NOMINAL RIGIDITIES IN WAGE SETTING BY RATIONAL TRADE UNIONS

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A B S T R A C T

Many rational wage setting schemes, such as the trade-unions paradigm, are usually thought to lead to pure real rigidities. This result is however dependent on the assumption that wages can be made dependent on the realization of every single shock hitting the economy, a somewhat unrealistic assumption.

In this article we construct a model where a rational trade-union without any kind of money illusion sets wage schedules in an economy subject to real and monetary shocks. We make the realistic assumption that wages can be conditioned on prices. It is found that, although the trade-union has the option of fully insulating workers from nominal disturbances, it will rationally choose not to do so, and therefore nominal rigidities will be present in the economy.

Keywords : Nominal rigidities, trade-unions.

Journal of Economic Literature Classification Numbers : J3, J5, E24.

RIGIDITES NOMINALES ET THEORIE DES SYNDICATS

R E S U M E

On rencontre souvent dans la littérature l'idée que des schémas rationnels de formation des salaires, tels que les modèles de syndicats, conduisent à des rigidités "réelles". Ce résultat dépend cependant fortement de l'hypothèse suivant laquelle les salaires sont fonction de tous les chocs qui touchent l'économie, une hypothèse peu réaliste.

On construit dans cet article un modèle où un syndicat rationnel, sans illusion monétaire d'aucune sorte, fixe les salaires dans une économie soumise à des chocs réels et monétaires. On fait l'hypothèse réaliste suivant laquelle les salaires peuvent être ajustés en fonction des prix. Bien que le syndicat ait la possibilité d'annuler totalement l'effet des chocs monétaires, on trouve qu'un comportement rationnel le conduit à laisser des éléments de rigidité nominale dans la fixation des salaires.

Mots Clefs : Rigidités nominales, syndicats.

Codes J.E.L. : J3, J5, E24.

1. INTRODUCTION [1]

Whether rational wage setting by explicitly maximizing agents leads to real or nominal rigidities (or none at all which is of course also a possibility) is evidently an issue of utmost importance to explain the causes of potential market imbalances and study corrective policies. We shall thus investigate this problem in a framework with explicitly utility maximizing wage setters, that of trade unions theory.

The standard literature on trade-unions (see for example the surveys by Farber, 1986, Oswald 1985) seems to give a clear picture of real rigidities coming out of rational trade-union behavior. This result, however, is very dependent on the assumption that wage contracts can be made conditional upon the realization of any shock in the economy, or costlessly renegotiated after each such shock. This feature is clearly unrealistic as contracts are typically signed for a period of time during which many shocks occur without renegotiation, and are not explicitly dependent upon all these shocks. We will thus construct a model where wages are determined before shocks occur, and see whether this leads to real or nominal rigidities.

In most macroeconomic models with such predetermined wages, these are assumed to be set in money terms. This introduces a nominal rigidity a priori, clearly an undesirable feature. What we want is a model which includes the possibility of both real and nominal rigidities, and the option for agents of rationally choosing between the two. We shall thus follow the line initiated in the literature on optimal indexation (see notably Gray, 1976, Fischer, 1977, Cukierman, 1980), and assume that trade-unions choose a wage schedule specifying in particular some degree of indexation of wages on prices. If there is full indexation we have pure real wage rigidity, if no indexation pure nominal wage rigidity, with of course all intermediate cases. We may note that such an assumption is quite realistic, as indexed wage contracts are often met in reality.

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[1] I wish to thank Bruno Jullien for his comments on an earlier version of this paper. I am of course solely responsible for errors and opinions.

An important feature of this model is that all parameters of the wage schedule will come from explicit utility maximization by the trade union. We shall see that inspite of this, and although the objective of the trade-union is purely real, his optimal behavior will nevertheless generate nominal rigidities.

2. THE MODEL

In order to have a simple dynamic model where both real and nominal shocks can occur, we shall consider an overlapping generations model with fiat money. At each period t there are two markets : Goods for money at the price P_t, labor for money at the wage W_t.

Agents

Agents in this economy are dynasties of capital owners, which we will call "capitalists" for short, who own the technology, and of workers, who own only their labor. Capitalists and workers have the same utility function :

$$U = (1-\lambda) \text{ Log } C_t + \lambda \text{ Log } C'_{t+1} \qquad (1)$$

and maximize expected utility under rational expectations. Workers have L_0 units of labor when young, zero when old. Young capitalists own the technology, represented by the production function :

$$Y_t = Z_t L_t^{\alpha} \qquad (2)$$

where Z_t is a stochastic technology shock. Young capitalists collect the profits when young, and then give property rights to the next generation of capitalists. Both capitalists and workers, which have no income when old, save under the form of money, which is the only store of value in this economy.

Wage setting

At the beginning of period t, a trade-union acting on behalf of the workers chooses a wage schedule :

$$w_t - \bar{w}_t = \theta(p_t - \bar{p}_t) \qquad 0 \le \theta \le 1 \tag{3}$$

where θ is the indexation parameter, w_t and p_t the wage and price, $\bar{w}_t$ and $\bar{p}_t$ the base wage and price, all in logarithms [2] .As we indicated above, this allows nominal rigidity (θ = 0), real rigidity (θ = 1) or any combination of the two.

Shocks

The economy is submitted to two types of shocks : Technology shocks Z_t and monetary shocks affecting the total quantity of money M_t. This last shock is achieved via multiplication of all individual money holdings by the same stochastic variable $\mu_{t+1} = M_{t+1}/M_t$.

The timing of events in period t is the following : At the beginning of period t, before shocks are known, the trade union chooses the wage schedule (3), and notably the degree of indexation θ. Then shocks become known and an equilibrium is established. In order to study the optimal behavior of the trade union, we shall first study the characteristics of this short run equilibrium.

3. THE SHORT RUN EQUILIBRIUM

Given the wage schedule (3) chosen by the trade-union, we have to determine the level (in logarithms) of prices p_t, wages w_t, output y_t and employment ℓ_t for all possible values of the shocks z_t and m_t. For that purpose we need four equations. The first one is equation (3) above. The second is the production function (2), which we rewrite in logarithmic form as :

$$y_t = z_t + \alpha\ell_t \tag{4}$$

The third relation comes from the labor market, which usually does not clear. Employment will be the minimum of supply and demand. Supply is equal

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[2] From now on lower case symbols denote the logarithm of the corresponding upper case variable.

to ℓ_0. Demand is given by the condition that the real wage is equal to marginal productivity which yields :

$$w_t - p_t = \text{Log } \alpha + z_t + (\alpha-1)\ \ell_t \tag{5}$$

so that employment is given by :

$$\ell_t = \min \left\{ \ell_0 \ , \ \frac{z_t + p_t - w_t + \text{Log } \alpha}{1 - \alpha} \right\} \tag{6}$$

Finally the fourth equation will come from the optimal consumption behavior of all agents. It is shown in the appendix that total consumption demand by the young agents (capitalists and workers) is :

$$C_t = (1-\lambda)\ Y_t \tag{7}$$

Total consumption by the old C'_t is equal to the real value of their savings M_t/P_t, so that :

$$Y_t = C_t + C'_t = (1-\lambda)\ Y_t + \frac{M_t}{P_t} = \frac{M_t}{\lambda P_t}$$

which in logarithmic form yields our fourth equation :

$$m_t = \text{Log } \lambda + p_t + y_t \tag{8}$$

The short-run equilibrium is determined as the solution to the four equations (3), (4), (6), (8). To make the solution more transparent, we shall define the base wage and price $\bar{w}_t$ and $\bar{p}_t$ by comparison to the expected values of the market clearing price and wage p^*_t and w^*_t. These expectations are easily computed as :

$$Ep^*_t = Em_t - \text{Log } \lambda - \alpha\ell_0 - Ez_t$$

$$Ew^*_t = Ep^*_t + \text{Log } \alpha + Ez_t + (\alpha-1)\ \ell_0$$

where Ez_t and Em_t are the expected values of z_t and m_t at the beginning of period t before shocks have occured. We shall take :

$$\bar{p}_t = Ep^*_t \qquad \bar{w}_t = Ew^*_t + \omega_t$$

which means that the trade union demands ω_t (positive or negative) in addition to the expected market clearing wage.

The two regimes

As appears notably in formula (6), the short-run equilibrium can be of two types : full employment ($\ell = \ell_0$) or underemployment ($\ell < \ell_0$). It turns out that, in order to find out which regime the economy is in, we shall only need to compare ω_t to the composite stochastic variable

$$x_t = \theta(z_t - Ez_t) + (1-\theta)\ (m_t - Em_t) \tag{9}$$

We shall now compute the values of employment and the real wage, which are the two variables the workers and trade union will be interested in the two regimes.

In the underemployment regime, which corresponds to $x_t \leq \omega_t$, equation (5) holds and one can compute :

$$\ell_t = \ell_0 + \frac{x_t - \omega_t}{1 - \alpha\theta} \tag{10}$$

$$w_t - p_t = \text{Log}\ \alpha + (\alpha-1)\ \ell_0 + z_t - \frac{(1-\alpha)(x_t - \omega_t)}{1 - \alpha\theta} \tag{11}$$

In the full employment regime, which corresponds to $x_t \geq \omega_t$, one obtains :

$$\ell_t = \ell_0 \tag{12}$$

$$w_t - p_t = \text{Log}\ \alpha + (\alpha-1)\ \ell_0 + z_t - (x_t - \omega_t) \tag{13}$$

We are now ready to study the optimal behavior of the trade union.

4. OPTIMAL TRADE-UNION BEHAVIOR

We shall assume that, either by worksharing or adequate compensation, income is shared equally between all workers. In that case all workers of the same generation have the same utility and it is shown in the appendix that, in order to maximize workers' expected utility, the trade union should maximize the expected value of the logarithm of the real wage bill, i.e. $E(w_t - p_t + \ell_t)$. We may note that this objective is in purely real terms and thus that the nominal rigidities we shall find will not come from any kind of "money illusion". Using formulas (10) to (13), we compute the value of this objective as:

$$E(w_t + \ell_t - p_t) = \text{Log}\ \alpha + \alpha\ell_0 + Ez_t + E\ \min\left[\frac{\alpha(x_t - \omega_t)}{1-\alpha\theta}\ ,\ \omega_t - x_t\right] \qquad (14)$$

The first three terms of the right hand side of (14) are given, so the trade-union should choose θ and ω_t so as to maximize the fourth term, which we rewrite, calling $\phi(x_t)$ the density function of the variable x_t :

$$V_t = \frac{\alpha}{1-\alpha\theta}\int_{-\infty}^{\omega_t}(x_t - \omega_t)\ \phi(x_t)\ dx_t + \int_{\omega_t}^{+\infty}(\omega_t - x_t)\ \phi(x_t)\ dx_t \qquad (15)$$

The target real wage

Let us start with the determination of the target real wage ω_t for a given degree of indexation θ. Clearly in choosing ω_t the trade-union faces a tradeoff between the value of the real wage and the average employment level. Differentiating (15) with respect to ω_t and assuming an interior solution, we immediately find that the optimal value of ω_t is given by :

$$\Phi(\omega_t) = \frac{1-\alpha\theta}{1+\alpha-\alpha\theta} < 1 \qquad (16)$$

where $\Phi(x_t)$ is the cumulative distribution of x_t. If we remember that there is underemployment when $x_t \leq \omega_t$, the interpretation of (16) is totally straightforward : The trade-union will choose a target real wage ω_t such that the probability of underemployment is equal to the value $\Phi(\omega_t)$ given by formula (16). We may note that this probability depends on θ, the degree of indexation.

We should also note that explicit utility maximization by the trade-union is quite important in obtaining a reasonable and intuitive expression for the target real wage. Under the traditional criterion in the optimal indexation literature, i.e. minimization of deviations from the Walrasian outcome, the optimal ω_t would have come out as minus infinity, thus yielding a zero base wage, obviously not a very realistic result.

The optimal degree of indexation

We shall now assume that the shocks z_t and m_t are independently and normally distributed with means Ez_t and Em_t and variances σ_z^2 and σ_m^2. The stochastic variable x_t is thus also normally distributed with mean zero and variance :

$$\sigma_x^2 = \theta^2\, \sigma_z^2 + (1-\theta)^2\, \sigma_m^2 \tag{17}$$

Let us make the change of variable $\omega = \sigma_x \cdot \xi$ and $x_t = \sigma_x \cdot \nu_t$ where ν is the standard normal variable. Calling $\psi(\nu)$ the standard normal density, the objective of the trade union is rewritten :

$$V_t = \frac{\alpha\sigma_x}{1 - \alpha\theta} \int_{-\infty}^{\xi} (\nu - \xi)\ \psi(\nu)\ d\nu + \sigma_x \int_{\xi}^{+\infty} (\xi - \nu)\ \psi(\nu)\ d\nu \tag{18}$$

Note that maximization in ξ for given θ yields :

$$\Psi(\xi) = \frac{1 - \alpha\theta}{1 + \alpha - \alpha\theta} \tag{19}$$

where Ψ is the cumulative normal density, which is equivalent to condition (16) above. Now let us call

$$A(\xi) = \int_{-\infty}^{\xi} (\xi - \nu)\ \psi(\nu)\ d\nu > 0$$

$$B(\xi) = \int_{\xi}^{+\infty} (\nu - \xi)\ \psi(\nu)\ d\nu > 0$$

Maximizing V_t with respect to θ for given ξ amounts to minimize the expression :

$$\frac{A(\xi)\ \alpha\sigma_x}{1-\alpha\theta} + B(\xi)\ \sigma_x \tag{20}$$

Let us call $\theta^*(\xi)$ the value of θ that minimizes (20) for given ξ. Though an exact expression for $\theta^*(\xi)$ would be too complex, simple intuitive bounds are easy to derive. Indeed the expression to minimize in (20) is the sum of two terms. The first one has an absolute minimum for $\theta = \theta_1$, the second one for $\theta = \theta_2$, where :

$$\theta_1 = \frac{(1-\alpha)\ \sigma_m^2}{\sigma_z^2 + (1-\alpha)\ \sigma_m^2} \qquad \theta_2 = \frac{\sigma_m^2}{\sigma_z^2 + \sigma_m^2}$$

For any given ξ, V_t will be maximized for a value of θ in between these two values, i.e. :

$$\frac{(1-\alpha)\ \sigma_m^2}{\sigma_z^2 + (1-\alpha)\ \sigma_m^2} < \theta^*(\xi) < \frac{\sigma_m^2}{\sigma_z^2 + \sigma_m^2} \tag{21}$$

Equation (19) and $\theta = \theta^*(\xi)$ fully determine the optimal policy of the trade-union. From (21) we immediately see that, unless $\sigma_z^2 = 0$ the optimal degree of indexation will be less than hundred percent, and thus nominal rigidities will be present.

Interestingly we may thus note that the existence of real shocks is necessary in this model for nominal rigidities to occur and thus for nominal shocks to have a real impact on the economy.

5. CONCLUSIONS

We studied in this paper a model usually thought to lead to pure real rigidities, that of the monopolistic trade-union. Within the traditional framework, we made the realistic modification that trade unions would negotiate the wage before all shocks that could hit the economy were known, and without being able to make wages contingent on all these shocks. We then saw that, although full real rigidity was an option available to the trade union via wage indexation, they would rationally choose not to fully index. As a result nominal rigidities are present and pure nominal shocks can affect the economy.

Clearly the point we have made here for traditional trade-union theory could be valid for other modes of wage determination as well. Uncertainty about future events and the impossibility to condition wages on every state of the world make full indexation suboptimal. This shows that many modes of wage formation which are traditionally thought to lead to pure real rigidities can actually lead to nominal rigidities as well, eventhough agents behave fully rationally.

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APPENDIX

We shall derive here a few results used in the main text.

The consumption behavior of young agents

Consider a young agent (worker or capitalist) indexed by i which has an income R_i. His consumption demand in t will be given by the solution in C_i to :

$$\text{Maximize } (1-\lambda) \text{ Log } C_i + \lambda E \{\text{Log } C'_i\} \qquad \text{s.t.}$$

$$P_t C_i + M_i = R_i$$

$$P_{t+1} C'_i = \mu_{t+1} M_i$$

where μ_{t+1} is the (stochastic) coefficient of money expansion between t and t+1 and M_i agent i's savings. The solution to this program is :

$$C_i = (1-\lambda) \frac{R_i}{P_t}$$

The sum of all young agents' incomes in t is $P_t Y_t$ so that total consumption demand by the young is :

$$C_t = (1-\lambda) Y_t \tag{7}$$

The trade-unions' objective

Since all workers work equally, the representative worker's income is $W_t L_t$. His consumption in the first and second periods are thus :

$$C_t = (1-\lambda) \frac{W_t L_t}{P_t} \qquad C'_{t+1} = \frac{\lambda \mu_{t+1} W_t L_t}{P_{t+1}} = \frac{\lambda M_{t+1} W_t L_t}{M_t P_{t+1}}$$

so that his expected utility, as viewed from the beginning of the first period is :

$$EU_t = E\{(1-\lambda) \text{ Log } C_t + \lambda \text{ Log } C'_{t+1}\}$$

$$= E \text{ Log } \left(\frac{W_t L_t}{P_t} \right) + (1-\lambda) \text{ Log } (1-\lambda) + \lambda \text{ Log } \lambda$$

$$+ \lambda E \left[\text{Log } \left(\frac{M_{t+1}}{P_{t+1}} \right) - \text{Log } \left(\frac{M_t}{P_t} \right) \right]$$

If the trade-union uses the same rule in all periods, the last term will be constant and thus the trade-union should maximize :

$$E \text{ Log } \left(\frac{W_t L_t}{P_t} \right) = E(w_t - p_t + \ell_t)$$

which is the objective function used in the text.