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# Markup, indexation and inflation: a bargaining approach

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**Abstract**

The paper introduces a wage indexation rule into a bargaining framework, and shows that increasing indexation and decreasing competition among firms affects the price level and nominal wage positively. The macroeconomic implication is that there is room for active macroeconomic policies to stabilise output and employment, avoiding or minimising the effects of indexation. © 2001 Elsevier Science B.V. All rights reserved.

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## 1. Introduction

Structuralist–inertialist theories of inflation have tried to explain chronic inflationary processes by introducing official wage indexation in a markup model. The case of Brazilian inflation and its stabilisation plans has been one of the main targets of such theories [see Simonsen (1983), Taylor (1988), Tulio and Ronci (1996) and Silva and Andrade (1996) among others]. However, these theories have failed to present optimising microfoundations. By introducing official wage indexation in a bargaining framework this paper proposes a microfounded model with structuralist–inertialist characteristics.

From a bargaining framework, which allows for official wage indexation, we derive a markup pricing equation. This equation is related to the indexation

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coefficient, the relative bargaining power of workers and firm owners, and competition among firms. In the symmetric equilibrium, where all prices are equal, the determination of nominal and real wages, output and employment follows the determination of prices. The model is closed by considering the macroeconomic policies to stabilise output and employment.

The model presents some traditional structuralist results such as the negative relation between the price level and growing competition among firms and the role of trade unions' power in restraining the markup. The novelty consists in the role of indexation. In an increasing inflationary environment indexation is found to be positively related to the price level and nominal wages. The effect of indexation on real wage is ambiguous. The macroeconomic implication of the model is that there is room for active monetary and fiscal policies to stabilise output and employment.

The paper is divided as follows: Section 2 presents the basic model; Section 3 discusses the symmetric equilibrium of the model and its macroeconomic implications; and Section 4 concludes.

## 2. Model

The model introduces a wage indexation rule into a bargaining framework (Sen and Dutt, 1995). In an inflationary environment with widespread indexation practices, the official indexation rule aims to protect wages against the effects of inflation. The bargaining problem below can be seen as reflecting an attempt to protect wages from inflation in negotiations at the firm level.

Following Sen and Dutt (1995), the market demand function is assumed to be isoelastic, and there are $n$ identical rival firms competing to supply a homogeneous product in an industry $j$. There are $m$ goods in this economy, $j = 1, 2,..., m$, all being imperfect substitutes, and each of them produced in oligopolistic sectors:

$$Y_j = K_j P_j^{-\varepsilon_j} \tag{1}$$

$$Y_j = \sum_{i}^{n} y_{ij} \tag{2}$$

$$y_{ij} = aL_{ij} \tag{3}$$

where $Y_j$ is industry output in sector $j$, $y_{ij}$ being the output of the $i$th firm, $i = 1, 2,..., n$, in the $j$th sector. $K_j$ is a parameter representing factors determining aggregate demand in industry $j$. $P_j$ is the price, and $\varepsilon_j$ is the price-elasticity of demand for good $j$. Eq. (3) is the constant returns production function in which labour ($L$) is the only input, where $a$ is the constant labour–output ratio and $L_{ij}$ is the level of employment of the $i$th firm in the $j$th sector.

The profit maximisation problem of the $i$th firm in the $j$th sector can be written as:

$$\Pi_{ij} = P_j y_{ij} - w_{ij} L_{ij} = \left[P_j - (w_{ij}/a)\right] y_{ij} \tag{4}$$

where $w_{ij}$ is the nominal wage.

The trade union maximises its utility function (see Oswald, 1985):

$$U_{ij} = (w_{ij} - w_{rj}) L_{ij} = (w_{ij} - w_{rj})(y_{ij}/a) \tag{5}$$

where $w_{rj}$ is the reservation wage in industry $j$.

The official indexation rule, given exogenously by the government, can be described as:

$$w_{ij} - \overline{w}_{ij} = \theta(P - \overline{P}), \quad \text{where} \quad \theta \in [0,1] \tag{6}$$

where $\theta$ is the official indexation coefficient,[1] and $\overline{w}_{ij}$ and $\overline{P}$ represent the base nominal wage and price level. The base nominal wage and price level are determined in the previous period.[2] Notice that $P$ is the actual price level, defined as the average weight of prices, $P = \sum_{j}^{m} \beta_j P_j$, where $\beta_j$ is the weight of good $j$, $\sum_{j}^{m} \beta_j = 1$. If $\theta = 1$, the variation in nominal wages is fully indexed to the variation in the price level.

Substituting Eq. (6) into Eqs. (4) and (5), and bearing in mind that there is a linear relationship between the level of employment and output given by Eq. (3), the bargaining problem is a function only of the output level. Thus the output level is chosen to maximise the following bargaining problem:[3]

$$S_{ij} = b_j \log \pi_{ij} + (1 - b_j) \log U_{ij}, \quad \text{where} \quad b_j \in (0,1) \tag{7}$$

where $b_j$ and $(1 - b_j)$ represent the relative bargaining power of firm owners and workers, respectively (the $b_j$ is assumed to be the same for each firm in an industry $j$). If $b_j = 1$ ($b_j = 0$), trade unions (firm owners) have no bargaining power.

[1]A similar equation is used in a different context by Bénassy (1995).

[2]The analysis can be done using other types of indexation. Eq. (6) was chosen due to mathematical convenience.

[3]This is the same procedure used by Sen and Dutt (1995). Moreover, notice that in Eq. (7) the profit function and the trade union's utility function are functions of the price level and industry price, and through Eqs. (1)–(3) the price level and industry price are functions of the output at the firm level.

The first-order condition is given by:

$$1 + y_{ij}\frac{\partial P_j}{\partial y_{ij}}\left[\left(1 - \frac{\theta\beta_j}{a}\right)\left(\frac{b_j}{P_j - \left(\frac{\overline{w}_{ij} + \theta(P - \overline{P})}{a}\right)}\right) + \left(\frac{(1-b_j)\theta\beta_j}{\overline{w}_{ij} - w_{rj} + \theta(P - \overline{P})}\right)\right] = 0 \tag{8}$$

From Eqs. (1) and (2) we can calculate: $\frac{\partial P_j}{\partial y_{ij}} = P'_j(1 + \alpha_{ij})$, where $P'_j = \frac{\partial P_j}{\partial Y_j}$ and $\alpha_{ij} = \frac{\partial \sum_{k \neq i} y_{kj}}{\partial y_i}$ is the parameter of conjectural variations, which denotes firm $i$'s conjectures about the effects of variations in its output on the output of the rivals.

Since firms are identical within an industry: $y_{ij} = y_j$, $\alpha_{ij} = \alpha_j$ and $w_{ij} = w_j$, $\forall i$. Since there are $n$ firms (and the number of firms $n$ is the same in each industry), then $y_j = Y_j/n$. Noting that $\varepsilon_j = -P_j/P'_jY_j$, and substituting into Eq. (8), we obtain:

$$P_j = \left\{1 - (1+\alpha_j)(n\varepsilon_j)^{-1} \times \left[b_j - \theta\beta_j\left(\frac{b_j}{a} - \frac{(1-b_j)\left(P_j - \frac{\overline{w}_{ij} + \theta(P - \overline{P})}{a}\right)}{\overline{w}_{ij} - w_{rj} + \theta(P - \overline{P})}\right)\right]\right\}^{-1} \left(\frac{\overline{w}_{ij} + \theta(P - \overline{P})}{a}\right) \tag{10}$$

Eq. (10) can be expressed as in the Kaleckian markup pricing formula:[4]

$$P_j = (1 + Z_j)(w_j/a) \tag{11}$$

where $Z_j$ is:

$$Z_j = \left\{ 1 - (1+\alpha_j)(n\varepsilon_j)^{-1} \left[ b_j - \theta\beta_j \right.\right.$$

$$\left.\left. \times \left( \frac{b_j}{a} - \frac{(1-b_j)\left( P_j - \dfrac{\bar{w}_{ij} + \theta(P-\bar{P})}{a} \right)}{\bar{w}_{ij} - w_{rj} + \theta(P-\bar{P})} \right) \right] \right\}^{-1} - 1 \quad (12)$$

Eq. (12) presents a problem, since $Z_j$ depends on $P_j$. One way to disentangle this problem is to analyse the case of an industry $j$ whose price does not enter with any great weight in the general price index, and thus whose impact on the price level can be ignored. So, let us assume $\beta_j = 0$. *This simplification leads to the important result that the markup in this sector is not affected by the indexation term*. Moreover, the markup is negatively related to the workers' bargaining power, which is the Kaleckian result derived by Sen and Dutt (1995). As expected, the conjectural variations parameter $(\alpha_j)$ is positively related to the markup.[5] The markup decreases with the number of firms $(n)$ and the price-elasticity of demand $(\varepsilon_j)$.

As a consequence of the assumption, $\beta_j = 0$, the impact of the indexation term $(\theta)$ on the price of good $j$ is positive for increasing price level:

$$\frac{\mathrm{d}P_j}{\mathrm{d}\theta} = \left\{ 1 - (1+\alpha_j)(n\varepsilon_j)^{-1} b_j \right\}^{-1} \left( \frac{(P-\bar{P})}{a} \right) > 0 \Leftrightarrow P > \bar{P}$$

Note that the partial equilibrium considered here is too confining to address some macroeconomic implications of the model, such as the impact of indexation on the price level, nominal and real wages, output and employment. Hence, we need a concept of equilibrium for all prices and quantities. The best way to focus on this issue is through the examination of the symmetric equilibrium.

## 3. Macroeconomic implications of the symmetric equilibrium

The most common concept of equilibrium for macroeconomic models with

[4] Notice that when $\theta = 1$, the $j$th industry price, and hence the price level are still determined by Eq. (10) and $P = \sum_j^m \beta_j P_j$. Therefore the markup formula in Eq. (11) still holds when $\theta = 1$.

[5] In the perfectly competitive case, $\alpha_j = -1$, which implies $Z_j = 0$. In the Cournot case, $\alpha_j = 0$, and then $z = \left[ \dfrac{n\varepsilon_j}{n\varepsilon_j - b_j} - 1 \right]$.

imperfect competition is that of symmetric equilibrium. In order to postulate the existence of a symmetric equilibrium there are conditions that have to be fulfilled.[6] In many settings, it is natural to suppose that firms face the same market demand functions across industries and that they use the same technology. The same demand conditions imply the same elasticity of demand ($\varepsilon_j = \varepsilon$), and the same parameter representing factors determining aggregate demand for the industry ($K_j = K$). Notice, however, that considering optimising households along the lines of Dixit and Stiglitz (1977), Weitzman (1985) and Dutt and Sen (1997), the parameter $K$ would reflect the output and the price level [$K = K(Y,P)$, $K_Y > 0$, $K_P < 0$]. The assumption of common technology and factor endowments implies that costs and labour employment do not differ between sectors (nominal wages and employment are the same). We must expect in such an environment that strategic reactions ($\alpha_j$) faced by firms and the bargaining power of trade unions and firm owners to be the same. As a consequence, prices and quantities for each firm in each industry should be equal.

The symmetric equilibrium for prices, $P_j = P$, allows us to rewrite Eq. (11) using Eqs. (6) and (10) as:

$$P = [1 + Z(\alpha,n,\varepsilon,\theta,\beta,b,P)]w(\theta,P)a^{-1} \tag{11'}$$

The model outlined in Section 3 is a block recursive system of equations.[7] It is formed by Eqs. (1)–(3), (6) and (11′). It must be read as follows: first, Eq. (11′) determines, in implicit form, the equilibrium price level ($P^*$). Given the price level, Eq. (6) determines the optimal nominal wage ($w^*$), since the nominal wage is the same in all industries [$w_{ij} = w(\theta,P^*) = w^*$]. Hence, using Eqs. (11′) and (6), the equilibrium real wage [$w^*/P^* = (w/P)^*$] can be calculated. In the same way, given ($P^*$), from Eq. (1) total output is found [noticing that $Y^* = mY_j = mK(P^*,Y^*)P^{*-\varepsilon}$]. Then, by Eqs. (2) and (3), total level of employment is determined ($Y^* = mY_j = m\sum_i^n y_{ij} = mnaL^*$).

The recursiveness of this system is quite different from a traditional monopolist competition model, as exposited, for example, in Benassi et al. (1994, ch. 5). The difference rests on the use of a bargaining model. To see the differences between our approach and the monopolistic competition model, it is enough to see how the monopolistic competition model works in our framework. The monopolistic competition model analyses the outcome of profit maximisation by maximising Eq. (4) with respect to employment. The first order condition of this maximisation provides a labour demand relation [in the sense of Lindbeck and Snower (1987)]. By assuming an upward supply of labour in relation to the real wage, we could reach

[6] These conditions hold true for homothetic preferences for consumers and identical technologies and factor endowments for firms [see Blanchard and Kyiotaki (1987), Blanchard and Fischer (1989) and Dixon and Rankin (1994)]. For an extension of the Blanchard and Kyiotaki set up see Soskice and Iversen (2000).

[7] For the concept of a block recursive system of equations, see Sargent (1987).

the equilibrium in the labour market, which determines the real wage and employment. This equilibrium from Eqs. (2) and (3) determines the optimal level of output and, then, by Eq. (1), the equilibrium price level can be established.

In contrast, in our model it becomes clear from its block recursive structure that the nominal variables (price level and nominal wage) are the first to be determined followed by real variables (real wage, output and employment). While in the traditional imperfect competition models this causality is inverted, that is, the real variables determine the nominal variables. Consequently this difference between these models has serious implications for the aggregate demand management driven by fiscal and monetary policies, as we explore below.

We can now assess the macroeconomic impact of indexation on the markup, price level, nominal and real wage, output and employment. In order to study the role of indexation in our model, we follow its recursive structure beginning with the impact of indexation on the price level. The effect of a variation in the indexation coefficient on the price level is the following:

$$\frac{\mathrm{d}P^*}{\mathrm{d}\theta} = \frac{[1 + Z(\bullet,P^*)]w_\theta + w(\theta,P^*)Z_\theta}{a - [1 + Z(\bullet,P^*)]w_P - w(\theta,P^*)Z_P} \tag{13}$$

As can be seen from Eq. (13) the effect depends on the markup term and its marginal variations in relation to the indexation coefficient and price level. The sign of Eq. (13) is ambiguous, but is likely to be positive the higher the inflation rate (which makes the term $w_\theta = P^* - \bar{P}$ greater) and the lower the indexation coefficient [which makes $w^*$ adjust slowly in relation to $(P^* - \bar{P})$].[8]

The impact of indexation on nominal wage is:

$$\frac{\mathrm{d}w^*}{\mathrm{d}\theta} = w_P \frac{\mathrm{d}P^*}{\mathrm{d}\theta} + w_\theta$$

which has the same sign as $\mathrm{d}P^*/\mathrm{d}\theta$ for the case of rising inflation (which makes $P > \bar{P}$). Therefore, if an increase in the indexation coefficient increases the price level, then it will increase the nominal wage as well.[9] However, this result does not imply that the real wage will increase with the indexation. The effect of indexation on real wage is given by:

$$\frac{\mathrm{d}(w/P)^*}{\mathrm{d}\theta} = \left(\theta \frac{\bar{P}}{P^*} - \bar{w}\right) \frac{1}{P^*} \frac{\mathrm{d}P^*}{\mathrm{d}\theta} + \frac{P^* - \bar{P}}{P^*}$$

which can be negative since the first term on the right-hand side, which is negative, is greater than the second term.

[8] It is assumed that the average productivity of labour is high ($a \gg 0$), and therefore the denominator term is positive.

[9] The inflationary spiral between prices and wages is common in markup theories. This process is bounded by the loss of competitiveness by firms and the threat of unemployment [see Kalecki (1971) and Vickrey (1992)]. For an empirical analysis on the presence of widespread indexation, see Faria and Carneiro (1997, 2000).

Following the same procedures as above, the impact of indexation on output is given by:

$$\frac{\mathrm{d}Y^*}{\mathrm{d}\theta} = m\frac{\left[K_P - \varepsilon P^{-1}K\right]}{P^{\varepsilon} - mK_Y}\frac{\mathrm{d}P^*}{\mathrm{d}\theta}$$

which can be negative if the denominator is positive, since the numerator is negative.[10] If the effect is negative, a variation of indexation coefficient that leads to an increase in the price level, decreases the output. In the same fashion, as the level of employment is linearly and positively related to output, the impact of indexation on employment would be negative:

$$\frac{\mathrm{d}L^*}{\mathrm{d}\theta} = (mna)^{-1}\frac{\mathrm{d}Y^*}{\mathrm{d}\theta}$$

One of the main characteristics of the model is that the price level, markup, and nominal and real wages are independent of $K$, the aggregate demand parameter. Thus this model shows that prices and wages are sticky with respect to demand fluctuations. As in Sen and Dutt (1995), this result is consistent also with Kalecki's approach where demand changes have an effect only on output and employment level.

Concerning the role of money in the model, the simplest way to introduce it is through the aggregate demand parameter $K$ (see Benassi et al., 1994, ch. 5). Let us assume this parameter depends positively on the quantity of money through a simple quantity-theory-like relation among nominal money ($M$), price level, and aggregate demand: $K = K[Y(M),P]$, $Y' > 0$. Therefore, there is room for an active monetary policy to stabilise output and employment, avoiding or, at least, minimising the impact of indexation.[11]

The macroeconomic role of workers' bargaining power can be analysed in a straightforward manner. Increasing bargaining power of trade unions reduces the markup, which, in turn, decreases the price level and increases output and employment. In the same vein, an increase in the number of firms and/or goods fostering competition decreases the markup and price level, which augments output and employment.

The workings of the model are represented in Figs. 1 and 2. Fig. 1 presents the macroeconomic equilibrium $(Y^*,P^*)$. Fig. 2 presents the active role of monetary policy. It depicts the case in which a change in the indexation term increases markup and wage costs, lifting the price level and decreasing the output (from $A$ to $B$). An exogenous increase in the quantity of money, shifts outwards the aggregate demand curve to point $C$, keeping the initial output and employment level constant.

[10] Recalling that $K$ is a function of $Y$ and $P$.

[11] This relation can be derived from the budget constraint of the households. $K$ can be affected by fiscal policy as well. See Silvestre (1993) for a survey on the role of monetary and fiscal policy effects in a non-competitive economy.

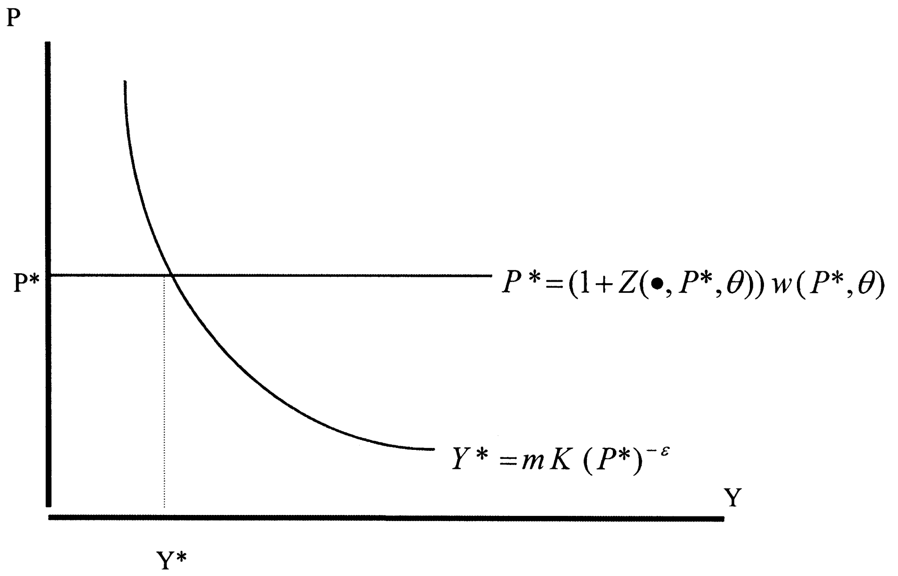


Fig. 1. The macroeconomic equilibrium ($Y^*$, $P^*$).

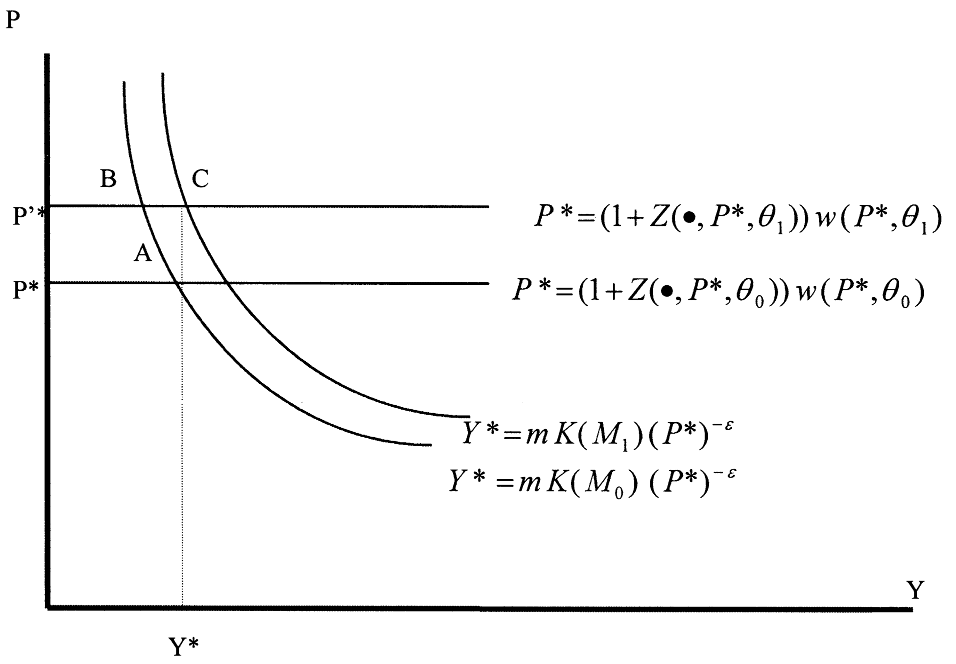


Fig. 2. Effects of monetary policy given an increase in the indexation coefficient.

It is interesting to note that indexation is introduced as a tool to protect wages from inflation. However, as seen above, from the supply side of our model, indexation increases the price level, nominal wages and enlarges the markup when inflation is high, having ambiguous effects on the real wage. In order to fight these negative effects of indexation, the government can stimulate the aggregate demand through appropriate monetary and fiscal policies. At the end of the day the government intervention on the demand side tries to offset or minimise its intervention on the supply side of the economy.

It should be stressed that the scenarios described above are only possible in the short-run where there is pure profits to be bargained between capitalists and workers. One possible long-run condition would be the increasing number of firms or goods in this economy squeezing the pure profits. Other possible long-run scenario would consist of technological barriers to entry, which allows for the existence of pure profits in the long-run. However, these two possibilities imply modifications in the bargaining behaviour of capitalists and trade unions, an analysis which is let for future research.

## 4. Conclusions

This paper introduces a wage indexation rule into a bargaining framework and examines the role of official wage indexation rules in a markup model. The model is an attempt to provide optimising microfoundations to the structuralist and inertialist theories of inflation. The main result of the paper regards the role of indexation. Indexation increases the price level, nominal wage and enlarges the markup in a rising inflationary environment. The effect of indexation on the real wage is ambiguous despite the increase in the nominal wage. Increasing competition among firms and industries and/or increasing workers' bargaining power reduce the markup and the price level. The macroeconomic implications of the model show that there is room for active fiscal and monetary policies to stabilise output and employment, avoiding or minimising the effects of indexation.

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