

# Keskusteluaiheita Discussion papers

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THE MONOPOLY UNION MODEL WITH  
ENDOGENOUS PRICE EXPECTATIONS

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## 1. Introduction

It is now quite widely admitted, also in economic literature, that the wage formation process is by and large determined by the negotiations between trade unions and employers. In practice the form and comprehensiveness of the negotiations differ quite a lot. This is one crucial reason why it took so long time until the economic model building started to utilize the microeconomic theory of trade unions extensively.

The main lines of approaches are the so-called monopoly union model and the so-called efficient-bargaining model (Calmfors, 1985). In the monopoly union model the trade union maximizes its utility function the arguments of which are the (real) wage rate and employment. While doing this it takes into account the relationship between these two, the relationship that arises from the profit maximization of the firm (taking wage rate as given). So, the trade-union is able to set the wage rate so that it is its own judgement between wage and employment that matters. But, the solution of these unilateral settings is not efficient i.e. it does not lie on the locus of tangency points between indifference curves and iso-profit contours (Oswald, 1985).

It is also partly an unsettled question whether the monopoly union model is at its best when we are dealing with a small (eg. local) trade union or a big nation-wide trade union. On the other hand we could argue that in economies where we have centralized labour market practice we usually have also strong confederations of trade unions having clear targets and acting rationally. Particularly in this kind

of institutional setting the union preferences can and must be treated explicitly. Also we may claim that bargaining over employment is something we do not observe at the macro level, and the concentration on wage setting is closely argued there. There are also opposite views. Pencavel (1985) reminds that the construction of a simple objective function may be very dangerous at the macro level.

Even if the justification of the utility function might be more difficult in the case of big trade unions (e.g. confederations of smaller ones), the approach may be powerful in treating some aspects of centralized negotiations that would otherwise be neglected. If we have a centralized labour market and postulate an all-embracing trade union, we have to be logical in what follows. The trade union has to take into account the fact that its own actions do influence the state of the economy and also the variables that are important for its own decisions. The most clear-cut example is the interdependence of wages and prices. If an all-embracing trade union is thinking of its wage claims, it cannot treat price expectations as exogenous. These aspects of the decision problem of the trade union have usually been neglected, but they can be analyzed formally with the tools of the monopoly union model.

In the next chapter we try to show how in the case of the simple standard model the solutions differ depending on whether the trade union treats prices as exogenous or as endogenous in an institutional setting where the union really does influence on prices.

## 2. THE MODEL

### 2.1. The basic model

Let us first recall the very basic model of a small monopoly union (see e.g. Oswald (1982)). A small union means here that the union is too small to influence the aggregate price level, and the price level is assumed to be a constant. The problem of the trade union is to solve its optimal wage claims for the next coming contract period taking into account the trade-off between wage development and its employment effects. Formally the union's problem is

$$(1) \quad \max U(W,N) \quad \text{s. t.} \quad N = N(W,q), \text{ where}$$

$W$  is the nominal wage,  $N$  is employment and  $q$  is a shift parameter.  $U$  is quasi-concave and increasing in both arguments and  $N$  is a decreasing function of the wage.

In many applications this type of formulation is consistent with the nature of the problem. But the situation changes when we turn to deal with an all-embracing trade union.

### 2.2. The real wage model with exogenous price expectations

Now we want to modify this problem so that the model can be used when we are dealing with an all-embracing trade union acting in a centralized labour market. We could interpret this abstraction to be appropriate e.g.

- (2a) when we have some kind of leader union (e.g. a trade union in the open sector in EFO-model) or
- (2b) when different trade unions act as one unit trying to arrive at a frame agreement that is a basis for sectoral agreements.

Our final aim is to get rid of the assumption of the constant price level and so instead of the nominal wage we use now the real wage as an argument in the utility function. Also, on the demand side of labour it is the real wage that now enters the employment constraint. For practical reasons we turn to use the logarithms of the real wage and employment ( $\ln W/P = \ln W - \ln P = w - p$ ,  $\ln N = n$ ). Let us for a moment consider an all-embracing trade union that does not take into account the interdependence of wages and prices. The best it can do is to make a good exogenous guess what the price level during the next contract period might be. Let us denote that guess by  $p^*$ . Then the maximization problem becomes

$$(3) \quad \max U(w - p^*, n) \quad \text{s.t.} \quad n = n(w - p^*, q)$$

and the optimum point can be obtained by solving the first order condition which is now

$$(4) \quad - U_1/U_2 = n_1 .$$

This condition means that we choose the  $w$  (given  $p^*$ ) that has the following property: the marginal rate of substitution between the real wage and employment equals to the slope of the labour demand curve with respect to real wage. Notice that the actual price level during the contract period may differ from the guess  $p^*$ .

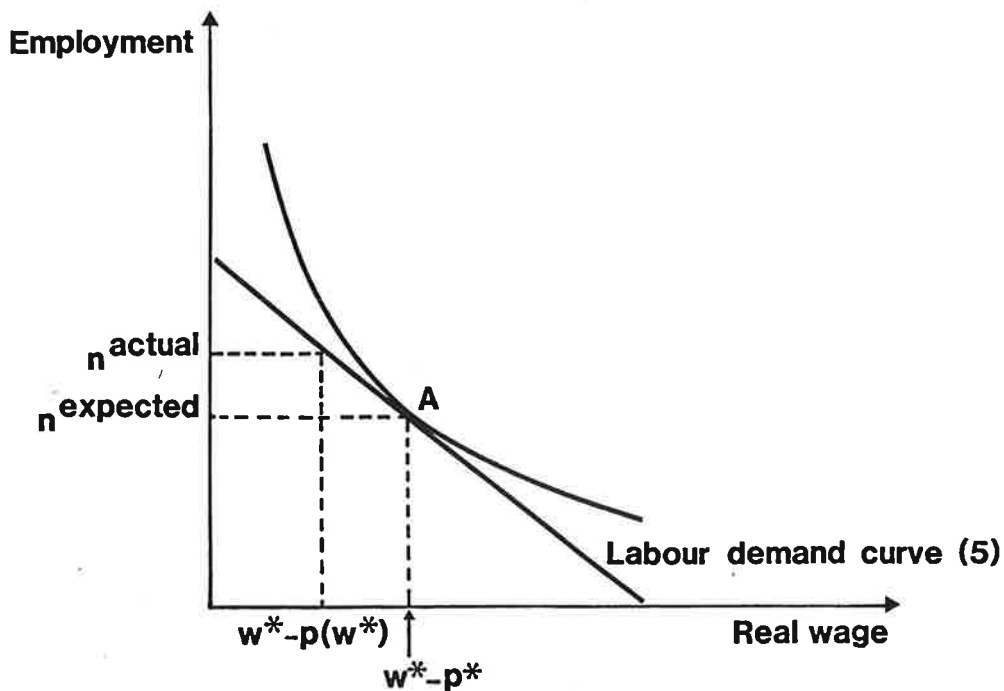
Let us analyze this situation with help of an explicit labour demand curve and graphics. Let the basic form of the labour demand function be  $N = C (W/P)^{-\delta} Q^{\alpha}$ , which can be derived e.g. from the CES-production function. By taking logarithms we get

$$(5) \quad n = c - \delta(w - p) + \alpha q,$$

where  $c = \ln C$  and  $q = \ln Q$  ( $Q$  is total output).

Graphically the problem and its solution are presented in Figure 1.

Figure 1. The maximization problem with exogenous expectations.



The optimum point satisfying (4) is A and the union sets the future wage rate equal to  $w^*$ . Let us now analyze what follows during the contract period, when the actual price level will differ from the guess  $p^*$ . We assume that the price level is determined via the price

equation  $p = p(w)$ . Let this equation be simply linear e.g.  $p(w) = z_0 + \rho w$ , where  $z_0$  presents exogenous elements and  $\rho$  is a transmission term  $0 < \rho < 1$ . The nominal wage was set at  $w^*$  in the beginning of the contract period and it cannot be altered. But when employers now determine the employment they take into account the new price level which is  $p(w^*) = z_0 + \rho w^*$ . Because the union did not utilize the price equation, it is not probable that the actual price level  $p(w^*) = z_0 + \rho w^*$  happens to equal to the exogenous guess  $p^*$ . Let us assume that  $p(w^*)$  is greater than  $p^*$ . Here the actual real wage  $w^* - p(w^*)$  is lower than the expected one  $w^* - p^*$ , and the actual employment is better than the expected one. Notice also that the union is on a lower indifference curve than it expected.

### 2.3. The real wage model with endogenous price expectations

Let us now consider a more consistent system where the union does take into account the relationship between wages and prices. Again we have to modify our decision problem. Now it is

$$(6) \quad \max U(w - p, n) \quad \text{s.t.} \quad n = n(w - p, q) \quad \& \quad p = p(w) \quad (0 < p'(w) < 1)$$

In other words, while solving the optimal wage claims the union uses the price equation  $p = p(w)$ . Again, let us analyze this more carefully with the help of an explicit labour demand function and graphics and let the price equation be  $p(w) = z_0 + \rho w$ .

Let us first mention some clarifying features of this problem.

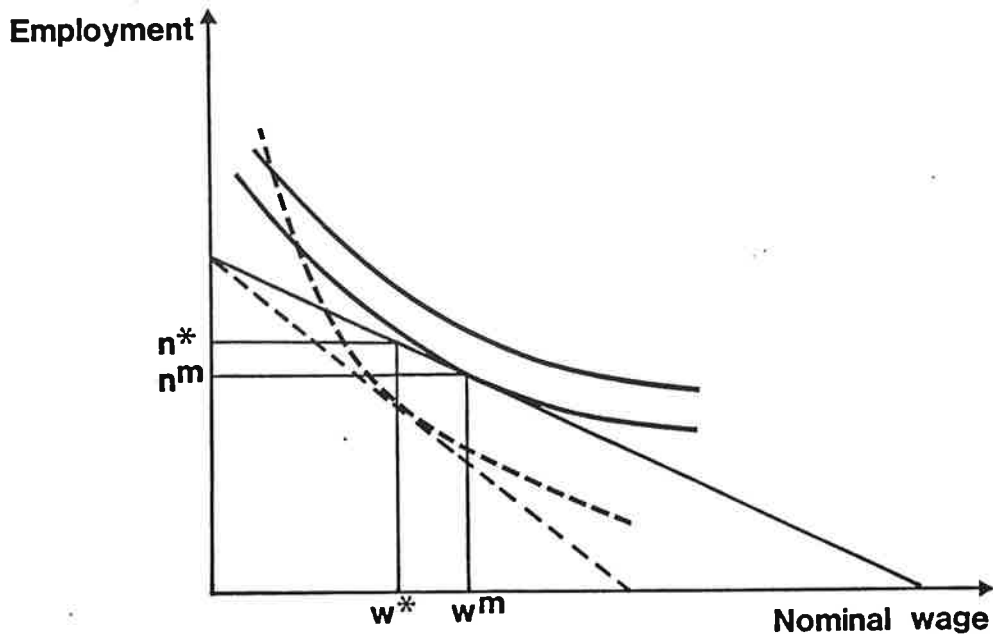
Originally preferences are expressed in terms of the real wage and

employment. Notice that according to (6) the utility function could also be interpreted so that it describes the preferences between nominal wages and employment. It is easier to understand the graphical presentation, if we start by considering the first order conditions. Let us determine the slope of the the indifference curve. We fix some utility level  $U^0$ . Then the equation  $U(w - p(w), n) = U^0$  implicitly defines  $n$  as a function of  $w$ , so  $n = I(w)$ . Then by implicit-function theorem we get the slope of the indifference curve,  $I'(w) = -U_1(1-p'(w))/U_2 = -U_1(1-\rho)/U_2$ . Because the labour demand function is now  $n = c - \delta(1 - \rho)w + \delta z_0 + \alpha q$ , the slope of the constraint is  $-\delta(1 - \rho)$ . At the optimum these two slopes must coincide. In Figure 2 the indifference curves and the labour demand function are presented. With dotted lines we have drawn the indifference curves and the constraint (ex ante) of the union that uses only exogenous expectations (on the assumption that  $z_0 = p^*$ ). The indifference curves and the constraint of the union of this type are steeper than the ones of a union using endogenous expectations (respective slopes are  $-U_1/U_2$  and  $-\delta$ ). It is easy to understand that preferences between nominal wage claims and employment are different in these cases, because the union using the endogenous price expectations knows that the increase in nominal wage claims does not directly imply as great an increase in real wages.

The union that uses endogenous expectation will set the nominal wage claims higher than the one with exogenous expectations ( $w^m > w^*$ ). The corresponding real wage  $(1 - \rho)w^m - z_0$  will also be higher and analogously employment lower than in the case of exogenous expectations.



Figure 2. The maximization problem with endogenous expectations.



Notice that in the above discussion we used the assumption that the union with exogenous price expectations was able to make right predictions concerning the exogenous price elements (the assumption  $z_0 = p^*$ ), but it neglected the transmission effect. Next we present an example where we have used the Stone-Geary utility function and we will return to the effect of this assumption again.

### 2.5. An example: Stone-Geary utility function

We adopt an explicit functional form for the utility function of the trade union: namely the Stone-Geary form which has been used in quite many applications on this field e.g., Pencavel (1981). In practice the arguments of the utility function are supernumerary real wage and supernumerary employment.

The utility function becomes

$$(7) \quad U = (w - p - \gamma_1)^\beta (n - \gamma_2)^{1-\beta},$$

where  $\gamma_1$  and  $\gamma_2$  are 'minimum required quantities' of real wage and employment respectively.

Let us first analyze the situation where the union uses the exogenous price expectations  $p^*$  in future calculations.

Let the labour demand function be (ex ante)

$$(8') \quad n = c - \delta(w - p^*) + \alpha q .$$

We present this relationship in another form so that we are able to interpret the results analogously to those in consumer theory. (8') is identical to a 'budget constraint'

$$(8) \quad n + \delta w = c + \delta p^* + \alpha q ,$$

where  $\lambda$  and  $\delta$  are the 'prices' of employment and wage respectively.

From consumer theory we know that the solution of Stone-Geary utility maximization problem

$$(9) \quad \max U = (x_1 - \gamma_1)^{\beta_1} (x_2 - \gamma_2)^{\beta_2}$$

$$\text{s.t. } p_1 x_1 + p_2 x_2 = y \quad (\beta_1 + \beta_2 = 1)$$

can be decomposed into two components (see e.g. Philips 1974, s. 125). The first part is the 'subsistence' expenditure to which the consumer commits himself in order to attain a minimal acceptable level and it is related to the corresponding  $\gamma_i$ -term. Then we subtract from income both 'subsistence' expenditures (related to  $\gamma_1$  and  $\gamma_2$ ) and we get the 'supernumerary income' which the consumer allocates among the commodities in the proportions  $\beta_1$  and  $\beta_2$ . In this general case we now that the solution is

$$(10') \quad p_i x_i = p_i \gamma_i + \beta_i (y - p_1 \gamma_1 - p_2 \gamma_2) , \quad i = 1, 2$$

or

$$(10) \quad x_i = \gamma_i + \frac{\beta_i}{p_i} (y - p_1 \gamma_1 - p_2 \gamma_2) , \quad i = 1, 2$$

Our maximization problem was  $\max (7)$  s.t. (8) and analogously we get the optimal wage claims. They are now

$$(11') \quad \delta w = \delta (p^* + \gamma_1) + \beta [c + \delta p^* + \alpha q - \delta (p^* + \gamma_1) - \gamma_2]$$

or

$$(11) \quad w = p^* + \gamma_1 + \frac{\beta}{\delta} [c + \alpha q - \delta \gamma_1 - \gamma_2]$$

We see for instance that the exogenous price expectations raise directly the nominal wage claims. The total effect of the minimum acceptable level of real wage is  $(1 - \beta)\gamma_1$ . On the one hand this a priori fixed element is a prerequisite for the solution and so increases the wage claims directly, but on the other hand it reduces the

scope within which the trade union can trade between wage level and employment. The minimum acceptable level of employment  $\gamma_2$  only reduces this range within which trade union can move and so its effect is negative on wage claims. The negative effect is the bigger the bigger is the relative importance of the wage target. The growth in total demand widens naturally the opportunity set of the trade union. The positive effect on wage claims is directly related to the demand elasticity of employment and reversely related to the wage elasticity of employment.

Now we want to consider how this decision problem changes when the trade union takes into account the fact that price level changes as a result of its own wage setting. Let the price equation be the same as in the general case i.e.  $p(w) = z_0 + \rho w$ . The maximization problem is now

$$(12) \quad \max U = ((1 - \rho)w - z_0 - \gamma_1)^\beta (n - \gamma_2)^{1-\beta}$$

$$\text{s.t. } n + \delta(1 - \rho)w = c + \delta z_0 + \alpha q .$$

We can see that both the utility function and the constraint have changed. For instance in the constraint the 'income' item includes now  $z_0$  instead of  $p^*$  and wage claims have become relatively cheaper. The solution is now

$$(13) \quad w = \frac{z_0}{1-\rho} + \frac{\gamma_1}{1-\rho} + \frac{\beta}{\delta(1-\rho)} [c + \alpha q - \delta\gamma_1 - \gamma_2]$$

At the first glance the impression is clear-cut. The inclusion of endogenous price expectations makes the coefficient of the super-

numeraire income bigger and also the coefficient of the subsistence item  $\gamma_1$  is bigger. Also that the effect of the level of economic activity on nominal wages increases. These changes are the bigger the bigger is the transmission term  $\rho$ . But, before we can give a final answer we must consider the exogenous price terms in the equations (11) and (13). If the exogenous elements of the price equation are equal to or bigger than the naive price expectation then we can give a definite answer: the endogenous price expectations have enforced the wage claims in this setting. On the other hand, there may also be a situation where the exogenous component  $z_0$  is in reality so small compared to  $p^*$  that the optimization procedure of the trade union ends up with smaller wage claims in the latter case than in the case of naive expectations.

Let us now seek a more definite answer to the question what causes the difference in (11) and (13). Denote the solution of the model with exogenous expectations as  $w^*$  and the solution of the problem (12) as  $w^m$ . Then

$$(14) \quad w^m = \frac{w^*}{1-\rho} + \frac{z_0 - p^*}{1-\rho}$$

We see immediately that if  $z_0 = p^*$  (as we assumed in the general case)  $w^m$  will be bigger than  $w^*$ . The corresponding real wages are  $(1-\rho)w^m - z_0$  and  $(1-\rho)w^* - z_0$  and so also the real wage will be bigger and correspondingly employment will be lower in the latter model (12) than in the model with exogenous expectations. This result is quite obvious, because in the model with exogenous expectations the effect of wages on prices can be seen as an extra element that reduces the actual real wage.

If  $z_0 > p^*$ , the above outcome is even clearer. If the union with exogenous expectations, in addition to neglecting the endogenousness in prices, also underestimates the exogenous elements, its wage claims are very much biased downwards. The expected real wage is much smaller than the one it would get in the case it would take into account the price equation.

There is still the case that  $z_0 < p^*$ . Now the following case is possible: if the union strategy is to exaggerate when it forms the price expectations ( $p^*$  includes extra 'room') and if the actual exogenous price elements are small, then it may be the case that this upward bias in exogenous expectations totally cancels out the extra endogenous effect of wages on prices. From (14) we get the exact rule: if the difference  $p^* - z_0$  is greater than the 'extra' price effect  $\rho w^*$ , the union will set lower nominal wage claims in case of endogenous expectations. Analogously the corresponding real wage will also be lower and employment higher than in the model with exogenous expectations.

### 3. CONCLUSIONS

The aim of this paper was to remind that if we use the monopoly union model in macroeconomic model building, the decision problem of the trade union is probably qualitatively different from that of a small union. One has to consider more carefully which elements are exogenous and which are not.

Let us consider the situation where we use the monopoly union model e.g. in the context of centralized labour markets so that we make an abstraction that the trade union movement has common preferences and targets. To be logical we should assume that this big unit knows that its own actions do influence the state of the economy. The connection between wages to be set and future prices that influence the future real wages is the most clear-cut example.

We showed that the solution of the 'logical' decision problem differs from a solution which is made on an inconsistent assumption that the union does not take into account the relationship between wages and prices. Naturally, if we use the wrong model, that will cause us problems e.g. in estimations. E.g. if we in wage equations treat prices that in essence are endogenous as exogenous we will end up with simultaneity bias.

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