2 through the demand composition effect but increases also the consumption price index, leading to an undetermined effect (the externality may be positive or negative) on union's utility.

In both cases, the authors show that there is *strategic complimentarity*, in the sense that the optimal wage level of a union depends positively on the wage set by the other union.

Calmfors and Driffill (1988) suggest an extension which does not neglect inter-industry sales of intermediate inputs. In a model with many sectors and intermediate goods, a nominal wage increase in one sector affects other sectors via input prices (if we assume price-making behaviour). This creates an effect on labour demand, whose sign depends upon the characteristic of the production function. i.e., if the intermediate inputs are substitutes or complements with respect to labour. However, it is unlikely that this extention could qualitatively

change the results. It adds an additional uncertainty on the nature of the externality.

Negatively sloped reaction function
The wage reaction functions that have been defined above are always positively sloped, i.e., the wage of one sector depends positively on the wages in the other sectors. When one considers complex interactions between sectors, it is possible to find different patterns of reaction involving for instance one negatively sloped reaction function. In this case, the non-cooperative equilibrium may not be stable. In a two-sector model, instability arises if the positively sloped reaction function is steeper than the negatively sloped reaction function. Two examples of such models are found in Rasmussen (1992) and in Sneessens and Mehta (1993).

   Rasmussen studies a tradeables-nontradeables model. In this model an asymmetry arises because the price of the tradeables sector is exogenous (determined in world market). The wage of the nontradeables sector depends negatively on the wage in the tradeables sector. This can be explained in the following way: 'A higher wage in the tradeables sector lowers the price of nontradeables (due to the fall in demand for nontradeables caused by lower aggregate income) which tends to decrease employment and increase the real consumption wage in the nontradeables sector. The negative employment effect tends, however, to dominate the positive real wage effect such that the union in the nontradeables sector reacts by lowering its wage.' An interesting feature of this model is that a simple cooperative agreement between unions does not always Pareto-dominate the non-cooperative outcome.

   In Sneessens and Mehta model, two labour groups are considered: skilled and unskilled workers. The wage of unskilled workers is a positive function of the wage of the skilled workers due to standard envy considerations. The wage of skilled workers is determined by firms in a monopolistically competitive skilled labour market. It depends positively on the tightness of this labour market and negatively on the other costs of production, including the wage of the unskilled workers. This asymmetric interdependence creates room for selective tax policy.

1.2.2. *Endogenous government behaviour*

If we introduce the government in a general equilibrium model with unions and wage bargaining specific to the public sector, two types of externalities may arise (Holmlund 1991):

- The *tax externality* arises when the public-sector union which negotiates the wage ignores that a wage increase in its sector involves a tax increase (in order to maintain a balanced budget) for workers in the other sectors.
- The *public-good externality* arises when the increasing wages in the public sector induces a lower level of public employment and therefore a lower level of public good production for all workers.

In both cases, there is a negative externality from the public sector to the private sector. Any change in the public-sector bargaining outcome affects union utility in the private sector, inducing changes to private wages. This illustrates that, when we complicate the basic model (here with endogenous government behaviour), new sources of externalities arise leading to more complex pattern of wage interdependence.

1.3. *Leaders and followers*

In the previous subsection, we have assumed that the wages of the different sectors interact mutually, with causality links in all directions. A second approach involves one-way causal flows only. In this approach, there are 'key' wage determination units that set patterns for other units: There are 'leading' sectors and 'following' sectors. The 'key' units are comparable to the 'wage contour' as described by Dunlop (1957), which consisted of stable groups of firms linked together by their wage determination set-ups. These firms generally have similar product markets and similar sources of labour.

This view is supported by many empirical studies: Eckstein and Wilson (1962) found that the age of some industries is determined mainly by the specific variables of the sector under consideration, while in other industries, the wage is simply determined by the wage of the leading sectors. Jacobson and Lindbeck (1971) found that manufacturing and construction are leading sectors in Sweden. Holmlund and Ohlsson (1990) show that age changes in the public sector are Granger caused private sector wage changes.

Flanagan (1976) mentions that small firms may find it cheaper to maintain a given wage differential by imitating the wage changes in reference firms in their sector; empirically, this could explain why many small firms participate in wage surveys of their industry. This is simply a way of economizing on personnel management costs.

2. Sub-optimality of decentralized bargaining

The outcome of the sectorial-level bargaining is a kind of Nash equilibrium if unions do not cooperate. The equilibrium wages are sub-optimal, because each union is not able to internalize the effect of its claims on the other sectors and on the aggregate variables. The following example shows how this inefficiency depends on the importance of the externality between unions (which is modelled here as a simple rivalry effect). Let us assume the following maximization programme for the union i of a two-sector economy;

$$U_i = n_i(w_i - \beta w_j - (1 - \beta)p) \qquad \beta < 1$$

$$s.t. \qquad n_i = \delta - \gamma(w_i - p)$$

The union of sector i maximizes a utility function defined over employment n_i and the difference between the wage w_i and an average of the wage of the other

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sector w_j and of the price level p (the variables are taken in logs). The maximization is subject to the labour demand constraint of the firm. In the absence of any externality, $\beta = 0$. The Nash non-cooperative equilibrium real wage is:

$$w_i - p = \frac{\delta}{\gamma(2 - \beta)}$$

The cooperative solution, obtained by maximizing the sum of the utilities $U_i + U_j$ gives:

$$w_i - p = \frac{\delta}{2\gamma}$$

The corresponding utilities are:

$$U_i^{Nash} = \frac{\delta^2(1 - \beta)^2}{\gamma(2 - \beta)^2} \qquad U_i^{Coop} = \frac{\delta^2(1 - \beta)}{4\gamma}$$

The utility is higher in the cooperative solution. The gap between the two solutions is a function of the intensity of the externality which is measured by β; in the absence of externalities the two solutions are the same (see Figure 1).

The recent literature about coordination failures allows to give more precise conditions to get this sub-optimality: if there is an interdependence at the level of objective functions (externality) and if there is a positive relation between the strategies of the players (strategic complementarity, a rise in w_i implies a rise in w_i), then the resulting equilibrium is sub-optimal. Moreover, if the externalities
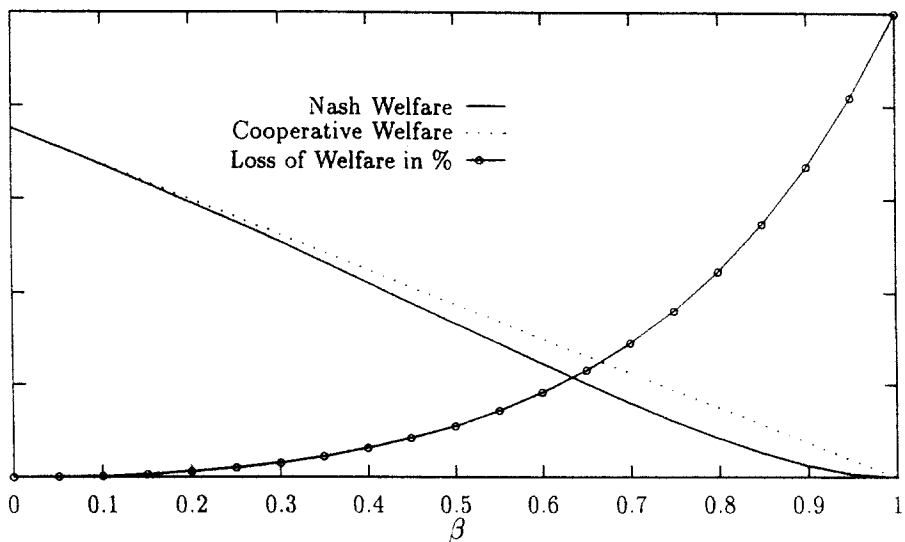

Figure 1. Sub-optimality of decentralized bargaining.

are strong enough, we may have multiple Pareto-ranked equilibria. If the agents coordinate their activities, they could achieve a better equilibrium.

The consequences of the sub-optimality in terms of macroeconomic variables can be seen from different points of view:

- The literature about relative wages and inflation (2.1) may be seen as analyzing the consequences of decentralized (and often desynchronized) wage setting on inflation. This non-desired inflation is the consequence of the loss of efficiency.
- The explanation of unemployment (2.2) can be based on this argument of inefficiency.
- In (2.3), the question is put in the open economy perspective. We analyze the implications of wage interdependence on the trade balance, using the results of the Scandinavian model (tradeables/non-tradeables).

2.1. *Relative wages and inflation*

The idea that sectoral bargaining may generate inflation without providing real gains to the workers seems widespread among authors around the second World War. For instance, in Beveridge (1944), we find an excellent illustration of the role of externalities in wage formation:

> The right of wage earners to combine for the purpose of negotiating wages, hours and conditions of work is generally regarded as an essential British liberty; the tradition that they should bargain sectionally is old and strong. (...) In so far as this leads to labour, as a whole, gaining a larger share of the total product industry, it leads to a desirable result. But, given the sectional structure of trade unionism, that is not the only possible result. Particular wage demands which exceed what employers are able to pay with their existing prices and which force a raising in prices, may bring gains to the workers of the industry concerned, but they will do so at the expense of all other workers, whose real wages fall owing to the rise in prices. The other workers will naturally try to restore the position, by putting forward demands of their own. There is a real danger that sectional wage bargaining, pursued without regard to its effect upon prices, may lead to a vicious spiral of inflation, with money wages chasing prices and without any gain in real wages for the working class as a whole. (...) Irresponsible sectional wage bargaining may lead to inflationary developments which bestow no benefits upon the working class (...) and which endanger the very policy of full employment whose maintenance is a vital common interest of all wage-earners.

The basic formal model is in Akerlof (1969). He builds a two-sector model with desynchronized wage setting in order to explain price inflation in terms of relative wages. The oligopolistic interdependence and the temporary fixity of wage contracts are used to explain how a Phillips curve does exist and why neutrality of money is false.[20]

The economy is composed of two firms. Each firm faces a simple linear production function. Goods' prices are free to adjust in each period. These prices are a linear homogeneous function of all other prices and wages:

$$p_i = p_i(w_i, w_j, p_j, ...) \tag{5}$$

$$p_j = p_i(w_i, w_j, p_i, ...) \tag{6}$$

There are two unions; each union deals with one firm. Bargaining takes place in each sector at two different points in time (let us say at $2t$ and $2t + 1$ for sector 1 and 2 respectively). Each union maximizes the excepted utility of its representative member.[21] When each union determines the wage, it is constrained by the fixity of the wage of the other sector (non-synchronization assumption):

$$w_i = w_i(p_i, p_j, w_j, ...) \tag{7}$$

Union one's view of the world at even times correspondings exactly to union two's view of the world at odd times (symmetry assumption), Consequently, the relative wage chosen by union one at even times is the same as the relative wage chosen by union two at odd times:

$$\frac{w_{i,2t}}{w_{j,2t}} = \frac{w_{j,2t+1}}{w_{i,2t+1}} \tag{8}$$

This argument is illustrated by Figure 2: at time $2t$, union 1 chooses a relative wage R. At time $2t + 1$, union 2 chooses the same relative wage. Combining the
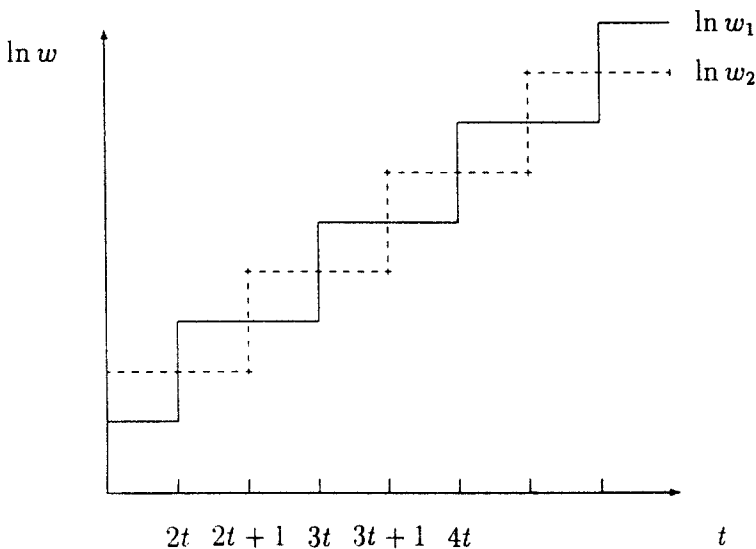

Figure 2. Relative wages and inflation.

assumptions of symmetry among firms and of non-synchronization, he shows that the relative wages of the two sectors determine the rate of inflation.

Although very different, the models of Akerlof (1969) and of Gylfason and Lindbeck (1984a) rely on the same intuition (which is the same as Keynes'): each union sees the wage of the other groups as given; it chooses or bargains its wage, as a function of the other wages; the other union(s) bargain(s) symmetrically when we put the claims together, the interaction leads to *non-desired overbidding*:

- in a static world, the Nash equilibrium implies a loss of efficiency which corresponds to higher prices in levels and lower employment (cf. 2.2);
- in a dynamic world, this leads to a rate of inflation which is a function of the relative wages among the two groups.

The link between the static and the dynamic framework becomes clear when we model a decision process with bargaining over three elements: wage level, contract length and bargaining period. This is presented in Fethke and Policano (1984) and (1986). They show mainly that synchronization will dominate if there is a large number of sectors, or when the aggregate shocks dominate the sectorial shocks.[22]

A problem with Akerlof's model is that the process seems infinite: each year, both unions repeat the same process leading to the same inflation without ever adapting their expectations. The inclusion of expectations in Akerlof's model is due to Taylor (1979). Each period, half of the labour force determines a nominal wage for two periods:

$$w_{i,2t} = (1 - d)w_{j,2t} + dw^e_{j,2t+1} + \gamma((1 - d)y^e_t + d\ y^e_{t+1}) + \varepsilon_t \qquad (9)$$

y is a measure of excess demand, d is a parameter measuring the intensity of forward looking behaviour and γ is a parameter measuring the sensitivity of wages with respect to demand pressure. The optimal wage is a function of past wage and expected wage for the next period. Taylor's interpretation is similar to that of Keynes: workers care about relative wages, which are the wages paid to the other half of the labour force this period and the next period. The aggregate age is simply:

$$w_t = (w_{i,2t} + w_{j,2t})/2$$

$$(10)$$

As in the previous models, the wages are desynchronized and determined for two periods:

$$w_{j,2t} = w_{j,2t-1}$$
$$w_{i,2t+1} = w_{i,2t} \qquad (11)$$

The model is completed by an aggregate demand equation:

$$y_t = m_t - w_t + v_t \qquad (12)$$

where y_t is output, m_t is the money stock and v_t is a stochastic component, and

by a policy rule

$$m_t = (1 - \beta) w_t \qquad (13)$$

where the parameter β is inversely related to the degree of policy accommodation.[23] Assuming the model is stable, one obtains a solution for the aggregate wage of the form:

$$w_t = \frac{\dfrac{1 + 0.5\gamma\beta}{1 - 0.5\gamma\beta} - \sqrt{\left(\dfrac{1 + 0.5\gamma\beta}{1 - 0.5\gamma\beta}\right)^2 - 4d(1 - d)}}{2d} \; w_{t-1} + 0.5(\varepsilon_t + \varepsilon_{t-1}) \qquad (14)$$

This framework allows for real effects of unanticipated increases in money which will disappear after some periods.[24]

From (14), the persistence of wages is high if the degree of forward looking is low (d), if the degree of policy accommodation is high (β) and if the effect of demand pressure on wages is low (γ). In Figure 3, we illustrate this point by computing the evolution of wages (as a deviation from trend) after transitory shock. Akerlof's model shows full persistence while the Taylor model display various degree of persistence depending on the degree of policy accommodation and the degree of forward-looking in wage formation.

Note that, in Taylor's model, the government may increase or decrease the speed of adjustment by changing its monetary policy. We find a similar property in Jackman (1985) where the speed of adjustment after a bad shock may be reduced by implementing a restrictive income policy.
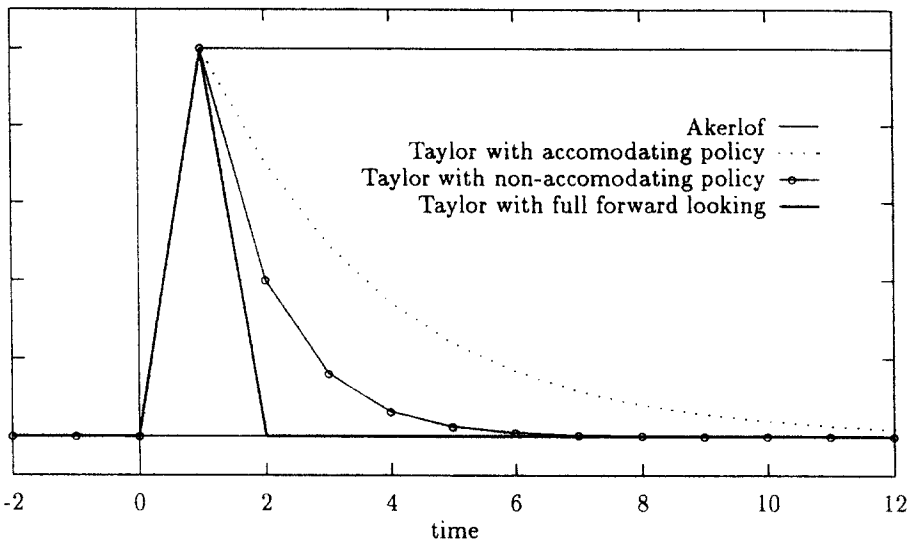

Figure 3. Sectorial wages (deviation form trend).

Wage formation under imperfect information
The non-synchronization assumption which is at the core of the Taylor and Akerlof models is crucial to obtain shock persistency in the presence of perfect foresight (in addition to the relative wage assumption). An alternative assumption is the one of imperfect information in a synchronized world: Andersen and Christensen (1989) assume that all agents in a given labour market (firm or sector) have the same information but that agents possess different information across the labour markets. Each wage rate will therefore be determined under imperfect information about the wages simultaneously set in other labour markets. If each wage is set under a relative wage hypothesis as in equation (1), one gets:

$$w_j = \lambda E_j(w) + (1 - \lambda)E_j(p)$$

The wage is not proportional in the locally expected nominal shock, except in the case where there is no envy, i.e. $\lambda = 0$. The aggregate wage level will respond less than proportionally to expected nominal shock, implying employment and output adjustment. In this model, the presence of both externalities and imperfect information are necessary to generate real effects of nominal disturbances.

Forward-looking contracts and credibility
The correct treatment of the expectation component of forward-looking overlapping wage contracts is also important when one considers credibility problems, as it, is the case for instance in the analysis of credible monetary policy. Driffill and Miller (1993) compare in a Taylor-Calvo type of model the effect of pegging the exchange rate to a hard currency when the peg is credible and when it is not. A recession is associated with the peg only when it is not credible, since in this case, wage contracts have to include an inflation premium because agents forecast future devaluations. The length of the recession depends on how fast agents incorporate the information that the devaluation they expect never takes place. Therefore. the parameters that determine the rapidity of agents' learning and the adjustment speed of prices govern the length of the recession.

2.2. Unemployment

The presence of unemployment[25] can be due to the combination of two elements: the existence of externalities or spillovers (if union 1 obtains a higher wage, union 2 is worse off) and the existence of strategic complementarity (if union 1 obtains a higher wage, union 2 claims a wage increase). As it has been illustrated by the example in the beginning of this section, when unions' utility contains the alternative wage, the two conditions are met and cooperation between unions increase total welfare. This cooperation reduces the level of wages since each union incorporates in its computation the negative externality of its wage on employment in the other sector. Employment is increased. In

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Figure 4a, cooperation allows to go from the Nash equilibrium N, which is at the intersection of the reaction functions (dashed lines) to the cooperative equilibrium C, where wages and therefore unemployment are lower.[26] This is always true as long as the externality remains negative, i.e. as long as the demand composition effect or the substitution effect between labour types do not dominate the rivalry effect. If the externality is positive, they indifference curves have another shape and the cooperative equilibrium C implies higher wages than the Nash equilibrium N (Figure 4b).

The way suggested by Figure 4a of considering part of unemployment as a lack of cooperation is true even if we abandon the ad hoc assumption about unions' utility which allow to include the alternative wage in the objective function of the union. In general equilibrium (cf. section 1.2), when unions cooperate, the take into account the effect of their decision on the aggregate price level so that the tradeoff between wages and employment is reinforced, leading to a higher level of employment (cf. Jackman (1985)). Moreover, it can be shown that the gain of coordinating unions' activity is increasing with the firms' monopoly power on the goods market (cf. Cahuc (1988) p. 330).

This story can also be put in terms of tradeoff between unemployment and inflation: 'The more intensely the unions compete with one another, the more costly in terms of increased inflation it is for the government to attempt to reduce unemployment at a given rate through monetary or fiscal expansion' (Gylfason and Lindbeck (1984b)). The problem is that the intensity of the competition is not really explained; the solution for the government is simply to reduce this competition and to encourage coordination between social actors.
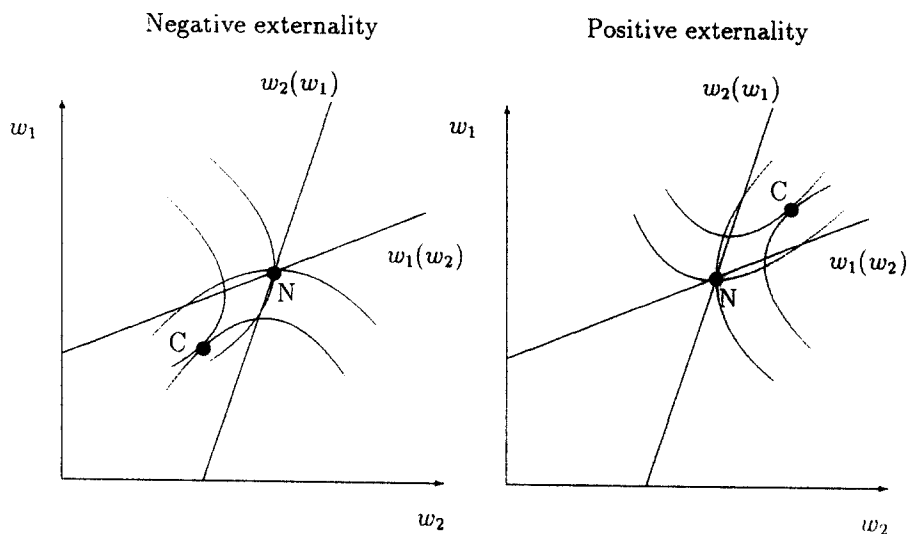

Figure 4. Externalities.

An additional topic that may arise in the story of unemployment as a coordination failure is the one of multiple equilibria. If the reaction functions depicted in Figure 4a are not linear, we may have more than one intersection between the reaction functions, leading to the existence of several equilibria. In general, these equilibria can be Pareto-ranked. This means that, *in addition to the inefficiency resulting from the non-cooperative solution, the actors could choose an equilibrium which is not the best among the set of non-cooperative equilibria*. Unfortunately, this topic has not yet been applied to decentralized wage formation, except in an empirical paper of Risager (1992) which is overviewed in the next section.

Wage interdependence and the role of demand

In a multi-sector general equilibrium model with exogenous labour supply, demand shocks affecting all sectors symmetrically imply only prices increase. Concerning sector-specific shocks, Dixon (1986), de la Croix (1993a) and de la Croix (1993c) show that sectoral demand shocks modify the allocation of output across sectors only in the presence of wage interdependence. This reallocation of output may increase or decrease unemployment, depending on the initial situation of the economy. The intuition behind this result is the following: a change in relative demand implies a change in relative prices. As long as there are no externalities, the bargaining outcome implies a proportional change in prices in order to kept the real variables unchanged. This is due to the fact that labour supply is inelastic. In the presence of externalities, this is no longer true. The change in prices will be less than proportional and will not completely offset the change in relative demand; part of the adjustment will be made through quantities: in the rising-demand sector, the price has to rise, but it will rise less because the wage in this sector is attracted downward by the falling wage in the falling-demand sector.

A crude application of this mechanism to the story of European unemployment could be the following: the drop in world demand after the first oil shock generated a negative sectoral demand shift for manufacturing sectors. Since the wages in these sectors are partly aligned on the wages in the service sectors, the price adjustment cannot fully absorb the shock so that employment falls in manufacturing sectors and rises in service sectors.

2.3. *Wage interdependence and the trade balance*

The idea that manufacturing sectors (tradeables sectors) are leading in wage formation is at the root of the Scandinavian model, such as described by Aukrust (1977), Lindbeck (1979) and Calmfors (1979).[27] We make here a third link between separate branches of the literature: it consists precisely to show that the Scandinavian model of inflation can be seen as a special case of the decentralized bargaining set-up which is not explicitly formalized, where we have one-way

causality only. This is due to two of their assumptions:

- Wage inflation in the tradeables sector is defined by the growth rate in the value of labour's product $(\dot{p}_1 + \dot{q}_1)$. This is equivalent to making a constant labour share assumption.

$$\dot{w} = \dot{p}_1 + \dot{q}_1 \tag{15}$$

  This is not based on an explicit wage bargaining model, but reflects a kind of implicit agreement which defines a trend in wage inflation, such that the labour share in value-added is constant.
- A wage transmission mechanism is postulated such that wage inflation in the non-tradeables sector is equal to the wage inflation in the tradeables sector:

$$\dot{w}_2 = \dot{w}_1 \tag{16}$$

This is equivalent to the leading and following sectors assumption.

When we add the price-taking assumption for the tradeables sector,

$$\dot{p}_1 = \dot{p}^w + \dot{e}, \tag{17}$$

where $\dot{p}_w$ is the rate of growth of world price and $\dot{e}$ *the rate of growth of the exchange rate and the price-making assumption for the non-tradeables sector,*

$$\dot{p}_2 = \dot{w}_2 - \dot{q}_2, \tag{18}$$

we find the crucial result that the non-tradeables price inflation exceeds world inflation by the same amount as the tradeables sector productivity increase exceeds productivity growth in the non-tradeables sector:

$$\dot{p}_2 - \dot{p}^w = \dot{q}_1 - \dot{q}_2$$

If the productivity growth differential is important, which is generally the case, the Scandinavian model predicts a steady fall in the relative price p_1/p_2. This leads to a steady shift from internal demand to the tradeables goods and consequently to a chronic trade balance deficit.

   This result is important since it shows that wage interdependence can have strong implications on the trade balance. In a more general framework, de la Croix (1993b) studies the effect of wage envy on competitiveness, allowing for monopolistic competition and quantity rationing features. The intensity of envy, together with union power, firm market power and quantity constraint, plays an important role both in the determination of sectoral competitiveness and in the transmission of shocks among sectors. Moreover, the loss of competitiveness implied by wage interdependence is more important in the highest phase of the business cycle.

   Since very few works have been done in order to combine the coordination failure models of wage rivalry with open economy features, it should be interesting to 'export' wage interdependence models in the field of international economics.

3. Empirical analysis

The inefficiency caused by decentralized bargaining can be used as an argument for state intervention through incomes policy. Moreover, it suggests that a direct intervention into the labour market should take full account of the differing characteristics of wage formation in different markets (cf. Flanagan (1976)) and of possible interactions between sectors. This stresses the importance of empirically evaluating the interdependence and analyzing its consequences on labour market behaviour.

Before reviewing some studies related to the empirical existence of strategic complementarities at the level of wage formation it is worth noting a recent work by Clark and Oswald (1993) testing the existence of fairness considerations at the level of objective functions. This study is based on a data set on a sample of workers who are asked how content they feel about their job. These feelings are treated as proxies for levels of work-related utility functions. Comparison incomes are constructed for each type of worker using an earnings regression model. These comparison incomes correspond to the average income of typical workers with given characteristics (age, education, ...) The reported levels of satisfaction can be statistically explained by a weighted difference between actual income and comparison income. This gives support to the idea that the utility of a worker is negatively affected by the income of other workers having similar characteristics.

Empirical studies and descriptive analyses dealing with wage interdependence are particularly numerous. They are generally devoted to proving the existence of spillovers in wage formation but also to determining the leading sectors. The one-way causality paradigm seems dominant in this literature. In (3.1) we present some investigations around the determination of the leading sectors. In (3.2), we show an example of multiple equilibria. In (3.3), we sketch some policy implications of the empirical studies.

3.1 *Determination of the leading sectors*

The first econometric attempt to determine the importance of wage spillovers is Eckstein and Wilson (1962). Their theoretical model is based on five assumptions: (1) wage rates are set by a bargaining process, (2) both product and labour market conditions influence wage determination, (3) profit (product market) and unemployment rate (labour market) are sufficient to explain most of the variation in the wage rate, (4) wage determination in a group of heavy industries is interdependent, (5) wages are determined in wage round. Assumptions (1)-(2)-(3) are more or less equivalent to computing the Nash product between profit and utility in determining the wage rate. Assumption (4) determines the key group, the leading sector, the 'wage contour'. Assumption (5) says that once the pattern for a round is set in early key bargains, the movements of wages in the remaining years are largely determined until the next round is settled. These last two assumptions are similar to the basic assumption about wage determination in Scandinavian models as described in the previous section.

The first main result is that both profit and unemployment rate are highly significant in the key group wages equation.[28] Concerning wage determination outside the key group, explicit allowance must be made for spillover from the key industries in order to get reasonable results. The inclusion of the key group wages in the non-key group wage equations significantly improves the fit. The existence of the key group is supported by the superiority of individual industry regressions with group variables over those with industry variables.

The main problem of this study is that the definition of the key group rests on *a priori* information only. This group is built by looking at the similarities among a large number of heavy industries, and after discussion with labour economists. For this reason we have to consider more sophisticated methodologies.

A response to the Eckstein and Wilson article is Mehra (1976), who tries to test more rigorously the existence of leading sectors. He decomposes the wage into two components: a deterministic one that can be explained in terms of exogenous market forces and a residual one. He then tests the correlation between the residual components to infer the interdependence of wages between sectors. The conclusion is that there is a large interdependence between the wages of a key group of industries; the composition of this group is enlarged with respect to the one of Eckstein and Wilson: it includes the majority of manufacturing sectors.[29] The second conclusion is that there is no evidence of large spillovers from key to non-key industries. This view is shared by Flanagan (1976).

Unfortunately, the implications for the loss of efficiency of this large wage interdependence among the key group has not been quantified.

3.2. *Tests of the Scandinavian model*

The pure Scandinavian model as defined by equations (15) to (18) has very strong empirical implications (see Nymoen (1991)):

> H0: equation (15) implies that the wage share in the tradeables sector is stationary.[30]
> H1: equation (16) implies that the relative wage is stationary.
> H2: if we understand (16) as a long-run relationship, the logic behind it would imply that there is a unidirectional short-run causality from wages in the tradeables sector to wages in the nontradeables sector.

Several papers have tested these statistical implications of the Scandinavian model. Assumption H0 is rejected by Nymoen (1991) for Norway and by Anderson and Hansen (1993) for Denmark, Germany, Sweden and Norway. In general, the stationarity of the labour share is very nearly accepted by standard unit root tests.

Concerning the stationarity of the relative wages, Nymoen (1991) does not reject H1 for the tradeables/nontradeables relative wage in Norway. This assumption is rejected by Jacobson and Ohlsson (1992) for Sweden. In their

paper, they consider the relationship between central government, local government and private sector wages, interpreting the nontradeables sector of the Scandinavian model as the public sector.

Nymoen (1991) rejects H2 while Jacobson and Ohlsson (1992) do not reject H2.

To conclude, it seems that the characteristics of the Scandinavian model are too sketchy to be supported as a whole by the data.

3.3. Non-linear reaction functions

In the previous empirical studies the wage reaction functions are assumed linear. This allows a well-defined and easily computable vector of equilibrium wages. The question of multiple equilibria can be treated in a simple way by testing for some non-linearities.

Risager (1992) uses non-linear reaction functions for the wage of skilled (w_1) and unskilled (w_2) labour group.[31] Its empirical results give the following long term functions:

$$w_1 - c = 1.110(w_2 - c) - 0.290(w_2 - c)^2 + \ldots$$

$$w_2 - c = 0.947(w_1 - c) - 0.135(w_1 - c)^2 + \ldots$$

where c denotes the consumption price index. Both reaction functions are positively sloped in the observed band of real wages.

The quadratic specification allows for multiple equilibria: only two of the four possible Nash solutions are feasible in the range of observed real wages. These solutions are represented by point N1 and N2 in Figure 5. Risager shows that the
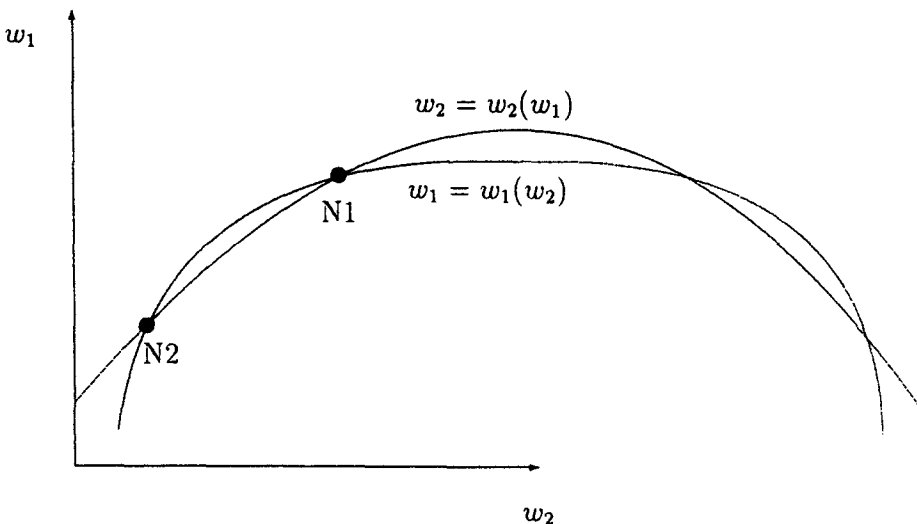

Figure 5. Multiple equilibria.

lower wage equilibrium is unstable and that, fortunately, the more plausible equilibrium is stable. Evaluated at this equilibrium, the slope of the reaction function for skilled men is equal to 0.734, which shows that the spillovers are strong enough to cause a significant welfare loss.

4. Policy implications

We first summarize the main policy implications found in the literature; in general wage interdependence is used to plead in favour of interventionist policies. Secondly we try to see if the inefficiency losses due to decentralized bargaining is in favour of a more centralized framework.

4.1. *Policy implications of wage interdependence*

If there exists identified leading sectors, policy efforts to control cost inflation need to be concentrated on the key industries as these are presumed to set the pace for the rest of the economy. This pleads for the use of *selective policies*.

If wage spillovers are too important, the wage differentials that are necessary for the allocation of resources may fail to emerge (cf. Flanagan (1976)), which may call for an interventionist *industrial policy* in order to reduce the distortion and to promote other ways for reaching the best industrial structure.

The *macroeconomic policy* can also be considerably revised when wage contamination dominates the labour market. Dixon (1986) shows that an increase in government expenditure can lead either to a decrease or an increase in employment, depending on the initial situation of the economy.

As far as the dynamics of the system is concerned, a policy intended to change labour market conditions may induce a very low response if the wages are mainly determined by past wages in the other sectors, and the lags may be very long.

With respect to *income policies*, Kolm (1988) shows that a first-best equilibrium can be reached in the presence of externalities in wage formation by implementing fiscal policies in order to correct the overbidding effect. Moreover, from most empirical analyses, it is clear that any intervention should take into account the various degrees of wage flexibility, in particular between the group where wages are highly rigid and interdependent, and the group where market conditions predominate in wage formation.

An important source of wage interdependence in countries like Belgium and Italy is the automatic indexation of wages on the consumption price index. This indexation can be seen as an institutional factor that implements in part the requirements of wage rivalry by reducing the gap between the wages in the different sectors.

Finally, the coordination of separate bargaining processes can be seen itself as a bargaining problem (Elster (1989)). Of course, coordination allows to internalize the externalities so that every body is better off. However, workers in low-wage industries could argue that, in addition to eliminating externalities, coordination has to achieve a more egalitarian wage structure. This is contrary

to the interest of the workers in high-wage industries, so that they may prefer a decentralized bargaining structure. This explains why coordination policies are often difficult to implement.

4.2. *Decentralized vs centralized bargaining*

Finally, drawing lessons from analysis of the inefficiency losses in decentralized bargaining are we sure that we can strongly recommend centralized bargaining?

In general, when we decentralize bargaining, three elements may play a role:

1. The effect of agents' decision on aggregate variables (consumption price, social security financing) is lower, so that, in a Nash equilibrium between agents where no one internalizes the actions of the other-agents, the outcome is worse. The agents internalize less and less the macroeconomic consequences of their actions, reducing the tradeoff between wages and employment and increasing the nominal wages.
2. The elasticity of substitution between the firms' or industries' products increases, so that a rise in wages will have more effect on employment. The tradeoff is reinforced, so that the agents will tend to reduce the level of nominal wages.
3. The wage externalities are less and less taken into account, leading to the same effect as in point 1.

The two first elements are used by Calmfors and Driffill (1988) as the basis of a 'hump-shape hypothesis': their theory says that the more efficient bargaining levels are the fully centralized one (since effect 1 is maximal, all externalities being taken into account) or the fully decentralized one (effect 2 is maximal, and so is the wage-employment tradeoff).

Of course, our inefficiency analysis of section 2 could be used as an argument for a centralized bargaining set-up. However, the conclusions in favour of any level of bargaining are fragile:

● The empirical evidence used by Calmfors and Driffill (1988) indicates that the countries where bargaining takes place at the sectorial level have experienced a sharper increase in unemployment between 1973 and 1985 (Belgium. Netherlands, West Germany, Australia, France). This is clear in Figure 6: we have ranked the countries by degree of centralization and computed the increase in the average unemployment rate between the seventies and the eighties. The resulting curve is clearly humpshaped. However, if we compare the average unemployment rate in 1990, 1991 and 1992 with the average unemployment rate in the eighties, the conclusions tend to go in the opposite direction. As can be seen in Figure 7, the countries with sectorial bargaining performed quite well with respect to those with highly centralized structure (Scandinavian countries) or those with a highly decentralized structure (USA, Canada).
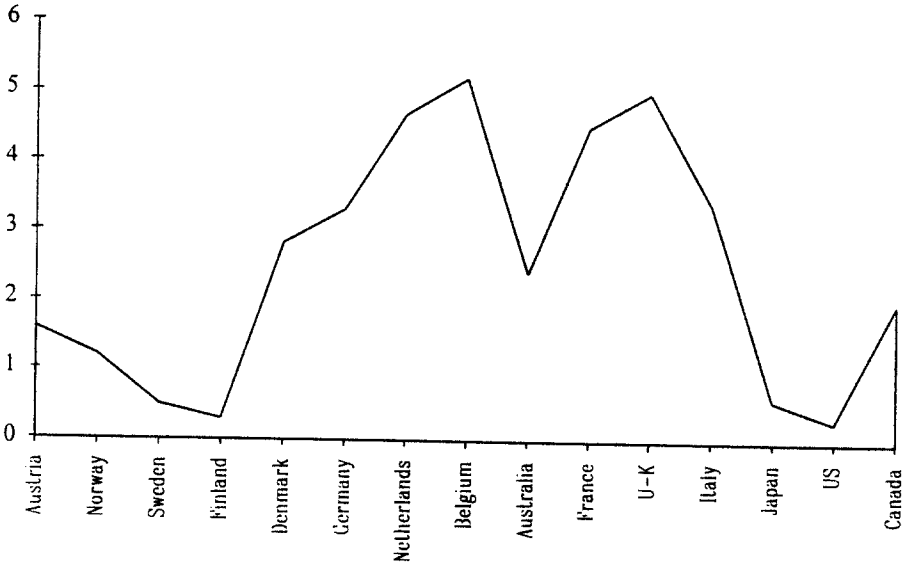● The hump-shape hypothesis relies too heavily on a specific market structure

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Figure 6. Unemployment rate increase between 1970–80 and 1980–90.
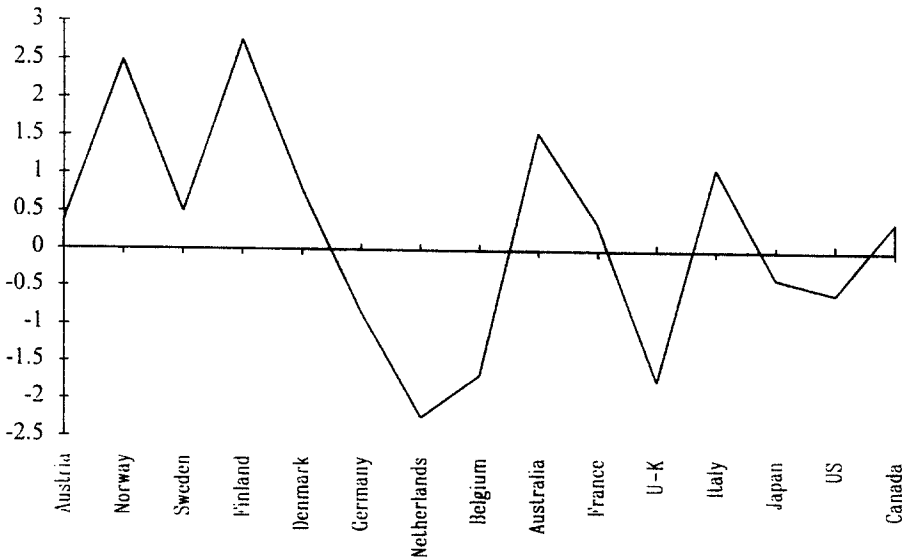

Figure 7. Unemployment rate increase between 1980–90 and 1990–92.

which implies that the elasticity of substitution between goods increases as the firm level bargaining is approached (this is represented by utility functions with a large number of embedded CES functions). If, for instance, this elasticity does not increase substantially when the level of bargaining decreases, effect 2 is very low, so that effects 1 and 3 dominate. In this case, sectorial level negotiation could Pareto-dominate the firm-level negotiation.

● If there are other kinds of externalities that could also be either negative or positive (e.g. technological externalities when there are different labour groups which are complements or substitutes in the production process), then there are no longer any straightforward conclusions.

A final remark can be taken from Bean *et al.* (1990). In a *two-country* Calmfors–Driffill model, they show that increasing economic integration reduces the differences between the various levels of bargaining; the hump is less accentuated. This result arises because economic integration increases the wage–employment tradeoff. The price to be paid in terms of job losses for a given wage claim is particularly increased for the agents who bargain at the intermediate level since it is the one who initially perceived the lower tradeoff.

In a more general set-up, a higher economic integration may change the Calmfors–Driffill ranking of bargaining levels, since (1) the wage-employment tradeoff increases and since (2) new externalities arise between the various countries and they are not internalized even in the most centralized set-up.

5. Conclusion

The idea that unions and employers are influenced by the wages perceived by employees in other sectors has been used mainly to support the empirical observation that wages are highly correlated among industries. This very old topic can find a new life in the growing literature about coordination failures. The presence of negative externalities and of strategic complementarity among unions enforces the idea that part of current unemployment can be eliminated by improving the coordination between the social actors who negotiate the wages.

In addition to the link between the literature about wage rivalry and the one about coordination failures, we have emphasized two other connections between different branches of the literature: the simple dynamic model of inflation due to Akerlof (1969) and Taylor (1979) gives an intertemporal perspective to wage interdependence; it stresses the potential importance of expectations and de-synchronization in decentralized bargaining models. The Scandinavian model provides a first approach to the analysis of the consequences of wage interdependence on the trade balance. However, in both cases, the modelling of interdependence is not derived from explicit bargaining set-ups as it is in rivalry models.

Concerning the main difficulties and interests of the various approaches

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surveyed in the paper, the following points are worth noting:

- The major interest of the general equilibrium approach to wage interdependence is to make a link we would like to emphasize in this survey. The old story of wage rivalry gets a new dimension in a more general model since we may fully exploit the concepts of externalities and strategic complementarities which came from the game-theory literature (Cooper and John (1988)). This should allow future research to treat topics such as multiple equilibria and sub-optimality resulting from union behaviour in a more rigorous context. On the other hand, it is interesting to note that the seminal paper of Cooper and John uses as examples (for externalities) technological interaction, demand externalities and price linkages in monopolistic competition environments, but they do not treat the interaction among unions.
- The approach concerned with leaders and followers has not yet received strong theoretical foundations. The main factors that determine a sector as leader or follower have not been analyzed. It is however sure that historical and institutional elements play an important role. Despite the lack of theoretical models explaining unidirectional wage interdependence, we showed that this pattern has strong implications, in particular on the trade balance and on income policies.
- The interest of treating the models of Akerlof (1969) and Taylor (1979) as wage interdependence models (this is the second link we want to emphasize in the survey) is to show that a dynamic approach, even very sketchy, allows to analyse dynamic wage interdependence, output persistence and inflation. Unfortunately, little has been done to reformulate an explicit decentralized bargaining model in an intertemporal framework, probably because of the difficulties linked with formalizing intertemporal bargaining procedures.[32]

With respect to the present overview of the topic, future research should focus on at least three points.

From the point of view of the foundations of the externalities, the inclusion of the relative wage in the utility of the union is unsatisfactory. A framework where the consumers' demand for goods and the unions' utility function are derived from the same assumptions about households behaviour seems more consistent than the models with specific ad hoc union utility functions. More work is needed in order to assess the externalities on more stable grounds, using the latest developments in bargaining theory and/or efficiency wages.

The implications of wage interdependence for an open economy have not been analyzed thoroughly. The Scandinavian model of inflation seems the only attempt to do so without setting up any explicit bargaining framework. It should be interesting to reconsider the question, by considering a tradeables/non-tradeables model with coordination failures.

Finally, many empirical studies have asserted the existence of wage spillovers, with or without implying the existence of key groups or leading sectors.

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However, the resulting loss of efficiency has not been quantified, neither in terms of additional inflation, nor in terms of unemployment.

The work on wage interdependence should aim at promoting structural changes and structural policies rather than usual Keynesian macroeconomic policy.

Acknowledgements

Notes

1. These models are generally static. We treat briefly the question of desynchronization of wage negotiation in the analysis of the inflation process as a consequence of decentralized bargaining.
2. We do not investigate the relation between union and nonunion sectors, since it has been surveyed by Oswald (1985).
3. The two-sector models with centralized bargaining will not be treated here.
4. The parameter β is to be interpreted as the relative reaction speed of the firm compared to the union.
5. We find a similar argument in Hahn (1982): the social norms are such that offering to work for less than the reference wage is so repugnant that the gain must be discrete to overcome the negative 'social norm' effect.
6. Combining this with the firm pricing rule leads to the determination of a range for the natural rate of unemployment instead of a unique level.
7. This corresponds to the Danish bargaining structure in which workers are organized along craft lines.
8. The properties of the production function are also quite important in explaining the optimal pattern of unionization. In this section, the pattern is considered as given. However, in a model where the type of unionization is a choice variable, Horn and Wolinsky (1988) (see also Elster (1989), chap. 4) have shown that, when the two types of labour are substitutable enough, the optimal pattern is an encompassing union. When the two types of labour are complementary enough, the optimal pattern is two separate unions.
9. This effect is also treated under the name 'spillover effect' in Udden Jondal (1992).
10. Notice that Risager (1993) finds a high degree of long-run substitutability between the two types of labour in Denmark.
11. In efficient bargaining, the players negotiate both wages and employment level; the outcome is located on the contract curve and is Pareto-efficient for the players. Cf. McDonald and Solow (1981).
12. For a survey, see Yellen (1984).
13. We use here a particular version of the efficiency wages model, i.e., the shirking version.
14. Two exceptions are Risager (1992) and Nickell and Wadhwani (1988).

15. This point may correspond to the time when strike-payments are exhausted, so that quitting becomes a credible threat.
16. This probability depends on the ratio *employment/labour supply* in other firms and sectors which depend on wages.
17. This would be more complex if the unemployment allowance w^u were a function of the mean wage paid in the economy.
18. The Cobb–Douglas household utility function is used to derive the goods demand functions while the Stone–Geary union utility function is used to derive the wage reaction function. It is probably more coherent to derive both equations from the same set-up as in Jacobsen and Schultz (1990) or in Arnsperger and de la Croix (1993). However, Jackman (1985), who mixes also a CES utility function for households and a Stone–Geary utility function for unions, argues that the decision-making process of unions does not seem sufficiently well understood to impose any specific requirement on the relationship between unions' decisions and the welfare of their individual members.
19. For example, if the wage of sector 1 rises, the income of firm owners is reduced and the demand for the good preferred by firm owners is lowered. The sector that produces this good is penalized. The situation of the sector that produces the good preferred by wage earners is improved. The outcome of the bargaining in sector 2 will be different.
20. Cf. Blanchard (1990) for a survey that comments on the place of Akerlof's paper in the discussion about money neutrality.
21. For two periods, without long term considerations.
22. Explaining the results in detail is beyond the scope of this survey. See Andersen (1992) for a discussion of endogenous asynchronized price structures. See also Kempf (1990a) for a discussion of the implications.
23. The demand side in the presence of staggered pricing and its implications for monetary and fiscal policy are more extensively discussed in Calvo (1983).
24. The staggered wage structure, even weakened by allowing reactions of the predetermined wage to excess demand variables, seems to be able to generate output persistence. In that case, output persistence is seen as the outcome of the coordination failures. See Kempf (1990b) for a recent research in this direction.
25. We make a shortcut when we call unemployment what is in fact a lower level of output and labour demand. Implicitly, we assume a large fixed labour supply.
26. At point C, the indifference curves (dotted lines) of the two unions are tangent.
27. This model was initially conceived for normative purposes wages have to maintain the export share. It becomes a positive theor later on.
28. Note that linear relationships are assumed.
29. Franz and Smolny (1993) also find clear cut results concerning wage spillovers for Germany: relative wages contribute to the explanation of nominal wage growth in all but one sector.
30. If a variable is bounded like the labour share, it cannot be integrated since an integrated variable has no bounded mean or variance. However this is true only if we consider a sample of an infinite length. In a finite sample a bounded series may look very much like an integrated series, provided its auto-regressive coefficient is greater than say 0.95. In this case the series is better predicted if the forecasting model imposes the unit root (see Campbell and Perron (1991)). Consequently if a test does not reject the null of a unit root for a bounded series, we could consider it as a locally integrated series.
31. Another study concerning skilled and unskilled workers is presented in Bughin (1991).
32. In Manning (1989), a link between explicit wage bargaining and the literature on staggered contracts is made. Such a framework provides the foundations to Tavlor's (1979) model and is able to take into account the observed sluggishness of wage series.

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