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INDEXING AND INFLATION

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ABSTRACT

Much of the opposition to indexation as a means of adapting to ongoing inflation arises from the view that indexation is itself inflationary. This paper examines the basis for that view in a simple macroeconomic model in which budget deficits are in part financed through the printing of money. It is shown that all aspects of indexing--wage indexation, bond indexation, and tax indexation--tend to increase the impact on the price level of any inflationary shock. However, this association between indexation and inflation is in large part a consequence of the monetary and fiscal policies being followed by the government.

Evidence from a cross-section of forty countries on the effects of indexation on the inflationary impact of the oil price shock of 1974 suggests that indexation did not in general increase the inflationary impact of the oil shock. However, the impact of the oil shock was significantly stronger in those countries that had adopted bond indexation.

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INDEXING AND INFLATION

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The main reason governments are reluctant to adopt price indexation in their own transactions and encourage its use in the private sector is that indexing is thought to be inflationary.[1] The argument is that an indexed economy inflates more, and more rapidly, in response to an inflationary shock than does a non-indexed economy, given the monetary and fiscal policies being followed. It is also argued that the will to fight inflation is weakened when the costs of inflation are reduced by indexing - equivalently, that the adoption of indexing affects the choice of policies.

The question examined in this paper is whether indexing is inflationary. Section I reviews a simple model that has previously been used to examine the effects of wage indexation on the price level and level of output. Then in Section II the model is expanded to include the government budget. Deficits are assumed to be financed in part through the printing of money. It is shown that all aspects of indexing--wage indexation, bond indexation, and tax indexation--tend to increase the impact on the price level of any inflationary shock. However, this association between indexation and inflation is in large part a consequence of the monetary and fiscal policies being followed by the government.

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1. Another reason for government reluctance to index, which applies particularly to indexation of the taxation of returns on capital, is that it is complicated. While this is no doubt true, the right question to ask is not whether perfect indexation is possible, but rather whether workable imperfect indexing is better than none at all.

Evidence from a cross-section of forty countries on the effects of indexation on the inflationary impact of the oil price shock of 1974 suggests that indexation did not in general increase the inflationary impact of the oil shock. However, the impact of the oil shock was significantly stronger in those countries that had adopted bond indexation.

I. Review.

There are at least two distinct senses in which indexing might be said to be inflationary. First, the impact on the price level of any given inflationary disturbance might be larger in an indexed than in a non-indexed economy.[2] It is probably in this first sense that it is commonly argued that indexing is inflationary. Second, the average price level or inflation rate might be higher in an indexed than in a non-indexed economy, given the monetary and fiscal policies being followed and the distribution of the disturbances affecting the economy.

Earlier United States literature on the effects of indexation on stability centered on the relationship between wage indexation and the variability of output and prices (Gray 1976, Fischer 1977, and Blanchard 1978). The conclusion on the price side was that wage indexing speeds up the transmission of shocks to the price level implying that wage indexing is inflationary in the first sense. Given the assumed constancy of the money stock, the extent of wage indexing has no effects on the average price level or inflation rate, implying that wage indexing is not inflationary in the second sense.

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2. If indexing is inflationary in the first sense, then a deflationary shock produces a larger impact on the inflation rate in an indexed than in a non-indexed system. It was in this context of deflationary policy that the virtues of Brazilian style indexation were stressed for U.S. audiences by Friedman (1974).

The simplest model with which to demonstrate these conclusions consists of a wage setting equation[3]

$$(1) \quad w_t = \delta p_t + (1-\delta)\,{}_{t-1}p_t + u_t,$$

an output supply function

$$(2) \quad y_t = \gamma(p_t - w_t) + v_t,$$

and an aggregate demand equation

$$(3) \quad m_t = p_t + y_t + z_t.$$

Lower case letters are deviations of the relevant variables from steady state values; w is the wage rate, p the price level, y real output, m the money stock, u, v, and z are mutually and serially uncorrelated disturbances. The notation ${}_{t-1}p_t$ denotes the expectation of p_t based on information available at time (t-1). The parameter δ represents the extent of wage indexation; for $\delta=1$, the wage is indexed, and for $\delta=0$ the wage is entirely predetermined.[4]

The aggregate supply function is derived from (1) and (2):

$$(2)' \quad y_t = \gamma(1-\delta)\,(p_t - {}_{t-1}p_t) - \gamma u_t + v_t.$$

Combining (2)' with (3), and assuming expectations are rational, the price level is

$$(4) \quad p_t = {}_{t-1}m_t + \theta[(m_t - {}_{t-1}m_t) + \gamma u_t - v_t - z_t]$$

where $\theta = [1+\gamma(1-\delta)]^{-1}$.

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3. The model is best thought of as the linearization around the steady state of an underlying model set up in Appendix 1, with the steady state money stock, wage rate and price level set at unity by choice of units.

4. In Fischer (1977) I noted that wage indexation is typically a means of making mid-contract adjustments to wage rates rather than a mechanism that adjusts wages to make ex post payments to workers for inflation that has already occurred. For that reason it is desirable to model wage indexation using multi-period contracts. The concentration on single period contracts in this paper is for the sake of simplicity.

Equation (4) shows that the effects of any inflationary disturbance (an increase in u_t, representing a wage push, a decrease in v_t, representing an adverse supply shock, or a decrease in z_t, representing a reduction in the demand for money or increase in aggregate demand) on the price level is larger, the larger is θ. And θ is clearly larger the more the wage is indexed, or the larger is δ. Thus the impact effect of any inflationary shock is larger when there is wage indexing. Wage indexing is therefore inflationary in the first sense.

Under the assumption that the disturbances in the model are white, it is also clear from (4) that the extent of indexation has no effect on the average price level or inflation rate, and thus that wage indexing is not inflationary in the second sense.

Three comments on equation (4) are in order. First, the variance of the price level can be calculated from (4) and is

$$(5) \quad \sigma_p^2 = \theta^2 [\gamma^2 \sigma_u^2 + \sigma_v^2 + \sigma_z^2]$$

where σ_x^2 is the variance of x.

Since θ increases with δ, the variance of the price level is larger the more wage indexation exists; the conclusion that wage indexing destabilizes the price level is thereby demonstrated.

Second, this simplest model contains no dynamics. All effects of disturbances are absorbed in the period the disturbance occurs. Of course, this is hardly a description of the real world unless the period is made too long to be interesting. In practice, wages adjust slowly, disturbances affect inventories and investment, and so forth, and adjustment to a disturbance is spread out over time. But there is no reason to think that

dynamizing this model by including reasons for persistence would change the basic result.

Third, it is clear that if monetary policy can react within the current period to disturbances, it can stabilize the price level completely. All that is necessary is to set the term in brackets in (4) to zero. Although there is no explicit maximization underlying this model, a case can be made that such a policy would be optimal. It would ensure no divergence between expected and actual prices and would allow real side disturbances to have their full impact on output. The level of output is:

$$(6) \quad y_t = (1-\theta)[m_t - {}_{t-1}m_t - z_t] - \theta[\gamma u_t - v_t]$$

If monetary policy operates to keep the price level constant, so that

$$m_t = {}_{t-1}m_t - \gamma u_t + v_t + z_t$$

then the level of output is given by

$$(6)' \quad y_t = -\gamma u_t + v_t$$

In (6)' both u_t and v_t have their full impact on real output. Workers who demand a higher real wage (when u rises) obtain that real wage, at the expense of lower output, and any increase in productivity or other supply shock (when v rises) increases output.

Why would allowing such shocks to affect output be desirable? The argument, advanced initially by Barro (1976), is that the level of output is optimal when markets clear without any expectations being disappointed and information in that sense is perfect. The argument is suggestive, but in the present context, it cannot be more than that without explicit optimization.

It should be noted that the policy that produces (6)' destabilizes real output--but the argument is that such destabilization is socially desirable.

Note also that when monetary policy stabilizes the price level perfectly, indexation is irrelevant to the behavior of prices, as should be expected. Anything that indexation would do is done by monetary policy.

The conclusion from this summary of the standard literature is that wage indexing is inflationary in the first sense but not in the second sense. A third sense in which indexation might be said to be inflationary occurs when indexation renders unstable a model that would otherwise be stable.[5] No such instability is present in the model of this section.

The stabilizing mechnaism in the present model can be viewed as the real balance effect. Given the strict quantity theory formulation of the demand for money, and the fixed money stock, any increase in prices reduces aggregate demand and thereby stabilizes the price level. The first sign of instability in a model of this type emerges when the demand for money is made a function of the nominal interest rate or expected inflation rate, and (3) is amended accordingly. The inclusion of an IS curve, or assumptions about the behavior of the real rate of interest, will close the system. It is well known that there are in general many rational expectations solutions for the price level in such a system, even given a constant nominal money supply; only one of the paths is a stable path. However - and this point bears emphasizing - this indeterminacy/instability has nothing to do with the presence or absence of indexation. It is therefore not discussed further in this paper.

If indexing is to be inflationary in the third sense, in the context of a simple model like that examined above, it must be because it affects

5. Reflection will suggest that the third sense in which indexing can be described as inflationary is a special case of the second sense.

the money stock. The link will come through partial or total financing of budget deficits by the printing of money and the interactions of the deficit with inflation. Indexation affects the links between the budget deficit and inflation.

Those links between indexation and the money supply process are the focus of the extension presented in this paper of the standard literature on indexing and inflation. The major links among indexing, inflation, the budget, and money growth are:

1. If government debt is indexed, the nominal deficit reacts to actual rather than previously expected inflation.
2. Indexation of wages and social security similarly ensures that the nominal deficit reacts to the actual rather than the previously expected price level.
3. Tax indexation removes the generally positive impact of higher prices on real government revenue.
4. Indexation of interest on past tax obligations on the contrary makes real government receipts less sensitive to the inflation rate.
5. Increases in the budget deficit are likely to be financed at least in part through the printing of money.
6. Since indexation makes inflation easier to live with, governments are more likely to adopt inflationary policies when the economy is substantially indexed.

The role of the first five factors in determining the relationship between indexing and inflation is examined in Section II. Factor six is briefly discussed in Section III. Evidence on the effects of indexing on inflation is presented in Section IV, and concluding comments are contained in Section V.

II. Including the Government Budget Constraint.

The implicit assumption in the standard analysis presented above is that taxes and/or government spending are manipulated to maintain the budget in balance. Alternatively, though less plausibly, it could be assumed that all deficits are financed by borrowing and that changes in the stock of debt are viewed by the public as merely delayed taxation, so that budget deficits are financed by future taxation.

The government budget deficit is financed either through the printing of money or by borrowing. Denote real government spending by G_t, nominal taxes by T_t, the nominal stock of government debt outstanding by D_t, and the nominal interest rate by i_t. Assume that all debt has a one-period maturity. Then the budget constraint is

$$(7) \quad M_t - M_{t-1} + D_t - D_{t-1} = P_t G_t + i_t D_{t-1} - T_t$$

Assuming that the real interest rate (r) on indexed debt is the same as that on non-indexed, the nominal interest rate payable by the government in period t is

$$(8) \quad i_t = r + \beta(p_t - p_{t-1}) + (1-\beta)\ (_{t-1}p_t - p_{t-1})$$

where β is the proportion of the debt that is indexed. The nominal interest payable on the indexed portion of the debt is determined on the basis of actual inflation and interest payable on the non-indexed portion is predetermined on the basis of the expected rate of inflation.

Based on a linearization of the budget constraint (7), as described in the Appendix, and assuming that taxes are proportional to income and that the ratio of debt to money is kept constant, the change in the money stock is described by

$$(9) \quad m_t - m_{t-1} = a\ (p_t - p_{t-1}) + b(_{t-1}p_t - p_{t-1}) + cy_t + dp_t + \hat{e}d_{t-1}$$

$a, b, \hat{e} > 0, c < 0, d \gtrless 0.$

The expressions for parameters a-ê are given in the Appendix. From (A7) it may be seen that, given a positive stock of government debt, the parameters a, b, and ê are positive. An increase in the extent of indexation of the government debt increases a while reducing b. Parameter c is negative (increases in the level of real income increase taxes and reduce the deficit).

It will be seen below that the parameter d is of decisive importance for the stability of the system. Without indexation of taxes, d is likely to be negative as increases in the price level increase taxes more than government spending. Or, if the tax system is indexed and nominal government purchases are proportional to the price level, the sign of d depends on whether the budget is in surplus or deficit. If the budget (exclusive of interest payments) is in surplus, d will be negative. But d may be positive, and we shall see that the system then is unstable.

The full model with which we are now work consists of equations (1), (2), (3), and (9). The standard model has been supplemented by the addition of an hypothesis about the determinants of money growth. We are interested particularly in the effects of parameters a, b, and d in (9) on the stability of the price level, and in possible interactions between the extent of wage indexing (the parameter δ) and the parameters of the money growth rule in determining the response of the price level to disturbances.

The addition of the money growth/deficit financing equation (9) will affect the analysis of the effects of indexation in two ways. First, the impact effects of disturbances will now be different than they were in the simple model where the money stock is fixed. Second, the analysis now contains some dynamics, in that disturbances that affect the money supply today can be

expected thereby also to affect the money supply and thus prices in subsequent periods.

From (2)', (3), and (9), we obtain the following equation for the determination of the price level:[6]

$$(10)\quad p_t = b_o p_{t-1} + b_1\, {}_{t-1}p_t + b_2\, {}_{t-2}p_{t-1} + b_3\varepsilon_t + b_4\varepsilon_{t-1} + b_5 z_t + b_6 z_{t-1}$$

where $b_o = \xi[(1+\hat{\gamma})(1+e) - a - b]$

$b_1 = \xi[\hat{\gamma}(1-c) + b]$

$b_2 = -\xi\,[\hat{\gamma}(1+e)]$

$b_3 = \xi[1-c]$

$b_4 = -\xi[1+e]$

$b_5 = -\xi$

$b_6 = \xi[1+e]$

$\xi = [1+\hat{\gamma}(1-c) - a - d]^{-1}$, $\varepsilon_t \equiv \gamma u_t - v_t$, $\hat{\gamma} \equiv \gamma(1-\delta)$, $e = \dfrac{\hat{e}(1-\lambda)}{\lambda}$

The first use of (10) is to discuss the impact effects of current supply disturbances, ε_t, and demand disturbances, z_t, on the price level. These impact effects are given by b_3 and b_5 respectively. Note that $\varepsilon_t \equiv \gamma u_t - v_t$ is treated as an aggregate supply side disturbance since an increase in γu_t that increases wages has the same effect on prices as a decrease in v_t that decreases aggregate output.

Consider first a unit decrease in z_t, an increase in aggregate demand or velocity. This will increase the current price level by the amount $(-b_5)$ or

$$\xi = [1+\hat{\gamma}(1-c) - a - d]^{-1}$$

which is assumed positive. Comparing ξ with θ in equation (4), we note that

(6) In solving for (10) it is assumed that the money debt ratio M/D is constant so d_{t-1} in (9) is equal to $((1-\lambda)/\lambda)m_{t-1}$, where λ is defined in the Appendix.

the parameters a and d both increase the impact effect of an inflationary shock on the price level. The parameter $\hat{\gamma}$ affects the price level in basically the same way here as in the simpler model, except that now $\hat{\gamma}$ is multiplied by (1-c). The interpretation of the changes is simple. When the price level increases in the current model, the money stock will increase to an extent that depends positively on a and d. Thus bond indexing, which means that the budget deficit increases when the current price level rises, and anything else that reduces the inflationary drag whereby inflation tends to put the budget into surplus (and thus increases d), will increase the impact effect of inflationary disturbances on the price level. As before, increases in the extent of wage indexing which reduce $\hat{\gamma}$, also increase the impact effects of inflationary disturbances. Since an inflationary nominal disturbance tends to increase output, the total impact effect of a disturbance is reduced by increased sensitivity of the budget deficit to the level of output, as represented by the parameter c. Thus the conclusion is that the impact effect of an inflationary demand side distrubance on prices is larger the more indexing there is: this applies to wage indexing, to bond indexing and, to the extent that tax indexation reduces inflationary drag, also to tax indexation.

A similar analysis with similar conclusion—that all forms of indexing are inflationary in the first sense--applies in the case of an adverse supply shock. The effect is summarized by the parameter b_3. The only difference with the analysis of the previous paragraph is that now the effect on prices is larger the larger is (-c), i.e. the greater the effect of changes in output on the budget deficit. The difference arises from the fact that an inflationary supply shock reduces output. The larger is c, the greater the effect of the output reduction on the budget deficit, therefore on the money stock, and therefore on the price level.

The result so far is that all types of indexation are inflationary in the first sense.[7] The explanation for the effects of wage indexing on the price level is the same as that in the model of Section I; the effects of bond and tax indexation follow from the link between the budget deficit and money growth.

As noted previously, the addition of the deficit financing hypothesis (9) adds dynamics to the simple model. We therefore turn next to the dynamics of the effects of shocks on the price level, and to the role of indexing in determining the magnitude of those effects. For that purpose, the price level equation has to be solved explicitly, giving the price level as a function of all current and past disturbances. Expectations are assumed to be rational.

The solution will be of the form

$$(11) \quad p_t = \sum_0^\infty \alpha_i \varepsilon_{t-i} + \sum_0^\infty \beta_i z_{t-i}$$

A solution specifies the values of the parameters α_i and β_i.

In order to work with stochastic steady states, it is necessary that there be such a state, equivalently that the process for the price level specified by (10) be stationary. There was no question in the simplest model with its constant money stock and white noise disturbances that the price level was stationary. Here however it is quite possible that the price level will not be stationary. In such a case, the price level will not fluctuate around a

7. If wages are not fully indexed, then increases in a and d increase the effects of an inflationary nominal shock on output. Thus obviously not all forms of indexing stabilize output in the face of nominal shocks. I do not discuss output behavior further, leaving calculation of the effects of disturbances on output for the interested reader.

constant average level, but may either explode in response to disturbances, or else move around aimlessly in the same general way as a random walk process. To show this it is convenient to solve for the parameters α_i and β_i in (11) by equating coefficients of the ε_i and z_i in (10) and (11).

The results are:

(12) $\alpha_0 = b_3$

$$\alpha_1(1-b_1) = b_0 b_3 + b_4$$

$$\alpha_i(1-b_1) = (b_0 + b_2)\alpha_{i-1} \quad , \quad i = 2, 3, \ldots..$$

(13) $\beta_0 = b_5$

$$\beta_1(1-b_1) = b_0 b_5 + b_6$$

$$\beta_i(1-b_1) = (b_0 + b_2)\ \beta_{i-1} \quad , \quad i = 2, 3, \ldots...$$

If the price level is to be stationary, the weights α_i and β_i have to converge to zero. From (12) and (13) the condition for stationarity is

$$(14) \quad \frac{b_0 + b_2}{1-b_1} < 1$$

or

$$(14)' \quad d + e < 0$$

The parameters in (14)' relate to the money growth rule and are independent of the extent of wage indexing. Further, since a and b do not enter (14)', the existence of stationarity is independent of whether the debt is indexed.[8] Given a positive stock of debt e is positive. Thus d, which represents the effects of the price level on the budget deficit, has to be negative if the price level is to be stable.

8. If it was assumed that the indexed debt carried a lower real interest rate than nominal debt, then stationarity would be more likely with indexed debt.

The reason for this instability is not hard to find. Suppose there was a budget deficit last period that increased both the money stock and the debt. The budget deficit this period will tend to be larger than it would otherwise have been because a larger stock of debt has to be turned over. The price level will tend to be higher this period because the money stock is higher. Unless the higher price level reduces the budget deficit (i.e. unless d is sufficiently negative) the budget deficit this period will be greater than last period's, the money stock will increase again, and so an unstable process is set in train. The view that indexing is inflationary in the third sense receives minor support from the analysis above in that indexation of the tax system would remove part of the fiscal drag associated with inflation that, in this model, feeds back to stabilize the money supply process.

But it is clear that this potential instability has nothing to do with the existence or non-existence of wage indexation and bond indexation, so long as both wages and interest adjust for expected changes in the price level, as has been assumed. Of course, if inflation is a method of reducing real wages or real interest, then indexation of wages and interest is more likely to be inflationary in the third sense.

There is no great mystery in this model about how to remove this possible instability. Fiscal policy has to be used to offset the instability associated with money financing of deficits. This can be ensured either by running a basic budget surplus (easier written than done) or by varying tax rates in a counter-inflationary direction. The timing of such adjustments of tax rates is not crucial, in that stability may still obtain even if there is a lag in the response of tax rates to the deficit.

Is it possible that although the price level in such a model is unstable, the inflation rate is stable? That is, might it be the case that disturbances produce temporary increases in the inflation rate that ultimately die down, but are never reversed, with the result that the price level is permanently higher than it would have been in the absence of the disturbances? With the money growth equation (9), such stability is not attained unless d is negative. The reason is that (9), as written, implies that during a process in which the price level is rising, the real deficit increases continually if d is positive. Since the increased deficit will have to be financed by an increase in the growth rate of money and through debt, the inflation rate too will be unstable. If d is negative or even if taxes are adjusted with a lag to close the deficit, the inflation rate may be stable. Thus the analysis of the stability of the price level applies also to the stability of the inflation rate around its average. Deficit financing provides a destabilizing element as it does in the analysis above. The conclusion is once again that sensible fiscal policy to control monetary policy will stabilize the system, but that blind adherence to money financing of the deficit will not.[9]

We return now to the dynamics of the effects of disturbances on the price level. We saw earlier that all forms of indexing increase the impact effect of disturbances--whether demand or supply side-on the price level in the period they occur. The full dynamic effects of disturbances are specified by the α_i

9. In the model used above, deficit financing through bonds is not formally destabilizing for the price level, because the stock of government bonds is not assumed to affect any of the behavioral equations. There are some models in which such a conclusion is appropriate (Barro, 1974) but it is assumed in those cases that taxes will at some time be levied to pay off the debt. Less is known about the implications for behavior of an ever-increasing stock of government debt, and I would not want to argue that there would be no effects on the price level from such a policy.

and β_i in equations (12) and (13). Solving (12) and (13):

$$(12)' \quad \alpha_0 = \xi[1-c] > 0$$

$$\alpha_1 = \frac{\xi[(1+e)(a-c+d)-(1-c)(a+b)]}{[1-a-b-d]}$$

$$\alpha_i = \frac{1-a-b+e}{1-a-b-d} \alpha_{i-1} \qquad i = 2,3,.....$$

$$(13)' \quad \beta_o = -\xi < 0$$

$$\beta_1 = -\frac{\xi[(\hat{\gamma}c+a+d)(1+e)-(a+b)]}{[1-a-b-d]}$$

$$\beta_i = \frac{1-a-b+e}{1-a-b-d} \beta_{i-1} \qquad i = 2,3,.....$$

Careful examination of (12)' and (13)' suggests that there are no simple relationships between the dynamic pattern of adjustment to disturbances and the extent of indexation. This is in large part because the signs α_1 and β_1 are indeterminate. For both supply and demand disturbances, it is quite likely that the price level overshoots its equilibrium level in the period after the shock.

Consider, for example, the expression for α_1 which gives the effect of an increase in ε_t on p_{t+1}. I assume that the model is stable so d is negative, and also that $(a+b) < 1$. Then α_1 will be negative if

$$(15) \quad (1+e)(a-c+d) - (1-c)(a+b) < 0.$$

There are two sets of terms in (15). The first describes the impact of the disturbance in period t on the money stock in period t and thus in (t+1), (this is the term (a-c+d)), as augmented by the need to service the increased stock of debt in (t+1) (hence the (1+e) term). If the model is stable, (a-c+d) is possibly negative. The second set of terms involves the fact that the disturbance that caused the inflation in period t is no longer present

in period (t+1). For that reason the price level is expected to fall, and the nominal interest rate adjusts downwards, reducing the needed amount of debt servicing. Both sets of terms in (15) may be negative, in which case there will certainly be overshooting of the price level, and there may be overshooting in any event. A similar argument will show why there may be overshooting of the price level after a demand side disturbance, under which circumstances β_1 will be positive.

Although there are no simple relationships between the dynamic pattern of adjustment to disturbances and the extent of indexation, it should be noted that all the coefficients in (12)' and (13)' include the term ξ and thus all are larger in absolute value the larger the impact effect of inflationary shocks on the price level. Thus the basic conclusion that indexation increases the impact effect on the price level of an inflationary shock--that indexing is inflationary in the first sense--carries over also to the lagged effects of the shocks.

In later periods the effects of the shock die away geometrically. The rate of decay is slower the larger is (1-a-b+e)/(1-a-b-d), the root of the system. Since a and b enter the expression as (a+b), bond indexing has no effect on the rate at which the disturbances decay. Nor does the extent of wage indexing. The reason is that the effects of ε_t on p_{t+1}, p_{t+2}, etc. are all anticipated once ε_t becomes known. These effects are thus reflected in the wage and the interest rate even without indexation.

Figures 1 and 2 show the dynamic effects of supply and demand shocks on the price level. An inflationary supply shock is shown as increasing the price level in all periods, but as noted above there may be overshooting in this case. If so Figure 2 would describe the adjustment pattern for a supply shock too. In Figure 2 an inflationary demand shock is shown increasing

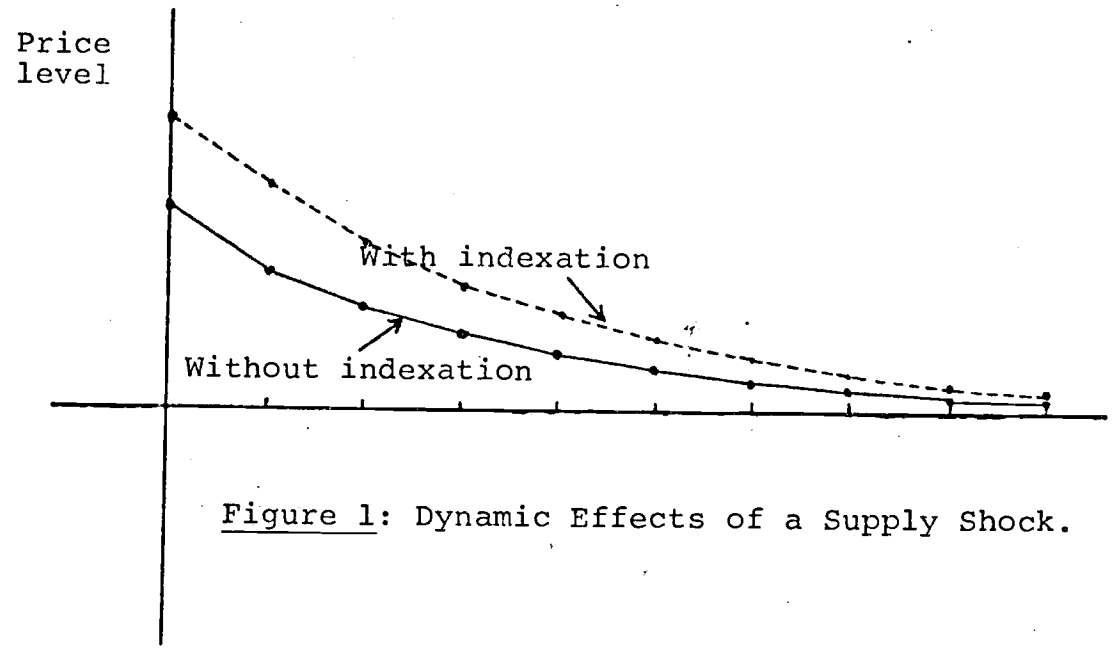

Figure 1: Dynamic Effects of a Supply Shock.

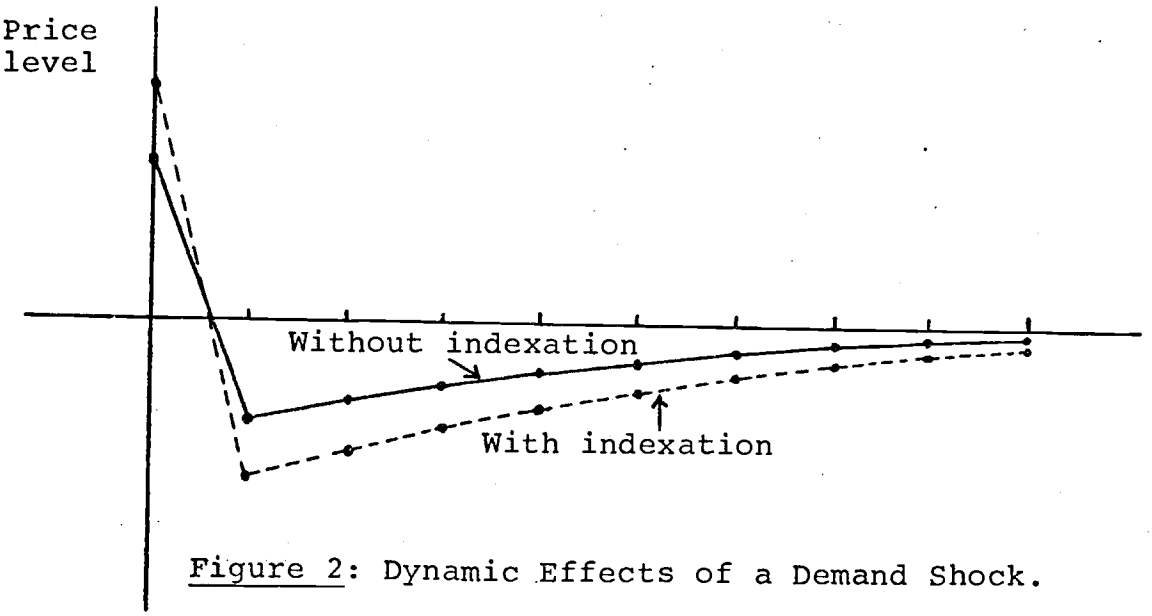

Figure 2: Dynamic Effects of a Demand Shock.

the price level in the current period and reducing it in subsequent periods. Also represented in the figures are the likely effects of indexation on the magnitude of the price effects.

The results of this section show that all forms of indexing tend to be inflationary in the first sense, given the assumed link between the budget deficit and monetary growth. Prices will increase more in response to an inflationary shock in an indexed than in a non-indexed economy. The absolute magnitudes of the lagged effects of the shocks are also larger the greater the extent of indexing. From the viewpoint of the stability of the system, the key issue is whether total taxes can be increased when the price level rises. This effect is frequently known as the inflationary fiscal drag. To the extent that indexing of the tax system tends to reduce the effects of inflation on total government revenue, a stabilizing element is removed from the system and tax indexation may be said to be inflationary in the third sense.

What should be made of these results? It does appear that indexing is inflationary for both supply and demand side disturbances. But is must be emphasized that this result stems mainly from an assumption about government policy, and particularly the money growth or fiscal policy rule (9). In this simple model, monetary and/or fiscal policy can be used to offset the potential inflationary effects--in both the first and third senses--of indexation.

Whether indexing is inflationary is thus not a question that can be answered a priori. The answer depends on the types of policy being followed. If governments follow the type of monetary/fiscal policy described by (9),

indexing is inflationary. But these policies are a matter of choice and not necessity.[10]

III. Further Considerations.

In this section I briefly discuss three issues suggested by the analysis of Section II.

1. The Stabilizing Mechanism, Adjustment, and Rational Expectations.

The stabilizing mechanisms in the Section II model are the real balance effect and the money growth rule, in which the feedback parameter d is crucial. The adjustment mechanism is one in which prices and wages are flexible, and expectations are rational. Under these curcumstances, adjustment to disturbances is extremely rapid.

The easy control over the price level that is potentially available to policymakers in the Section II model is doubtless unavailable in practice. But there is no reason to think that the basic result--that indexation speeds up the transmission of inflationary disturbances to the price level--would be affected by the inclusion of sticky prices, (using a Phillips curve in which unemployment is needed to move wages) or slow expectations adjustment.

2. Mutual Causation.

The previous section analyzed the effects of indexation on inflation or the price level for a given monetary/fiscal policy and set of disturbances. But there is also a reverse link, from inflation to indexation. If an inflationary process becomes established, the private sector will begin to use indexation as a means of reducing the costs the inflation imposes on them. And typically, if the inflation rate is high enough, the government will

10. The link between budget deficits and money growth represented in equation (9) certainly does not hold for all countries (Dornbusch and Fischer, 1981).

eventually do likewise. This reverse link is a potential problem in empirical work, but it is not relevant to the question considered in Section II, which is whether the presence of indexation, for whatever reason it was introduced, is inflationary.

3. Dynamic Inconsistency.

It has been argued that introducing indexation would be a "confession of failure"[11] in the battle against inflation, and would also weaken the will to fight inflation. The confession of failure argument, which may have been plausible in the fifties is no longer attractive: there is no need for a confession when the murderer is caught red-handed at the scene of the crime.

However, the argument that indexation would weaken the will to fight inflation is not absurd. It is related to the problem of dynamic inconsistency in optimal control problems.[12] The problem arises when a plan that is optimal from the viewpoint of a given date is no longer optimal at a later date, even if no new information has arrived in the meantime. The most important case in which the problem can arise is in the short-run inflation-output tradeoff. Because getting rid of inflation is a slow process in which the costs are paid early, and success comes late if at all, the temptation in any short run situation is to avoid contracting output even if that is necessary to reduce inflation. The plan would be to keep output constant now and start the battle against inflation later. But of course when later comes, it is again not optimal in the short run to try to reduce inflation at the cost of unemployment.

11. Report of the Committee on the Working of the Monetary System (Radcliffe Committee), London, HMSO, Cmnd 827, 1959, paragraph 573.

12. See Kydland and Prescott (1977); Fischer (1980) contains a simple exposition.

Under such circumstances, the government will have a tendency to choose inflationary policies even though it recognizes that from the viewpoint of the long run, it has at some time to confront the inflation issue. One way of avoiding the inconsistency is by structuring the environment so that the easy option is removed.

In this view, not indexing the economy is one way of making the inflation option less attractive. The political will to fight inflation will be stronger when inflation matters more.

Interesting as this approach to policy-making is, in the context of indexation it raises the question of whether inflation is to be treated as an evil independent of its costs. Indexing may lower the costs of inflation even if it results in a higher inflation rate.

Whatever the welfare economics of this type of argument, there is an underlying political plausibility to the view that indexation is inflationary because it makes it easier to adopt inflationary policies. The emphasis on policy choice reinforces the message that there is no inevitable theoretical link between indexing and inflation. Evidence on the cross-country association between indexing and inflation is examined in Section IV.

IV. Empirical Evidence.

The model of Section II suggested that indexation would increase the inflationary impact of adverse supply side disturbances, especially given policy that links money growth to the budget deficit. It was also emphasized that policies can be adopted that would avoid this association. This section presents evidence on the relationship between indexation and the change in the average inflation rate experienced after the oil shock of 1973, for a cross-section of forty countries. I interpret the evidence as bearing on the impact effect of an inflationary shock.

Table 1 lists dummy variables representing different aspects of indexation for the forty countries, as of 1974. The dummy takes the value one if there was indexation in that aspect of the economy in 1974 and zero otherwise. There was no attempt to quantify the extent of indexation: any positive evidence of indexation in a particular area resulted in a dummy equal to one for that variable. For instance, if tax brackets were indexed, the tax dummy is one, even if capital income taxation remained on a nominal basis.

The table lists sources. Data on indexation of social security is probably the most reliable, and that on wages least reliable; it would not be surprising to discover that wage indexation occurs in all countries.[13] There are separate dummies for bond indexation, present only in Argentina, Brazil, France, and Israel, and for indexation of any capital market transactions (excluding rents), present in an additional five countries.

For each country, the ratio of the average inflation rate 1974-1978 to the average inflation rate 1969-1973 was calculated. The log of that ratio, called LPIR, was then used as the dependent variable in a regression in which the right hand side variables were the dummies shown in Table 1. The basic regression results are presented in (R1) and (R2) in Table 3.

What should we expect to find? The analysis of Section II suggested unambiguously that all forms of indexing increase the impact effect on the price level of an inflationary shock. Subsequent price level reactions were less clearly affected by indexation, and if there was overshooting, indexation could even stabilize the response to a supply shock. What should be seen in the regressions is primarily the impact effect, which is certainly likely to

13. Comments that will improve the accuracy of the table are solicited and will be much appreciated.

be spread out over several years, of the oil shock. We expect therefore an inflationary effect of indexing, unless policies that avoid this link were chosen.

The regressions are set up to avoid the reverse causation problem. Simultaneity is removed by making the dependent variable the ratio of the inflation rate pre and post the oil shock, and having different aspects of indexation at the time of the shock as the independent variables.

The results presented in Table 3 show that no form of indexation, other than that on bonds, significantly affected comparative inflation performance after the oil shock.[14] The main implication is that the policy responses to the oil shock were probably largely independent of whether there was indexation in place in 1974.

In the case of bond indexation, the regression tells us basically that Argentina, Brazil, France and Israel on average had worse relative inflationary experience in the face of the oil shock than did other countries. It does appear, since the relative Argentinian inflation rate is a spectacular outlier, that the result may be attributed to Argentina. However, as (R3) shows, the other countries do contribute to the significant effect of bond indexation.

The results shown in Table 3 provide little support for the implications of the model discussed in Section II. There is nothing in that model that points particularly to bond indexation as the primary link between indexation and inflation. Indexation of social security should have a similar effect. The question thus arises of what the link between bond indexation and the

14. Other regressions run but not reported included all possible subsets of the dummy variables as independent variables. In no case did the coefficient on any variable other than that for bond or capital market indexation approach significance.

inflationary process is in the four countries.[15] Dornbusch and Fischer (1981) find a significant association between budget deficits and money growth in Israel, and Aghevli and Khan (1978) have found such a link for Brazil, reporting also on similar findings for Argentina. Whether indexed bonds play any special role in the association between the budget deficit and inflation will have to be the subject of future research.

V. Concluding Comments.

The theoretical development of Section II implied that indexation does put potential destabilizing mechanisms in place that will worsen the impact of an inflationary shock, given monetary and fiscal policies that link money growth to the budget deficit. But it was also emphasized that the link between inflation and indexing is not inevitable, and that appropriate policies can prevent the inflationary shock-cum-indexing effect on the budget deficit that is responsible for the result.

The empirical evidence is that countries with bond indexation were more seriously affected by the oil shock than other countries. For three of the four countries with bond indexing, there is also evidence of the link between budget deficits and money growth, which is the central mechanism of Section II. Whether and why bond indexing might play a special role in this regard is a subject for further research.

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15. Bond indexation in France has been on a small scale and France does not really belong in this group of four. But it did not seem desirable to adjust the data shown in Table 1 to reflect my incomplete knowledge of the extent of indexing in some countries while not making adjustments for others. I have instead relied entirely on the published data.

Table 1

Indexation Dummies

Country	Wages	Taxes	Social Security	Investment	Government Bonds
Argentina	0	1	1	1	1
Australia	0	0	0	0	0
Austria	1	1	1	0	0
Belgium	1	0	1	0	0
Bolivia	0	0	1	0	0
Brazil	1	1	1	1	1
Canada	1	1	1	0	0
Chile	0	1	1	0	0
Columbia	0	1	1	1	0
Denmark	1	1	1	1	0
Ecuador	0	0	1	0	0
Egypt	0	0	0	0	0
Finland	1	0	1	1	0
France	1	1	1	1	1
Germany, FR	0	0	1	0	0
Greece	0	0	0	0	0
Iceland	1	1	0	1	1
India	0	0	0	0	0
Indonesia	0	0	0	0	0
Ireland	1	0	1	0	0
Israel	1	1	1	1	1
Italy	1	0	1	0	0
Japan	0	0	1	0	0
South Korea	0	0	0	0	0
Mexico	0	0	0	0	0
Netherlands	1	1	1	0	0
New Zealand	0	0	1	0	0
Norway	1	0	1	0	0
Philippines	0	0	0	0	0
Portugal	0	0	1	0	0
South Africa	0	0	0	0	0
Spain	0	0	1	0	0
Sweden	0	1	1	1	0
Switzerland	1	1	1	0	0

Country	Wages	Taxes	Social Security	Investment	Government Bonds
Thailand	0	0	0	0	0
Turkey	0	0	0	0	0
United Kingdom	1	0	1	1	0
USA	1	0	1	0	0
Uruguay	0	0	1	0	0
Venezuala	0	0	0	0	0

Sources:

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Table 2

Comparative Inflation Rates

Country	1969-73	1974-78	Ratio
Argentina	0.368	2.135	5.802
Australia	0.080	0.116	1.450
Austria	0.065	0.057	0.877
Belgium	0.066	0.075	1.136
Bolivia	0.197	0.100	0.508
Brazil	0.198	0.410	2.071
Canada	0.059	0.089	1.508
Chile	1.391	1.213	0.872
Columbia	0.145	0.236	1.628
Denmark	0.086	0.099	1.151
Ecuador	0.114	0.122	1.070
Egypt	0.048	0.108	2.250
Finland	0.087	0.119	1.368
France	0.077	0.101	1.312
Germany, FR	0.056	0.041	0.732
Greece	0.101	0.141	1.396
Iceland	0.183	0.395	2.158
India	0.114	0.029	0.254
Indonesia	0.181	0.158	0.873
Ireland	0.108	0.146	1.352
Israel	0.176	0.460	2.614
Italy	0.089	0.155	1.742
Japan	0.106	0.073	0.689
South Korea	0.135	0.166	1.230
Mexico	0.100	0.190	1.900
Netherlands	0.073	0.068	0.932
New Zealand	0.086	0.143	1.663
Norway	0.082	0.085	1.037
Philippines	0.170	0.096	0.565
Portugal	0.132	0.213	1.614
South Africa	0.075	0.118	1.573
Spain	0.098	0.183	1.867

Table 2 (continued)

Country	1969-73	1974-78	Ratio
Sweden	0.074	0.097	1.311
Switzerland	0.070	0.029	0.414
Thailand	0.086	0.069	0.802
Turkey	0.130	0.326	2.508
United Kingdom	0.096	0.155	1.615
USA	0.061	0.080	1.311
Uruguay	0.548	0.598	1.091
Venezula	0.042	0.090	2.143

Source: International Financial Statistics Yearbook.

Table 3: Regression Results.

Regression	Dependent Variable	Independent Variables				$\bar{R}^2$
	LPIR	DUMWAGE	DUMTAX	DUMSS	DUMINV	
R1		-.055 (.203)	-.106 (.233)	-.092 (.206)	.632 (.241)	.093
R2		-.087 (.199)	-.146 (.227)	.035 (.204)	DUMBOND .909 (.301)	.140
R3		.064 (.207)	-.162 (.219)	-.054 (.202)	DUMBOND .633 (.323)	.028

Notes: 1. Standard errors in parentheses.
2. See Table 1 for variable definitions
3. R3 excludes Argentina from the sample.

Appendix

1. Let upper case letters denote levels of variables and letters without subscripts the points around which the equation is linearized. Then the wage is given by:

$$(A1) \quad \frac{W_t}{P_t} = \frac{W}{P}\left[\delta + (1-\delta)\frac{{}_{t-1}P_t}{P_t}\right] + \frac{u_t}{P_t}$$

so that $W_t = \frac{W}{P}\left[\delta P_t + (1-\delta)\,{}_{t-1}P_t\right] + u_t$

Setting $W = 1 = P$, we obtain (1) in the text.

The aggregate supply equation is

$$(A2) \quad Y_t = \gamma \frac{P_t}{W_t} + v_t$$

Linearization gives

$$Y_t - Y = \gamma\left[\frac{P_t}{W} - \frac{P}{W^2} W_t\right] + v_t$$

This imolies (2) in the text.

Finally, the money demand equation is

$$(A3) \quad M_t = P_t Y_t + z_t$$

so $M_t - M = P_t Y + P Y_t - 2PY + z_t$

With $Y = 1$ we obtain (3) in the text.

2. The government budget constraint is

$$(7) \quad M_t - M_{t-1} + D_t - D_{t-1} = P_t G_t + i_t D_{t-1} - T_t$$

Now assume that a fraction λ of the budget deficit is financed by money printing and $(1-\lambda)$ through the issue of debt.

(A4) $M_t - M_{t-1} = \lambda\ [P_t G + i_t D_{t-1} - \tau P_t Y_t]$

In (A4) we have assumed the level of government spending is fixed, and that taxes are proportional to nominal income (no tax lag is included). Now linearizing (A1) around assumed stationary values of the interest rate, the debt, the price level and real output, denoted i, D, P and Y respectively, we have

(A5) $M_t - M_{t-1} = \lambda\ [P_t G + iD_{t-1} + i_t D - iD - \tau(P_t Y + PY_t - PY)]$

Using equation (8) of the text:

(A6) $M_t - M_{t-1} = \lambda\ \{P_t(G-\tau Y) + [r + \beta(P_t - P_{t-1}) + (1-\beta)({}_{t-1}P_t - P_{t-1})]\ D$

$$- \tau PY_t - iD + \tau PY\} + \lambda\ iD_{t-1}$$

Equation (9) in the text is based on (A6), which implies

(A7) $a = \lambda\beta D$

$b = \lambda(1-\beta)D$

$c = -\lambda\tau P$

$d = \lambda\ (G-\tau Y)$

$\hat{e} = \lambda i$

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