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THE RATIONAL BASIS OF WAGE DETERMINATION IN REGIMES OF HIGH INFLATION

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ABSTRACT

In this paper we address the logic of wage determination in a regime of high and accelerating inflation, and the rational basis of 'overindexation' of wages. We discuss the incentives and costs of wage overindexation to the workers, and the determination of the 'optimal' level of wage adjustment. We argue that the degree of overindexation is likely to increase as negotiations become more centralized at the industry level. However, at near-national levels of wage negotiation, the incentives to overindex become much smaller. We also argue that increasing uncertainty over the future path of inflation tends to increase the degree of indexation of wages.

RESUMEN

En este trabajo analizamos la lógica de la determinación de los salarios en un régimen de inflación alta y acelerada, así como el fundamento racional de la "sobreindización" salarial. Discutimos los incentivos y los costos de la sobreindización salarial para los trabajadores, y la determinación del nivel "óptimo" de ajuste de los salarios. Proponemos que el grado de sobreindización tiende a aumentar conforme las negociaciones se vuelven más centralizadas a nivel de rama industrial. Sin embargo, a niveles aún mayores de centralización, cuando las negociaciones salariales se vuelven casi nacionales, los incentivos para la sobreindización se vuelven menores. También proponemos que una mayor incertidumbre con respecto a la trayectoria futura de la inflación tiende a incrementar el grado de indización salarial.

1. Introduction

The conventional wisdom on the relation between inflationary processes and income distribution is that as inflation accelerates, real wages tend to fall. The reason for this is that money wages are usually indexed to inflation with a lag. This, of course, is only a half-truth. Some wages are only partially indexed to past inflation and others are fully indexed to past inflation, which implies that in both cases (in the first more than in the second) real wages do fall as inflation accelerates. But there are groups of workers whose money wages are "overindexed" in relation to past inflation, and therefore these wages not only fuel the acceleration of inflation but also increase in real terms over time.

Where labor unions are combative and workers very militant, money wages may grow ahead of inflation. Unions are said to be "irresponsible" when trying to overindex wages, for what they are actually doing is creating inflationary pressures which eventually will reduce their real wage. If, instead, wage restraints were the rule, the rate of inflation would fall and the purchasing power of wages would increase. This, again, is only a half-truth. If there were a coordinated process of wage determination, in which all wages were adjusted to inflation simultaneously, and if firms agreed to keep their profit margins constant, the rate of inflation would remain constant, as would real wage differentials. If, furthermore, firms agreed to reduce their profit margins, inflation would fall and real wages would increase.

But usually wages are not determined simultaneously (wage bargaining is scattered over the year) and firms do not have any commitment to a fixed mark-up. Indeed, uncertainty concerning the outcome of negotiations elsewhere in the economy is an essential feature of wage bargaining in decentralized systems. Not only is the effect upon the rate of inflation of the indexation of wages in one firm or industry usually not taken into account by the negotiating union, but even if it were, it may be rational in many circumstances to overindex wages in relation to past inflation. "Rational" in the sense that it might increase the real wage, or at least protect it from unexpected inflationary shocks.

This paper addresses the logic of wage determination in a regime of high and accelerating inflation, and the rational basis of overindexation. Unions look at the inflationary effects of overindexation of wages only to the extent that they might reduce their real wages. Hence, to assume that unions see inflation as "bad" in itself is misleading. Here we shall assume that unions face incentives and costs to increase the degree of indexation of wages, and that only to the extent to which the marginal benefits are greater than the marginal costs will the level of indexation increase. If the result of the wage bargain is inflationary, in principle this should not be seen as a concern of the unions.

There are institutional as well as structural factors accounting for the costs and incentives of overindexation. Given the institutions and the structural factors, it is hopeless to try to impose wage restraints on unions. Two important institutions in this respect are the degree of centralization of wage bargaining and the length of the indexation period of wages. The organization of unions and the degree of mobilization of workers are also quite important. The structural variables are those which affect the market constraints faced by firms in the goods market, such as the level of protection in relation to foreign competitors and the size of entry barriers in a certain industry.

The paper is organized as follows. In section 2 we present the steady-state inflation model which provides the basic relations between the rate of inflation, the indexation period, and the real wage. In section 3 we discuss the incentives and costs of overindexation, and the determination of the "optimal" level of wage adjustment is presented. Section 4 examines the role of the degree of centralization of negotiations on the incentives and costs of overindexation and the relation between uncertainty and overindexation. Section 5 provides the basic lessons to be drawn from the analysis.

2. The Basic System

The aim of this section is to lay down the basic relations between the indexation period, wage and price determination, and distributive variables. The model assumes that negotiations between unions and firms (or groups of firms) take place once a year on the same day, but separately, so that parties at different bargaining tables do not know what is going on in other negotiations. This is meant to reproduce the case in which negotiations are not synchronized (that is, they are spread over the year). The hypothesis that they take place at the same time simplifies the model.

Throughout the year, in between the negotiations, there are N adjustment periods. At the end of each of them, wages are fully indexed and the real wage recovers the peak value of the first day after the new agreement.[1] Over adjustment periods, firms are assumed to increase prices at a fixed rate in order to recover the peak profit margin at the end of the period. Given these assumptions, real wages fall linearly over the period.

The steady-state inflation environment can be described as follows. At the end of each indexation period, wages in all sectors are fully indexed to the average rate of inflation:

1. $$w_{j,\psi} = p_{\psi,\psi}$$

[1] We assume that there is a wage policy which guarantees that at the end of each indexation period wages are fully adjusted.

where $w_{j,\psi}$ and $p_{\psi,\psi}$ stand for variations of wages in sector j and of the average price level over a typical indexation period of length ψ. Over the indexation period, prices in all sectors change to reestablish the peak profit margin,

2. $$p_{j,\psi} = w_{j,\psi} = p_{\psi,\psi}.$$

Taking the year as the unit time period, the length of the indexation period is given by $\psi = 1/N$, where N is the number of indexation periods per year. The relation between the rate of inflation in the indexation period and the annual rate of inflation is given by

3. $$1 + p_t = (1 + p_\psi)^N = (1 + p_\psi)^{1/\psi}$$

where p_t measures the annual rate of inflation over year t. The rate of wage inflation and of prices in all sectors over the typical indexation period can be written as a function of the annual average rate of inflation in the following fashion:

1'. $$1 + w_{j,\psi} = (1 + p_t)^\psi \qquad \text{and}$$

2'. $$1 + p_{j,\psi} = (1 + p_t)^\psi.$$

The average real wage over an indexation period (and the year, for that matter) will be given by the peak wage deflated by the average rate of inflation of the indexation period:

4. $$\omega_{j,t} = \Omega_{j,t} / (1 + p_\delta) \text{ where } \delta = \psi / 2 = 1/(2N)$$

or in terms of the annual rate of inflation,

4'. $$\omega_{j,t} = \Omega_{j,t} / (1 + p_t)^\delta = \Omega_{j,t} / (1 + p_t)^{\psi/2}.$$

These equations show quite clearly that, as noted by Ros (1989), the average real wage depends on the peak wage (as determined during the wage bargain), the annual rate of inflation, and the indexation period.

Wage Bargaining and Price Determination

Wages in each sector j are negotiated once a year, and the new money wage in the first day of year $t+1(W_{j,t+1})$ will be indexed to past inflation according to parameter λ, so that:

5. $$W_{j,t+1}=W_{j,t}(1+\lambda_j p_t)=(1+\lambda_j p_t) \text{ making } W_{j,t}=1.$$

Equation 5 implies that the annual variation in the wage is

5'. $$w_{j,t}=\lambda_j p_t.$$

The indexation parameter λ_j is at least as great as 1, given the assumption that wages are at least fully adjusted to past inflation. Firms are assumed to wait until the negotiations are over before changing prices to reflect the change in their costs. Accordingly, they alter the rate of inflation over the first indexation period after the wage bargaining. At the end of the first indexation period in year $t+1$ (that is, at $t+1+\psi$), the price level in sector j will be given by:

6. $$P_{j,t+1+\psi}=P_{j,t+\psi}(1+\varepsilon_j w_{j,t})=(1+\varepsilon_j\lambda_j p_t)$$

making $P_{j,t+\psi}=1$, where ε_j is the indexation parameter of the price in relation to variations in the wage. The annual variation of the price level in sector j by the end of the first indexation period in t+1 is

7. $$p_{j,t+1+\psi}=\varepsilon_j\lambda_j p_t.$$

The average price level, assuming there are two sectors in the economy, is a weighted average of the price level in sectors 1 and 2:

8. $$P = P^{\alpha_1 *}P^{\beta_2} \qquad \alpha+\beta=1.$$

The annual average rate of inflation at $(t+1)+_\psi$ is given by:

9. $$p_{t+1+\psi}=(\alpha\varepsilon_1\lambda_1+\beta\varepsilon_2\lambda_2)p_t.$$

By the end of the first indexation period, wages will have been eroded according to the ratio between the price level in $(t+1)+\psi$ and the price level at the end of year t. The assumption of full indexation of wages hence implies:

10. $$1+w_{j,\psi}=P_{t+1+\psi}/P_{t+1}=1+p_{t+1+\psi}$$

and the assumption of full recovery of the profit margin at the end of each indexation period implies that

11. $$1+p_{j,\psi}=1+p_{t+1+\psi}.$$

After the first indexation period, the system is reproduced according to the steady-state inflation model described above. Indeed, equations 10 and 11 apply not only to the first indexation period but to all such periods over the year. Accordingly, the annual rate of inflation will be given by

12. $$1+p_{t+1}=[\alpha(1+p_{1,\psi})+\beta(1+p_{2,\psi})]^{1/\psi}=(1+p_{\psi})^{1/\psi}=(P_{t+1+\psi}/P_{t+1})^{1/\psi}.$$

The annual rate of inflation can be decomposed into two factors: one expressing the annual rate of inflation at the end of the first indexation period—$1+t+\psi$—and another expressing the rate of inflation over the first indexation period of year t +1:

13. $$P_{t+1+\psi}/P_{t+1} \equiv (P_{t+1+\psi}/P_{t+\psi})*(P_{t+\psi}/P_{t+1}) = (1+p_{t+1+\psi})(P_{t+\psi}/P_{t+1}).$$

As a result of the relation between the rates of inflation over the year and the indexation periods under the assumption of constant inflation, the following equation ensues:

14. $$P_{t+\psi}/P_{t+1}=(1+p_{t,\psi})^{\psi-1}.$$

Equations 10 to 14 give rise to the following equation for the annual rate of inflation in year $t+1$:

15. $$1+p_{t+1}=\{[1+(\alpha\varepsilon_1\lambda_1+\beta\varepsilon_2\lambda_2)p_t][(1+p_{t,\psi})^{\psi-1}]\}^{1/\psi}.$$

It seems clear from this equation that the rate of inflation will accelerate between years t and $t+1$ when $(\alpha\varepsilon_1\lambda_1+\beta\varepsilon_2\lambda_2)>1$.

The average rate of inflation over $t+1$ depends on the peak real wage, the average rate of inflation over a typical indexation period, and the length of the indexation period. The peak real wage in sector j is given by:

16. $$\Omega_{j,t+1}=(1+\lambda_j p_t)/(1+p_t)$$

since wages in the first day of the year are adjusted to past inflation according to parameter λ_j and prices did not yet adjust to the changes in wage costs. Based on equations 3 and 15, the average rate of inflation over a typical indexation period $t+1$ becomes:

17. $$1+p_\delta=\{[1+(\alpha\varepsilon_1\lambda_1+\beta\varepsilon_2\lambda_2)p_t](1+p_t)^{\psi-1}\}^{1/2}.$$

Equations 15 to 17 give rise to the equation of the average real wage over year $t+1$ under the assumption of constant inflation:

18. $$\omega_{j,t+1}=(1+p_t)^{-\delta-(1/2)}(1+\lambda_j p_t)[1+(\alpha\varepsilon_1\lambda_1+\beta\varepsilon_2\lambda_2)p_t]^{-1/2}.$$

It seems quite clear that the average real wage of workers in sector j depends not only on the peak wage but also on the rate of inflation—both functions of the indexation parameter negotiated between the union and the firm (or firms) in sector j.

FIGURE 1

In figure 1 we depict the movement of the log of the real wage over time. Steady annual inflation implies that the log of the real wage decreases linearly over indexation periods. At the end of each indexation period the wage recovers its peak value. Once a year the wage bargain defines a new peak real wage, and after that, depending on the indexation parameters of wages and prices, a new rate of inflation is determined. For a given length of the indexation period, the average real wage will depend on the peak wage and the rate of inflation. The real wage in year $t+1$ in figure 1 is greater than in the previous year: the peak real wage is greater than in year t, and although inflation accelerated, it offset the increase in the peak wage only partially.

3. The Optimal Indexation of Wages

In order to understand a union's incentives to increase the indexation parameter, we will concentrate on the negotiations between the firm (or firms) and the union in sector 1. We assume that the union in sector 1 will look at the other negotiating unions and firms as homogeneous group. Accordingly, the union will form an expectation of the size of the indexation parameters ε_2 and λ_2, and their product will be represented in what follows by

$$\varepsilon_2^{\,e} * \lambda_2^{\,e} = \phi .$$

The union also has to form an expectation of the indexation parameter to be applied to wage changes by the firm or firms with which it is negotiating. The union recognizes that a smaller indexation parameter increases the real wage, and depending on certain costs and incentives associated with the bargaining process, will impose conflict costs on firms in order to reduce the indexation of prices. However, the union cannot be expected to know what the indexation parameter ε_1 will actually be, and therefore, will be assumed to form a point estimate of it to which we will refer as $\varepsilon_1^{\,e}$.

Given the estimated values of ε_2 and λ_2 and ε_1, and the length of the indexation period $(\delta = \psi/2)$, the incentive to increase the indexation parameter of wages in sector j will depend on the effect of changes in λ_1 on the average real wage. Both the peak wage and the rate of inflation are positively affected by an increase in λ_1. However, it is possible to show that after a certain level of λ_1, the effect of an increase in it will have a positive effect on the average real wage. This is so because the effect over the peak after a certain point dominates the negative effect through the rate of inflation.

The effect of changes in the indexation parameter over the average wage is given by the partial derivative of the latter in relation to the former:

19. $$\gamma\omega_{1,t+1} / \gamma\lambda_1 = \left[(1+p_t)^{-\delta-(1/2)}\left(1+p_{t+1+\psi}\right)p_t\right]\left\{1-\left[1/\,2(1+\lambda_1 p_t)\alpha\varepsilon_1^{\,\varepsilon}\right]/\left[1+p_{t+1+\psi}\right]\right\}.$$

This expression will be positive for λ_1 greater than

20. $$\lambda_1^{*} = [1/\ 2\alpha\varepsilon_1^{e} - 1 - \beta\phi p_t]/[1/\ 2\alpha\varepsilon_1^{e} p_t].$$

In general the critical value λ^* will be smaller than 1.[2] The second derivative of the real wage in respect to the indexation parameter shows that the relation is concave for λ_1 larger than $\lambda_1 ** = \{1.5\alpha\varepsilon_1^{e} - 2[1+(1-\alpha)\phi p_t]/\ [1/\ 2\alpha\varepsilon_1^{e} p_t]$ and that $\lambda_1 ** < \lambda_1 *$ for the relevant values of the parameters.[3, 4]

Figure 2 shows the relation between the average real wage and the indexation parameter in sector 1 for the case in which $\lambda_1 ** < \lambda_1 *$. In what follows we assume that this is the relevant case.

As noted above, we assume that wages are at least fully adjusted to past inflation, which implies that the $\lambda_1 \geq 1$. We are interested in the incentives to the unions to negotiate an increase in the indexation parameter above 1. It seems obvious that, in general, the incentives exist. In what follows we discuss the factors which would qualify this general conclusion.

Unions will face costs in order to increase the indexation parameter above 1. These costs will be greater or smaller depending on the effect such an increase has on the profit margin of the firm (firms) with which the union negotiates and on the support of workers or the level of militancy during negotiation periods.

The basic constraint faced by the firm when negotiating with the union is its capacity to pass along increases in costs to its customers. We assume that in order to maintain its share of the market, the firm (or firms) cannot increase its (their) price above a certain limit. Of course, if the

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2 The condition for $\lambda_1^{*} < 1$ is that

$$\alpha < (1+\phi p_t)/\ ([1/\ 2\varepsilon_1^{e}(1-p_t) + \phi p_t]$$

which, remembering that $\alpha < 1$, will hold if $\varepsilon_1^{e}(1-p_t) \geq 2$. This condition will be satisfied in general. Only if $p_t < 1$ and ε_1^{e} is exceptionally large, will the condition not hold.

3 The second derivative is given by:

$$\gamma^{2}\omega\ /\ \gamma\lambda_1^{2} = 1/\ 2\alpha\varepsilon 1^{e} p_t \left(1+p_t\right)^{-\delta-(1/2)} \left(1+p_{t+1+\psi}\right)^{-(3/2)}$$
$$\{1.5\alpha\varepsilon_1^{e}(1+\lambda_1 p_t) - 2[1+(\alpha\varepsilon_1^{e}\lambda_1) + (1-\alpha)\varepsilon_1^{e}]p_t\}$$

4 Note that $\lambda_1 ** < \lambda_1 *$ when $\alpha < (1+\phi p_t)/\ (\varepsilon_1^{e} + \phi p_t)$ which again will hold except when ε_1^{e} assumes exceptionally large values.

price grows less than the "limit rate of inflation," the firm's share of the market will increase. We represent the constraint faced by the firm with the following relation:

$$p_{1,t+1} = \varepsilon_1 \lambda_1 p_t \leq p^*$$

where p* is the limit rate of inflation. This equation implies

21. $$\varepsilon_1 \lambda_1 \leq k = p^* / p_t.$$

FIGURE 2

The size of the constraint is essentially affected by two variables. One is the degree of centralization of negotiations. It is assumed that the higher the level of aggregation of negotiations within the industry, the smaller the constraint. The reason for this is that when firms operating in the same industry negotiate side by side with a union, their costs rise equally, and therefore the risks of losing market shares associated with different cost conditions become smaller. Also, the elasticity of demand for a substitute set of goods is smaller than the elasticity of

individual goods. It is reasonable to assume that the constraint falls until negotiations reach the industry or branch level (see Calmfors & Driffill, 1988).

The other variable affecting the constraint is the aggregate excess demand conditions of the economy. It is assumed that if the economy is in a recession, the limits to increasing the market share of an individual firm become greater.

Thus, constraint k is really a function of the level of negotiations (α) and the average degree of capacity utilization of the economy (U). Equation 21 can be rewritten to consider these effects:

21'. $$\varepsilon_1 \leq k(\alpha, U)/\ \lambda_1$$

We will take the k constraint exogenously, and assume that firms have full knowledge of the trade-off between the parameters ε_1 and λ_1. The maximum level of ε_1 associated with a certain value of λ_1 is given by the curve $\varepsilon_1 = k / \lambda_1$. If the market constraint falls (due to an increase in the level of wage bargain or an increase in capacity utilization), k increases and the trade-off between ε_1 and λ_1 becomes less stringent.

The average profit margin of firm j in year $t+1$, as defined by the ratio of its price to the wage, is given by the product of the peak profit margin and the average rate of inflation of the price of goods produced in the firm over a typical indexation period:

22. $$\rho_{1,t+1} = [(1+p_t)/(1+\lambda_1 p_t)]\left\{\left[1+\varepsilon_1\left(\frac{\lambda_1}{\lambda_1}\right)p_t\right](1+p_t)^{\psi-1}\right\}^{1/2}$$

The indexation parameter of the price is inversely related to the indexation parameter of the wage if we assume that the equality holds in equation 21'. Indeed, under this assumption, $d\varepsilon_1 / d\lambda_1 = -\varepsilon_1 / \lambda_1$. Hence the derivative of the profit margin with respect to the indexation parameter of the wage, λ, is given by:

23. $$d\rho_1 / d\lambda_1 = -\rho_{j,t+1} p_t \{1/2(\varepsilon_1/\lambda_1)(1+\varepsilon_1\lambda_1 p_t)^{-1} + (1+\lambda_1 p_t)^{-1}\} < 0$$

An increase in the wage indexation parameter is associated with a lower price parameter and a lower profit margin. If the market constraint becomes stronger (lower k), the profit margin associated with a given wage indexation parameter becomes smaller.

If the union wants to increase the indexation parameter of wages it will obviously face the opposition of the firm (firms). If we assume there exists a profit margin which the firm considers "normal" (say, from a long-term perspective), attempts by the union to increase money wages will face an increasing willingness of the firm to impose conflict costs on the union. The willingness of

the firm to impose conflict costs can therefore be seen as a function of the gap between the "normal profit margin" (ρ*) and the margin associated with different levels of the wage indexation parameter and the market constraint:

24. $$C_F = G[\rho^* - \rho_{j,t+1}(\lambda_1, k)] \quad \text{with } G_{\lambda} > 0 \text{ and } G_k < 0.$$

On the side of the union, its capacity to impose conflict costs on the firm depends on the support it has from the workers. If there are reasons for the latter to be dissatisfied with their real wage or the prospects of their real wage over the year after the bargain takes place, they will tend to back up the union's conflicting attitudes. In some circumstances they may even push the union into a more conflicting attitude.

The real wage curve on which the incentives to increase the indexation parameter of wages are based assumes certain expected or estimated values for the indexation parameters of wages and prices in other sectors (φ), for the indexation parameter of the firm (ε_1^e), and for the length of the indexation period (δ). Of course, once the indexation parameter of wages is fixed, any unexpected change in the values of φ, ε_1, or δ will lead to a real wage different from that expected. In particular, as shown by the partial derivatives of equation 18 which follow, an increase in the value of any of the three variables will lead to a reduction of the real wage as compared with the planned wage:

25. $$\gamma\omega_{j,t+1} / \gamma\delta = -\omega_{j,t+1} In(1 + p_t) < 0$$

26. $$\gamma\omega_{j,t+1} / \gamma\varepsilon_1^e = -1/2\omega_{j,t+1}\alpha\lambda_1 p_t (1 + p_{t+1+\psi})^{-1} < 0$$

27. $$\gamma\omega_{j,t+1} / \gamma\phi = -1/2\omega_{j,t+1}\beta p_t (1 + p_{t+1+\psi})^{-1} < 0.$$

In the face of a greater probability that the indexation parameters of wages and prices elsewhere in the economy will be greater than expected $(\lambda_2\varepsilon_2 > \phi)$, and/or that the length of the indexation period may increase, the workers' dissatisfaction will increase, as will their support for a more aggressive attitude by the union.

The relation between the actual real wage and the planned real wage over year $t+1$ depends on the relation between the actual and expected rates of inflation. If we assume that the actual rate of inflation is a random variable with normal distribution, mean $(1 + p_{t+1})$, and standard deviation (σ), and that the union has rational expectations, in the sense that it assumes that the average rate of inflation will prevail when bargaining with firms, the relation between the actual and

expected rates of inflation then becomes a random variable, normally distributed, with mean 1, and fixed standard deviation:

28. $$(1 + p_{t+1}) / (1 + p_{t+1}^{e}) = \tau(1, \sigma)$$

where p_{t+1^e} is the expected average rate of inflation. Given all the information available to it, we may assume that, on average, the union will correctly predict the rate of inflation, and the expected and actual real wage will coincide.

When the actual value of variable τ is different from one, the actual and real wages will differ. Given the indexation parameter of wages in sector 1, the ratio of the planned real wage (based on an expected value of $\lambda_2 \varepsilon_2$ and ε_1) to the actual real wage (based on the actual values of the same variables) will be a positive function of the value assumed by τ and the length of the indexation period:

29. $$\omega(\phi, \varepsilon_1^{e}) / \omega^{a}(\lambda_2 \varepsilon_2, \varepsilon_1) = f[\tau(1, \sigma), \delta] \text{ with } f_\tau, f_\delta > 0.$$

When $\tau > 1$, the actual real wage (ω^a) will be smaller than the expected wage. The longer the indexation period, the greater the difference. It is a generally accepted fact concerning inflationary processes that the variance of the rate of inflation increases with the rate of inflation, that is, that σ is a positive function of p_t [see Frenkel (1979) and Ros (1989)]. If this is indeed the case, then it becomes quite reasonable to expect that the probability of forming mistaken expectations of the rate of inflation on the part of the union would increase as inflation accelerates.

The greater the variance of the rate of inflation, the higher the probability of an unexpected gap between the actual and the estimated real wage, and the greater the likelihood of workers being willing to support preemptive actions on the part of the union. These actions would aim at a reduction in the profit margin of the firm or firms, or in other words, a change in the level of indexation of wages and prices consistent with the market constraint. Workers will not have any guarantee that the firm will in fact reduce its margin, but might be prepared to increase the conflict costs for the firm in order to force it to adjust the admissible level of indexation of wages and prices.

In the face of these considerations, it will be assumed that the willingness of workers to impose conflict costs on the firm (C_W) is positively related to the gap between the expected and the actual real wage—a gap which is likely to be different from zero when the variance of the rate of inflation is positive, and to increase as the variance increases and the length of the indexation period becomes longer:

30. $$C_W = H[\omega_{1,t+1} - \omega_{1,t+1}^{a}] = H\{\omega_{1,t+1}[1 - 1/\ f(\sigma,\delta)]\}$$

with $H_\sigma, H_\delta > 0$. The combination of the workers' and firm's willingness to impose costs on each other gives rise to a "net cost function" of increasing money wages (or λ_1) for the union. The greater the likelihood of an acceleration of inflation over the year and the longer the length of the indexation period, the greater the incentives to workers to impose conflict costs on the firm in an attempt to force the latter to reduce its profit margin. But the greater the increase in money wages, given the market constraint, the smaller the profit margin. The net cost for the union to increase the indexation parameter of the wage will therefore be a positive function of the difference between the willingness of firms to impose costs on workers and the willingness of workers to impose costs on the firms:[5]

31. $$\mu = \mu\left[C_F(\lambda_1, k) - C_W(\sigma, \delta, \lambda)\right].$$

Equation 31 gives rise to a positive relation between the net cost and the wage indexation parameter.[6] The μ curve is depicted in Figure 3. The cost curve will shift upwards the greater the market constraint, and the smaller the variance of inflation or the shorter the length of the indexation period.

The union in sector 1 will consider the incentives and costs to increase the indexation of wages in order to decide on the optimal level of indexation. On the one hand, it will consider the effect of changes in the indexation parameter on the real wage based on estimated values of the indexation parameters of wages and prices elsewhere in the economy, the indexation parameter of the price in sector 1, and the length of the indexation period. On the other hand, the union will consider the costs of increasing wages based on the net effect of the willingness of firms to impose conflict costs on workers (an increasing function of the indexation of wages and the goods market constraint), and the willingness of workers to impose conflict costs on the firm (an increasing function of the variance of inflation and the length of the indexation period).

In short, the union will maximize the difference between the benefits (or incentives) of increasing the indexation of the wage (as measured by the increase in the expected real wage associated with the increase in the money wage) and the costs associated with it, that is:

32. $$\text{Max } \omega(\lambda, \varepsilon_1^{e}, \phi, \alpha, \delta) - \mu(\lambda_1, k, \sigma, \delta).$$

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5 The costs to the workers can be measured in terms of wage losses associated with strikes.

6 We assume the relation to be convex, but it makes no difference for the results if it were linear.

The optimal level of the indexation parameter must satisfy the following condition:

33. $$\gamma\omega(\lambda_1) / \gamma\lambda_1 = \gamma\mu(\lambda_1) / \gamma\lambda_1.$$

FIGURE 3

The equilibrium configuration is depicted in figure 3. The exogenous variables of the system are: the expected values of indexation parameters of wages and prices (including the parameter of price indexation in sector 1), the length of the indexation period, the goods market constraint, the variance of the rate of inflation, and the share of sector 1 in the economy's output and labor force. The endogenous variables are the indexation parameters of the wage and the price in sector 1 and the profit margin in sector 1. The actual real wage will of course depend on

the actual values of the indexation parameters and the actual length of the indexation period. It should be noted that wages are at least fully indexed to the rate of inflation and that, therefore, we should refer to the optimal level of "overindexation" rather than indexation.

4. The Determinants of the Degree of Overindexation

How does the level of centralization of negotiations affect the optimal level of indexation of wages? To answer this question we must consider the way it affects the benefits and net costs of overindexation. An increase in the level of negotiations reduces the goods market constraint and hence reduces the net costs of overindexation of wages. In order to evaluate the effect of an increase in the size of sector 1 on the incentive for overindexation we look at the derivative of the real wage (as estimated by the union) given by equation 18 in relation to the size of the sector:

34. $$\gamma\omega / \gamma\alpha = -\Omega_{1,t+1}[1/\ 2(\varepsilon_1^{\ e}\lambda_1 - \phi)p_t(1+p_t)^{\psi^{-1}}(1+p_{t+1})^{-(3/2)}].$$

This expression is positive for $\varepsilon_1^{\ e}\lambda_1 < \phi$, and vice versa. This implies that for $\lambda_1 < \phi / \varepsilon_1^{\ e}$, an increase in the size of sector 1 will lead to a higher real wage. Because we know that the $\omega(\lambda_1)$ function is concave, the fact that the real wage curve associated with a larger size of sector 1 intersects the curve associated with a smaller size of the sector from above implies that the incentive to overindex will always be smaller the larger the size of the sector. That is, it implies that $\gamma(\gamma\omega / \gamma\lambda_1)/\ \gamma\alpha < 0$. The net result of an increase in the size of sector 1 will depend on the relative reduction of marginal costs and marginal incentives. If marginal costs fall more than marginal incentives, the optimal level of indexation will increase, and vice versa.

It is important to bear in mind that what matters in the decision to fix the optimal level of indexation is not the actual real wage but the real wage as estimated by the union. This is particularly important in the case of increases in the relative size of the negotiating sector. If it is small and increasing, it may happen that the reduction in costs will be clearly perceived by the union (for firms will become more tolerant), but that the negative effect on the incentives will not be perceived. In this case, the level of indexation may well increase in a situation when it would be optimal for workers to reduce it. What matters really is the extent to which the unions and the workers become aware of the actual effect of overindexation on the rate of inflation. It is reasonable to assume that after a certain size of the negotiating sector is reached, it becomes more likely that the union will take notice of the inflationary effects of increasing the indexation parameter.

Beginning at very low levels of aggregation of negotiations, as the size of the negotiating sectors increases, the perceived costs will fall more than the perceived incentives, and therefore

the level of indexation will increase. For very low levels of aggregation, unions may simply not see any effect of an increasing level of aggregation on the real wage. Only when a certain level of aggregation is reached it is reasonable to assume that unions will become aware of the effects of their actions on the rate of inflation, and therefore on the real wage.

In a system in which negotiations are completely centralized, not only will the effects of overindexation of wages on inflation be immediately perceived, but also the effect of the overindexation of prices. In such circumstances, therefore, the limits of overindexation of both wages and prices become very clear, and the result will probably be a reduction in the level of indexation as compared with situations in which the level of negotiations is smaller.

When discussing the costs to the union of overindexation, we noted that they might react to changes in the variance of the rate of inflation. In situations when the rate of inflation is accelerating very fast—as it did in many Latin American economies over the 1980s—the uncertainty concerning the path of inflation in the future (even the near future) becomes quite great. It becomes difficult for agents to anticipate the likely trajectory of inflation. For agents whose indexation periods are flexible (as in the case of firms), the danger of unexpected changes in relative prices is not so important. But in the case of unions, because wage bargaining only takes place one (or at most two or three) time(s) a year, the growing uncertainty concerning the future rate of inflation implies an increasing risk of unexpected reductions in real wages.

In regimes of high and accelerating inflation, workers know by experience that, in general, wages fall more than what they expected at the time of the last negotiation. It is just rational therefore to take preemptive measures. We know from the last section that if the negotiation sector is large enough, the effects of overindexation are likely to be taken into account by the unions; but that in the case of small negotiating sectors, these effects might be completely overlooked. In the latter case, workers and unions might see the effect of their wage bargain on the peak real wage only. If this is indeed the case, the lack of incentives associated with overindexation are underestimated, and the only relevant limits to overindexation are the conflict costs of increasing the indexation parameter.

In fact, the assumption that workers do not see the actual effects of overindexation is not required to show that the optimal level of indexation will increase when uncertainty increases. In section 3 we argued that the willingness of workers to impose conflict costs on firms increases when the variance of inflation increases, and that this would reduce the net costs of overindexation for the union. Hence, an increase in the variance of inflation would tend to reduce the costs of overindexation but would not affect the incentives function. If in addition we assume that workers overlook the disincentives of overindexation, the indexation parameter will be still greater.

5. Concluding Remarks

There are several lessons to be drawn from the foregoing analysis:

1. The overindexation of wages can be seen as the result of a rational decision by unions, and therefore should not be seen as a cultural phenomenon of economies with high inflation, or as a desperate but irrational behavior of workers.

2. There are congenial circumstances for the occurrence of overindexation. In closed economies, or in sectors in which the barriers to entry are important or in which wage bargains are centralized, and therefore the goods market constraints are negligible, overindexation is likely to prevail.

3. The degree of overindexation is likely to increase as negotiations become more centralized at the industry level. Not only because costs may fall more than incentives fall, but also because workers may not see the reduction in incentives. The higher the level of negotiations, the greater becomes the likelihood of unions perceiving the reduction in incentives to overindex wages as the degree of centralization increases.

4. Increasing uncertainty over the future path of inflation, or the increase in the variance of the rate of inflation, tends to increase the willingness of workers to impose conflict costs on firms, and hence tends to reduce the costs to increase the indexation parameter for unions. The longer the indexation period, the greater the reduction in costs.

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