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WAGE MODERATION AND UNION STRUCTURE

By STEINAR HOLDEN and ODDBJØRN RAAUM*

1. Introduction

Centralization versus decentralization of wage formation is an issue which has received increasing attention in recent years. An important conclusion which has been drawn is that centralized wage formation leads to lower real wages than does less centralized (e.g. Calmfors and Drifill (1988), Cahuc (1988), Jackman (1990), Strand (1987) and Hoel (1989)). The basic intuition behind this conclusion is that under centralized wage formation, wage setters will take into consideration the full social costs of higher wages, whereas under decentralized wage formation each group will only consider the costs it will have to bear itself.

In these and related studies (cf. also the literature on macroeconomic models with unions, e.g. Drifill (1985) or Calmfors and Horn (1985)), the countries with the most centralized wage setting are often viewed as having one single trade union only, representing the whole labour market. This however is a very crude simplification. In countries like Norway and Sweden, which are usually thought of as the most centralized, the largest unions’ confederation, LO, represents only 36 and 52% of the wage earners, respectively. Other confederations cover 23% (mainly AF and YS) in Norway (Rødseth and Holden (1990)) and 37% (mainly TCO and SACO-SR) in Sweden (Calmfors and Forslund (1990)). Furthermore, the large unions’ confederations consist of industry trade unions which may have conflicting views on the confederation’s policy. Occasionally the industry unions even choose to negotiate separately, rather than jointly. Hence it is not at all unproblematic to assume that countries like Sweden and Norway will show the wage moderation predicted by models with only a single trade union. This can perhaps best be illustrated by the statement of the leader of the Norwegian unions’ confederation LO that the total wage increase had been too high (Halvorsen (1986)).

In this paper we look at an economy with many trade unions, one in each industry. Independent wage setting in each industry is assumed to lead to high nominal wages and high unemployment. Consistent with the literature referred to above, it is also assumed that a better outcome could be obtained if the unions agreed to set a lower nominal wage. We analyse whether an agreement

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on wage moderation can be sustained as a non-cooperative equilibrium in a repeated game.

If the unions form and adhere to an agreement on wage moderation, this is in effect as if there were a single central union. However, our analysis shows that this will only hold within certain limits. If a central union would want a very low wage, this may not be sustainable as an agreement between several unions.

The idea that industry unions may cooperate to achieve wage restraint is neither surprising nor new (cf. e.g. Danthine and Lambelet (1987)). Yet the issue of how this cooperation may come about has received little attention. Because of this, there is no framework for evaluating under what conditions such cooperation is likely to exist. Therefore, we also discuss how various political and economical factors may affect an agreement between the unions. Because such an agreement can be very fragile, seemingly unimportant changes can have dramatic effects on a country’s macroeconomic performance.

As in the literature on policy credibility (see Blackburn and Christensen (1989) for a survey), we analyse the economy as a game between macroeconomic agents. As is common in this literature, we deliberately keep the underlying economic model as simple as possible in order to focus on the game-theoretical aspects. However, while this literature deals with games between the government and the private sector (or alternatively a central trade union), we concentrate on games within the private sector (between unions).

The paper is organized as follows. Section 2 presents the basic economic model and discusses when wage moderation is desirable for the unions. Section 3 analyses whether such a voluntary wage restraint is sustainable in a non-cooperative game and section 4 contains some applications. Finally section 5 gives some concluding comments.

### 2. Macroeconomic framework

In an economy with wage setting at industry level, the wage in one industry will in general have external effects on agents in other industries, which will not be taken into consideration in the wage setting. Many different types of external effects have been discussed in the literature. First, higher wages in one industry will lead to increased costs, thus a higher aggregate price level (see e.g. Calmfors and Driffield (1988) and Hoel (1989)). Secondly, higher wages for one union implies lower relative wages for other unions (see e.g. Oswald (1979) and Gylfason and Lindbeck (1984)). Thirdly, higher wages will cause a reduction in employment, which will raise expenditures on unemployment benefits and reduce the tax base (cf. e.g. Jackman (1990) and Holmlund and Lundborg (1989)). This will eventually lead to either reduced government spending or higher taxes.

A positive external effect is via the demand system; if prices increase in one industry, the substitution effect will tend to raise demand in other industries. Calmfors and Driffield (1988) argue that this effect will be small for unions at industry level, since the elasticities of substitution usually are small between
goods from different industries. Thus we shall follow the general conclusion and assume that total external effects are negative.

We illustrate this issue in an extremely simple macroeconomic model. To keep the analysis tractable, the only external effect we consider is through the financing of unemployment benefits, which we assume are financed by a tax on all labour income in the economy. Hence all workers in the economy will have to pay for the unemployment in all industries, while a union will have influence on the unemployment level in its own industry only.

Consider a completely open economy, where all prices are determined from the world market, and for simplicity set to be unity. The economy consists of $K$ symmetrical industries, each producing a different good. In each industry there are many identical firms. There are a given number of $L^f$ workers in each industry, and no labour mobility between industries. $s$ of the industries are unionised while the remaining $K - s$ industries are competitive. To simplify the derivations, $s$ is a real number in the interval $(1, K)$. In the competitive industries, wages are at the full employment level $W^f$, given by $L^f = L(W^f)$, where $L(\cdot)$ is labour demand which is a decreasing function of the wage. In each of the $s$ unionised industries, there is a single union and a single employers' confederation, which cover all workers and firms in the industry. In these industries, the nominal wage is determined simultaneously and separately in a wage bargain between the union and the employers' confederation in each industry, once a year. Afterwards, each firm determines the employment level unilaterally.

Union payoff is equal to the wage bill (cf. Dunlop (1944)), net of income taxes

$$u = u(W(1 - t), L(W)) = W(1 - t)L$$

(1)

where $W(1 - t)$ is the after-tax wage and $L$ is employment. As the reader will appreciate, (1) can be generalized considerably without altering the main results (but at the cost of making the exposition more complicated). The tax rate is determined by the restriction to finance the expenditures on unemployment benefits, i.e. by

$$t[sL^uW^u + (K - s)L^fW^f] = (KL^f - L^a)bW^a$$

(2)

where $KL^f$ is total labour force, $L^a = sL^u + (K - s)L^f$ is total employment, $W^u$ and $L^a$ are the wage and employment levels in the unionised industries, $W^f$ and $L^f$ are the wage and employment levels in the competitive industries, and $bW^a$ is after-tax unemployment benefit ($0 < b < 1$). $W^a$ is the average wage, defined by

$$W^a = [sL^uW^u + (K - s)L^fW^f] / KL^f$$

(3)

From (2) and (3), the tax rate is found to be

$$t = b(KL^f - L^a) / KL^f,$$

(4)

Subscripts indicating industry are omitted for simplicity.
and the impact on the tax rate of increased employment and wages in (i) all unionised industries and (ii) one single industry are

(i) \[ \frac{dt}{dL^u} = -\frac{bs}{KL^f}, \quad \frac{dt}{dW^u} = -\left(\frac{bs}{KL^f}\right) \frac{dL^u}{dW^u}, \]
and

(ii) \[ \frac{dt}{dL_i} = -\frac{b}{KL^f}, \quad \frac{dt}{dW_i} = -\left(\frac{b}{KL^f}\right) \frac{dL_i}{dW_i}. \] 

(5) shows the obvious fact that the effect on the tax rate of increased employment in \( s \) industries will be \( s \) times the effect of higher employment in one industry.

To simulate the wage negotiations in the unionised industries, we use an asymmetric Nash bargaining solution, where the wage is determined by

\[ W^0 = \arg\max_w \left[ u(W(1 - t), L(W)) - u_0 \right]^\beta \pi(W)^{1-\beta} \]

where \( \pi \) is the profit of the firm, \( \beta \) is the bargaining power of the union, \( u_0 \) is the disagreement point of the union (assumed to be exogenous),\(^2\) and the disagreement point of the firm is set to zero. The disagreement points reflect the parties’ utility levels during a strike. The Nash bargaining solution can also be justified as the outcome of a non-cooperative bargaining game (see Binmore et al. (1986)).

The first order condition of (6) is

\[ \beta u_w/(u - u_0) + (1 - \beta) \pi_w/\pi = 0 \]

where \( u_w \) and \( \pi_w \) are the respective total derivatives. The resulting wage will increase monotonically in the union power \( \beta \), i.e. \( W^0'(\beta) > 0 \), since the left hand side of (7) is increasing in \( \beta \) and the second order condition is assumed to hold. We assume that \( \beta \) is so high that \( W^0 > W^f \).

We do not consider the possibility of a central bargain where the unions negotiate jointly with the employers (cf. the discussion in section 3 below). However, the \( s \) unions will nevertheless have the opportunity to come together ahead of the wage setting and talk about the subsequent wage setting. If they agree on a common wage level which is lower than what each union can achieve on its own, then it can be implemented by the unions in the industry-level bargaining. The employers will clearly not object to a wage level which is lower than what the unions can obtain through industry-level bargaining. In principle it could also be the case that the unions would wish to cooperate to achieve a higher wage than that which they could obtain independently. However, we will not analyse this possibility, because we want to focus on wage moderation.

\(^2\) If \( u_0 \) were to depend on aggregate variables like the benefit level and the unemployment rate, then the bargaining outcome would also depend on the same variables. However, this would not affect the qualitative results, and is thus neglected.
The optimal common wage for all the unions is given by

$$W^* = \arg\max_{W^u} [W^u(1 - t)L(W^u)].$$

(8)

The first order condition is

$$\frac{du}{dW^u} = L(W^u)[(1 - t) + (W^ubs/KE) dL/dW^u] + W^u(1 - t)dL/dW = 0,$$

(9)

where \(dL/dW\) is the derivative of employment with respect to the wage level, and we have inserted (5) for the effect through the tax rate. However, for \(s\) close to \(K\) and \(b\) close to one, (8) will not necessarily have an interior solution as the unions may prefer to set the wage at the full employment level \(W^f\), cf. Jackman (1990). In this case \(du/dW^u \leq 0\) for \(W^u = W^f\), so \(W^* = W^f\). This distinction is not important for our purposes, so for simplicity we shall assume an interior solution, what is \(W^* > W^f\).

If \(W^* < W^0\), we will say that wage moderation is beneficial for the \(s\) unions, as the payoff when collaborating is higher than what each union can achieve by itself (as \(W^*\) maximizes the payoff of the \(s\) collaborators by construction).

We now have the following.

**Proposition 1**

(i) For any \(s > 1\), there will exist a \(\beta^*(s) \in (0, 1)\), such that wage moderation will be beneficial for the \(s\) unions if and only if \(\beta > \beta^*(s)\).

(ii) A positive shift in the absolute value of \(dL/dW\) will reduce \(W^*\), i.e. the wage level that is chosen by the collaborating unions is lower the more responsive employment is to wages.

(iii) \(W^*\) is decreasing in \(s\), i.e. the wage level that is chosen by the collaborating unions is lower the more unions that cooperate.

(For proofs, see appendix. If (8) has a corner solution so \(W^* = W^f\), (ii) and (iii) may not hold, as the unions clearly never will choose a lower wage than \(W^f\).)

The propositions can be explained intuitively in the following way. If the unions are very strong (\(\beta\) close to one), they will be able to achieve a very high wage level on their own. The negative external effects of wage increments will then dominate the advantage of a higher wage and therefore make moderation beneficial. Furthermore, the more responsive employment is to wages, the bigger the disadvantages from high wages, and the lower the wage that is preferred. Additionally, as the benefit from wage moderation in terms of lower taxes is increasing in the number of industries taking part in the agreement, the preferred wage will be lower the more industries cooperate.

It follows from Proposition (1) that if \(\beta > \beta^*(s)\), the industry unions will prefer the same wage as would have been set by a single central trade union, which acted like a monopolist in the labour markets in the \(s\) organized industries. Thus, if a single central union represents industry unions which agree on wage moderation, then the appropriate assumption concerning the wage determination
is a central monopoly union. The industry wage setting provides the unions with a means of achieving the wage level they want; there is no need to ‘share the surplus’ as would happen in a central bargain. Observe, however, that this conclusion only holds as long as wages are set at industry level. If wages were determined through a central bargain, then the wage level would be lower than that which the unions prefer, because in bargaining no party can obtain a wage level which it is indifferent to at the margin (that is, the unions’ marginal utility of wages must be strictly positive).

3. Sustainable moderation

Even if wage moderation is desirable for all unions, this is not enough to ensure that it can be accomplished. Clearly, as long as cooperation is better for all unions, a binding agreement will be preferable. It will, however, be difficult to enforce an agreement, so a binding agreement does not seem plausible.\(^3\)

One substitute for a binding agreement would be for the unions to negotiate jointly with the employers. This however would not be a good representation of the real world. The dominant confederation of unions does not usually cover all organized workers. There are also some smaller confederations (for an illustration, see the figures for Norway and Sweden above). Joint negotiation among the confederations is very rarely observed. Furthermore, the dominant confederation consists of many industry trade unions, and frequently these industry unions also choose to negotiate separately.\(^4\) In the following we shall take the extreme view and assume that neither a binding agreement nor joint negotiations are possible.

As wage determination takes place simultaneously in each industry, any one union can deviate from the agreement and choose a ‘high wage’ policy, i.e. use its bargaining power. This will not be discovered until the other unions have decided their wage policy. The motivation for this assumption is that bargaining is a process during which the parties take actions influencing the final outcome. The industry unions are thus assumed to be unaware of how negotiations in the other industries proceed, until the final result is reached in all industries simultaneously.

If one wage setting was viewed in isolation, cooperation would not be achievable. Each union prefers a high wage for itself irrespective of the wage level set in the other industries. Thus the unique Nash equilibrium in a one-shot wage setting game is that all unions set \(W^0\).

\(^3\) The employers’ confederations at the industry level are not able to push wages below \(W^0\), thus they cannot help making the agreement binding.

\(^4\) Considering the possible benefits from cooperation it remains a puzzle why joint negotiations rarely occur. One possible explanation is that various confederations and unions have opposing views on important issues like retirement age and relative wages which may complicate joint negotiations. Moreover, in some industries the existence of wage drift provides an opportunity to obtain higher wages even after a joint negotiation. Thus, not even joint negotiations solve all coordination problems.
However, we consider a situation where wages are set for one year at a time. When deciding whether to cheat on the agreement, the unions will clearly consider the effect on wage setting in later years. The situation can be analysed as a repeated game, where the yearly wage setting presented above is repeated over an infinite period of years. The assumption of an infinite horizon seems reasonable as the notion of a last year where the unions can neglect the consequences on the future seems highly implausible in this setting (cf. Rubinstein (1988)). We also assume that there is perfect monitoring, i.e. that all unions observe the wage levels in other industries, after wages are determined in all industries.

A crucial question is what will happen if one union deviates from cooperation. In a standard trigger strategy equilibrium (cf. Friedman (1986)), a deviation results in a punishment of infinite length, as no cooperation is possible in the future. However, this kind of equilibrium strategy has been criticized on the grounds that it is not renegotiation-proof. That is, if a deviation were to occur, the unions would have an incentive to agree on not undertaking the punishment. After all, the punishment damages everybody, so everybody would be better off by restarting the cooperation immediately. But if the punishment is not credible, then the original cooperation is not sustainable, and the whole equilibrium breaks down.

The views above can be seen as two extremes; either that the punishment is of infinite length or that the players will not undertake any punishment at all. We shall take what can be seen as an intermediate approach. If a deviation occurs, the agreement breaks down and each union plays the one-shot Nash strategy $W^0$. However, in each year there is an exogenous probability $0 < p < 1$ that the cooperation is re-started, that is, a new game starts. Thus, the length of the punishment is an exogenous random variable.

The justification for this assumption is based on the idea emphasized by Pemberton (1988), that a union consists of two distinct groups, namely the leadership and the membership. It seems reasonable that the leadership, in contrast to the membership, is fully aware of the need for wage moderation. In normal times the leadership can be assumed to succeed in persuading the membership that moderation is beneficial. If, however, another union cheated on the previous year’s agreement, the membership will become angry. An angry membership is hardly convinced by arguments like ‘Last year was a mistake, but they promised that this year...’. Therefore, after a deviation the unions will not be able to show moderation for some time. The number of years the membership is ‘angry’ is an exogenous random variable, represented by an exogenous probability that this game stops and a new starts.

When choosing strategies the unions will be concerned about the total,

\[5\text{ We assume } p \text{ to be constant, but the main results hold also if } p \text{ is allowed to vary.} \]

\[6\text{ This, this is our justification for not restricting attention to 'renegotiation proof equilibria'.} \]
discounted future payoff, i.e. by

\[ U = \sum_{t=0}^{\infty} u_t \delta^t \]  

(10)

where \( u_t \) is the payoff in year \( t \), \( \delta = 1/(1 + r) \) is the discount factor and \( r \) is the interest rate.

Let

\[ u^c = W^u(1 - t^u)L^u, \]  

(11)

by the yearly payoff for the \( s \) unions if they cooperate and set the wage \( W^u \), and where \( L^u = L(W^u) \) and \( t^u \) are the corresponding employment level and tax rate. If one union alone deviates from the agreement, its payoff is

\[ u^d = W^0(1 - t^d)L^0, \]  

(12)

where \( L^0 = L(W^0) \) and \( t^d \) are the corresponding employment level and tax rate in this case. In case there is no agreement between the unions (or alternatively all unions deviate from the agreement), the outcome will be a Nash equilibrium in the one year (one shot) game. The payoff for each union in this case is

\[ u^0 = W^0(1 - t^0)L^0, \]  

(13)

where \( t^0 \) is the tax rate without cooperation. An agreement will be sustainable as a non-cooperative outcome if, for all cooperating unions, the total, expected, discounted future payoff is higher by sticking to the agreement than by deviating.

Consider the following strategies

(1) Cooperate, i.e. set \( W^* \), if all unions set \( W^* \) last year or if a new game starts.

(2) Set \( W^0 \) otherwise.

With these strategies the condition for the agreement being sustainable is

\[ U^{dev} \leq U^{coop}, \]

or

\[ u^d + \sum_{t=1}^{\infty} u^0 \alpha_t + \sum_{t=1}^{\infty} u^c(\delta^t - \alpha^t) \leq u^c + \sum_{t=1}^{\infty} u^c \alpha^t + \sum_{t=1}^{\infty} u^c(\delta^t - \alpha^t), \]  

(14)

where \( \alpha = (1 - p)/(1 + r) \). The second term on the left hand side represents union payoff without cooperation, while the third term represents payoff after cooperation has re-started. Deducing the last term on both sides and utilising \( \sum_{t=1}^{\infty} u\alpha^t = \alpha u/(1 - \alpha) \) yields

\[ u^d - u^c \leq \frac{\alpha}{1 - \alpha}(u^c - u^0). \]  

(15)

The left hand side in (15) is the one shot gain of defecting, and the agreement will be sustainable if this is smaller than the (expected) future loss of a breakdown of the agreement (the right hand side in (15)).
Formally the strategies above are identical to the standard trigger strategies. The exogenous probability can be incorporated in the discount factor (so \( \alpha \) can be viewed as the discount factor), and the union strategies can formally be treated as standard trigger strategies where there is punishment of infinite length (even though the expected length of the punishment can be small if \( p \) is large). As is well-known, with trigger strategies there exists a critical value for the discount factor (defined by equality in (15)) such that it is possible to sustain the most collusive agreement (in our model, \( W^* \)) as a subgame perfect equilibrium, if and only if the discount factor is above this critical value (cf. Friedman (1986)).

An attractive feature with these strategies is that they constitute an optimal penal code, in the sense of Abreu (1988). As any one union is always able to achieve the wage \( W^0 \) irrespective of the actions taken by the other unions, and no union is ever able to get a higher wage than \( W^0 \), the situation where all unions set \( W^0 \) is the worst possible punishment the other unions can inflict on any single union. Thus, if an agreement is not sustainable as a perfect equilibrium with these strategies, then there are no other strategies that make the agreement sustainable.

This can be summarised in the following

**Proposition 2**  There exists a critical value \( \alpha^* \in (0, 1) \) such that cooperation is sustainable if and only if \( \alpha \geq \alpha^* \).

Consider now a situation where \( \beta > \beta^* \) and \( \alpha > \alpha^* \) for \( W^u = W^* \), that is, cooperation is beneficial and sustainable for the unions. As noted in Section 2, one can regard the agreement among the industry unions as a means of constituting a single central union, covering all organized workers. The trigger strategies discipline the unions and make a central unions' federation's decision sustainable as a non-cooperative equilibrium. Thus, such an agreement between industry unions provides a justification for the common assumption of the existence of one single union covering the whole labour market (if \( s = K \)) or at least all organized workers.

There will however be situations where the industry unions cannot be viewed as a single central union. If \( \alpha < \alpha^* \), an agreement on the wage level a central union would prefer will not be sustainable. Yet a less ambitious agreement can still be sustainable. Observe that at \( W^u = W^* \), \( du^u/dW^u = -W^0 dt^u/dW^u < 0 \), while \( du^c/dW^u = du^0/dW^u = 0 \). That is, the payoff of a deviating union will decrease if the unions choose a slightly higher wage than \( W^* \), while the payoff of the cooperating unions will be unaffected (the first order condition of \( W^* \)), and so will the payoff in case of no agreement. As is immediate from (15), an agreement on a wage level slightly higher than \( W^* \) implies a lower critical value for the discount factor—which may be lower than the actual discount factor of the unions. Thus, if the central union represents an agreement between industry unions, there will be certain limits to the wage level it can set. If the central union wants too moderate a wage policy, the benefit from deviating can
become too big, compared to the future loss from a breakdown. In this case the central union is forced to set a higher wage than it actually wants. Hence there will be situations where the assumption of one central union representing all industry unions exaggerates the wage moderation shown by the cooperating unions.

We shall discuss various applications of the model in the following section. The model is relevant for two different types of analysis. If an economy is exposed to a sudden change, it seems reasonable to assume that the unions are not able to modify the agreed wage level immediately. Thus, if the sudden change results in the critical value of the discount factor exceeding the discount factor of the unions, the agreement on wage moderation will break down.

When one analyses effects of changes over time (or compress different countries), however, it seems reasonable to assume that the unions are able to adjust the agreement and find one that is sustainable.

In some cases these types of analysis will yield very similar answers, and to avoid tedious repetition we will not discern sharply between them.

4. Some applications

4.1 Political climate and duration of wage contracts

Recall that \( p \) is the exogenous probability that the game stops, i.e. that an exogenous event takes place which makes it natural to reconsider a breakdown of an agreement. This event can be of political or economical nature, and has the implication that the membership in the unions that have been cheated are again willing to join an agreement on wage restraint. As noted above the discount factor \( \alpha = (1 - p)/(1 + r) \), where \( r \) is the interest rate. It seems reasonable that \( p \) will increase in more turbulent political or economic climate, so \( \alpha \) will go down. If \( \alpha \) drops below the critical value \( \alpha^* \), the agreement on wage moderation becomes unsustainable. In order to achieve a sustainable agreement, the collaborators may have to set a higher wage. Hence an unstable political climate may itself cause higher wages.

This also admits an effect of the duration of wage contracts. For a given annual interest rate, \( r \) will be greater the longer the duration of the wage contracts. If \( \alpha \) is small, an agreement may not be possible. Hence long wage contracts can be a hindrance to wage moderation. The intuition is that the longer the duration of the wage contracts, the longer the time a deviating union will enjoy the benefits of the deviation because it takes a longer time before the other unions are able to catch up.

4.2 Union density

Consider the case where the unionised industries have formed a sustainable agreement on wage moderation. Then one industry becomes unorganized for one reason or another, so the overall unionisation rate in the economy goes down. The overall impact on aggregate wages and employment of this change
is in general indeterminate, as there are effects working in opposing directions.
In the industry where the union dissolves, wages go down and employment
increases. However, this change will affect the possibility of cooperation among
the remaining unions. The critical value of the discount factor, \( \alpha^* \), is determined by

\[
\frac{u^d - u^c}{u^c - u^0} = \frac{\alpha^*}{1 - \alpha^*},
\]

(for \( W^u = W^* \)). (15') determines \( \alpha^* \) as an decreasing function of \( s \) (see appendix
for proof). A reduction in \( s \) will rise \( u^d \), \( u^c \) and \( u^0 \) since employment increases
and the tax rate declines. However, \( u^0 \) will increase relatively more because the
adverse effects of unionisation are stronger when the unions do not cooperate.
Thus, the benefits from wage moderation will be reduced relatively more than
the benefit from a deviation.

Consider a situation where the initial agreement on wage moderation is only
just sustainable, in the sense that the discount factor of the unions is identical
to the critical value. If there are many industries, the effect of de-unionisation
in one industry will be a negligible change in the aggregate wage level. Yet this
de-unionisation will raise the critical value of the discount factor, so that it
exceeds the actual discount factor of the unions. The agreement on wage restraint
will break down, and this will have a non-negligible impact on aggregate wages.
The striking result is that a lower union density might increase aggregate wages
and reduce total employment, as the agreement on wage moderation is no
longer sustainable.

A similar result may hold also when the agreement is sustainable and we
allow for adjustment of the agreed wage. Observe that the agreed wage \( W^* \)
can be determined by the first order condition also at the point where \( W^* = W^f \).
In this situation a de-unionisation of one industry will have no direct impact
on aggregate wages, as the wage level in this industry is already at the full
employment level. However, when \( W^* \) is determined by the first order condition,
Proposition (iii) above ensures that a reduction in \( s \) leads to an agreement on
a higher wage level, so that aggregate wages will actually increase.

4.3 Government policy

It is a well known result from the literature on games between the government
and a central trade union that an accommodating employment policy may
cause an aggressive union wage policy. (See Driffield (1985) or Calmfors and
Horn (1985)). This literature often associates accommodating employment
policy with a particular government reaction function, where public employment
is increased as a response to lower private employment. The accommodating
employment policy makes a wage increase cheaper for the central union (in
terms of reduced employment), hence the union chooses a higher wage level.

This issue can also be discussed with a basis in the analysis above. Let
accommodating employment policy be defined as in the literature referred to
above, by a government reaction function with a particular target value for total employment, and where any deviation in total employment from this target is partially offset by changes in public employment (the basic model would have to be modified slightly, by allowing for government production in each industry of the economy). For simplicity, we assume that the government target value for employment is equal to the employment level which would result from union cooperation in a situation without accommodating employment policy (this assumption corresponds to a simplifying assumption in Calmfors and Horn (1985)).

Thus, for a given agreed wage level and as long as the unions cooperate, there is no effect of an accommodating employment policy, because total employment is already at the target value. Yet the reduction in employment resulting from a higher wage level will be smaller, as the reduction in private employment is partially offset by a rise in public employment. Therefore the payoff of a deviating union and of all unions if there is no agreement will increase. The critical value of the discount factor will clearly rise, and may exceed the discount factor of the unions. In this case the one-year gain from defecting exceeds the future loss from a breakdown of the agreement. Hence accommodating economic policy can make coordination untenable because the punishment for defecting (and causing a breakdown) will not be harsh enough. (See Holden (1990) for a similar argument concerning the effect of an accommodating exchange rate policy.)

When the agreement is endogenous, the introduction of an accommodating employment policy can simply be represented by a reduction in the absolute value of \( dL/dW \). Thus, Proposition (2) above ensures that the unions will agree on a higher wage level than they would without accommodating employment policy, as the resulting reduction in employment is less because of the accommodating employment policy. Hence, the present model predicts a result quite similar to the standard one, but justified somewhat differently.

5. Concluding remarks

We have addressed the problem of which conditions are necessary to make wage moderation possible in an economy with industry unions. It is argued that a turbulent political climate, a low union density, or an accommodating employment policy may all result in aggressive wage policies by the unions. The model also gives some support to the common simplification of letting a single union represent the whole labour market, since one can view this as a cooperative solution between industry unions. Yet it also stresses the weakness of the single union approach, as this may exaggerate the scope for wage moderation. In some situations an agreement on a low nominal wage will not be sustainable. This can perhaps best be exemplified by the Norwegian law (1988–9) which had a ceiling on wage increases. This law was supported by leaders of the unions' federation LO and it followed statements by LO representatives that one could not expect LO to show wage restraint if other
groups opted for high wages. One could interpret this as a sign that under present conditions LO is not ‘big enough’ to be able to sustain an agreement on wage moderation, and it wants legal enforcement of a wage moderation policy.

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APPENDIX

Proof of Proposition 1

(i)

Reformulate (9) to
\[ \frac{du}{dW^*} = u_w + L(W^*)[W^* b(s - 1)/KL'] dL/dW = 0, \]  \hspace{1cm} (A1)

where the first term of the right hand side,
\[ u_w = (1 - t)L(W^*) + W^*(1 - t) dL/dW - W^*(b/KL') dL/dW, \]

represents the direct effect of increasing its own wage, while the second term represents the negative external effect through taxes of all the other unions in the agreement increasing their wages. In the monopoly union case (where \( \beta = 1 \)), \( u_w \) is equal to zero for \( W = W^0 \), and (A1) will be negative at the point \( W = W^0 \) irrespective of the size of the negative effect (as long as \( s > 1 \)). Hence, \( W^* > W^0(\beta) \), where \( \beta = 1 \), for all \( s > 1 \).

Assuming that \( W^* > W^0(0) \) (that is, industry wage bargaining where union power is zero yields a lower wage than what the unions prefer), and as \( W^0(\beta) \) is continuous in \( \beta \), there exists, for any given \( s > 1 \), a \( \beta^*(s) \) such that \( W^0(\beta^*(s)) = W^* \). As \( W^0(\beta) > 0 \), we also have that \( W^0(\beta) < W^* \) if and only if \( \beta < \beta^* \).

Q.E.D.

(ii)

Let \( g = -dL/dW \): The second order condition for a maximum of (8) is
\[ \frac{d^2 u(W)}{dW^*^2} < 0 \]  \hspace{1cm} (A2)

in an interval around \( W^* \) and we assume this condition to be fulfilled. (A2) ensures that \( W^* \) is a function of \( g \), defined implicitly by the first order condition
\[ \frac{du}{dW^*} = 0. \]  \hspace{1cm} (9)

Differentiating \( du/dW^* \) with respect to \( g \) yields
\[ \frac{d^2 u}{dW^* dg} = -L(W^*)W^* b s/KL' - W^*(1 - t) < 0. \]  \hspace{1cm} (A3)

By implicit derivation of (9), we obtain
\[ \frac{d^2 u}{dW^*^2} \frac{dW^*}{dg} + \frac{d^2 u}{dW^* dg} \frac{dW^*}{dg} = 0. \]  \hspace{1cm} (A4)

Thus,
\[ \frac{dW^*}{dg} = -\frac{d^2 u}{dW^* dg} \frac{d^2 u}{dW^*^2} < 0. \]  \hspace{1cm} (A5)

Q.E.D.
(iii) (The proof is of the same type as the proof of (ii)). Reformulate (9) to
\[ \frac{du}{dW^u} = (1 - \varepsilon) L(W^u) + W^u (1 - t^u) \frac{dL}{dW} - W^u dt/dW^u L(W^u) = 0 \] (A6)
or
\[ \frac{du}{dW^u} = (1 - \varepsilon) L(W^u) \frac{[1 - \varepsilon]}{W^u} dt/dW^u L(W^u) = 0, \] (A6')
where \(-dL/dW W^u/L = \varepsilon\) is the elasticity of demand for labour. At \(W^u = W^*, \ du/dW^u = 0\) which implies that \(\varepsilon < 1\).

Differentiating \(du/dW^u\) with respect to \(s\) yields
\[ \frac{d^2 u}{dW^u ds} = -L(W^u)(1 - \varepsilon) \frac{dt}{ds} - W^u L(W^u) \frac{d^2 t}{dW^u ds} < 0, \] (A7)
as \(dt/ds > 0, \ d^2 t/dW^u ds = (-b/KL^f) dL^u/dW^u > 0, \) and \(\varepsilon < 1\). By implicit derivation of (9), we obtain
\[ \frac{d^2 u}{dW^u ds} + \frac{d^2 u}{dW^u ds^2} = 0, \] (A8)
Thus,
\[ \frac{dW^u}{ds} = \frac{d^2 u}{dW^u ds} \frac{d^2 u}{dW^u ds^2} < 0. \] (A9)
Q.E.D.

Union density

We substitute out for (11), (12) and (13) in (15'), and divide both the numerator and the denominator on the left hand side by \((1 - t^u)\), to obtain
\[ \frac{W^0 \ell^0 (1 - t^f)/(1 - t^u) - W^u \ell^u}{W^u \ell^u - W^0 \ell^0 (1 - t^f)/(1 - t^u)} = \frac{\alpha^*}{1 - \alpha^*}. \] (A10)

From (4), we have
\[ t^0 = b(KL^f - sL^0 - (K - s)L^f)/KL^f, \] (A11)
\[ t^u = b(KL^f - sL^u - (K - s)L^f)/KL^f, \] (A12)
and
\[ t^d = b(KL^f - (s - 1)L^u - (K - s)L^f)/KL^f. \] (A13)
Thus, \(dt^0/ds = -b(L^0 - L^f)/KL^f > dt^u/ds = dt^d/ds = -b(L^u - L^f)/KL^f\). Furthermore \(1 - t^0 < 1 - t^u < 1 - t^d\). Therefore,
\[ d[(1 - t^0)/(1 - t^u)]/ds = \frac{[ -dt^0/ds (1 - t^u) + dt^u/ds (1 - t^0)]}{(1 - t^u)^2} < 0, \] (A14)
and
\[ d[(1 - t^d)/(1 - t^u)]/ds = \frac{[ -dt^d/ds (1 - t^u) + dt^u/ds (1 - t^d)]}{(1 - t^d)^2} < 0. \] (A15)
Thus, as \(s\) increases, both \((1 - t^0)/(1 - t^u)\) and \((1 - t^d)/(1 - t^u)\) go down, so equality in (A10) requires that the critical value \(\alpha^*\) is decreasing in \(s\).
Q.E.D.
REFERENCES


