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WAGE INDEXATION IN AN OPEN ECONOMY WITH TRADED AND NONTRADED GOODS

by

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1. INTRODUCTION

The purpose of the present paper is to analyze the effect of various wage indexation rules on macroeconomic stability in a model of a small open economy with fixed exchange rates. The indexation rules to be considered differ from each other by the extent to which wages are indexed and by the weight attached to each of the goods,- tradeables and nontradeables-, in the price index used to escalate wages.

2. THE MODEL

Production Functions

Output in each of the industries is produced by means of capital and labor. The amount of capital is fixed in each industry and is included in the positive constants A and A* in equations (1) and (2), which describe the production functions of the domestic and tradeable good, respectively. The production functions include a productivity factor, e^{Π_t}, which is common to both industries. The logarithm of the productivity factor, Π_t, is a serially uncorrelated random variable with zero expectation and variance σ_{Π}^2. Input of labor in the domestic and tradeable good industry is denoted, respectively, by L_t and L_t^*; α is a positive fraction. Equations (3) and (4) describe the production functions in terms of the logarithms of output and labor input. (In the following the logarithm of any variable X will be denoted by x).

(1) $$Y_t = Ae^{\Pi_t} L_t^{\alpha}$$

(2) $$Y_t^* = A^* e^{\Pi_t} L_t^{*\alpha}$$

(3) $$y_t = a + \Pi_t + \alpha \ell_t$$

(4) $$y_t^* = a^* + \Pi_t + \alpha \ell_t^*$$

Demand Functions

The demand for each of the goods is a function of its own price, the price of the other good and money balances. The logarithm of the price of tradeables, μ_t, is a serially uncorrelated random variable with zero expectation and variance σ_μ^2. The logarithm of money supply is composed of an endogenous term, m_t, and an exogenous term, ε_t, which is a serially uncorrelated random variable with zero expectation and variance σ_ε^2. Tradeables and domestic goods are gross substitutes in demand. This assumption imposes the restriction that $\eta - \delta > 0$, so that by equation (6) the cross elasticity of demand for tradeables with respect to the price, p_t, of domestic goods is positive. Equations (5) and (6) describe the logarithm of the demand for domestic and tradeable goods, respectively.

(5) $$d_t = \eta\mu_t - (\eta + \delta)p_t + \delta(m_t + \varepsilon_t)$$

(6) $$d_t^* = -\eta\mu_t + (\eta - \delta)p_t + \delta(m_t + \varepsilon_t)$$

Trade Balance

Money being the only financial asset available, any increase in the endogenous money supply equals the trade balance surplus, so that identity (7) holds:

(7) $$M_t - M_{t-1} = e^{\mu_t}(Y_t^* - D_t^*)$$

This identity can be linearly approximated[1/] by equation (8):

(8) $$m_t - m_{t-1} = k(y_t^* - d_t^*)$$

The Labor Market

Wages for any period t are determined before the realizations of the random variables of that period have become known. At the time wages for the next period are determined, labor is completely mobile between the industries. Once the realizations of the random variables have become known, labor becomes completely immobile. Wage contracts afford employers the opportunity to determine actual

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1/ A Taylor expansion of M_t and M_{t-1} around $\overline{M}$ yields, neglecting nonlinear terms:

$$M_t \simeq \overline{M}m_t - \overline{M}\ \ln \overline{M} + \overline{M}$$

$$M_{t-1} \approx \overline{M}m_{t-1} - \overline{M}\ \ln \overline{M} + \overline{M}$$

so that

$$M_t - M_{t-1} \approx \overline{M}(m_t - m_{t-1})$$

Similarly expansion of $e^{\mu_t}Y_t^*$ and $e^{\mu_t}D_t^*$ around $\overline{Y}$ yields:

$$e^{\mu_t}Y_t^* \approx \overline{Y}(\mu_t + y_t^*) - \overline{Y}\ \ln \overline{Y} + \overline{Y}$$

$$e^{\mu_t}D_t^* \approx \overline{Y}(\mu_t + d_t) - \overline{Y}\ \ln \overline{Y} + \overline{Y}$$

so that

$$e^{\mu_t}(Y_t^* - D_t^*) \approx \overline{Y}(y_t^* - d_t^*)$$

Define $k = \frac{\overline{Y}}{\overline{M}}$ and equation (8) follows.

labor input after the realizations of the random variables have become known, subject to certain restrictions to be discussed below. Assuming for the moment that those restrictions are ineffective, labor input will be set so as to equalize the value of marginal product of labor with nominal wages.[1/] Consequently, input of labor in each of the industries is described by equations (9) and (10):

$$L_t = \left[\frac{W_t^{1-\beta}\left(Z_t P_t^{\gamma} \left(e^{\mu_t}\right)^{1-\gamma}\right)^{\beta}}{P_t \, \alpha A e^{\Pi_t}}\right]^{1/\alpha-1} \tag{9}$$

$$L_t^{*} = \left[\frac{W_t^{1-\beta}\left[Z_t P_t^{\gamma} \left(e^{\mu_t}\right)^{1-\gamma}\right]^{\beta}}{e^{\mu_t} \, \alpha A^{*} \, e^{\Pi_t}}\right]^{1/\alpha-1} \tag{10}$$

where β is the degree of wage indexation, γ the weight attached to the domestic good in the price index used to escalate wages, W_t the predetermined nominal wage rate, and Z_t the wage rate in terms of a base period. The logarithms of labor input are given by equations (11) and (12).

1/ In this paper, it is assumed that the indexation formula is the same in both industries. The case of different indexation rules will be taken up separately.

(11) $$\ell_t = \frac{1}{1-\alpha}[p_t + \ln\alpha + a + \Pi_t - (1-\beta)w_t - \beta z_t - \beta\gamma p_t - \beta(1-\gamma)\mu_t]$$

(12) $$\ell^*_t = \frac{1}{1-\alpha}[\mu_t + \ln\alpha + a^* + \Pi_t - (1-\beta)w_t - \beta z_t - \beta\gamma p_t - \beta(1-\gamma)\dot{\mu}_t]$$

The restriction imposed by wage contracts on employers' ability to acquire, ex post, any amount of labor according to their demand function is that workers agree to supply an amount of labor that differs from that they anticipated to supply only if there is some objective circumstance that causes employers to deviate from that level of labor input. Specifically, workers in the domestic good industry agree to increase the amount of labor supplied beyond the anticipated level only if the real wage of a productivity unit of labor in terms of the domestic good happens to be lower than anticipated. They agree to a decrease in the amount of labor employed below the anticipated level only if the real wage of a productivity unit of labor in terms of the domestic good is larger than anticipated. Workers in the tradeable good industry act similarly, except that their standard of reference is the real wage of a productivity unit of labor in terms of the tradeable good.

Given this restriction, any individual employer has an incentive to secure himself a labor force of a size that renders the restriction on actual employment ineffective, whatever the realization of the random variables. This level, $\tilde{L}_t$ and $\tilde{L}^*_t$ for the domestic and tradeable good industry, respectively, is given by equations (13) and (14).

(13) $$\tilde{L}_t = \left[\frac{W_t^{1-\beta}(Z_t \hat{P}_t^{\gamma} (e^{\hat{\mu}_t})^{1-\gamma})^{\beta}}{\hat{P}_t \, \alpha A e^{\hat{\Pi}_t}}\right]^{1/\alpha-1}$$

$$\tilde{L}^*_t = \left[\frac{W_t^{1-\beta}(Z_t\hat{P}_t^{\gamma}\,(e^{\hat{\mu}_t})^{1-\gamma})^{\beta}}{e^{\hat{\mu}_t}\,\alpha A^* e^{\hat{\Pi}_t}}\right]^{1/\alpha-1} \tag{14}$$

Comparison of (9) to (13) and (10) to (14) yields that

$$L_t \overset{(=)}{>} \hat{L}_t \quad \text{iff} \quad \frac{W_t^{1-\beta}[P_t^{\gamma}(e^{\mu_t})^{1-\gamma}]^{\beta}}{P_t\, e^{\Pi_t}} \overset{(=)}{<} \frac{W_t^{1-\beta}[\hat{P}_t^{\gamma}(e^{\hat{\mu}_t})^{1-\gamma}]^{\beta}}{\hat{P}_t\, e^{\hat{\Pi}_t}}$$

$$L^*_t \overset{(=)}{>} \tilde{L}^*_t \quad \text{iff} \quad \frac{W_t^{1-\beta}[P_t^{\gamma}(e^{\mu_t})^{1-\gamma}]^{\beta}}{e^{\mu_t}\, e^{\Pi_t}} \overset{(=)}{<} \frac{W_t^{1-\beta}[\hat{P}_t^{\gamma}(e^{\hat{\mu}_t})^{1-\gamma}]^{\beta}}{e^{\hat{\mu}_t}\, e^{\hat{\Pi}_t}}$$

These conditions suggest that if employers secure themselves a labor force that is given by (13) and (14), they will not be restricted as to their actual labor input. Note that for the individual employer no cost need be incurred to acquire the labor force given by (13) and (14), so that these equations describe the demand for labor when wages for the next period are determined.

Labor supply at the point of time where wages for the next period are determined is an increasing function of the anticipated real wage, which equals the anticipated nominal wage deflated by the price index relevant for labor, which is not necessarily the same as that used to escalate wages. Equation (15) describes the labor supply function.

(15) $$L^s_t = \frac{W_t^{1-\beta}(Z_t \hat{P}_t^{\gamma} (e^{\hat{\mu}_t})^{1-\gamma})^{\beta}}{\hat{P}_t^{\lambda} (e^{\hat{\mu}_t})^{1-\lambda}}$$

It is assumed that all participants in the labor market are indifferent between any given nominal wage rate and a real wage rate with equal anticipated nominal value. This assumption is expressed by equations (16) and (17)

(16) $$W_t = Z_t \hat{P}_t^{\gamma} (e^{\hat{\mu}_t})^{1-\gamma}$$

(17) $$w_t = z_t + \gamma \hat{p}_t + (1-\gamma)\hat{\mu}_t$$

Formation of Expectations

Expectations are formed rationally. In particular, the expected value of the exogenous random variables μ_t and Π_t equals its mathematical expectation, which is zero. The expected value of the logarithm of the domestic price level equals its mathematical expectation which is calculated by using the model of the economy. Equations (18)-(20) summarize the formation of expectations:

(18) $$\hat{\mu}_t = E(\mu_t) = 0$$

(19) $$\hat{\Pi}_t = E(\Pi_t) = 0$$

(20) $$\hat{p}_t = E(p_t)$$

Equilibrium

Equilibrium in the domestic goods market is obtained if demand for that good equals its supply:

$$(21) \qquad d_t = \eta\mu_t - (\eta + \delta)p_t + \delta(m_t + \varepsilon_t) = a + \Pi_t + \alpha\ell_t = y_t$$

The equilibrium value of wages is determined by equality of economy wide demand for and supply of labor, as described by equations (13), (14) and (15):

$$(22) \qquad \left(\frac{W_t}{\alpha}\right)^{1/\alpha-1} \left([A\hat{P}_t]^{1/1-\alpha} + A^{*\,1/1-\alpha}\right) = \frac{W_t}{\hat{p}_t^{\lambda}}$$

where use has been made of (16), (18) and (19). Assuming A^* relatively small as compared to AP_t, the logarithmic transformation of (22) will be approximated by equation (23):

$$(23) \qquad (1/\alpha-1)\, w_t + (1/1-\alpha)\ln\alpha + (1/1-\alpha)a + (1/1-\alpha)\hat{p}_t = w_t - \lambda\hat{p}_t$$

Solution

Equations (3), (4), (5), (6), (8), (11), (12), (17), (20), (21) and (23) can be solved for the endogenous variables y_t, y_t^*, ℓ_t, ℓ_t^*, d_t, p_t, m_t, d_t^*, w_t, z_t, $\hat{p}_t$ in terms of the exogenous variables Π_t, ε_t, μ_t, and m_{t-1}.

The solutions for p_t, m_t, y_t, y_t^* and d_t^* are given by equations (24)-(28), neglecting unimportant constants.

(24) $$p_t = \frac{(1-\alpha)\delta}{\alpha\Omega} m_{t-1} - \frac{1}{\alpha\Delta}\Pi_t + \frac{(1-\alpha)\eta(1+2k\delta) + \alpha\beta(1-\gamma)+\alpha k\delta}{\alpha\Delta}\mu_\tau + \frac{(1-\alpha)\delta}{\alpha\Delta}\varepsilon_t$$

where:

$$\Delta \equiv 1 + k\delta + \frac{1-\alpha}{\alpha}(\eta+\delta + 2k\delta\eta) - \beta\gamma$$

$$\Omega \equiv \Delta+\beta\gamma - \frac{1+(1-\alpha)\lambda}{2-\alpha}$$

(25) $$m_t = \frac{(\eta+\delta)\frac{1-\alpha}{\alpha} + \frac{(1-\alpha)(1-\lambda)}{2-\alpha}}{\Omega} m_{t-1} + \frac{k(1 + 2\frac{1-\alpha}{\alpha}\eta)}{\Delta}\left(\frac{\Pi_t}{1-\alpha} - \delta\varepsilon_t + [\delta+(1-\beta)\frac{\alpha}{1-\alpha}]\mu_t\right)$$

(26) $$y_t = \frac{(1-\alpha)(1-\lambda)\delta}{\Omega(2-\alpha)} m_{t-1} + \frac{k\delta + \frac{1-\alpha}{\alpha}(1 + 2k\delta)\eta + \frac{1-\alpha}{\alpha}\delta}{(1-\alpha)\Delta}\Pi_t$$

$$+ \frac{(1-\beta\gamma)}{\Delta}\varepsilon_t + \frac{\alpha k\delta(1-\beta) - \beta(1-\gamma)\delta(1-\alpha) + (1-\beta)(1-\alpha)\eta(1 + 2k\delta)}{(1-\alpha)\Delta}\mu_t$$

(27) $$y^*_t = \frac{\frac{1+(1-\alpha)\lambda}{2-\alpha}\delta}{\Omega + m} m_{t-1} - \frac{\delta\beta\gamma}{\Delta}\varepsilon_t + \frac{(\eta+\delta)\frac{1-\alpha}{\alpha} + \delta k(1 + 2\frac{1-\alpha}{\alpha}\eta) + 1}{(1-\alpha)\Delta}\Pi_t$$

$$+ \frac{(1-\beta)[\eta + \delta + \frac{\alpha}{1-\alpha} + k\delta(2\eta + \frac{\alpha}{1-\alpha})\delta\beta\gamma}{\Delta}\mu_t$$

(28) $$d^*_t = \frac{2\eta\frac{1-\alpha}{\alpha}\delta + \delta\frac{(1-\alpha)(1-\lambda)}{2-\alpha}}{\Omega} m_{t-1} + \frac{\alpha k\delta + \eta(1-\alpha)(2k\delta - 1) + \delta(1-\alpha)}{\alpha(1-\alpha)\Delta}\Pi_\tau$$

$$+ \frac{2\eta\delta\frac{1-\alpha}{\alpha} + \delta(1-\beta\gamma)}{\Delta}\varepsilon_t + \frac{\eta(\beta-1) - \delta\beta(1-\gamma) - 2\eta\delta\frac{1-\alpha}{\alpha} + k\delta(1-\beta)(2\eta+\frac{\alpha}{1-\alpha})}{\Delta}\mu_t$$

Short-Run Stability

From equation (26) we have the familiar result that full indexation to domestic prices insulates output of the domestic good completely from monetary disturbances at home. Similarly, it can be seen that the effect on output of domestic goods of productivity disturbances is brought to a minimum[1/] if $\beta\gamma = 0$, i.e., if there is no indexation to the price of the domestic good.[2/] A new element that has not been considered before concerns the effect on domestic output of wage indexation in face of foreign disturbances that manifest themselves in the price of the traded good. From equation (26) we have that β and γ can be chosen so that disturbances in the price of the traded good will not affect output of the domestic good. The values of β and γ that yield this result are described by equation (29)

$$(29) \qquad \beta = \frac{\alpha k\delta + (1 - \alpha)\eta(1 + 2k\delta) + \beta\gamma\delta(1-\alpha)}{\alpha k\delta + (1-\alpha)\eta(1 + 2k\delta) + \delta(1-\alpha)}$$

Note that a particular solution of (29) is obtained for $\beta = \gamma = 1$, that is full indexation to the price of the domestic good. Note also that (29) cannot hold if there is no indexation at all ($\beta = 0$), so that there must be at least partial wage indexation to stabilize output of the domestic good in view of foreign price disturbances.

1/ Attention here will be restricted to values of β and γ between zero and one.

2/ As far as stability of domestic output in view of productivity shocks is concerned, it is sufficient to set either β or γ equal to zero, one degree of freedom being left for the choice of one of these parameters according to other considerations.

From equation (27) the impact of various indexation rules on output in the traded good industry can be derived. It can be seen that output of the tradeable good will be insulated from domestic monetary shocks if wages are not linked to the price of domestic goods. As far as the effect of productivity shocks on output is concerned, we have the same result as with output of domestic goods. Output of the tradeable good industry can be insulated completely from foreign price shocks by indexing wages to the price of tradeables ($\beta = 1$, $\gamma = 0$). Note then that as far as short-run stability of output in the tradeable good industry is concerned, the variability minimizing indexation rule is to link wages completely to the price of tradeables, whatever the source of the disturbance.

These results suggest that in addition to the trade-off created by different indexation rules, between stability of output in view of monetary and real disturbances, there is an additional tradeoff between stability of output in the domestic and tradeable good industries.

Yet, it could be argued that stability of output in the tradeable good industry should not be attached any importance, as long as stability of consumption of the tradeable good is maintained by means of an appropriate trade balance surplus or deficit. Consider therefore the effect of different wage indexation rules on the demand for tradeables, which equals consumption. From equation (28) we have that wages should not be linked to domestic prices as far as stability of demand in view of productivity shocks is concerned. The stability maximizing value of $\beta\gamma$ depends on the sign of $(\eta-\delta) - \delta k((\alpha/1-\alpha) + 2\eta)$, as follows:

$$\text{If } \eta-\delta - \delta k((\alpha/1-\alpha) + 2\eta) > 0 \quad \text{then } \beta\gamma = 0$$

$$\text{If } \eta-\delta - \delta k((\alpha/1-\alpha) + 2\eta) < 0 \quad \text{then } \beta\gamma = 1$$

As far as stability of demand with respect to the price of tradeables is concerned, we have that the combinations of β and γ described by equation (30) insulate demand completely from disturbances.

$$(30) \qquad \beta = 1 + \frac{\delta(1-\beta\gamma) + 2\eta\delta\frac{1-\alpha}{\alpha}}{\eta-\delta - k\delta(2\eta + \frac{\alpha}{1-\alpha}}$$

A necessary condition for equation (30) to yield values of β and γ between zero and one is that $\eta - \delta - \delta k((\alpha/1-\alpha)+2\eta)<0$. If this condition does not hold, wages should be linked entirely to the price of the traded goods $(\beta = 1, \gamma = 0)$.

Consequently, if $\eta - \delta - \delta k((\alpha/1-\alpha)+ 2\eta) > 0$ demand for tradeables is stabilized in view of all disturbances if full wage indexation to the price of tradeables prevails. If $\eta - \delta - \delta k((\alpha/1-\alpha) + 2\eta) < 0$ there is a tradeoff between stability of demand in view of monetary and real disturbances. In any case, there will be an additional tradeoff between stability of demand for tradeables and stability of output of domestic goods.

Long-Run Stability

A common measure for long-run stability is the asymptotic variance of the economy's real variables. The asymptotic variances of output in each of the sectors and of the demand for tradeables are described by equations (31)-(33):

$$(31) \qquad \sigma_y^2 = \frac{V}{\Delta^2}\{\frac{\sigma_\Pi^2}{(1-\alpha)^2} + \delta^2\sigma_\varepsilon^2 + (\delta + (1-\beta)\frac{\alpha}{1-\alpha})^2\sigma_\mu^2\} + \frac{1}{\Delta^2}\{(\frac{k\delta + (1-\alpha/\alpha)(1+2h\delta)\eta + (1-\alpha)/\alpha\delta^2}{1-\alpha})\sigma_\pi^2$$

$$+ (1-\beta\gamma)^2\delta^2\sigma_\varepsilon^2 + (\frac{\alpha k\delta(1-\beta) - \beta(1-\gamma)\delta(1-\alpha) + (1-\beta)(1-\alpha)\eta(1+2k\delta)}{1-\alpha})^2\sigma_\mu^2\}$$

where:

$$V \equiv \frac{[\frac{(1-\alpha)(1-\lambda)}{2-\alpha}]^2\delta k(1 + 2\frac{1-\alpha}{\alpha}\eta)}{k\delta(1 + 2\frac{1-\alpha}{\alpha}\eta) + 2(\frac{(1-\alpha)(1-\lambda)}{2-\alpha} + \frac{1-\alpha}{\alpha}(\eta+\delta))}$$

(32) $$\sigma^2_{y*} = \frac{V}{\Delta^2}\left(\frac{1+(1-\alpha)\lambda}{(1-\alpha)(1-\lambda)}\right)^2 \left\{ \frac{\sigma^2_\pi}{(1-\alpha)^2} + \delta^2\sigma^2_\varepsilon + (\delta + (1-\beta)\frac{\alpha}{1-\alpha})^2 \sigma^2_\mu \right\}$$

$$+ \frac{1}{\Delta^2}\{(\delta\beta_\gamma)^2\sigma^2_\varepsilon + \left[\frac{\frac{1-\alpha}{\alpha}(\eta+\delta) + \delta k(1 + 2\frac{1-\alpha}{\alpha}\eta) + 1}{1 - \alpha}\right]^2 \sigma^2_\pi$$

$$+ [(1-\beta)(\eta+\delta + \frac{\alpha}{1-\alpha} + k\delta \; (2\eta + \frac{\alpha}{1-\alpha})) + \delta\beta_\gamma]^2\sigma^2_\mu\}$$

(33) $$\sigma^2_d = \frac{V}{\Delta^2}\frac{(2\eta/\alpha + (1-\lambda)/(2-\alpha))^2}{((1-\lambda)/(2-\alpha))^2}\left(\frac{\sigma^2_\pi}{(1-\alpha)^2} + \delta^2\sigma^2_\varepsilon + (\delta + (1-\beta)\frac{\alpha}{1-\alpha})^2\sigma^2_\mu\right\}$$

$$+ \frac{1}{\Delta^2}\{\left(\frac{\alpha k\delta + \eta(1-\alpha)(2k\delta - 1) + \delta(1-\alpha)}{\alpha(1-\alpha)}\right)^2\delta^2_\pi + (2\eta\delta\frac{1-\alpha}{\alpha} + \delta(1-\beta_\gamma))^2\sigma^2_\varepsilon$$

$$+ [\eta(\beta-1) - \delta\beta(1-\gamma) - 2\eta\delta\frac{1-\alpha}{\alpha} + k\delta(1-\beta)(2\eta + \frac{\alpha}{1-\alpha})]^2\sigma^2_\mu\}$$

The analysis of the impact of different wage indexation rules on the asymptotic variance of output of domestic goods and demand for tradeables is in general complicated. Therefore particular cases that lend themselves to easy analysis will be considered.

Case 1: $\sigma^2_\mu = 0$

In this case the value of $\beta\gamma$ that minimizes the asymptotic variance of output of domestic goods is given by equation (34):

(34) $$\beta\gamma = 1 - \frac{V(\sigma^2_\varepsilon\delta^2 + \sigma^2_\pi/(1-\alpha)^2) + \left(\frac{k\delta + (1-\alpha)/(1+2k\delta)\eta + (1-\alpha)/\alpha}{\alpha}\right)^2\sigma^2_\pi}{\delta^2\sigma^2_\varepsilon[k\delta + \frac{1-\alpha}{\alpha}(\eta+\delta + 2k\delta\eta)]}$$

From (34) we have that the variance minimizing value of $\beta\gamma$ is always smaller than one and may be zero. Furthermore, while this value of $\beta\gamma$ is a decreasing function of the variance of productivity disturbances, the effect of changes in the variance of monetary disturbances on the optimal value of $\beta\gamma$ is ambiguous. Note also that even if there is no variability at all in productivity, long-run stability of output will be maximized by indexing wages partially to the price of domestic goods. This result differs from those arrived at by various authors[1/] who discussed the effects of wage indexation on output in closed economies, as well as the result derived above as far as short-run stability is concerned, namely that full wage indexation insulates output from monetary disturbances.

The fact that partial wage indexation minimizes the variance of domestic output in the model presented here has to do with the possibility of relative price changes which cause labor to move between industries. To demonstrate this, consider an increase in money supply at time t due to a monetary disturbance. From equation (25) we have that this disturbance causes a decrease in the endogenous part of the money supply, via a balance of payments deficit, which will be larger the higher the value of $\beta\gamma$. It is clear from equation (26) that the monetary disturbance will have a contemperaneous effect on output of the domestic good only if wages are not fully indexed. However, in period $t+1$ the only impact left by the monetary disturbance in the previous period will be the decrease in m_t, which affects the price level in period $t+1$ by equation (24). From that equation we have that the price level in period $t+1$ will be lower, and the more so the higher the value of $\beta\gamma$. As expectations are formed rationally the price decrease will be taken into account when wages for period $t+1$ are determined. From (23) we have that the nominal wage rate will decrease but to a smaller extent than the expected decrease

1/ See, for example, Gray [2], Fischer [1], and Razin and Lusky [3].

in domestic prices. As a result the expected real wage in terms of the domestic good will be lower so that the labor force in the domestic good industry will shrink, and output in period $t+1$ will be smaller on average than that in period t. Yet, the decrease in output is aggrevated by indexing wages completely to domestic prices, since in that case the decrease in the price level in period $t+1$ will be the highest. Therefore there is a tradeoff between short-run and long-run stability of output in the domestic good industry in view of monetary disturbances.

Case 2: $\sigma_\pi^2 = \sigma_\varepsilon^2 = 0$

In this case partial wage indexation will generally minimize the asymptotic variance of output of domestic goods. It can be shown that the optimal value of β must be larger than zero while the optimal value of γ must be smaller than one. Note that from equation (26) we had that full indexation to the domestic good insulated output from disturbances in the price of the traded good. Similarly, any other combination of β and γ that amounted to full indexation to the domestic good achieved the same result. Yet, in the long-run full indexation to the price of the domestic good is not desirable any longer, essentially for the same reasons that were pointed out in Case 1.

As far as the asymptotic stability of the demand for tradeables is concerned we have a particular case when $\eta - \delta - \delta k((\alpha/1-\alpha)+2\eta) > 0$. If this condition is fulfilled, the asymptotic variance is minimized if wages are linked entirely to the price of tradeables ($\beta = 1, \gamma = 0$). If $\eta - \delta - \delta k(\frac{\alpha}{1-\alpha} + 2\eta) < 0$ and $\sigma_\mu^2 = \sigma_\varepsilon^2 = 0$ the same result holds. For all other cases the results are not clearcut.

The asymptotic stability of output in the tradeable good industry is minimized by indexing wages entirely to the price of tradeables ($\beta = 1, \gamma = 0$).

3. CONCLUSIONS.

One conclusion to be drawn from the above analysis is that the case for full wage indexation in an economy that is subject to monetary disturbances seems to have been overstated. It has been shown that if relative price changes are admitted which cause labor to move between industries, partial wage indexation is preferable to full wage indexation as far as long-run stability of output of the domestic good in view of monetary disturbances is concerned.

Furthermore, it has been shown that in addition to the tradeoff between output stability in case of monetary disturbances and output stability in case of productivity disturbances, there are tradeoffs between stability of output in different industries that have to be taken into consideration when optimal wage indexation rules are discussed.

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