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Nominal Income Targeting: A Critical Evaluation

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Abstract

This paper evaluates the proposal that government authorities ought to target nominal income. It begins by viewing the literature in some detail. It then undertakes a theoretical analysis of the proposal first for the small country and next for the large country. There is then a general discussion of various issues posed by nominal income targeting. Finally, the paper summarizes the empirical work to date. We show that traditional theoretical analysis tends to be too simple and overly biased in favor of nominal income targeting. When more realistic assumptions are made or econometric simulations are undertaken the case for nominal income targeting is substantially weakened but not, however, destroyed.

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*I am particularly grateful to Kellett Hannah who solved many of the models in the paper on the computer, using "mathematica." Some of the solutions, which are too complicated to report, are on computer printout. I am also grateful to Phyllis Lake for very efficient and helpful secretarial assistance.

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The paper evaluates the proposal that government authorities ought to target nominal income.

It first reviews the literature in some detail and then undertakes a theoretical analysis of the small country case. It compares three alternative monetary strategies: first, the case in which exchange rates are flexible and the money stock is fixed; second, the case in which exchange rates are flexible but the monetary authorities target nominal income; and third, the case in which monetary policy is used to target the exchange rate. The analysis is undertaken for unindexed and indexed wage contracts.

The paper also compares alternative wage rules: where wages are indexed to home prices, where wages are indexed to consumer price, and where wages are indexed to nominal income. Finally, a comparison is made between a nominal income wage rule and a nominal income monetary rule.

The paper then looks at the large country case. It compares five regimes: a fixed money case with a stock-flexible rate, a monetary nominal-income rule, a symmetrical fixed-rate regime, an asymmetrical fixed-rate regime, and a wage-nominal income rule. The primary conclusion is that each country's ranking of these five regimes will depend on the type of disturbance, the country origin of the disturbance, the weights the authorities attach to output, price, real exchange rate and real interest rate volatility, the structural coefficients in the model, and institutional considerations (e.g., the degree of indexation in wage contracts).

A number of general issues are also taken up, including the political feasibility of the proposal, the definition of the target, the instrument to be used, the question of potential instrument instability, the realism of the theoretical models, and the question of alternative strategies.

Finally the paper reviews the econometric work to date. We show that traditional theoretical analysis tends to be too simple and overly biased in favor of nominal income targeting. When more realistic assumptions are made or econometric simulations are undertaken, the case for nominal income targeting is substantially weakened, but not destroyed.

I. Introduction

This paper evaluates the proposal that government authorities ought to target nominal income (or some variant of the national product).

There are three key strands to this literature. The first strand analyses the question in a policy framework which assumes that nominal income is the only target for the authorities. The question is then one of whether monetary or fiscal policy should be used to achieve a nominal income target. Virtually all of that literature takes as a starting point that monetary policy is the appropriate instrument. It then proceeds to compare that strategy with other potential monetary strategies.

The proposal to target nominal income was first advocated by Meade (1978), Tobin (1980), and Corden (1981). Although these writers provided the basic underlying rationale for such a policy, it is fair to say that they did not develop the analytics in any detail.

Among the earliest of the analytical treatments was Bean (1983), whose work became very influential on the later treatment of the subject. Subsequently, formal analysis was also undertaken by Aizenman and Frenkel (1986), Taylor (1985), Alogoskoufis (1989), and Frankel (1989).

There were, as well, several treatments of the subject written for a wider audience (see Bradley and Jansen (1989), Kahn (1988), McNees (1987) and Gordon (1985)).

A second strand analyses the question in a framework where nominal income is one of two targets, the other generally, but not universally, being external balance (the current account). The question here is how two instruments--monetary and fiscal policies--should best be used to achieve the two targets. To simplify a little, there are here three views.

One view, associated with the work of Boughton (1989) and Genberg-Swoboda (1987), would assign monetary policy to nominal income (internal balance) and fiscal policy to external balance. (For the large countries there are some refinements on this basic theme.) Another view (associated with the work of Williamson and Miller (1987)) would reverse the assignment. Yet another view (associated with the New Keynesians) has nominal income and wealth (of which the current account is one component of the change in wealth) as the two principal targets of policy; again monetary and fiscal policies are the two instruments, but this school leaves open the question of how they should be assigned, indeed if at all. Moreover, they make an important distinction between potential short-run and long-run assignments.

A third strand, which we call the wage rule would link the wage rate to nominal income. Under this proposal, the wage rate would rise or fall proportionately to the movement in nominal income. There are no formal advocates of such a proposal (although those who support profit sharing would not oppose this), but there is some (although rather little) theoretical analysis. (See, for example, Aizenman and Frenkel (1986a) and Wagner (1989)).

Finally, there are numerous econometric studies of the proposal to target nominal income. These studies can be divided into two groups: those that evaluate simple monetary rules (of which the nominal income monetary rule is one) and those that are concerned with two instrument-two target assignment issues.

The study is in six sections. Section II surveys the theoretical literature for the small country. Section III does the same for the large country. Section IV undertakes some independent theoretical analysis of the small country. Section V has a parallel analysis of the large country case. Section VI raises a variety of issues associated with nominal income targeting. Section VII reviews the econometric findings, and Section VIII summarizes the conclusions of the paper.

The conclusions we reach are disappointing. On the one hand, theoretical analysis tends to be too simple. While it appears to strongly favor nominal income targeting there are good reasons for suspecting that some at least of the assumptions underlying the theoretical work are unrealistically biased in favor of a nominal income strategy. On the other hand, econometric analysis can be more subtle and realistic, taking account of refinements absent from theoretical work; unfortunately, however, the work reviewed turns out to be inconclusive.

II. A Survey of the Theoretical Literature--The Small Country Case

This selective survey, for the small country, is divided into two parts. Part 1 reviews the contributions which evaluate alternative monetary rules, including one which targets nominal income. Part 2 starts from a broader framework in which there are two targets, of which nominal income is one, and two instruments; the analysis then turns on how the two instruments should be used to achieve the two targets.

1. Alternative monetary rules

The contributions reviewed here are those by Bean (1983), Aizenman and Frenkel (1986)(AF), Alogoskoufis (1989)(A), and Frankel (1989). This covers a reasonable sample of the approaches used in this context.

Bean

Because Bean's paper has been so influential on this topic it is rewarding to spend more time on it. Much of the literature that follows is derivative either in the sense of extending Bean's original analysis or of adopting a similar methodological strategy.

We begin by presenting Bean's model and his principal results. We then offer some general comments on Bean's paper, comments which we return to later in this paper.

Bean's model, which he presents in the body of his paper, is that of a small 'closed' economy. (Towards the end of his paper and in an Annex he extends the analysis to the open economy but this is done only briefly.) The model comprises an aggregate demand equation and an aggregate supply equation. Money supply is the instrument used to achieve a nominal income target but because of the lags in the availability of information and in policy adjustment money supply policy is set so as to achieve a nominal income target in the <u>next</u> period. (It is assumed that this is achieved without error). The economy is exposed to two types of shocks: a temporary demand or supply shock and a 'permanent' demand or supply shock. Rational expectations are assumed to hold throughout; as well the private/government sectors are all assumed to know, once a shock has appeared, whether it is temporary or permanent. A nominal income strategy is compared with a money stock or an optimal monetary policy strategy. (We will limit ourselves only to the first comparison).

Performance is evaluated in terms of deviations from the 'full information' level of output. Workers are assumed to set wages in advance so as to achieve labor market equilibrium [a la Gray-Fischer--see Gray (1976) and Fischer (1977)], so when expectations have stabilized or events are perfectly anticipated and wages are flexible the economy converges towards a level of output which corresponds to full employment. For reasons which will be evident, Bean assumes that contracts extend over two periods.

<u>Bean's Model</u> <u>1</u>/

<u>Aggregate demand</u>

$$y = \gamma \ (mo - p) + vt \qquad (1.1)$$

<u>Aggregate supply</u>

$$y = (1 - a)l + u \qquad (1.2)$$

$$ld = - - (w \frac{1}{a} p) + \frac{1}{a} u \qquad (1.3)$$

<u>1</u>/ All constants are dropped from the model below to simplify the presentation.

Substituting (1.3) into (1.2)

$$y = -\left(\frac{1-a}{a}\right)(w-p) + \frac{1}{a}u \qquad (1.4)$$

$$ls = \frac{1}{d}(w-p) \qquad (1.5)$$

Setting (1.3) = (1.5) solving for (w-p) substitute in (1.5) then in (1.2).

$$y^* = \frac{1+d}{a+d}u \qquad (1.6)$$

$$w^* = p + \left(\frac{d}{a+d}\right)u \qquad (1.7)$$

$$w = (1-\lambda)[t_{-1}Ept + \theta t_{-1}Eu] + \lambda[t_{-2}Ept + \theta t_{-2}Eu] \qquad (1.7a)$$

where $\theta = \frac{d}{a+d}$

Substituting (1.7a) into (1.4) yields

$$y = \beta(1-\lambda)[pt-t_{-1}Ept - \theta t_{-1}Eu] + \beta\lambda[pt-t_{-2}Ept - \theta t_{-2}Eu] + \frac{1}{a}u \qquad (1.8)$$

where $\beta = \frac{1-a}{a}$

Loss function (L)

$$L = (y - y^*)^2 \qquad (1.9)$$

Nominal Income Targeting

$$mo = \pi_{10}[t_{-1}E(p+y) - (p+y)^{**}] \qquad (1.10)$$

$$\pi_{10} \to \infty$$

Notation (in logs)

y = output

y^* = full employment output

mo = money stock

w = wage rate

w^* = full employment wage rate

p = price level

ld = demand for labor

ls = supply for labor

v, u = respectively aggregate demand and supply shocks, which could be temporary or permanent.

(1.1) is an aggregate demand equation, with v the demand disturbance. (1.2) represents a short run production function, with u a productivity disturbance. (1.3) is the derived labor demand equation, which after substituting into (1.2) yields (1.4). (1.5) is the labor supply equation. Setting ld = ls we can derive the bench mark full employment level of output as in (1.6). Setting again ld = ls we can also derive the full employment wage rate (w^*), as in (1.7).

(1.7a) is a conventional 2 period wage equation. A proportion $1-2\lambda$ of contracts last one period while a proportion 2λ last 2 periods, evenly distributed over these two periods. When expectations are fully realized (1.7a), of course reduces to (1.7).

(1.8) is the actual level of output. Thus deviations from full employment [equal to the loss function in (1.9)] can only emerge from misperceptions. If all expectations are realized (1.8) = (1.6). (1.10) is *the equation which represents nominal income targeting: the money stock is* set for the next period so as to achieve the income target exactly.

The graphical representation

Figures 1 and 2 represent the model graphically; Figure 1 corresponds to the case of a permanent demand disturbance, Figure 2 to the case of a permanent productivity disturbance.

XX is the aggregate demand schedule corresponding to target nominal income. It thus corresponds to (1.10). (Note that money stock adjusts with a one period lag.) Do is the aggregate demand equation corresponding to (1.1).

So is the original 'long run' aggregate supply schedule corresponding to (1.6). It is vertical at its full employment level. It shifts as u (the productivity shock) shifts. S_1 corresponds to the 'first period' adjustment. It corresponds to (1.8) with all expectations set at zero (i.e., the shock is unanticipated). S_2 corresponds to (1.8) but now some workers (a proportion $1 - \lambda$), having observed the disturbance, and anticipating that it will be permanent can adjust their wages [$pt = {}_{t-1}Ept$ and ${}_{t-1}Eu = u$] but other workers (a proportion λ) cannot [${}_{t-2}Ept = {}_{t-2}Eu = 0$). S_3 in Figure 2 corresponds to the new supply curve, following a supply disturbance, after full adjustment by the two groups of workers has taken place (i.e., when all expectations are realized).

A demand disturbance

We focus on the performance of a nominal income versus a money stock target using the loss function (1.9). Consider first the case where a shock is temporary and perceived as such. Since the money stock cannot adjust till one period later the money stock will be the same with either strategies. The authorities cannot offset a temporary disturbance; there is thus an inevitable disequilibrium which emerges here, whatever the regime.

Consider now the case of a perceived permanent but unanticipated demand disturbance. In period t, when the shock occurs, again, as above, the same disequilibrium emerges in the two regimes. This is easily calculated as follows: with all expectations set at zero we have [(from (1.8)]

$$y = \beta pt + \frac{1}{a} u \qquad (1.11)$$

Combined with (1.1), and a fixed money stock we can solve for y and p in terms of v and u. This corresponds to the solution 0_1 in Figure 1.

From the next period, however, the paths of the two strategies diverge. With a fixed money stock and partial rational wage adjustment the general aggregate supply schedule is

$$y = \beta\lambda pt + \frac{a(1 + d) + d\lambda(1 - a)}{a(a + d)} u \qquad (1.12)$$

Combined with (1.1) dropping u we have the solution for output for v.

$$y = \frac{\beta\lambda}{\gamma + \beta\lambda} vt \qquad (1.13)$$

Figure 1
A Permanent Demand Disturbance

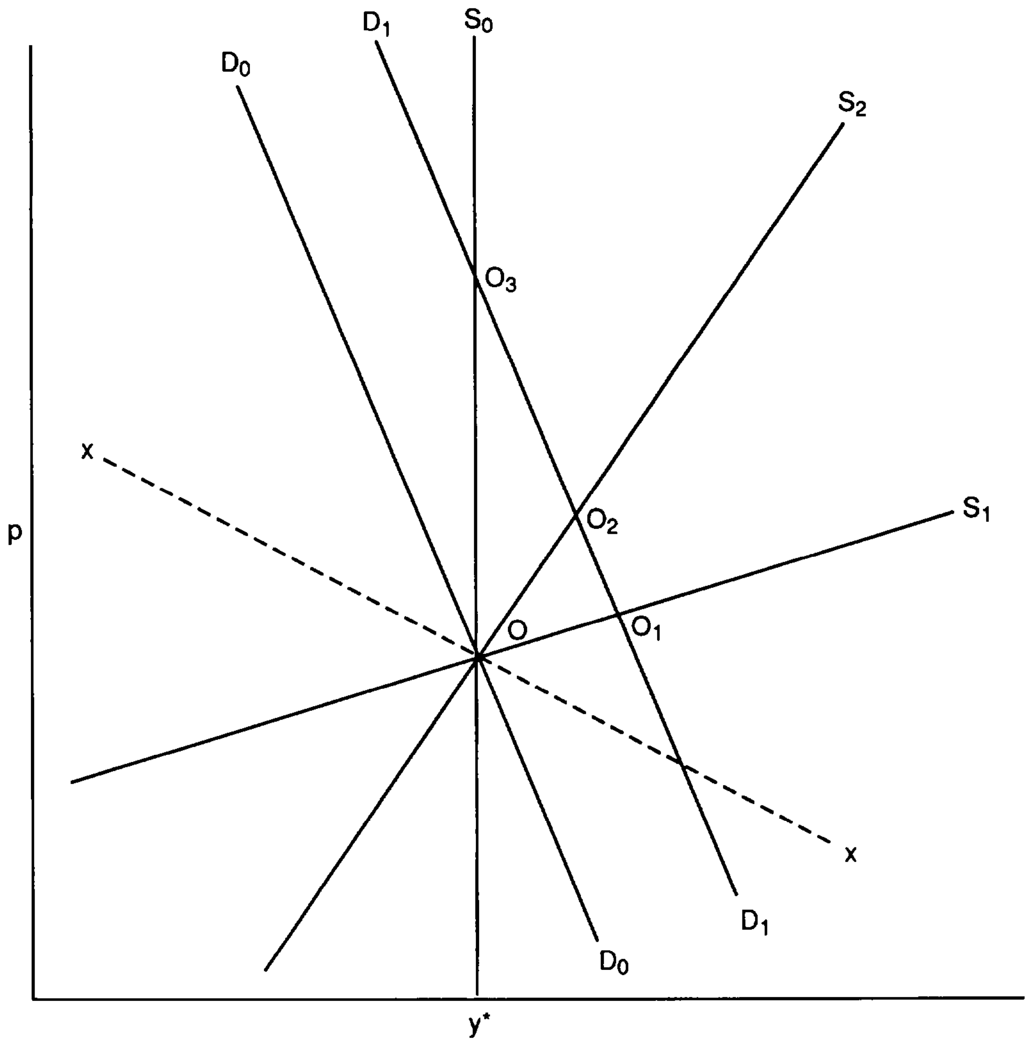
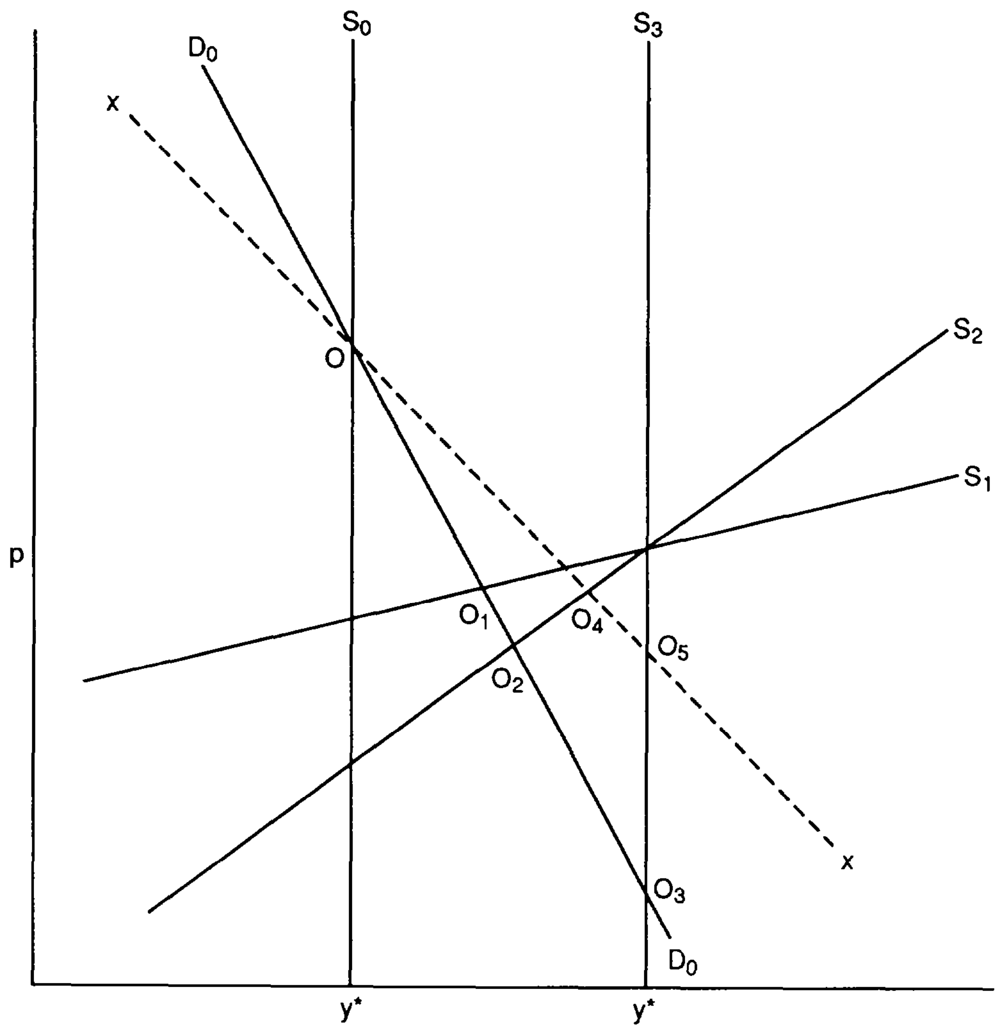


Figure 2
A Permanent Productivity Disturbance



This corresponds to 0_2

The loss in this case is

$$L = \left(\frac{\beta\lambda}{\gamma + \beta\lambda}\right)^2 \quad (1.14)$$

It is also readily seen that, with a nominal income target, if we substitute p = -y into (1.12) output and prices will be unchanged. The economy will return to 0 in Figure 1.

It is evident, therefore, that losses in period t_{+1} are larger for a money target than for a nominal income target (where losses are zero).

Ultimately in t_{+2} the economy finds itself at 0_3 for money stock targeting but it will stay at 0 for nominal income targeting. The disequilibrium reverts to zero for both strategies. It can be seen from (1.8) that with all expectations realized the level of output returns to its full employment level. However, with money stock fixed the price level will rise [Eq.(1.1)].

<u>A productivity disturbance</u>

Now consider the case of a perceived permanent but unanticipated productivity disturbance (u). Again in the first period t the solution is the same for the two strategies. This is located at 0_1 in Figure 2 and can be arrived by solving (1.11) and (1.1) for output, in terms of u with money stock fixed. In the meantime the long run supply schedule So shifts to its new long run position S_3.

In period t_{+1} for a fixed money stock strategy the solution is located at 0_2, the intersection of D_0 and S_2 in Figure 2. The solution for output is obtained by combining (1.12) and (1.1), keeping m_0 fixed. This is now

$$y = \frac{\gamma[1 + \beta(1-\theta(1- \lambda))]}{\gamma + \beta\lambda} u \quad (1.15)$$

The loss is then

$$(y - y^*)^2 = \left[\gamma \frac{[1 + \beta(1-\theta(1-\lambda))]}{\gamma + \beta\lambda} - \frac{1 + d}{a + d}\right]^2 \quad (1.16)$$

For nominal income targeting, using (1.12) and imposing $y = -p$, we have

$$y = \frac{1 + \beta[1 - \theta(1-\lambda)]}{1 + \beta\lambda} \tag{1.17}$$

and the loss is

$$(y - y^{*})^2 = \left[- \frac{\beta\lambda[1 + \beta(1 - \theta) - \theta]}{1 + \beta\lambda}\right]^2 \tag{1.18}$$

How does (1.18) compare with (1.16)? It turns out to be ambiguous, depending on the value of θ. An important result is that if $\theta = 1$ ($d \to \infty$) (the supply of labor is insensitive to the real wage rate) the disequilibrium in (1.18) is zero and nominal income targeting in unambiguously superior.

Why is this? From (1.17) if $\theta = 1$ $y = u$. From (1.2) labor employed is unchanged. With a fixed supply of labor the labor market remains in equilibrium. Also from (1.4) setting $y = u$ we have $w-p = u$, i.e., the real wage rate increases in proportion to productivity.

There is one other result which is interesting. Clearly the <u>closer</u> the economy is to the new equilibrium level of output the <u>smaller</u> the disequilibrium. If we divide (1.15) by γ we have as the denominator $1 + \beta\lambda/\gamma$. Comparing (1.15) with (1.17) it is readily seen that if $\gamma < 1$ (1.15) < (1.17) and if $\gamma > 1$ (1.15) > (1.17). Thus a nominal income target is unambiguously superior if $\gamma < 1$.

These results are demonstrated graphically. For a money target the economy moves from 0_1 to 0_2 to 0_3. For a nominal income target the economy moves from 0_1 to 0_4 to 0_5 (one potential scenario). Note that 0_4 is (arbitrarily) shown to be closer to full equilibrium output than 0_2. [As demonstrated above the position of 0_4 relative to 0_2 depends on the slope of Do. If the slope is greater than unity, as drawn, 1/ 0_4 will be to the right of 0_2].

To conclude, Bean's elegant and careful analysis demonstrates that in a two-period contract model with lagged monetary policy adjustment differences in performance will only appear in the second period; in this period a nominal income target is superior to a money target for an aggregate demand shock; for a supply shock it will be unambiguously superior if labor supply is weakly responsive to the real wage rate.

1/ The slope of course is, from (1.1), $\Delta p/\Delta y = 1/\gamma$ so the slope will exceed unity if $\gamma < 1$ as already shown.

Comments on Bean's analysis

Several general comments on Bean's paper are in order.

1. The extension to the open economy case is made almost as an after thought. In particular, there is no treatment of shocks originating abroad; nor is the role of expectations in the open economy developed.

2. Bean's loss function is widely used in the literature (see Aizenman and Frenkel (1986)) but appears unsatisfactory. There are two key types of criticisms that may be made. First, full employment is not the only macro objective of policy. An obvious case could be made for taking account of inflation and possibly too, real exchange rates and real interest rates. Second, the analysis presupposes that with full information full employment will be restored because wages, a la Gray-Fisher, are always set so as to achieve full employment. This is unrealistic.

3. Although Bean allows the money stock to adjust with a lag he assumes throughout that both the public and the government can correctly identify whether a shock is temporary or permanent. The possibility that the private/public sector may misperceive a shock as permanent, for example, when it may in fact be temporary is not considered. In other words there is perfect knowledge of the future behavior of the shocks.

4. Comparisons are only made with a money stock target (and a theoretically optimal monetary policy). No other alternative strategies are considered.

Aizenman and Frenkel (1986) (AF)

The AF paper can be seen as an extension of Bean's analysis. Their model is also one of a closed economy and their loss function is identical to Bean's. Labor market contracts are assumed to be for one period only, while disturbances are assumed to be only temporary (and unanticipated). In these last respects the model is a special case of Bean's. Unlike Bean, however, monetary policy is assumed to adjust instantly (in the same period as the disturbance); also the range of disturbances is broader than Bean's; finally, the strategies evaluated are also wider.

The key equations in the model are (as above)

$$y = -\frac{(1-a)}{a}(w-p) + \frac{1}{a}u \qquad (1.4)$$

$$y^* = \frac{(1+d)}{a+d}u \qquad (1.6)$$

As indicated, in their model, $\lambda = 0$ (there are only one-period contracts). Since temporary disturbances (in t) are all unanticipated (in t_{-1}) w = 0 i.e. the wage rate is fixed. Also, as in Bean

(1.9) $L = (y - y*)^2$

The money market is

$$mo - p + \alpha_4 y - \alpha_5(rd - rdo) + vt \tag{1.19}$$

$$rd - (tEPt_{+1} - pt) = rdo + u_2 \tag{1.20}$$

The left hand expression in (1.20) is the real interest rate. Given the temporary nature of the shocks $tEpt_{+1} = 0$. u_2 is a stochastic shock to the real interest rate. Substituting (1.20) into (1.19) we have

$$mo = \alpha_4 y + (1 + \alpha_5)p - \alpha_5 u_2 + vt \tag{1.21}$$

There are thus three types of disturbances: a productivity disturbance (u), a money demand disturbance (v) and a real interest rate disturbance (u_2).

AF evaluate activist monetary strategies and a money stock target rule. Amongst the activist monetary strategies are: an optimal (discretionary) rule; nominal income targeting, CPI targeting and interest rate targeting. Solutions for y, given w, are easily found for each strategy. 1/

Substituting these into (1.9) allows us to evaluate welfare losses for each strategy.

Comparing the three (non-optimal) activist strategies AF find that the rankings depend critically on whether 1/a exceeds or falls short of 1/d. When 1/a > 1/d nominal income targeting performs best. If 1/a < 1/d CPI targeting performs best with ambiguous outcomes for the other two. As with Bean if the elasticity of supply of labor is very low (1/d -> 0) nominal income targeting performs well. How a money stock rule performs depends on the values of the parameters and the variance of the shocks.

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2 1/ For CPI targeting w = p = o. The solution for y is obtained directly from (1.4). For interest rate targeting $rd = rd_0$. so from (1.20) p = u2 which can be substituted into (1.4). For nominal income targeting p = - y in (1.4).

Alogoskoufis (1989), (A)

A's model is that of a small open economy, which produces two types of goods, a traded good the price of which is fixed in foreign currency and a non traded good, best thought of in this context as representing public employment. The regimes compared are: fixed nominal income targets, fixed monetary targets and fixed exchange rates. As in AF shocks are assumed to be temporary; also as in AF the money stock is allowed to respond in the same period to achieve a nominal income target. Unlike Bean and AF, however, A explicitly allows for an error in nominal income control.

Using (1.2) and (1.3) above and using the subscript $_T$ to stand for traded goods we have

$$y_T = - \frac{1 - a}{a} (w_T - p_T) + \frac{1}{a} uT \tag{1.22}$$

Where uT is again a productivity shock to the production of traded goods. With disturbances only temporary $w_T = 0$.

In the non traded goods sector output is assumed to be proportional to employment (demand for which is insensitive to the real wage rate). Employment in this sector (l_N) is assumed to be subject to an exogenous temporary disturbance.

$$Y_N = l_N \tag{1.23}$$

where the subscript $_N$ stands for nontraded goods.

At the same time the price of the nontraded good is a mark up on wages; with wages equalized in the two sectors and by definition assumed to be fixed the price and wage rate are fixed here too.

We can write p_T as

$$p_T = e + p^* \tag{1.24}$$

where p^* represents a temporary foreign price disturbance.

If α_{15} and $(1-\alpha_{15})$ represent the respective weights of the traded and non-traded sectors we have (setting w = 0).

$$y = \frac{\alpha_{15}(1-a)}{a}(e + p^*) + \frac{\alpha_{15}}{a} u_T + (1 - \alpha_{15})1_N \tag{1.25}$$

and

$$p = \alpha_{15}p_T \tag{1.26}$$

where p is the overall price level (recalling $p_N = 0$).

Finally, we represent the money sector as follows

$$mo_d = p + y - \alpha_5 rd + k_1 \tag{1.27}$$

where k_1 is a temporary money demand disturbance.

$$rd = rf + tEe_{+1} - e \tag{1.28}$$

Where rf is the foreign interest rate (also subject to a temporary disturbance) and $tEe_{+1} = 0$ (given that all disturbances are temporary).

$$mod = mos \tag{1.29}$$

A assumes that with a fixed money stock regime there is an error in the money stock control so

$$mos = k_2 \tag{1.30}$$

Substituting (1.30), (1.29) and (1.28) into (1.27) and substituting out for p gives

$$0 = (\alpha_5 + \alpha_{15})e + \alpha_{15}p^* + y - \alpha_5 rf + (k_1 - k_2) \tag{1.31}$$

For a nominal income target regime (p + y) A now assumes that there is an equivalent error in achieving this target as for a money stock target so we now have

$$\alpha_{15}e + \alpha_{15}p^* + y = k_2 \tag{1.32}$$

For a fixed rate regime we have

$$e = 0 \tag{1.33}$$

The solutions to output are now readily obtained. For a fixed money stock we combine (1.25) and (1.31) to solve for y and e. The disturbances that bear on the solution are p*, rf. k_1. k_2. u_T. 1_N. For a nominal income target we combine (1.32) and (1.25) to solve again for e and y. The relevant disturbances are now u_T, ℓ_N and k_2 (p^* cancels out). For a fixed rate regime e is fixed so we can use (1.25) to solve for y. The relevant disturbances are now p^*, u_T. 1_N.

To complete the system we can also arrive at a full employment level of output. Out starting point, as previously, is a labor demand and labor supply function.

$$1d = \alpha_{15} 1d_T + (1 - \alpha_{15}) 1d_N \tag{1.34}$$

which is equal to

$$1d = - \frac{\alpha_{15}}{a} (w - p_T) + \frac{\alpha_{15}}{a} u_T + (1 - \alpha_{15}) 1_N \tag{1.35}$$

and we have

$$1s = \frac{1}{d} (w - p) \tag{1.36}$$

Noting that $p_N = w$ we can solve for the full employment wage rate (w*)

$$w^* = p_T + \frac{d}{a+d} u_T + \frac{ad(1 - \alpha_{15})}{\alpha_{15}(a+d)} 1_N \tag{1.37}$$

Substituting (1.37) into the level of output [which is a weighted average of (1.22) and (1.23)] we obtain

$$y^* = \frac{\alpha_{15}(1 + d)}{a + d} u_T + \frac{(1-\alpha_{15})d\ [1 - \alpha_{15}(1 - a)] + (1 - \alpha_{15})a}{a + d} 1_N \tag{1.38}$$

The full employment full information level of output changes only when there is a supply shock (u_T, l_N).

The three regimes can now be evaluated in terms of the full employment output gap i.e., using again (1.9) above.

Compare first a nominal income target with a money stock target. The outcomes depend on the relative importance of the shocks and nothing conclusive can be said. It is evident from what has been said so far that a nominal income target strategy completely protects the economy from external shocks (p^*, rf) and money demand shocks (k_1), and so is to be preferred on these counts. However, it is a worse performer for the control error (k_2) whilst for supply shocks (u_T, l_N) outcomes are ambiguous.

Finally, compare a nominal income target strategy with a fixed exchange rate strategy. A fixed exchange rate regime avoids the 'control error' but magnifies the disequilibrium for a foreign price shock (p^*); for supply shocks outcomes are ambiguous.

Frankel (1989)

Frankel's analysis differs from some of the other contributions.

Frankel starts with a loss function of the form

$$L = ap^2 + (y - ky^*)^2 \quad k > 1 \tag{1.39}$$

Where p is the price level y and y^* are respectively output and the level of output corresponding to the natural rate of unemployment. The loss in utility is assumed to be positively related to the square of inflation and the square of the excess of output over the target level; the target level of output is represented, importantly by ky^* where k is assumed to be greater than unity (to reflect the assumption that the 'target' unemployment rate is below the natural rate). The loss function (1.39) differs in three respects from (1.9): in (1.9) k is implicitly assumed to be unity; in (1.9) too inflation is omitted; also in (1.39) above y^* is fixed while in (1.9) it is allowed to change.

In the body of his paper he compares three regimes: a discretionary monetary regime, where the authorities use monetary policy to minimize each period's loss, taking expectations as given; a money stock rule and a nominal income rule. Money is assumed to adjust contemporaneously.

We now add an output supply function which is very similar to one used previously.

$$y = y^* + b(p - p^e) + u \tag{1.40}$$

where p^e is the expected price level.

Consider first the case of discretionary policy. If (1.40) is substituted in (1.39) and the loss function is then differentiated with respect to the price level, keeping p^* fixed, we have the price level solution which minimizes the loss.

$$p = \frac{- y^* (1-k) b - bu}{a + b^2} + \frac{b^2 p^e}{a + b^2} \tag{1.41}$$

With rational expectations the public will anticipate this policy, so in due course $p = p^e$. The solution now becomes 1/

$$p = - \frac{y^*(1 - k)b}{a} - \frac{bu}{a} \tag{1.42}$$

The first expression on the right hand side represents the steady state 'equilibrium' price level, the second the unanticipated 'disturbance' to the price level which comes from 'u' (which is white noise).

Substituting (1.42) into (1.39) yields the expected loss (L^e)

(recalling $y = y^* + u$ and $u^e = 0$ $u^2 = \text{var } u$)

$$L^e = (1 + \frac{b^2}{a}) [y^* (1 - k)]^2 + (1 + \frac{b^2}{a}) \text{ var } u \tag{1.43}$$

The first expression on the right hand side reflects the familiar steady state inflation 'bias' which comes from discretion. [See on this Barro and Gordon (1983) and Fischer (1988).]

Consider now the money stock rule. We need to introduce a money market equation, which we assume takes the form

$$mo = p + y - v \tag{1.44}$$

1/ The last expression in (4) and (5) is different from Frankel. Some error appears to have crept into Frankel's reported results.

where v represents a velocity disturbance (which has a zero mean).

The money stock is set so as to achieve zero inflation and at the same time to absorb the expected long run level of output, which is y^*. So we have

$$y^* = p + y - v \text{ or } y = y^* + v - p \qquad (1.45)$$

Combining (1.45) and (1.40) and noting that $pe^* = 0$ (i.e., the expected price level on average will be zero) we have

$$p = \frac{v - u}{1 + b} \qquad (1.46)$$

The expected loss now becomes

$$L^e = [(1 - k)y^*]^2 + \frac{1 + a}{(1 + b)^2} \text{ var } u + \frac{a + b^2}{(1 + b)^2} \text{ var } v \qquad (1.47)$$

Comparing (1.43) with (1.47) it is readily seen that the first term on the right hand side in (1.47) is smaller than in (1.43) (because of the commitment now to lower inflation), the second term is ambiguous while there is now a potential loss from velocity shifts in (1.47) absent from (1.43). What this means is that the incapacity to apply discretion carries both gains (the lower equilibrium inflation) and losses (the inability to react to velocity shocks).

Finally, we evaluate nominal income targeting. With monetary policy reacting contemporaneously and with complete success we have

$$y + p = y^* \text{ (v is offset by changes in mo)} \qquad (1.48)$$

or $y - y^* = -p$

with $p^e = 0$ again we can combine (1.48) and (1.40) to yield

$$bp + u = - p \text{ or } p = - \frac{u}{1 + b} \qquad (1.49)$$

which is as above in (1.46) with the omission of v.

We can now rewrite (1.39) using (1.48)

$$L = ap^2 + [(1 - k)y^* - p]^2 \qquad (1.50)$$

or

$$L = (1 + a)p^2 + [(1 - k)y^*]^2 \qquad (1.51)$$

Using (1.49) this reduces to

$$L^e = \frac{(1 + a)}{(1 + b)^2} \text{ var } u + [(1 - k)y^*]^2 \qquad (1.52)$$

(1.52) is identical to (1.47) except for the disturbance term v. Hence on this analysis a nominal income target must unambiguously be superior to a money stock target. Compared, however, to a discretionary regime it is unambiguously superior in so far as inflation is concerned but is ambiguous in respect of the response to the supply shock.

In the second part of the analysis Frankel extends the loss function to take account of exchange rate movements

$$L = ap^2 + (y - ky^*)^2 + cs^2 \qquad (1.53)$$

where s is the exchange rate and c now represents the weight attaching to the exchange rate.

Instead of a formal model incorporating exchange rate movements he uses the following equation to explain exchange rate behavior.

$$s = mo - y + e \qquad (1.54)$$

Where e is the disturbance term to the exchange rate (again with zero mean).

Using now (1.53) and (1.54) the money market equation (1.44) the supply equation (1.40) he is able to evaluate the same three previous regimes, plus a fourth one, a fixed rate regime ($s = 0$).

Carrying out similar exercises to the above and imposing certain not unrealistic assumptions (e.g., that the variance of e dominates over u) he is able to conclude that the nominal GNP rule dominates over the money stock and fixed rate rules.

2. <u>The two target-two instrument case</u>

The literature reviewed so far has in common that it evaluates alternative monetary rules (including the use of monetary policy to target nominal income), by reference to traditional loss functions. We now turn our attention to a different formulation of the problem. The literature to be reviewed here takes more or less as a starting point that nominal income ought to be targeted. However, it poses the broader policy question: in a world where say, there are two targets of policy, of which nominal income is one, and two instruments, monetary and fiscal, how should policy be designed and, in particular which instrument ought to be assigned to which target?

There are two contributions that belong in this framework, one represented by Genberg and Swoboda (1987) and Boughton (1989) (henceforth BGS), and the other by the New Keynesians, whose evolving views have appeared in a succession of papers beginning with Meade (1978) evolving through Vines et al (1983), Blake and Weale (1988), Blake et al (1988), Vines (1989) and culminating in a volume Weale et al (1989).

<u>Boughton (1989)-Genberg and Swoboda (1987), (BGS))</u>

Although the analysis presented here is very much in the spirit of BGS, it is not an exact replication of their own models or detailed presentations. The two targets are nominal income (y + pd) and the adjusted current account (CA/Xo). Exchange rates are flexible and the two instruments are the money stock (mo) and fiscal policy (gr).

Consider the following medium run (as distinct from long run) model:

$$y = \alpha_1(e - pd) - \alpha_2\bar{r} + \alpha_3(gr + u_1) \tag{1.55}$$

$$mo = y + pd - \alpha_5\bar{r} + u_2 \tag{1.56}$$

$$y = - \alpha_6(1 - \alpha_{15})\ (e - pd) + u_3 \tag{1.57}$$

$$\frac{CA}{Xo} = \alpha_{20}(e - pd) - y \tag{1.58}$$

Equations (1.55-1.58) are a fairly standard set of medium run equations of a small open economy. The demand for output is a function of the real exchange rate (e - pd) and of real government expenditure (or equivalently a real expenditure disturbance u_1). Real money balances (mo - pd) are a function of output and a disturbance term (u^2). Assuming wages are fully indexed to the consumer price index and output is a function of the real wage rate (wages being deflated by the price of home goods) the supply of output will be a negative function of the real exchange rate [Argy and Salop (1979)]; u_3 represents a supply shock. Finally, the current account (CA) deflated by initial exports (Xo) is a positive function of the real exchange rate and a negative function of output. The interest rate ($\bar{r}$) is determined abroad.

The medium run solutions for nominal income and the current account are straightforward.

$$(y + pd) = \pi_1 mo + \pi_2 gr \tag{1.59}$$

$$\frac{CA}{Xo} = \pi_3 mo + \pi_4 gr \tag{1.60}$$

where $\pi_1 = 1 \quad \pi_2 = 0 \quad \pi_3 = 0 \quad \pi_4 = - \dfrac{\alpha_3[1 + \alpha_6(1 - \alpha_{15})]}{\alpha_6(1 - \alpha_{15}) + \alpha_1}$

A change in the money stock leaves output unchanged and increases prices proportionately; at the same time it leaves the real exchange rate unchanged and thus has no impact on the current account. Fiscal expansion has no impact on nominal income (this is readily seen from (1.56), with the money stock fixed) but generates a current account deficit.

It is evident form these results that <u>in the medium run at any rate</u> the money stock must be assigned to nominal income while fiscal policy has to be assigned to the current account. The reverse assignment is likely to pose problems, as we will now demonstrate.

To illustrate the workings of this model consider three types of domestic disturbances corresponding to u_1, u_2 and u_3. Suppose there were a sustained expenditure shock (u_1) which left in its trail nominal income unchanged, but a current account deficit. The BGS assignment would require the fiscal authorities to tighten fiscal policy until in due course the deficit were corrected. Nominal income is, in the end, untouched so monetary policy is not invoked.

Assuming now a monetary expansion is thought to reduce a CA deficit, the reverse assignment would trigger a monetary expansion but this in turn would create an inflationary income spiral, triggering, at this point fiscal contraction which in turn reduces the current account deficit but leaves nominal income unchanged. At some point the tight fiscal policy will create a current account surplus, now triggering a monetary contraction, which will start pulling nominal income back. This sequence is represented in Figure 3 below. The starting point following the shock will be 0. This triggers a monetary expansion putting the economy into quadrant A, from which it will move to B, then on to C, etc.

A monetary disturbance (say a fall in u_2^*) generates an excess level of income but leaves the current account imbalance. Now, following BGS this could be corrected by a monetary contraction, without a need to invoke fiscal policy. The economy would be pushed back to Q_0 from, say, Q_1. However, with the alternative assignment fiscal policy would be tightened at first then as a current account surplus emerged monetary policy would also be tightened. The economy would move into the B quadrant.

A supply disturbance (u_3) leaves nominal income unchanged but has an ambiguous effect on the current account. 1/ Suppose that the current account is improved; the economy will then be placed at say Q_2. A tight fiscal policy would, in principle, be sufficient to move to Q_0. However, with the reverse assignment there will be a monetary contraction and the economy will then find itself in quadrant C.

We have simplified by focusing only on 'medium run' assignment without introducing dynamics. Obviously assignment issues are much more complicated if we start from the short run and allow dynamics.

The New Keynesian proposals

For some years now a team based at Cambridge (UK) has been developing and refining a set of policy proposals for the design of monetary, fiscal, exchange rate and wage policies. These proposals, represented by the authors as New Keynesians, are sharply distinguished from "monetarist" and "Keynesian" thinking.

What distinguishes New Keynesian thinking about the design of policy? First, labor market policies should be directed at securing full employment. This particular theme is fully developed in Meade (1982). At the same time monetary and fiscal policies should both be directed at two targets of policy: a "wealth" target and a nominal income target. The preferred fiscal instrument is the "tax rate", the preferred intermediate monetary instrument is the real exchange rate, with the real interest rate used as a control instrument to achieve the exchange rate objective. Although they do

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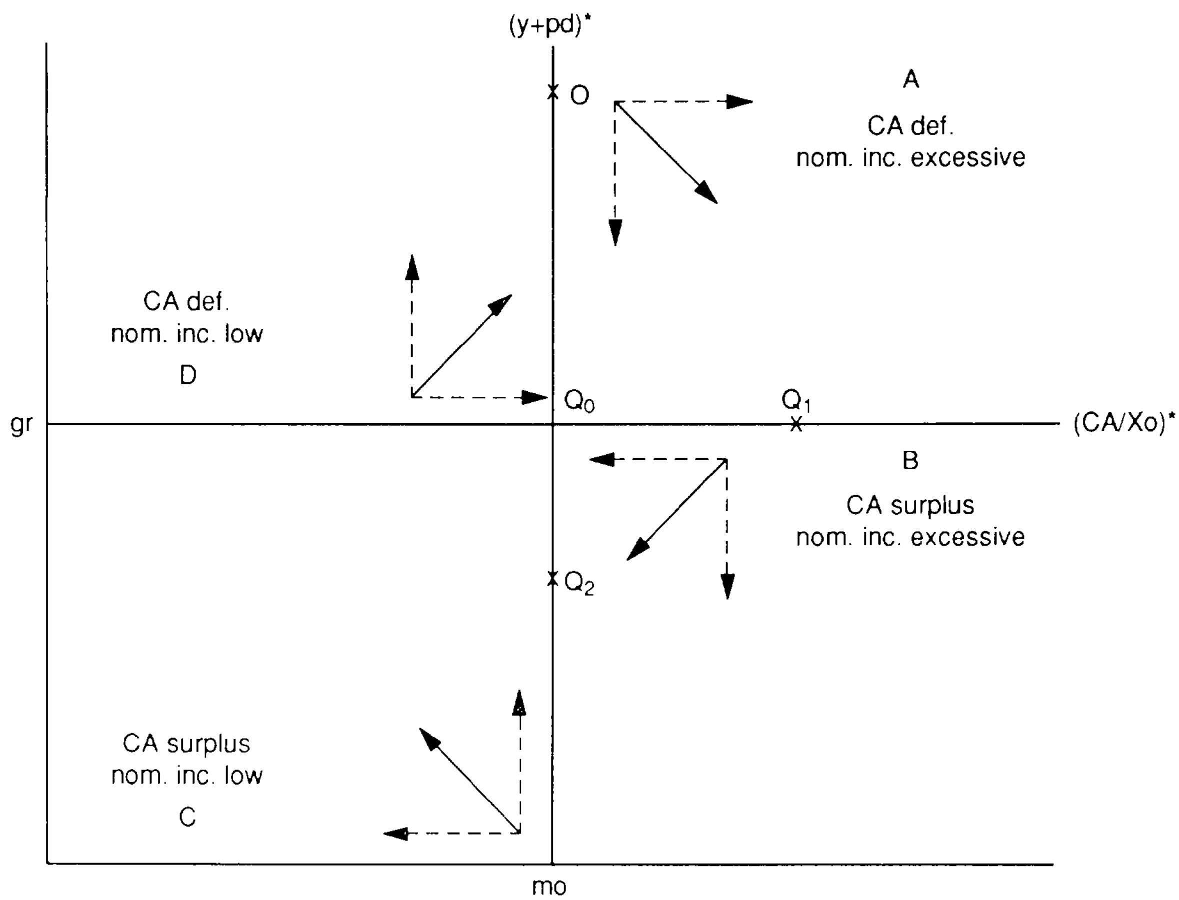
1/ The solution is:

$$\frac{CA/Xo}{u_3} = \frac{1 - \alpha_1}{\alpha_6(1 - \alpha_{15}) + \alpha_1}$$

Figure 3
External/Internal Balance and Monetary Fiscal Assignments



not propose pure assignment rules (i.e., assigning a particular instrument solely to one target) they do investigate in some detail the 'comparative advantage' each instrument has over a target. Moreover, they make a sharp and important distinction between short run and long run comparative advantage, noting that these could be quite different.

Their model, which I will present, is one which appears in Blake et al (1988). (See also Weale et al (1989)). This model is also empirically estimated, allowing them to evaluate alternative policy rules.

The underlying equations

Aggregate demand

$$y = \bar{y} - k(\alpha_1 r + \alpha_2 a + \alpha_3 s - j) \quad (1.61)$$

$$i = \bar{i} - \alpha_1 r - \alpha_2 a - ny \quad (1.62)$$

Financial markets

$$\dot{a}^e = rf - r \quad (1.63)$$

$$r = rf + \theta(a^* - a) \quad (1.64)$$

Supply side

$$p = \bar{m} + w \quad (1.65)$$

$$\dot{w} = \bar{b} + b_1(l^d - l^s) + b_2(\dot{p} - n\dot{a}) + b_3\dot{s} + b_4 p^* \quad (1.66)$$

$$l^s = b_5[w - (p - na)] - b_6 s \quad (1.67)$$

$$l^d = y \quad (1.68)$$

Notation (in logs, except for the interest rate)

p = domestic output price

r = real interest rate

rf = real interest rate abroad

a = real exchange rate (units of foreign currency per unit of domestic currency) (an increase means of real appreciation)

$\dot{a}^e$ = the expected percent change in the real exchange rate y = level of output

w = wage rate

n = fraction of spending on imports (no imported materials)

l^d = demand for labor

l^s = supply for labor

i = national investment

p^* = 'core' rate of inflation

s = tax rate

a^* = (intermediate) target real exchange rate

j = real government expenditure

A dot over a variable represents the rate of change.

The equations are fairly straightforward. The real demand for goods is a negative function of the real interest rate, the real exchange rate and the tax rate. k is the Keynesian multiplier while j stands for real government expenditure.

Wealth is one of the two principal targets of policy. It is defined as national investment which is the sum of home and foreign investment, the latter being of course the current account surplus. (1.62) explains this broad investment [$-\alpha_2 a$ - ny, capturing the current account component].

(1.63) assumes perfect asset substitution. The expected percent change in the real exchange reflects the difference in the two real interest rates. (1.64) says that although the real exchange rate is an intermediate target (a^*) the real interest rate is used as the control instrument to achieve the target real exchange rate.

(1.65) - (1.68) spell out the supply side of the economy. (1.65) says that the price of home goods is a simple fixed mark up ($\bar{m}$) on wages. (1.66) is a key equation. The rate of change in wages is explained by demand pull factors (the excess demand for labor l^d - l^s) and cost push factors, represented by the rate of change in the consumer price index ($\dot{p}$ - $n\dot{a}$) 1/, the rate of change in the tax rate and the 'core' rate of inflation. The supply of labor is a positive function of the real wage rate (in terms of consumer prices), with some adjustment for the tax rate. The demand for labor is determined by the level of output.

We want, finally to arrive at equations which explain the two targets ($\dot{p}$ and i) 2/ in terms of our two instruments (s and a). 'a' in turn is then controlled by 'r', as already indicated. The optimal rate of inflation is taken to be zero.

The basic structure of the model is then

$$i^* = \pi_1 s + \pi_2 a \qquad (1.69)$$

$$\dot{p}^* = 0 = \pi_3 s + \pi_4 a \qquad (1.70)$$

Comparative advantage is determined by the ratio

$$k_1 = \frac{\pi_1/\pi_3}{\pi_2/\pi_4}$$

If $k_1 > 1$ s has a comparative advantage in controlling investment; if $k_1 < 1$ s has the comparative advantage in controlling inflation.

To arrive first at the investment (wealth) equation we substitute (1.61) into (1.62). This gives us (dropping j, which is taken as given), using (1.63).

1/ If pc is the consumer price index

$$pc = \alpha_{15} p - (1-\alpha_{15})(e-pf)$$

where e is the nominal exchange rate and pf is the foreign price level.

$$a = e + p - pf \text{ or } e = a - p + pf$$

Substituting this above gives

$$pc = p - (1 - \alpha \quad)a \qquad \text{where } n = (1 - \alpha_{15}).$$

2/ Although the analysis is undertaken in terms of inflation they in fact support targeting nominal income.

$$i^* = \bar{i} - \alpha_1(1 - nk)\ (rf - \dot{a}^e) - \alpha_2(1 - nk)a + nk\alpha_3 s \tag{1.71}$$

where i^* is the target level of investment.

In the long run $\dot{a}^e = 0$ (or some constant) so we have

$$i^* = \bar{i} - \alpha_1(1 - nk)rf - \alpha_2(1 - nk)a + nk\alpha_3 s \tag{1.72}$$

$nk < 1$ 1/ the slope s/a is the long-run trade off between a and s, given the target national investment and rf.

An appreciation reduces national investment (by reducing the current account surplus) and this requires a rise in the tax rate (direct or indirect) to restore the investment target [now by increasing the current account surplus through a fall in output - as in (1.61)]. (See Figure 4). A rise in the investment target would shift the schedule to the left. (For a given s a real devaluation would be required).

Turning now to the inflation target (set at $\dot{p} = p^* = 0$) and imposing the long run condition that $\dot{a} = \dot{s} = 0$ we can arrive at (noting that $1 - b_2 = b_4$).

$$0 = -\frac{b_1 k\alpha_1}{1 - b_2} rf - \frac{b_1(k\alpha_2 + b_5 n)}{1 - b_2} a + \frac{b_1(b_6 - k\alpha_3)}{1 - b_2} s \tag{1.73}$$

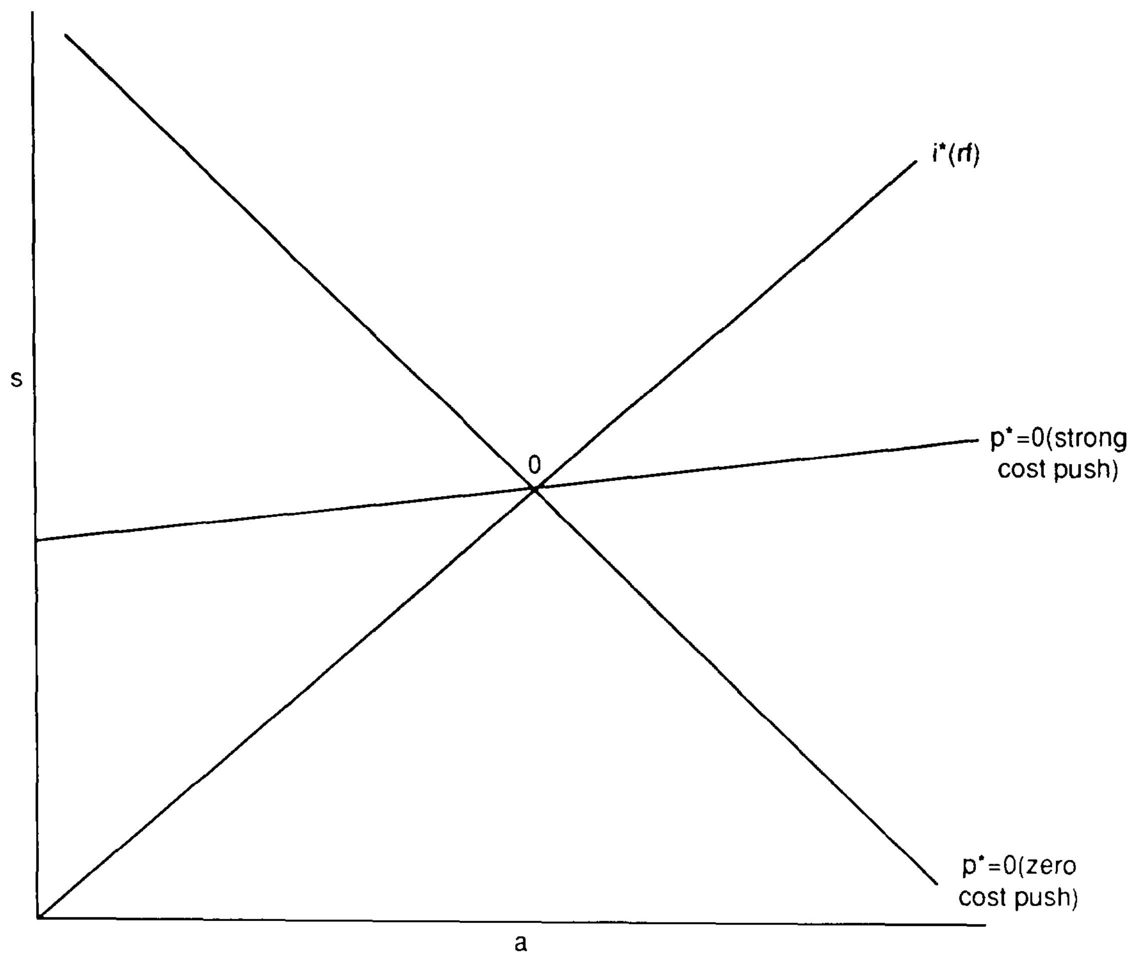
It is readily seen that the slope of the inflation target schedule depends on the sign of $b_6 - k\alpha_3$. $k\alpha_3$ is the demand pull effect of an increase in taxes [equation (1.61)]; b_6 is the long run 'cost push' effect acting through the supply of labor (an increase in taxes reduces the supply of and increases the excess demand for labor, thus reinforcing inflation). (See (1.67) and (1.66)).

Two extreme cases only are demonstrated in Figure 4. The case where b_6 is zero and the case where b_6 is very large.

Clearly where the two schedules intersect (at 0) gives the long run solution for s and a.

1/ We can rewrite the expression as $n/1 - c(1 - t) + n$, where c is the marginal propensity to consume and t is the tax rate on income. Provided $c(1 - t) < 1$ the expression must be less than unity.

Figure 4
New Kaynesian Assignment



To evaluate long run, as distinct from short run, comparative advantage the ratio k_1 can be calculated, substituting the coefficients in (1.72) and (1.73) for π_1, π_2, π_3 and π_4 into (1.69) and (1.70).

III. Survey of the Theoretical Literature--The Large Country Case

Here we briefly discuss two proposals: the Williamson-Miller (WM) blueprint and the Boughton-Genberg-Swoboda (BGS) proposal.

The WM blueprint

Williamson-Miller (1987) have proposed a blueprint for the conduct of global macropolicy. First, exchange rate target zones would be defined for the leading currencies. The center of a target zone would be calculated with an eye on securing long run current account objectives. A margin of 10 percent would be allowed on each side of the center. Each central bank would defend the upper and lower points by adjusting its interest rate.

Second, national fiscal policies would also be adjusted so as to achieve national target rates of growth of domestic demand. However, if fiscal deficits are already too high or the public debt to GDP ratio excessive, the rule that fiscal policy should be expansionary when nominal demand growth has stalled would be suspended.

Third, the average level of the world interest rate should be adjusted so as to achieve the target growth of nominal demand for the participating countries.

The BGS framework

We focus here on the spirit of the BGS framework, extended to the large country case. Assume a two country world with flexible rates. Each of the two countries is assumed to target internal, external (current account) balance and the real interest rate (to achieve a desired mix of consumption - investment); at the same time, we have four policy instruments, monetary and fiscal policies in each of the two countries. Since the current account target is common to the two countries we have, in essence, as many instruments as targets.

How then should these be assigned? Monetary policy has, as an empirical fact, weak and ambiguous effects on the current account; fiscal policy, on the other hand has unambiguous effects on the current account and on the assumed common world real interest rate. Monetary policy has unambiguous effects on 'income' but uncertain effects on the real interest rate.

Given these comparative effects on the targets they propose that the two monetary instruments be assigned to each country's internal balance (nominal income), that one fiscal instrument be assigned to the common external balance and the other be assigned to the real interest rate target. Thus, whereas no coordination is strictly needed on the monetary front (except an initial agreement to abide by these rules), coordination is obviously necessary on the fiscal front (see Annex 1).

Swoboda (1989) provides a simple illustration of how fiscal policy in the two countries might in the medium run be assigned to the current account and real interest rate targets, assuming each monetary policy has taken care of its nominal income targets (and the world economy is at full employment).

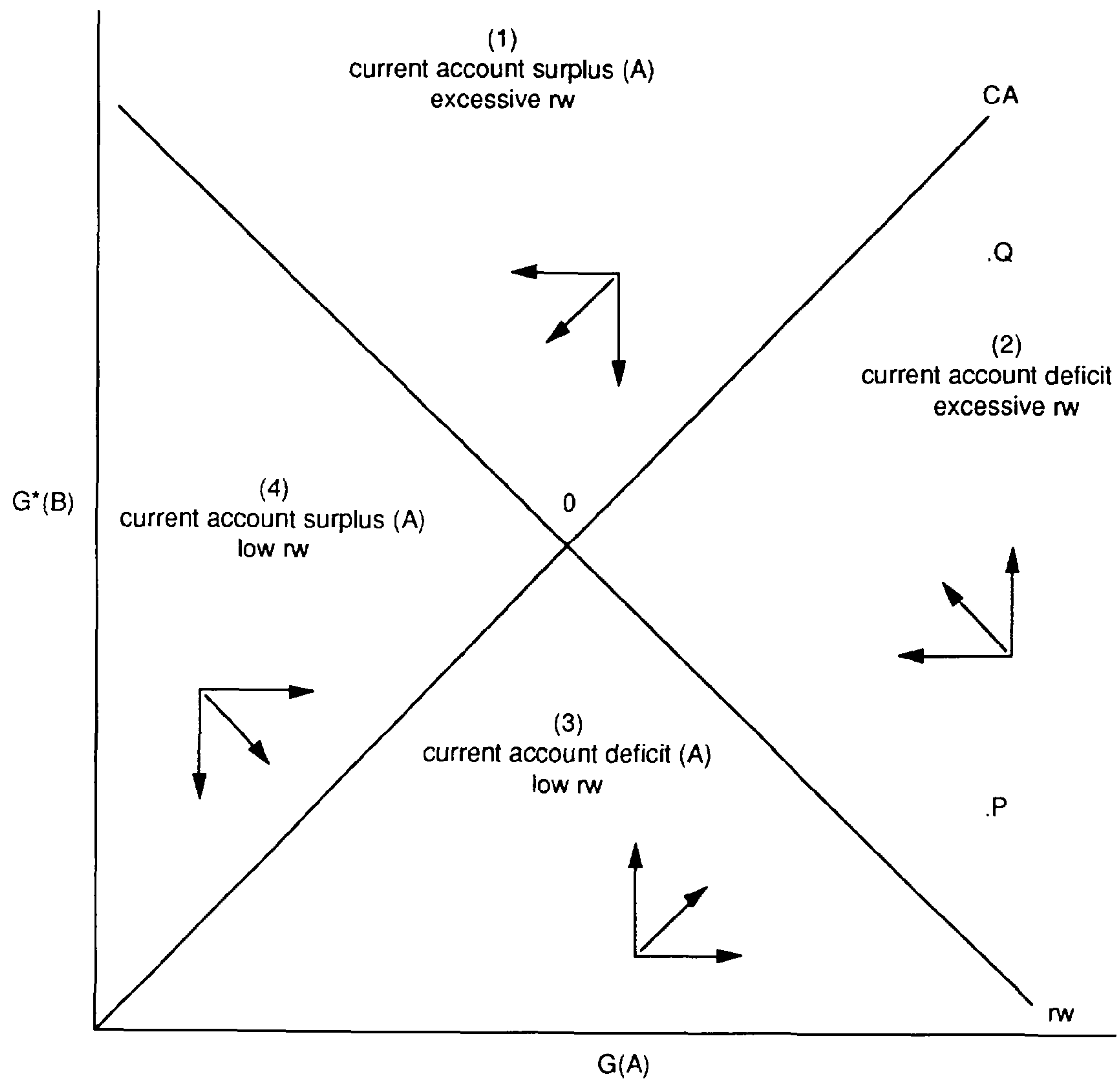
Figure 5 reproduces Swoboda's graphical presentation. The CA schedule represents the combinations of government expenditures in A and B which maintains the common external balance. Clearly if G(A) increases G(B) must also increase to maintain the same current account. The rw schedule represents the combinations of fiscal policy which maintain an 'acceptable' common real world interest rate. If G(A) were to rise, pushing up rw, GB must now fall to keep the real interest rate at its desired level.

If A represents the US today and B say Japan and Germany then clearly we would have to place the world economy in quadrant 2 where A has a current account deficit (B a surplus) and rw is 'too high'. If the world economy were at Q where the CA deficit is relatively small but the real interest rate is very high both A and B must adopt tight fiscal policies (A's being the tighter) to reach 0. If the economy were at P, where the deficit is the overriding problem (but less so the real interest rate), A must tighten and B must ease its fiscal policy. (A tightening by more than B eases). Alternatively A could be assigned the task of securing the real interest target, B the task of correcting current account imbalances. Arrows point in the direction in which each country would proceed.

<u>WM and BGS compared</u>

There are three principal differences between the WM and the BGS frameworks. First, WM want to target the real exchange rate, BGS do not. Second, and most importantly, the assignment is reversed in BGS. In WM monetary policy is assigned to the real exchange rate (but ultimately to achieve current account objectives); fiscal policy is assigned to internal (nominal demand) balance, but global monetary policy is assigned to global internal balance (raising questions about too many instruments doing the same job). BGS, as already indicated, basically reverse this assignment assigning money to the internal balance and fiscal policy to the current account. The extra fiscal instrument goes to the real interest rate. Third, the WM blueprint probably makes greater demands on coordination than the BGS framework.

Figure 5
Fiscal Policy Coordination



IV. Theoretical Evaluation of a Nominal Income Strategy--The Small Country Case

So far we have reviewed the literature in some detail. In Section III we undertake our own theoretical evaluation of nominal income targeting of the small country. In Section IV we undertake a parallel evaluation for the large country. Subsequently, moving away from abstract modelling we try to review some broader issues associated with a strategy of targeting nominal income. Finally, we review the empirical work which bears on our own study.

In this Section we first present a model of a small open economy. The model provides the basis for the subsequent analysis of a nominal income target strategy.

1. The base model

The home economy

3.1 $ya = \alpha_1(e + pdb - pda) - \alpha_2[ra - (tEpa_{+1} - pa)] + \alpha_7 yb + \alpha 3 u_1 a$

3.2 $ma = \alpha_4 ya + pda - \alpha_5 ra + u_2 a$

3.3 $ra = rb + (tE_{e+1} - e)$

3.4 $ya = -\alpha_6(wa - pda) + \alpha_6/k_1 u_3 a \qquad \alpha_6 = (1-a)/a \qquad k_1 = (1-a)$

3.5 $wa = t_{-1}\ Epa + \Pi_1(pa - t_{-1}Epa)$

3.6 $pa = \alpha_{15}\ pda + (1-\alpha_{15})(e+pdb)$

3.7 $La = \pi_{20}\ (ya-y\bar{a})^2 + \pi_{22}(pda - pd\bar{a})^2 + \pi_{24}(er - e\bar{r})^2 + \pi_{26}(rra - rr\bar{a})^2$

The rest of the world

3.8 $yb = -\alpha_{12}[rb - (tEpdb_{+1} - pdb)] + \alpha_{14} u_1 b$

3.9 $mb = \alpha_4 yb + pdb - \alpha_5 rb + u_2 b$

3.10 $yb = -\alpha_8(wb - pdb) + \alpha_8/k_2\ u_3 b$

3.11 $wb = t_{-1}Epdb + \pi_1(pdb - t_{-1}Epdb) \qquad \alpha_8 = (1-b)/b \qquad k_2 = 1-b$

Notation

Subscripts a and b describe the small country and the rest of the world, respectively. A bar over a variable indicates a target level (equal to base level).

y = output

pd = home prices

p = consumer prices

e = exchange rate (units of the small country per unit of the rest of the world.

er = real exchange rate = $e + pdb - pda$

w = wage rate

r = interest rate

rr = real interest rate

$_tEx_{+1}$ = expectation formed at time t about the variable x for period t+1

m = money stock

u_1 = serially uncorrelated expenditure disturbance

u_2 = serially uncorrelated money demand disturbance

u_3 = serially uncorrelated productivity disturbance

$(1-a)/a$ = share of wages to profits (in A)

$(1-a)$ = share of wages in private sector production (in A)

k_1 = $(1-a)$

k_2 = $(1-b)$(share of wages in private sector production (in B)

$(1-b)/b$ = share of wages to profits in B

L = welfare loss.

The model is very well known so we can be very brief in describing it.

Equation 3.1 describes the demand for real goods in A, which is a function of the real exchange rate, the real interest rate, output in the rest of the world and an expenditure disturbance. Equation 3.2 is a conventional money demand equation, with a disturbance term represented by u_2a. (For most of our analysis we are going to impose the condition that $\alpha_4 = 1$.) Equation 3.3 captures the assumption of perfect asset substitution.

The supply side is represented by Equations 3.4 and 3.5. Output is a function of the real wage rate; u_3 is a productivity disturbance. Contracts are for one period only, and may or may not incorporate an indexation provision. If wages are fully indexed to the consumer price index $\pi_1 = 1$ and expectations become irrelevant. The consumer price index, in turn, is a weighted average of home and import prices (in the home currency).

We are interested in evaluating alternative policy regimes from A's perspective. We need therefore some criterion by which to evaluate performance. We choose to adopt an eclectic loss function (represented by 3.7). We suppose that the authorities are concerned about variations in output, home prices, the real exchange rate and the real interest rate. Without finally attaching weights to these we simply note in our analysis how each of these variables is affected by the strategies.

The rest of the world is modelled, in principle, in a parallel fashion to economy A, except that the rest of the world is so large that it is effectively a closed economy. Economy A variables do not appear in B and the exchange rate plays no role.

2. Alternative monetary rules

In this part we compare three alternative monetary strategies, first for the case of unindexed contracts and next for the case of fully indexed contracts.

The first monetary strategy is one where exchange rates are flexible and the money stock is fixed; the second strategy is one where exchange rates are again flexible but now the monetary authorities target nominal income, adjusting monetary policy in line with the gap between a target and actual nominal income; the third strategy is one where monetary policy is used to target the exchange rate (the fixed rate regime).

In this part we also make a number of key assumptions. First that all disturbances are at once unanticipated and temporary (in reality, and correctly perceived as such). Second, that the activist monetary adjustment required to achieve a nominal income target is contemporaneous. Third, the nominal income objective is exactly achieved (these three assumptions will be relaxed in part 4). Fourth, throughout we assume all expectations are rationally formed.

The methodology underlying the analysis is the following. If we take the first regime as the starting point we can see that if nominal income should rise (fall) then a monetary adjustment mechanism will be set in motion in regime 2, generating a new set of outcomes. Alternatively, to move from the flexible to the fixed rate regime we need to know only the movement in the currency; this then triggers a monetary adjustment to stabilize the currency; the new set of outcomes will represent regime 3.

Consider first the case of domestic disturbances. Table 1 reveals that in regime 1 for a domestic expenditure disturbance nominal income will rise (ya + pda > 0). At the same time (not shown) the currency will appreciate in nominal terms. In regime 2 monetary policy will now be tightened; this at once stabilizes output and prices but destabilizes the real exchange rate and the real interest rate (see solutions). In regime 3 money will be injected into the economy to stabilize the currency (a monetary policy reaction which is the exact opposite of that for regime 2). This now destabilizes output and prices (relative to regime 1) but stabilizes the real exchange rate and the real interest rate.

For a money demand disturbance, in regime 1 the currency again appreciates but nominal income now falls. In regime 2 an easy monetary policy will be set in motion, which in turn serves to stabilize all variables (see Table 1). In regime 3 a similar monetary adjustment will take place to stabilize the currency, with identical results. So for this disturbance a nominal income regime performs identically to a fixed rate regime.

Finally, for a productivity disturbance at home the outcomes are less clear cut. Compare first a money stock with a nominal income target. It is readily seen from Table 1 that nominal income will rise in regime 1 if ya+pda > 0, i.e, if $\alpha_1+\alpha_2\alpha_{15} > 1$. In this case monetary policy will be tightened in regime 2, which in turn will moderate the increase in output but destabilize inflation. If $\alpha_1+\alpha_2\alpha_{15} < 1$ the increase in output will be reinforced but inflation will be dampened. This result parallels the one in Taylor (1985) and West (1986). Comparing now a nominal income target with a fixed rate regime it is readily shown that if $\alpha_1 + \alpha_2\alpha_{15} > 1$ a nominal income target stabilizes all the real targets but destabilizes prices.

To conclude the analysis of domestic disturbances, it seems that the magnitude of $\alpha_1 + \alpha_2\alpha_{15}$ is important in the assessment. Empirical evidence suggests that $\alpha_1 + \alpha_2\alpha_{15}$ is likely to be less than unity (see Fischer 1988). This, if anything, somewhat weakens the theoretical case for nominal income targeting.

Table 1. Solutions for Domestic Disturbances

(Unindexed one-period contracts)

	ya	pda	er 1/	rra
	(Flexible rates, money target)			
$u_1 a$	$\frac{\alpha_3\alpha_5\alpha_6}{k_8}$	$\frac{\alpha_3\alpha_5}{k_8}$	$-\frac{\alpha_3(1+\alpha_5+\alpha_4\alpha_6)}{k_8}$	$\frac{\alpha_{15}\alpha_3(1+\alpha_5+\alpha_4\alpha_6)}{k_8}$
$u_2 a$	$-\frac{\alpha_6(\alpha_1+\alpha_2\alpha_{15})}{k_8}$	$-\frac{\alpha_1+\alpha_2\alpha_{15}}{k_8}$	$-\frac{\alpha_6}{k_8}$	$\frac{\alpha_{15}\alpha_6}{k_8}$
$u_3 a$	$\frac{\alpha_6(1+\alpha_5)(\alpha_1+\alpha_2\alpha_{15})}{k_1k_8}$	$-\frac{\alpha_5\alpha_6+\alpha_4\alpha_6(\alpha_1+\alpha_2\alpha_{15})}{k_1k_8}$	$\frac{\alpha_6(1+\alpha_5)}{k_1k_8}$	$-\frac{\alpha_{15}\alpha_6(1+\alpha_5)}{k_1k_8}$
$k_8 = \alpha_5\alpha_6 + (\alpha_1+\alpha_2\alpha_{15})(1+\alpha_5+\alpha_4\alpha_6)$		$\alpha_6 = \frac{1-a}{a}$ $k_1 = 1 - a$		
	(Fixed rates)			
$u_1 a$	$\frac{\alpha_3\alpha_6}{\alpha_6+\alpha_1+\alpha_2\alpha_{15}}$	$\frac{\alpha_3}{\alpha_6+\alpha_1+\alpha_2\alpha_{15}}$	$-\frac{\alpha_3}{\alpha_6+\alpha_1+\alpha_2\alpha_{15}}$	$\frac{\alpha_3\alpha_{15}}{\alpha_6+\alpha_1+\alpha_2\alpha_{15}}$
$u_2 a$	0	0	0	0
$u_3 a$	$\frac{\alpha_6+(\alpha_1+\alpha_2\alpha_{15})}{k_1[\alpha_6+\alpha_1+\alpha_2\alpha_{15}]}$	$-\frac{\alpha_6}{k_1[\alpha_6+\alpha_1+\alpha_2\alpha_{15}]}$	$\frac{\alpha_6}{k_1[\alpha_6+\alpha_1+\alpha_2\alpha_{15}]}$	$-\frac{\alpha_6\alpha_{15}}{k_1[\alpha_6+\alpha_1+\alpha_2\alpha_{15}]}$
	(Nominal income targeting)			
$u_1 a$	0	0	$-\frac{\alpha_3}{\alpha_1+\alpha_2\alpha_{15}}$	$\frac{\alpha_3\alpha_{15}}{\alpha_1+\alpha_2\alpha_{15}}$
$u_2 a$	0	0	0	0
$u_3 a$	$\frac{\alpha_6}{k_1(1+\alpha_6)}$	$-\frac{\alpha_6}{k_1(1+\alpha_6)}$	$\frac{\alpha_6}{k_1(1+\alpha_6)(\alpha_1+\alpha_2\alpha_{15})}$	$-\frac{\alpha_6\alpha_{15}}{k_1(1+\alpha_6)(\alpha_1+\alpha_2\alpha_{15})}$

1/ er equals real devaluation. A rise in er means a real devaluation.

Consider now the case of external disturbances, again with unindexed contracts. To figure out the effects of each parallel foreign disturbance on the home economy there are two steps to be taken: First, solve for the foreign interest rate, foreign price level and foreign output for each foreign disturbance; second, substitute these solutions into the home economy model. Table 2 gives details of the direction of change in a number of variables at home and abroad.

As previously, to be able to compare regimes we need to know how each foreign disturbance affects nominal income and the currency in regime 1. We consider in a little more detail, the effects of an expenditure disturbance. Abroad output prices and the interest rate all rise. At home nominal income rises while the currency devalues (in nominal and real terms); at the same time the real interest rate rises. In both regimes 2 and 3 money will be tightened. In regime 2 this stabilizes output and prices again at home, strengthens the currency in nominal and real terms, but reinforces the upward movement in the real interest rate. In regime 3 the tighter monetary policy generates ambiguous price-output outcomes, dampens the real exchange rate effect but again reinforces the real interest rate effect. These results appear, on balance, to favor a nominal income strategy.

Price and output at home are stabilized completely whatever the disturbance abroad. However, because nominal income effects of the two other disturbances are ambiguous, very little of substance can be reported on comparative real exchange rate-interest rate impacts.

Suppose now we have fully indexed contracts. How does a nominal income strategy perform relative to the other strategies in these circumstances?

The answer is simple. We recall that the only difference between the three regimes is in respect of the monetary policy implemented, so essentially we need to ask, in an indexed world, how a change in the money stock alters real and nominal variables. It turns out that an expansion in the money stock leaves output, the real exchange rate and the real interest rate all unchanged; at the same time prices will increase and the currency devalue, both less than proportionately (by a factor $1/1+\alpha_5$). In terms of real outcomes, therefore, there is nothing to choose between the regimes. Clearly the case for a nominal income target in relation to the other regimes is substantially weakened in the presence of indexed contracts.

One particular result here is worth highlighting. A nominal income target strategy no longer protects the economy from price-output fluctuations (see Table 3). To illustrate, consider the solution for regime 1 for a domestic expenditure disturbance. Output increases, the real exchange rate appreciates and the real interest rates rises. The effect on home

Table 2. Direction of Change in Key Variables-External Disturbances--Unindexed Contracts 1/

	yb 2/	pdb 2/	rb 2/	ya	e	pda	er	rr
Regime 1 u_1b	↑	↑	↑	↑	↑	↑	↑	↑
u_2b	↓	↓	↑	?	↑	?	↑	↑
u_3b	↑	↓	?	?	?	?	↓	↓
Regime 2 u_1b	↑	↑	↑	0	?	0	↑ 3/	↑
u_2b	↓	↓	↑	0	↑	0	↑	↑
u_3b	↑	↓	?	0	?	0	↓	↓
Regime 3 u_1b	↑	↑	↑	?	0	?	↑	↑
u_2b	↓	↓	↑	↓	0	↓	↓	↑
u_3b	↑	↓	?	?	0	?	↓	↓

1/ Assumes $\alpha_1 > \alpha_2(1-\alpha_{15})$ $\alpha_6 = \alpha_8$ and $\alpha_1 > \alpha_{12}\alpha_{15}\alpha_7$.
2/ Same outcomes across all regimes.
3/ Likely condition is $\alpha_2(1+ \alpha_5 +\alpha_8) > \alpha_5\alpha_7\alpha_8$.

Table 3. Solutions: Domestic Disturbances-Indexed Contracts

	ya	er	rr
$\underline{u_1a}$ Rules 1,2,3	$\frac{\alpha_3\alpha_6(1-\alpha_{15})}{k_4}$	$-\frac{\alpha_3}{k_4}$	$\frac{\alpha_3\alpha_{15}}{k_4}$
$\underline{u_2a}$ Rules 1,2,3	0	0	0
$\underline{u_3a}$ Rules 1,2,3	$\frac{\alpha_6(\alpha_1+\alpha_2\alpha_{15})}{k_1k_4}$	$\frac{\alpha_6}{k_1k_4}$	$\frac{\alpha_6\alpha_{15}}{k_1k_4}$

$$k_4 = \alpha_6(1-\alpha_{15}) + \alpha_1 + \alpha_2\alpha_{15}$$

prices is ambiguous (not shown in Table 3); however, nominal income (ya + pda) rises. So in regime 2 the money stock will be tightened; this lowers the price level, appreciates the currency but leaves all real variables unchanged. The home price level must fall (given that ya = -pda).

In effect, then the only criterion left by which to evaluate the regimes is in terms of inflation outcomes (which are not shown in the Table). However, careful analysis of these proves inconclusive so this is not pursued in detail.

Before completing this section we deal very briefly with two questions. First, many smaller countries peg their exchange rate to a large country; How is a smaller country affected by the unilateral adoption of a nominal income target by the large country? Second, in the light of our own analysis how is a nominal income monetary rule different from a monetary rule which targets inflation?

The smaller country which pegs cannot itself adopt a nominal income target but it is of course affected by the monetary strategy adopted by the large country. Abroad, a money disturbance leaves the interest rate, the price level and output all unchanged so the small country is unambiguously better off. An expenditure disturbance abroad, however, while leaving output and the price level stabilized, will raise the interest rate, with the money stock abroad accommodating, so the small country is not entirely sheltered from this disturbance. Finally, a productivity disturbance abroad raises output, lowers prices proportionately but has ambiguous effects on the interest rate, so there is now transmission to the small country on all three fronts.

The answer to the second question is even more straightforward. Provided the disturbance originates on the demand side at home or from abroad, the impact on the home economy of an inflation target is exactly the same as if nominal income had been targeted. However, the contrast is sharp in the event of a productivity disturbance at home. For example, if output falls and the price level rises proportionately (as would happen under a nominal income strategy) monetary policy will now be tightened to stabilize the price level and this will reinforce the fall in output. Quite evidently in this case a policy of stabilizing prices destabilizes output.

3. Nominal Income Target as a wage rule

So far we have evaluated alternative monetary rules, including a nominal income rule. In this section we focus on alternative wage rules, including now a rule which indexes wages to nominal income. There is a large literature evaluating indexation rules (see for example Marston (1984) and Marston and Turnovsky (1985)); a wage rule which indexes the wage rate to nominal income has also been evaluated by Aizenman and Frenkel (1986a) and briefly by Wagner (1989). Using now a similar framework to the above we *first compare the performance of a number of wage rules, assuming again* disturbances are temporary and unanticipated (see Table 4).

Rule 1: wa = pda
Rule 2: wa = pda + ya
Rule 3: wa = pa = α_{15}pda + (1-α_{15})(e + pdb)

Consider first the case of a temporary expenditure disturbance at home (u_1a). Our rule 2 (the nominal income rule) performs identically to rule 1 in every respect. (This is readily seen by substitution of rules 1 and 2 into 3.4 of the base model.) These rules in turn are superior to rule 3 in terms of stabilizing output; they are both, however, inferior to rule 3 in *respect of real exchange rate and real interest rate volatility.* In respect of the price volatility rules 1 and 2 are ambiguous vis-a-vis rule 3.

Now consider the case of a temporary money demand disturbance at home (u_2a). All three rules now perform identically.

Consider also the case of a temporary productivity disturbance. One result stands out: the nominal income rule 2 is superior on all counts to rule 1. It is, however, difficult to compare rule 2 with rule 3.

Finally consider the case of external disturbances. Rules 1 and 2 are again identical in all respects. These in turn are clearly superior to rule 3 *in respect of output variability output is completely insulated in rules* 1 and 2). However, the rules are more difficult to compare for the other target variables.

In conclusion, we compare a nominal income <u>wage</u> rule with a nominal income <u>monetary</u> rule (with unindexed wages). For an expenditure disturbance a nominal income monetary rule is unambiguously superior. All real outcomes are the same but the monetary rule also suppresses price effects. For a money disturbance the monetary rule is also unambiguously superior (for identical reasons); for a productivity disturbance again real outcomes are identical. The differentiation turns on the price outcome: it turns out that the nominal income monetary rule outperforms the wage rule if $1 > \alpha_2\alpha_{15}$. *This is likely to hold.*

Finally, for external disturbances we have identical real impacts but whereas there are some price effects with a wage rule these are absent with a monetary rule.

Thus it appears that a nominal income <u>monetary</u> rule is superior on all counts to a nominal income <u>wage</u> rule.

Table 4. Wage Rules

(Domestic Disturbance)

($\alpha_4 = 1$)

	y	pd	er	rr
u_1a				
Rules 1 and 2	0	$\frac{\alpha_3\alpha_5}{(\alpha_1+\alpha_2\alpha_{15})(1+\alpha_5)}$	$-\frac{\alpha_3}{\alpha_1+\alpha_2\alpha_{15}}$	$\frac{\alpha_{15}\alpha_3}{\alpha_1+\alpha_2\alpha_{15}}$
Rule 3	$\frac{\alpha_3\alpha_6(1-\alpha_{15})}{k_4}$	$\frac{\alpha_3[\alpha_5-\alpha_6(1-\alpha_{15})]}{k_4(1+\alpha_5)}$	$-\frac{\alpha_3}{k_4}$	$\frac{\alpha_3\alpha_{15}}{k_4}$
u_2a				
Rules 1, 2, 3	0	$-\frac{1}{1+\alpha_5}$	0	0
u_3a				
Rule 1	$\frac{\alpha_6}{k_1}$	$-\frac{\alpha_5\alpha_6+\alpha_6(\alpha_1+\alpha_2\alpha_{15})}{k_1(1+\alpha_5)(\alpha_1+\alpha_2\alpha_{15})}$	$\frac{\alpha_6}{k_1(\alpha_1+\alpha_2\alpha_{15})}$	$-\frac{\alpha_{15}\alpha_6}{k_1(\alpha_1+\alpha_2\alpha_{15})}$
Rule 2	$\frac{\alpha_6}{(1+\alpha_6)k_1}$	$-\frac{\alpha_5\alpha_6+\alpha_6(\alpha_1+\alpha_2\alpha_{15})}{k_1(1+\alpha_6)(1+\alpha_5)(\alpha_1+\alpha_2\alpha_{15})}$	$\frac{\alpha_6}{k_1(1+\alpha_6)(\alpha_1+\alpha_2\alpha_{15})}$	$-\frac{\alpha_{15}\alpha_6}{k_1(1+\alpha_6)(\alpha_1+\alpha_2\alpha_{15})}$
Rule 3	$\frac{\alpha_6(\alpha_1+\alpha_2\alpha_{15})}{k_1k_4}$	$-\frac{\alpha_5\alpha_6+\alpha_6(\alpha_1+\alpha_2\alpha_{15})}{k_1k_4(1+\alpha_5)}$	$\frac{\alpha_6}{k_1k_4}$	$-\frac{\alpha_6\alpha_{15}}{k_1k_4}$

$k_4 = \alpha_6(1-\alpha_{15})+\alpha_1+\alpha_2\alpha_{15}$

4. Some extensions to the theoretical analysis of monetary rules

Part 2 demonstrated that, for demand disturbances (expenditure and money demand), a monetary rule that targets nominal income performs particularly well, notably so if we focus on price-output behavior. However, one suspects that the assumptions underlying these results may be a little unrealistic and overly biased in favor of such a strategy. In this part, therefore, we change at least some of the assumptions so they appear less favorable to the strategy.

It will be recalled that there were three key assumptions underlying our analysis. These were (a) that unanticipated disturbances were, at once, temporary and correctly perceived to be so; (b) that monetary policy acted contemporaneously and, (c) that the nominal income target is exactly achieved. These assumptions are unrealistic.

Suppose we retain (a) and (b) but relax (c). There is bound to be some error in achieving the nominal income target given money stock control [as assumed, for example, in Alogoskoufis (1989)]. This reduces the comparative advantage enjoyed by a nominal income strategy.

We now undertake a more detailed analysis of the implications of relaxing (a) and (b). We modify the assumptions in two ways. First, we suppose that the disturbance in anticipated but at the same time universally perceived after the event to be permanent. However, unlike Bean, we suppose that ex post the disturbance turns out to be temporary and is now correctly perceived as temporary. In other words, we allow for the possibility that forecasts are incorrectly made. Second, as in Bean, we assume that activist monetary policy operates with a lag. So now monetary policy is set for the next period to achieve a nominal income target on the basis of the expected potential level of income in that period, which by assumption ex post turns out to be wrong. All expectations, at all levels, are assumed to be formed rationally. [For a general framework for this kind of analysis see Argy (1990)].

Since it is demand disturbances in particular which favor a nominal income strategy we focus only on such disturbances. Also, we compare two strategies only, the fixed money stock and the nominal income money rule.

There are two periods to consider. These are saddled by 'stationary state' solutions where all variables are at original levels. In period t, there is an unanticipated disturbance, at home or abroad, which now is expected to be permanent. During period t, wages are fixed and predetermined by negotiations in t_{-1}; at the same time, however, there is now some expectation formed about the level of prices and the exchange rate in t_{+1}; these expectations themselves impact on the behavior of the economy in period t. The expected level of prices and the exchange rate in period t_{+1}, formed in t, will be influenced by the expected monetary policy in t_{+1}, taking full account of a potentially known strategy of targeting nominal income. Also, during period t, wages will be negotiated for t_{+1} on the basis of the expected level of consumer prices.

To illustrate, for a <u>domestic</u> disturbance, period t_{+1} will inherit (a) a wage rate negotiated the previous period; (b) a potential monetary policy linked to the expected level of income formed in t for t_{+1} by the monetary authorities. Also, since the disturbance, by assumption, is not sustained in t_{+1} (a) and (b) are the only sources of disturbance in t_{+1} (i.e., the only source of deviation from the stationary path). (For a foreign disturbance there are additional complications.)

To understand what is happening first in period t we need to know the solution for a 'permanent' disturbance, since it is this which will be the basis for expectations in t.

Consider first the case of a domestic money demand disturbance. What are the 'permanent' effects? With a money stock target prices and the exchange rate will fall proportionately; at the same time the real exchange rate, the level of output and the real interest rate will all be unaffected. With a nominal income target, the money stock will be increased so in the end, prices as well as all real variables will be unchanged. So, in period t, the expectation is that, for a money stock strategy, the currency will appreciate and prices will fall in proportion, while for a nominal income strategy neither the exchange rate nor prices will change.

Is there any difference in the behavior of the economy in period t, given the anticipations held for t_{+1}? In this instance, disregarding foreign variables the model can be reduced to:

3.12. $ya = (\alpha_1+\alpha_2+\alpha_{15})(e-pda) - \alpha_2\alpha_{15}(tEer_{+1})$

3.13. $0 = ya + pda - \alpha_5 Ee_{+1} + \alpha_5 e + u_2 a$

3.14. $ya = \alpha_6 pda$

where $tEer_{+1}$ is the real exchange rate expected in t_{+1}. As already indicated $tEer_{+1} = 0$ for the two strategies; for a nominal income strategy $tEe_{+1} = 0$, but for a money stock strategy $tEe_{+1} = -tEu_2t_{+1} = -u_2t$.

Solutions for period t are shown in Table 5. It is readily seen that the expected appreciation <u>amplifies</u> the movement in <u>all</u> variables. Thus the expected stabilization of the exchange rate under a nominal income target serves to stabilize the economy ahead of its actual implementation.

Table 5. Solutions for an Anticipated Permanent Domestic Money Disturbance (u_2a) which is Unrealized

Period t	ya	pda	er	rr
Money target	$-\frac{\alpha_6(1+\alpha_5)(\alpha_1+\alpha_2\alpha_{15})}{k_{15}}$	$-\frac{(1+\alpha_5)(\alpha_1+\alpha_2\alpha_{15})}{k_{15}}$	$-\frac{\alpha_6(1+\alpha_5)}{k_{15}}$	$\frac{\alpha_6\alpha_{15}(1+\alpha_5)}{k_{15}}$
Nominal income target	$-\frac{\alpha_6(\alpha_1+\alpha_2\alpha_{15})}{k_{15}}$	$-\frac{\alpha_1+\alpha_2\alpha_{15}}{k_{15}}$	$-\frac{\alpha_6}{k_{15}}$	$\frac{\alpha_6\alpha_{15}}{k_{15}}$
<u>Period t+1</u> Money target	$\frac{\alpha_6(1+\alpha_5)(\alpha_1+\alpha_2\alpha_{15})}{k_{15}}$	$-\frac{\alpha_6(\alpha_5+\alpha_1+\alpha_2\alpha_{15})}{k_{15}}$	$\frac{\alpha_6(1+\alpha_5)}{k_{15}}$	$-\frac{\alpha_6\alpha_{15}(1+\alpha_5)}{k_{15}}$
Nominal Income target	$\frac{\alpha_6(\alpha_1+\alpha_2\alpha_{15})}{k_{15}}$	$\frac{\alpha_1+\alpha_2\alpha_{15}}{k_{15}}$	$\frac{\alpha_6}{k_{15}}$	$-\frac{\alpha_6\alpha_{15}}{k_{15}}$

$k_{15} = \alpha_5\alpha_6 + (\alpha_1+\alpha_2\alpha_{15})(1 + \alpha_5 + \alpha_6)$

What will happen in period t_{+1}? The formal representation of the verbal description above is as follows. For a money target (setting all expectations for t_{+2} at zero).

3.15. $ya = (\alpha_1 + \alpha_2\alpha_{15})(e - pda)$

3.16. $0 = ya + pda + \alpha_5 e$

3.17. $ya = \alpha_6 \, {}_{t-1}Eu_2 + \alpha_6 pda$

Wages will have been negotiated to fall in proportion to the anticipated money demand shock.

For a nominal income target

3.18. $ya = (\alpha_1 + \alpha_2\alpha_{15})(e-pda)$

3.19. ${}_{t-1}Eu_2 = ya + pda + \alpha_5 e$

3.20. $ya = \alpha_6 pda$

Period t_{+1} inherits a larger money stock in proportion to the expected money disturbance. At the same time, given that the consumer price index would not be expected to change, the wage rate will have been set at the initial level.

Table 5 also shows the solutions for t_{+1}. The change in real variables is <u>reversed</u> in t_{+1}, with the same amplification evident for a money target. Inspection of the Table reveals that insofar as real variables are concerned there is greater <u>volatility</u> in the two periods. Hence one can conclude that, in this instance, a nominal income rule outperforms a money stock rule.

Next consider the case of a domestic expenditure disturbance. A permanent upward expenditure disturbance leaves the level of nominal income unchanged; output will rise and home prices will fall in the same proportion. This is readily seen from 3.2 of the base model. (In steady state ra = rb; if = α_4 = 1 and ma is fixed, under flexible rates ya + pda cannot change.) So the anticipated monetary policy will be identical in the two regimes as will be the anticipated price-exchange rate eut_{+1}. Thus, without going into the dynamics in t and t_{+1} the economy will behave identically under the two strategies.

Consider now a perceived permanent money disturbance abroad. The foreign price level will be expected to fall in proportion, while leaving foreign output and the interest rate unchanged. The currency is expected to depreciate at home in proportion to the fall in the foreign price level. This leaves all real variables and home prices at home all unchanged.

This is the expectation formed at home in t for t_{+1}, but since nominal income is not expected to change in t_{+1} the expected monetary policy will be the same whatever the strategy. Hence again the dynamics of adjustment will be the same.

Finally what happens if there is an expenditure disturbance abroad? This case is the hardest to analyze.

What will be the expectation in t for t_{+1}? This is another way of asking what are the permanent effects on the small economy of an expenditure disturbance abroad? Abroad output will be unchanged and prices and the interest rate will both rise. The fact that the interest rate rises abroad and that ra = rb must mean that, with a money stock target, nominal income will <u>rise</u>. More precisely, output falls, home (and consumer) prices rise by relatively more and the currency devalues. There is also a real devaluation. If nominal income were targeted, the money stock would be allowed to fall, prices would be allowed to fall proportionately, while the nominal currency strengthened. The real exchange rate would be unchanged. Consumer prices rise but the direction of the change in the currency is now ambiguous.

So in period t, there is now a <u>differential</u> impact on expectations in period t for t_{+1}. The <u>expected</u> consumer price level is lower and so is the value of the currency for a nominal income strategy. At the same time, however, there will be effects transmitted from abroad in period t. Abroad there are parallel expectations about the foreign price level and the foreign interest rate. In t output, the interest rate and prices all rise abroad, compounding the effects of the small economy.

It can be shown that the solution for output in t that emerges is:

3.21 $$ya = k_5\alpha_1 tEet_{+1} + k_5\alpha_2\alpha_{15} tEpda_{+1} + k_5\alpha_2(1-\alpha_{15}) tEpdb_{+1}$$

$$+ k_5[\alpha_1 - \alpha_2(1-\alpha_{15})](pdb+rb) + k_5\alpha_7 yb$$

$$k_5 = \frac{\alpha_5\alpha_6}{\alpha_5\alpha_6 + (\alpha_1+\alpha_2\alpha_{15})(1+\alpha_6+\alpha_5)}$$

It is readily confirmed that the <u>differential</u> impact of a nominal income strategy in t is likely to <u>moderate</u> the increase in output and prices. If $\alpha_1 > \alpha_2 (1-\alpha_{15})$ (which is highly likely), we have first positive transmission from abroad from the rise in pdb, rb, yb and the expected inflation; however, with the currency and home inflation expected to be lower the drop in output is almost certain to be moderated. (Indeed must moderate if there is an expected devaluation with a nominal income target.)

What happens in t_{+1}? t_{+1} inherits, with a nominal income target strategy, (a) a lower money stock; (b) a lower wage rate; and (c) the impacts from abroad coming from changes in foreign prices, output and interest rates (these impacts will be the same for both strategies).

Abroad t_{+1} inherits higher wages but expenditure is not sustained. This lowers output, raises prices but has ambiguous effects on the interest rate.

It is thus readily appreciated that the <u>differential</u> impacts of a nominal income strategy are very complex.

The themes we have developed can be extended further but this will not be pursued here. The important conclusion here is that when the model is made more realistic the comparative advantage of a nominal income strategy is considerably weakened, if it does not disappear altogether. Moreover, the simple result that price output changes are insulated for "demand' disturbances, whatever their origin, no longer holds.

5. <u>Conclusions on the theoretical analysis of the small country</u>

1. If contracts are unindexed, disturbances are temporary and correctly perceived to be so, using monetary policy nominal income targeting appears to have an advantage over either money stock targeting or a fixed rate regime for domestic expenditure and money demand disturbances, as well as for all external disturbances, particularly so if output-inflation are the primary targets of policy.

The advantage is less obvious if significant weight attaches to real exchange rate, and real interest rate targets by the authorities . Moreover, for a productivity disturbance at home performance is ambiguous. Finally, if nominal income is missed the advantage is again less evident.

2. If contracts are indexed and disturbances temporary, the advantages of a nominal income target virtually disappear altogether.

3. A nominal income <u>wage</u> rule appears to have substantial advantages over other <u>wage</u> rules, e.g., one which indexes to home prices or to the consumer price index.

4. In general a monetary nominal income rule appears to be superior to a wage nominal income rule.

5. If we modify two key underlying assumptions of the theoretical model (that monetary policy acts contemporaneously and that disturbances are correctly perceived to be temporary), allowing, at once, for a lag in the setting of monetary policy and incorrect forecasts, the results are no longer so favorable to a nominal income strategy. Also, and quite evidently, output-price effects reappear in the face of demand disturbances which are incorrectly forecast.

6. Summarizing our theoretical analysis above, the following seem to be the circumstances in which a nominal income strategy has very little, if any, comparative advantage:

(a) when contracts are indexed.

(b) with unindexed contracts for a productivity disturbance.

(c) when the nominal income target is missed.

(d) when monetary policy is set with a lag and there is a 'forecast error' (and parallel variations on this theme).

(e) when the authorities' loss function attaches considerable importance to real exchange rate-interest rate objectives.

Other difficulties associated with a nominal income strategy are taken up in Part VI.

V. Theoretical Evaluation of a Nominal Income Strategy: The Large Country Case

In Section IV we evaluate the large country case. We first present a two-country model which parallels the small country model of Section III and then evaluate a number of alternative regimes, including a nominal income target strategy. To simplify the analysis we assume throughout that the two countries are identical in size and have identical structural coefficients (but potentially asymmetrical policy strategies).

1. The base model

Goods markets

4.1 $ya = \alpha_1(e + pdb - pda) - \alpha_2[ra - (tE_{pa+1} - pa)] + \alpha_7 yb + \alpha_3 u_1 a$

4.2 $yb = -\alpha_1(e + pdb - pda) - \alpha_2[rb - (tE_{pb+1} - pb)] + \alpha_7 ya + \alpha_3 u_1 b$

Money markets

4.3 $ma = ya + pda - \alpha_5 ra + u_2 a$

4.4 $mas = m\bar{a} - \pi_7(e-\bar{e})$

4.5 $mb = yb + pdb - \alpha_5 rb + u_2 b$

4.6 $mbs = m\bar{b} + \pi_8(e-\bar{e})$

4.7 $ra - rb = tE_{et+1} - e$

4.8 $ma = mas$

4.9 $mb = mbs$

Labor markets/production

4.10 $ya = -\alpha_6(wa - pda) + \alpha_6/k_1 u_3 a$

4.11 $yb = -\alpha_6(wb-pdb) + \alpha_6/k_1 u_3 b$

4.12 $wa = \pi_2[t_{-1}Epa + \pi_1(pa - t_{-1}Epa)] + \pi_3[ya + pda]$

4.13 $wb = \pi_4[t_{-1}Epb + \pi_5(pb - t_{-1}Epb)] + \pi_6(yb + pdb)$

$\alpha_6 = 1-a/a$ $\qquad k_1 = 1-a$

4.14 $pa = \alpha_{15}pda + (1-\alpha_{15})(e+pdb)$

4.15 $pb = \alpha_{15}pdb - (\alpha_{15})(e-pda)$

Loss function

4.16 $La = \pi_{10}(pda-p\bar{d}a)^2 + \pi_{11}(ya-y\bar{a})^2 + \pi_{12}(er-\bar{e}r)^2 + \pi_{13}(rra-r\bar{r}a)^2$

4.17 $Lb = \pi_{14}(pdb-p\bar{d}b)^2 + \pi_{15}(yb-y\bar{b})^2 + \pi_{16}(er-e\bar{r})^2 + \pi_{17}(rrb-r\bar{r}b)^2$

Subscripts a and b stand for countries A and B, respectively

y = output

r = interest rate

pd = home price

p = consumer price

e = exchange rate (units of A's currency per unit of B's currency)

$\bar{e}$ = target exchange rate

m = money stock

w = wage rate

u_1 = serially uncorrelated expenditure disturbance

u_2 = serially uncorrelated money demand disturbance

u_3 = serially uncorrelated productivity disturbance

$tExt_{+1}$ = expectations about x formed in period t for t+1

er = real exchange rate (e + pdb - pda)

rr = real interest rate $[r-(tEp_{+1} - p)]$

α_6 = 1-a/a = share of wages to profits in private sector

k_1 = (1-a) = share of wages in gross private sector production

L = welfare loss

The model is a fairly familiar one, so one can be brief in describing it. Equations 4.1 and 4.2 represent the real demand for goods in A and B. Real demand is a function of the real exchange rate, the real interest rate, the other country's level of output and an expenditure disturbance. Equations 4.3 to 4.9 describe the money markets. Equations 4.3 and 4.5 are conventional money demand equations (the coefficient on output is constrained to be unity) with a disturbance term u2. 4.4 and 4.6 are equations which explain the money stock in A and B. $\pi7$ and $\pi8$ represent the degree to which the monetary authorities 'lean against the wind' to stabilize exchange rates. If exchange rates are flexible $\pi7 = \pi8 = 0$; if exchange rates are symmetrically managed $\pi7 = \pi8$ and mas = -mbs. If exchange rates are fixed with symmetrical monetary adjustment $\pi7 = \pi8 = \infty$ and mas = -mbs. If exchange rates are fixed with A fully sterilizing $\pi7 = 0$; and $\pi8 \rightarrow \infty$. Equation 4.7 embodies the assumption of perfect asset substitution.

Equations 4.10 and 4.11 describe the production side of the economy. Output in A and B is a negative function of the real wage rate; u3 represents a productivity disturbance. 4.12 and 4.13 are generalized wage equations which accommodate a number of possibilities. Contracts are negotiated one period in advance. If these contracts are unindexed and based solely on the expected consumer price index $\pi1 = \pi5 = 0$ and $\pi2 = \pi4 = 1$, $\pi3 = \pi6 = 0$. If contracts are fully indexed $\pi3 = \pi6 = 0$, $\pi2 = \pi4 = 1$, and $\pi1 = \pi5 = 1$. If wages adjust in line with nominal income $\pi2 = \pi4 = 0$; $\pi3 = \pi6 = 1$. The equations also accommodate potential asymmetries in wage determination in the two economies: e.g., if A has indexed contracts but B does not then $\pi 3 = \pi 6 = 0$; $\pi 1 = 1$; $\pi 5 = 0$; $\pi 2 = \pi 4 = 1$. Equations 4.14 and 4.15 define the consumer price index, which is a weighted average of home and import prices.

Finally, equations 4.16 and 4.17 describe the loss functions for the two economies. There are welfare losses from deviations of actual from "desired" levels of output, home prices, the real exchange rate and the real interest rate. Since the weights attaching to each of these variables may be different in A and B the equations allow us to accommodate potential asymmetries in loss functions.

2. Base regimes to be compared

Our objective is to evaluate a nominal income target strategy. Our first task therefore is to define the alternative strategies. The strategies (regimes) to be compared are:

Regime 1: Flexible rates with a target money stock.

Regime 2: Flexible rates with a monetary rule, which targets nominal income (in one or both countries)

Regime 3: Flexible rates with a wage rule linked to nominal income (in one or both countries)

Regime 4: A symmetrical fixed exchange rate regime

Regime 5: An asymmetrical fixed exchange rate regime (with A sterilizing).

We have then a structural model, a loss function for each economy and five base alternative policy strategies. The question we address is: in the face of expenditure, monetary and supply disturbances and given the structural model, which regime performs best in terms of the defined loss function? Each country will have its own ranking of the regimes; these rankings need not be the same.

The disturbances take five forms:

(1) A unilateral expenditure disturbance ($u,a > 0$ or $u,b > 0$)

(2) An expenditure switch ($u_1a = -u_1b$)

(3) A unilateral money demand disturbance ($u_2a > 0$ or $u_2b > 0$)

(4) A money demand switch ($u_2a = -u_2b$)

(5) A unilateral productivity disturbance ($u_3a > 0$ or $u_3b > 0$).

All disturbances, which are unanticipated, are assumed to be temporary and correctly perceived as such. This means that with expectations rationally formed, $tE_{pa+1} = tE_{pb+1} = tE_{et+1} = 0$. Also with disturbances unanticipated $t_{-1}E_{pa} = t_{-1}E_{pb} = 0$.

To anticipate, the final rankings of the regimes in each country will be shown to depend on:

(1) The type of disturbance (expenditure, monetary, productivity).

(2) The country origin of the disturbance (whether it originates in A or in B).

(3) The country loss function (the importance each country attaches to the target variables).

(4) The particular structural model used (notably in this context the coefficients in the behavioral equations).

(5) Institutional conditions (notably in this context whether contracts are indexed or otherwise).

The technical derivation of the solutions for each regime is shown in Annex II.

3. Some results for the five base regimes

In this part we present results for the five base regimes summarized above. Where possible, in summarizing, we try to present an intuitive explanation for some at least of the results.

One way to understand how the adjustment mechanism works in each regime is to take regime 1 outcomes as our starting point and then to show how each of the other regimes entails some additional policy adjustment which in turn will modify the initial outcomes. This, of course, was also the basic methodology we employed in Section III, except that now the policy adjustments are a little more complicated.

The same two variables in the initial solution for regime 1 are again critical in an assessment of the further adjustments required to obtain solutions for the other regimes: the level of nominal income and of the exchange rate. Starting with regime 1, then, suppose that a disturbance occurs in A which (a) raises nominal income in both A and B ($ya + pda > 0$; $yb + pdb > 0$); and (b) appreciates A's currency (devalues B's). To move from regime 1 to regime 2 we note that A and B have now targeted nominal income (at its original level), so monetary policy will initially at least be tighter in both A and B. Since world nominal income cannot change the world money stock must fall in equilibrium. In the end adjustment will generate a new set of outcomes for regime 2.

To move to regime 3 we note that with nominal income up in A and B the wage rate will rise, initially at least, in the two economies. Again the wage rate in the world economy will need to rise; this will provoke adjustments and generate a new set of outcomes for regime 3.

To move to regime 4 it must be recalled that we now require symmetrical monetary adjustment to restore the original exchange rate. Since the exchange rate has appreciated this requires that A increase its money stock and B reduce its money stock equivalently. This generates a new set of outcomes which now represents the solution for regime 4. It is worth noting the intuitive result that world outcomes are the same for regimes 1 and 4 but the distribution of outcomes is different.

Finally, to move from regime 1 to regime 5 (with asymmetrical adjustment) again as in regime 4 the exchange rate must be restored to its original level but now the full burden of monetary adjustment falls on B, which means B will now have to reduce its money stock by twice as much to achieve the same result. So whereas in regime 4 the world money stock is fixed, in an asymmetrical regime such as 5 the world money stock will change, depending on the exchange rate outcome of the country which has responsibility for adjustment.

In our presentation below we intend to proceed as above, always taking the first regime as the base for the analysis of all other regimes. Initially, we assume that contracts are unindexed, except for regime 3 where indexation takes a special form.

A unilateral money demand disturbance

Suppose the disturbance occurs in A. Consider what happens in regime 1 (Table 6). Output and home prices in A fall but the impact on output and home prices in B is ambiguous. A's currency appreciates in nominal and real terms; A's real interest rate rises while in B the outcome is again ambiguous. Given the net disturbance to the world economy, world output and prices, on balance, must fall while the real interest rate, on average, must rise.

What happens in regime 2? Nominal income unambiguously falls in A. If monetary policy targets nominal income the money stock will rise in A; on balance the world money stock must rise. Nominal income is restored in both A and B so in equilibrium neither output nor prices will change in the two economies (This is readily seen from equations 4.10 and 4.11, substituting the constraints ya = -pda and yb = -pdb). At the same time since the money stock rises in A relative to B the currency depreciates in A and the real interest rate falls. In the end all variables return to their original levels. Nominal income targeting in A and B thus acts as a perfect stabilizer on all counts. It is readily seen that to equilibrate all markets the money stock must rise in A to absorb the money demand disturbance while the money stock in B will in the end be unchanged (see Equations 4.3 and 4.5).

Consider now what happens in regime 3. Whereas in regime 2 with world nominal income down the money stock was allowed to rise, now the money stock in both A and B is fixed but the wage rate is allowed to adjust. This acts as a perfect stabilizer to <u>output</u> in A and B. 1/ It is readily shown that A's currency appreciates in nominal terms (but the real exchange rate is unchanged), its home prices fall and its real interest rate is unchanged. In B, however, prices and real interest rates are unchanged. Interestingly, B is completely sheltered in real terms from the money disturbance in A.

Now consider regime 4. Taking regime 1 as the starting point A will increase its money stock, B decrease it equally, sufficiently to restore the original exchange rate. As a result, output will partially reverse itself in A and fall back in B. In the end output will fall <u>equally</u> in A and B and there will be parallel falls in home prices. The real exchange rate will be unchanged (since home prices in A and B fall equally) while now the real interest rate rises equally in A and B.

Finally, consider regime 5. There is now an asymmetrical monetary adjustment which is set in motion. Intuitively, it is readily seen that now to restore the original exchange rate, with A's money stock fixed, the drop in B's money stock must be twice that in regime 4, so the world money stock now falls, injecting a <u>further</u> deflationary bias to the world economy. Output and home prices again fall equally in A and B but now by more than in regime 4. The nominal and real interest rate will rise equally in A and B again by more than previously. It is also readily seen from equations 4.3 and 4.5 that with ya = yb; pda = pdb; ra = rb; mb = $-u_2a$. Finally the real exchange rate is also unchanged.

With asymmetry assumed, it now matters greatly which country experiences a money demand disturbance. Suppose it originated in B and A held its money stock fixed. Now B would pump sufficient money into its economy to restore the exchange rate and this will stabilize all variables, not only in B, but also in A. (See table 6, regime 5 for u_2b.) So, if the money demand disturbance originates in the economy which sterilizes the two economies are disturbed while if the disturbance originated in the other country, the two economies are perfectly stabilized.

1/ Again this is readily seen from equations 4.10 and 4.11. If we substitute 4.12 and 4.13, and set $\pi_2 = \pi 4 = 0$ and $\pi_3 = \pi_6 = 1$ we have ya = yb = 0. With ya and yb fixed equations 4.1, 4.2, 4.3, 4.5, and 4.7 then solve for pda, pdb, e, ra, rb.

A money demand switch

Suppose money demand increases in A and falls equally in B. We can now superimpose on the previous results a fall in money demand in B.

In regime 1, output and prices fall in A and rise equally in B while the nominal and real exchange rate appreciates in A. The real interest rises in A and falls equally in B.

What happens in regime 2? A implements an easy monetary policy; B an equally tight monetary policy. This serves to neutralize the money demand shifts, stabilizing all key variables in the two economies.

In regime 3 the changes in nominal income will set in motion wage adjustments in A and B. In the end output is perfectly stabilized in A and B, prices (and wages) fall in A and rise equally in B. There is a nominal appreciation in A but in real terms this is exactly neutralized by the relative price change. The real interest rate is also unchanged in A and B (this is readily seen from equations 4.1 and 4.2). So, interestingly, in this regime all real variables are stabilized; the money demand shifts are exactly absorbed by price changes.

In regime 4 the money stock will rise in A and fall equally in B to stabilize the exchange rate. This acts as a perfect stabilizer (unlike the case of a unilateral money demand shift).

Technically, as we have shown, a nominal income target regime performs identically to a symmetrical fixed rate regime. In reality, however, the fixed rate regime is likely to perform better because exchange rate data is available instantly whereas nominal income data is only available with some lag. We return to this question later.

Finally, consider regime 5. The money stock will now fall in B to stabilize the exchange rate. This now injects a deflationary bias to the world economy. Output falls equally in A and B, as do prices. (This result exactly parallels the result of a unilateral money demand disturbance in A.) The real exchange rate is unchanged but the real interest rate rises equally in A and B.

A unilateral expenditure disturbance

In regime 1 output and prices increase in A and B but by more in A then in B. 1/ A's currency appreciates in nominal and in real terms. The real interest rate rises in A but the outcome is ambiguous in B.

1/ Strictly the impact on B is ambiguous but positive transmission is almost certain. A sufficient condition is $\alpha_1 > \alpha_2(1-\alpha_{15})$. From equations 4.3 and 4.5 it is readily seen that the money stock will fall by more in A than in B (ya + pda = 0; yb + pdb = 0 and ra > rb).

What happens when monetary policy is used to target nominal income? Again in the two economies output and prices are stabilized. An important result here is that tight monetary policies (more stringent in A than in B) will now reinforce A's real appreciation and as well the rise in the real interest rate (as in the small country case).

What happens when the wage rate is linked to nominal income? The wage rate rises in the two economies, output is stabilized while prices rise in A and B, in A by more than in B. At the same time there is a real appreciation while the real interest rate rises in A and B.

In regime 4 A will now implement an expansionary monetary policy, B an equally restrictive policy. The increase in output and prices will be reinforced in A but in B the outcome is ambiguous. There will be a real appreciation while real interest rates will rise, in A by more than in B.

Finally what happens in regime 5? The money stock in B falls by more than in regime 4. Output and prices increase in A but the impact on B is ambiguous. There is now a real appreciation while the real interest rate rises in A and B.

What if the expenditure disturbance had originated in B instead of A? Now B's currency would (potentially) appreciate, so B would now inject money into its economy to stabilize its currency. In sharp contrast to the previous case the world money stock now <u>increases</u>, so output and prices increase in B as well as in A. In effect, real world expansion is now reinforced by monetary expansion. There is now a real devaluation of A's currency while the real interest rate rises in A and B.

<u>An expenditure switch</u>

In regime 1 an expenditure switch (A increasing, B decreasing) increases output and prices in A and decreases them equally in B. A's currency appreciates in nominal and real terms; also the real interest rate rises in A and falls equally in B.

If the monetary authorities targeted nominal income the money stock would fall in A and rise equally in B. This stabilizes output and prices in the two economies. However, the relative change in the money stock destabilizes both the real exchange rate and the real interest rate.

If wages are linked to nominal income wages will rise in A and fall equally in B. This again stabilizes output in A and B but, in the end, the home price level rises in A and falls equally in B. A's currency appreciates in real terms while the real interest rate again rises in A and falls equally in B.

With exchange rates fixed and adjustment symmetrical A will now increase the money stock, B decrease it equally, to stabilize the currency (so the direction of change in monetary policy is the exact opposite to that in regime 2). Output and prices are thus destabilized in <u>both</u> A and B. The currency appreciates in real terms while the real interest rate will increase in A and fall equally in B.

What will happen in regime 5? Now the money stock falls in B to stabilize the currency. B's output and prices are <u>further</u> destabilized downwards, while output and prices will rise in A. At the same time the real exchange rate appreciates while the real interest rate rises in A but in B the outcome is ambiguous (the downward push being reversed by the fall in the money stock).

Had the switch been the reverse, expenditure rising in B and falling in A, B's money stock would have increased, not fallen, with of course quite different consequences for aggregate outcomes.

<u>A unilateral productivity disturbance</u>

Suppose there is an upward productivity disturbance in A. In regime 1, in A output unambiguously rises while home prices fall, but the outcome for nominal income is ambiguous; so is the impact on A's currency and on A's interest rate. At the same time, in B output and prices move together but again the outcome for nominal income is ambiguous.

It is these ambiguous initial outcomes for regime 1 that make it so difficult to compare performance across regimes. Nevertheless, a few general comments can be made.

Suppose in A and B the monetary authorities targeted nominal income. Because in B output and prices move in the <u>same</u> direction, the monetary authorities will take steps to adjust monetary policy (one way or the other) and this will again stabilize both output and prices. So B's output and prices are completely protected from a productivity disturbance in A. In A, however, the situation is more complicated. If nominal income <u>increases</u> (<u>decreases</u>) in A money will be <u>tightened</u> (<u>eased</u>), stabilizing (destabilizing) output but destabilizing (stabilizing) prices. Output in A must ultimately increase and prices fall exactly in proportion to the productivity disturbance.

We also have an interesting result for regime 3. The wage rate will again adjust in B (in either direction) in such a way that output (but not prices) is completely stabilized. B's output is again fully protected from A's productivity disturbance. In A, output will also increase exactly in proportion to productivity (as in the previous regime). (These results are easily confirmed by appropriate substitutions in the aggregate supply equations).

Table 6. Direction of Change in Key Target Variables
Two-Country Model--Temporary Disturbances

Disturbance	ya	yb	pda	pdb	er	rra	rrb
Regime 1							
u_2a	↓	?	↓	?	↓	↑	?
$u_2a + u_2b = 0$	↓	↑	↓	↑	↓	↑	↓
u_1a	↑	↑	↑	↑	↓	↑	↑
$u_1a + u_1b = 0$	↑	↓	↑	↓	↓	↑	↓
u_3a	↑	?	↓	?	↑	↓	?
Regime 2							
u_2a	0	0	0	0	0	0	0
$u_2a + u_2b = 0$	0	0	0	0	0	0	0
u_1a	0	0	0	0	↓	↑	↑
$u_1a + u_1b = 0$	0	0	0	0	↓	↑	↓
u_3a	↑	0	↓	0	↑	↓	?
Regime 2a 3/							
u_2a	0	0	0	0	0	0	0
u_2b	0	↓	0	↓	↑	?	↑
u_1a	0	↑	0	↑	↓	↑	↑
u_1b	0	↑	0	↑	? 2/	↑	↑
u_3a	↑	?	↓	?	↑	↓	?
u_3b	0	↑	0	↓	↓	?	↓
Regime 3							
u_2a	0	0	↓	0	0	0	0
$u_2a + u_2b = 0$	0	0	↓	↑	0	0	0
u_1a	0	0	↑	↑	↓	↑	↑
$u_1a + u_1b = 0$	0	0	↑	↓	↓	↑	↓
u_3a	↑	0	↓	?	↑	↓	?
Regime 3a 5/							
u_2a	0	0	↓	0	0	0	0
u_2b	0	↓	?	↓	↑	? 4/	↑
u_1a	0	↑	↑	↑	↓	↑	↑
u_1b	0	↑	↑	↑	? 3/	↑	↑
u_3a	↑	↑ 4/	↓	?	↑	↓	?
u_3b	0	↑	↓	↓	↓	?	↓

Table 6 (continued). Direction of Change in Key Target Variables
Two-Country Model--Temporary Disturbances

Regime 4 u_2a	↓	↓	↓	↓	0	↑	↑
$u_2a + u_2b = 0$	0	0	0	0	0	0	0
u_1a	↑	?	↑	?	↓	↑	↑
$u_1a + u_1b = 0$	↑	↓	↑	↓	↓	↑	↑
u_3a	↑	?	↓	?	↑	↓	?
Regime 5 u_2a	↓	↓	↓	↓	0	↑	↑
$u_2a + u_2b = 0$	↓	↓	↓	↓	0	↑	↑
u_1a	↑	?	↑	?	↓	↑	↑
$u_1a + u_1b = 0$	↑	↓	↑	↓	↓	↑	?
u_3a	↑	?	↓	?	↑	↓ 2/	?
Regime 5 u_2b	0	0	0	0	0	0	0
$u_2a + u_2b = 0$	↓	↓	↓	↓	0	↑	↑
u_1b	↑	↑	↑	↑	↑	↑	↑
$u_1a + u_1b = 0$	↑	↓	↑	↓	↓	↑	↓
u_3b	?	↑	?	↓	↓	↓ 2/	↓

1/ Results assume: $\alpha_1 > \alpha_2(1-\alpha_{15})$ and $2\alpha_{15} > 1$ unindexed contracts except for regime 3 (see text).
2/ Very likely.
3/ In regime 2a, A targets nominal income, using monetary policy. B targets the money stock (see text).
4/ Likely real devaluation.
5/ A adopts a wage rule B does not.

Because of ambiguous effects on the exchange rate in regime 1 it is difficult to determine the direction of change in monetary policies in A and B for regimes 4 and 5. The performance of these regimes in relation to the others is thus difficult to evaluate.

Asymmetrical nominal income targeting

Suppose again contracts are unindexed and exchange rates are flexible, but suppose now that only one country (the monetary authority in A) targets nominal income while the other, (B), for one reason or another, does not (it targets the money stock).

We now pose the following question. Is B actually better off from the fact that A targets nominal income? In other words, we compare B's welfare under regimes 1 and an asymmetrical version of regime 2 (regime 2a, see Table 6).

In some ways the analysis of this case is straightforward. The only difference between regime 1 and regime 2a is A's monetary strategy and the impact this has on B's welfare.

Consider a money demand disturbance in A. A implements an expansionary monetary policy which exactly neutralizes all effects on both A and B. In this case B clearly is advantaged by A's strategy.

Suppose the money demand disturbance had originated in B. Nominal income falls in B but the impact on nominal income in A, as we have seen, is ambiguous. A now takes steps to neutralize the change in nominal income, which could mean an easier or a tighter monetary policy. This in turn has ambiguous effects on output and price in B. All in all the change in B's welfare is indeterminate.

Suppose there is an expenditure disturbance in A. Monetary policy is unambiguously tightened in A; this stabilizes output and prices in A. In turn this has ambiguous effects on B's output, prices and the real interest rate. (See solutions for u_2a in regime 1.) However, the real exchange rate appreciation is unambiguously reinforced, as we have seen, so on this front B is clearly worse off.

Suppose the expenditure disturbance had originated in B. The spillover of nominal income into A is positive in the model, so A will tighten monetary policy. This again has ambiguous feedback effects on B's output, prices and the real interest rate.

Finally, suppose we have a productivity disturbance in A. Because the effect on nominal income in A is ambiguous, A's monetary policy is also ambiguous, as is the impact on B.

If the productivity disturbance had originated in B, outcomes would continue to be ambiguous.

To sum up, then, it is difficult to reach conclusions about the impact on B's welfare of A's adopting a nominal income monetary rule.

An asymmetrical wage rule

Instead of an asymmetrical nominal income monetary rule we can visualize an asymmetrical wage rule and we can again ask a parallel question: how is B's welfare affected by A's adoption of the wage rule? We now compare regime 1 with the asymmetrical variant of regime 3 (regime 3a, see Table 7).

We can proceed in a similar way, except that now when A's nominal income alters in regime 1 a change in the wage rate is brought into play, so instead of analyzing the effects on B of any change in monetary policy in A we need to analyze effects on B of a change in the wage rate in A.

It is readily seen from the original model that the analysis of an "exogenous" wage change in A on B is similar to the effects of a productivity disturbance in A on B. Equation 4.10 can be rewritten as:

4.10 $ya = \alpha_6 pda - \alpha_6 w\bar{a} + \alpha_6/k_1 \; u_3 a$

where now $\frac{B}{w\bar{a}} = - k_1 \frac{B}{u_3 a}$, B standing for the effects on B. In turn

the effects of a wage-productivity disturbance in A on B in regime 1 can be read from Table 6. (Most of these effects are ambiguous.)

If there is a money demand disturbance in A, B will again be better off by A's adoption of a wage rule. Indeed B will be totally sheltered from this disturbance.

If the money demand disturbance had originated in B the effects of A's adoption of a wage rule on B are indeterminate.

An expenditure disturbance in A raises income in A and B. If A adopted a wage rule the effects on B are again indeterminate. B, however, is not insulated from the disturbance in A.

An expenditure disturbance in B also raises income in A, where now the wage rate will adjust upwards, but this has mostly ambiguous feedback effects on B.

Finally, for productivity disturbances in A or B we have parallel difficulties in evaluating impacts on B.

We can conclude, as in the case of an asymmetrical monetary rule, that, except for a money demand disturbance in A, it is difficult to determine how B's welfare is affected by A's adopting a wage rule.

The case of indexed contracts

A key to understanding the results here is to first evaluate the effects of a monetary change in regime 1. As we have already seen this is going to determine how the other regimes compare. The monetary change will be triggered in regime 2 by any potential change in nominal income and in regimes 4 and 5 by any potential change in the currency.

As in the case of the small economy it turns out that a monetary change leaves all real variables (output, the real exchange rate, the real interest rate) unchanged. Only nominal variables change. If A expands its money stock we can figure out the nominal effects from 4.3 and 4.7

$$ma = (1+\alpha_5)\ pda = (1+\alpha_5)e \qquad\qquad ra = -e$$

In A labor and goods markets are also in equilibrium. With $u_3a = 0$, $ya = \alpha_6(1-\alpha_{15})er = 0$

and from 4.1

$$ya = er = rra = yb = u_1a = 0.$$

This means that a change in monetary policy initiated in regimes 2, 4 or 5 will not change the base real outcomes (see Table 7).

Performance can thus only be evaluated in terms of the associated price change. Adopting this criterion we have first the intuitive result that for a money demand disturbance a nominal income target strategy will also stabilize the home price level and hence in this respect is a superior strategy. Beyond that, for other disturbances, outcomes are mostly indeterminate.

An important point to note here is that in a nominal income regime expenditure disturbances in A no longer leave both output and home prices unchanged in A and B. Now in A output will rise while prices will fall proportionately. In B, however, output will fall and prices rise proportionately.

Table 7. Indexed Contracts

(Real effects) 1/

	ya	yb	er	rra	rrb
u_1a	↑ 2/	↓ 2/	↓	↑	↑
u_2a	0	0	0	0	0
u_3a	↑	↑	↑	↓	?

1/ These effects are identical across all regimes.
2/ Equal and opposite in sign.

(d) Strategic considerations--country rankings of regimes

The framework presented above now allows us to rank in A and B the five base regimes for each disturbance in terms of the four key variables in our loss function. These rankings are shown in Table 8.

Drawing partly on the table and on the analysis above, we now demonstrate how rankings in A and B are sensitive to: (1) the type of disturbance; (2) the country origin of the disturbance; (3) the loss function used in A and B; (4) the structural coefficients in the model; and (5) institutional considerations.

The type of disturbance

O.T.B.E. it is readily seen that if we focus on output-price volatility in A a symmetrical fixed rate regime (4) is superior to a money stock-flexible rate regime (1) for a money demand disturbance but inferior for an expenditure disturbance all originating in A. This result is now commonplace in the literature (see Argy (1990b)).

The country origin of the disturbance

Does it make a difference in which country the disturbance originates?

We can demonstrate the importance of the country-origin with two illustrations. For a given expenditure disturbance originating in A, A will rank regime 1 unambiguously above regime 4, while B, in all probability,

Table 8. Rankings for A and B for each Regime for Four Key Variables (Select Disturbances)

	y	pd	er	rr
u_2a				
A	2=3>4>5 1	2>4>1>3 5	2=3=4=5>1	2=3>4>1 5
B	2=3>1>5 4	2=3>4>5 1	2=3=4=5>1	2=3>1>5 4
u_2b				
A	2=3=5>1 4	3=2=5>1 4	2=3=4=5>1	2=3=5>1 4
B	2=3=5>4>1	2=5>4>1>3	2=3=4=5>1	2=3=5>4>1
$u_2a=-u_2b$				
A	2=3=4>5 1	2=4>1>3 5	2=3=4=5>1	2=3=4>1 5
B	2=3=4>1>5	2=4>1>3 5	2=3=4=5>1	2=3=4>1>5
u_1a				
A	2=3>1>4 5	2>1>3 5 4	4>1>2 5 3	4>1>2 5 3
B	2=3>4>1 5	2>4>1 5 3	4>1>2 5 3	1>4>5 2 3
u_1b				
A	2=3>4>5 1	2>4>1 5 3	4>1>3 5 2	5>2 1 3 4
B	2=3>1>4>5	2>1>3>5 4	4>1>2 5 3	5>1>2 4 3
$u_1a = -u_1b$ A	2=3>5>4 1	2>5>3 1 4	5>1>3 4 2	4>5>3 1 2
B	2=3>1>4>5	2>1>4>5 3	5>1>3 4 2	4>1>3 5 2
u_3a (A)				
case 1 2/	2>1>4 3 5	3>1>2 4 5	2>1>4 3 5	2>1>4 3 5
case 2 2/	4>1>2 5 3	2>1>4 5 3	4>1>2 5 3	4>1>2 5 3

1/ When regimes are ranked together this means rankings between these are uncertain.

2/ Case 1 is where ya+pda > 0 and e ↓ Case 2 is where ya+pda < 0 and e ↑.

will reverse the ranking. If the expenditure disturbance had originated in B the rankings would be reversed.

A more powerful illustration, already noted, is the case of a monetary disturbance in regime 5. The regime has a very low rating if the disturbance originates in A (the country which sterilizes); it has the highest rating if the disturbance originates in B.

The loss function

The role of the loss function is easily illustrated. For an expenditure disturbance in A, ultimate rankings will depend on weights attaching to output-price on the one hand and real exchange rate-real interest rates on the other. A and B will both rank regime 2 ahead of regime 1 if price-output considerations dominate; by contrast, regime 1 will rank ahead of regime 2 if real exchange rate-interest rate considerations dominate. These differences also imply that if the country loss functions were different the rankings for the two regimes would also diverge.

A striking illustration of the importance of the loss function is evident in the case of a productivity disturbance in A. Suppose in regime 1 a (negative) productivity disturbance in A increases nominal income (lowering output but increasing prices), appreciates the currency in real terms and raises the real interest rate. In regime 2 money will tighten; this reduces output further but stabilizes price; at the same time the real exchange rate and the real interest rate are both destabilized. If, on the other hand, nominal income had fallen the associated monetary expansion in regime 2 would have stabilized all the real variables.

The structural coefficients in the model

There are question marks attached to some of the signs of the solutions; in turn, the ambiguities here are inevitably reflected in ambiguities in the rankings. The case of the productivity disturbance discussed above provides a good illustration of the ambiguities flowing from uncertainty about the model coefficients.

Institutional considerations

Finally, we recall that labor market assumptions, and hence institutional considerations, were critical in determining the choice of regime. We were able to demonstrate that, in terms of our own analysis, if wage contracts were perfectly indexed and if the loss function took account only of the three real variables (output, the real exchange rate and the real interest rate) A and B would both be indifferent between the five regimes.

VI. Issues Raised by Nominal Income Targeting

The survey of the literature and our own independent analysis still left many questions unanswered and issues unresolved. Some of these are addressed here.

1. Political feasibility

Are there political constraints on nominal income targeting?

Consider first the monetary rule. It is sometimes contended that governments do not like to announce nominal income targets because nominal income cannot be directly controlled so errors will entail a loss of credibility. To support this argument reference is made to the disappointing experience with money stock targeting. If, the argument runs, money targets have been frequently missed, even in cases where generous bands were allowed, how much more difficult would it be to achieve nominal income targets (see Argy et al (1990a) on the experience with money targeting).

Consider next the wage rule. Clearly there are more political constraints on implementing a wage rule, e.g., support from unions needs to be forthcoming. Perhaps what can be said here is that a wage rule that links the wage rate to nominal income is a form of profit sharing, so a more extensive adoption of profit sharing arrangements would be a step in the direction of the adoption of the wage rule (on profit sharing see Estrin et al (1987)).

2. Definition of the target

A first question is how the target is to be defined. There are several proposals here. Meade-Tobin propose a GNP target, Williamson-Miller propose a gross domestic expenditure target, Gordon (1985) proposed a 'final sales' target. It is the first two alternatives that have in fact received the most attention, yet surprisingly there has been no serious analytical treatment of the differences between these two. 1/

A related question is the following: assume a failure to achieve a target income should 'bygones be bygones" in setting the next period target or should a correction be undertaken? The difference is crucial. Suppose that the target income is expected to grow by 5 percent each year. This can be converted into a GNP level in each of a succession of years or, alternatively, it can be revised each year to achieve a target growth. To take a concrete illustration. Suppose income is targeted to grow at

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1/ Since nominal income equals gross domestic expenditure (absorption) plus the current account, stabilizing absorption implies that nominal income will reflect movements in the current account (Annex III). For an empirical evaluation of the difference see Pauly and Petersen (1990).

5 percent in the next year but, in fact, because of a major unanticipated disturbance it grows by 10 percent. In the next period the new 'excessive' level of income can be taken as a base and a new target growth of income of 5 percent can be prescribed. Alternatively, a correction is undertaken to restore the target level of income; the new target growth of income may be 2.5 percent in each of the next two years (or zero if adjustment is over one year).

Assume a target growth rate in an aggregate is adopted, how is this target growth rate to be determined? (See also Section VII). In particular, if the inflation rate is 'above' the target rate of inflation, should the target growth of nominal income be brought down gradually or sharply?

3. Which instrument should be used to achieve a nominal income target?

There are two question here. First, which monetary instrument, assuming monetary policy is used? Second, should monetary or fiscal policy be used?

The bulk of the theoretical literature assumes the money stock is used to achieve a nominal income target. The bulk of the econometric literature assumes the interest rate (sometimes nominal, sometimes real) is the appropriate instrument (Section VII). Taylor (1985) emphasizes that the instrument should be the "real after tax interest rate."

We have already addressed the assignment question. We recall here that some would assign monetary policy, and some fiscal policy, to nominal income. Some again (the New Keynesians) keep the question open but are inclined to the view that both should be used.

A related question is the frequency with which the monetary instrument should be allowed to adjust in line with the gaps between actual-forecast and target income. Is the strategy a short-run or medium-run one?

4. Potential instrument instability

A question that needs to be addressed in any evaluation of nominal income targeting is what it implies about instrument instability. We have already noted that for certain types of disturbances (e.g., domestic expenditure disturbances) stabilizing nominal income may entail greater interest rate instability. There is, perhaps, nothing at all surprising about this result; however, more serious is the possibility that the interest rate may in principle explode.

A more formal presentation of this is in Frenkel, Goldstein and Masson (1989). We now allow for the fact (but, however, absent from our theoretical models) that there is a lag in the adjustment of nominal income to a change in the interest rate.

$$yn = -ar - br_{-1} + u \qquad (6.1)$$

where yn is nominal income, r is the interest rate and u is a disturbance to yn, a, and b represent first and second period effects.

Suppose the authorities are determined to stabilize yn in the face of a disturbance. What path for the interest rate does this entail?

Rearranging 6.1.

$$r = -\frac{b}{a} r_{-1} + \frac{1}{a} (u - y\bar{n}) \qquad (6.2)$$

This is a simple first order difference equation. The system could be unstable and oscillatory if $b/a > 1$. In any event even with $b/a < 1$ cycles and overshoots are almost certain to occur.

The intuitive reason is straightforward. Suppose a disturbance raises nominal income. The interest rate is raised sufficiently to stabilize nominal income; however, in the next period nominal income falls requiring a rise in the interest rate, and so on.

5. Realism of theoretical models

Theoretical models cannot capture the subtleties of the real world. In particular, lags in adjustment in goods and money markets, the time pattern of disturbances are all much more complex in reality than in simple models.

From our perspective, in this context, an important question that needs to be addressed concerns information lags and lags in the implementation and impacts of monetary policy. Suppose it takes some two to three months for information on nominal income to be available 1/ (such information will be subsequently revised--but we put that point to one side). Suppose too, it takes a month or two for a decision on a change in the direction of monetary policy to be made. Suppose finally, there is a mean lag of some six months from the change in the direction on policy to the impact on nominal income. Monetary policy then impacts on nominal income some 9-11 months "after the event" so to speak. The potential for destabilizing nominal income remains a distinct possibility. (Argy (1988) surveys the literature on the implications of monetary policy lags.)

1/ A review of the industrial countries for quarterly GNP data reveals large divergences in information lags. At one end we have Japan and the United States where the delay is about one month in reporting the reference quarter. In Germany, Australia and Norway the delay is 2-3 months; in Austria, Sweden, Italy, the United Kingdom and France, the delays of 5-7 months.

To have, perhaps, a better chance of stabilizing nominal income, it seems that monetary policy must react to the gap between the forecast nominal income (in say, six months) and the target nominal income. The success or otherwise of monetary policy then hinges on the success or otherwise of nominal income forecasts--some of this was analyzed at the theoretical level in Section III (Kahn (1988) and McNees (1987)).

Figures 6a to 6g provide some clues, for the G7, as to the success or otherwise in (IMF) forecasting of the growth of GNP between 1983 and 1990 for each half year. In some half years errors are very large: e.g., the United Kingdom 1986(S1), 1987(S2), 1988(S2); the United States 1984(S1); Canada 1987(S2); Japan 1987(S2), 1990(S1); Italy 1988(S1); Germany 1987(S1), 1989(S1,S2), 1990(S1), France 1986(S1), 1988(S2), 1989(S1). In some countries, too, errors in the same direction persist over several periods. The importance of such errors (biased or otherwise) in our context is that if a nominal income strategy had been adopted over this period and if monetary policy had been set in line with the gap between the forecast growth of nominal income and the target growth in the next half year, monetary policy at its time of impact could have turned out quite inappropriate. This is not pursued further (see however, Section VII). (On the success of forecasting output and inflation see Artis (1988) and Kenen (1988), and on the success of forecasting nominal income in the United States see Kahn (1988).)

6. Alternative strategies

In the theoretical literature the alternatives analyzed are: a money stock target, fixed exchange rates (the last two are also in our study); as well, an "optimal" monetary policy [Bean(1983), Aizenman-Frenkel (1986)] a discretionary monetary policy [Frankel (1989)], price or interest rate targeting [Aizenman-Frenkel(1986)].

The theoretical literature aside, what monetary policy strategies have the industrial countries adopted and how dramatic a change would it be to shift to nominal income targeting?

In reviewing experience, a useful division is between those countries whose currencies are largely determined by market forces, and which are able, in principle, to conduct an independent monetary policy and those who have entered into some exchange rate arrangement-commitment, and whose capacity to control monetary policy, and hence nominal income, is restricted to a greater or lesser degree.

The smaller countries in the EMS are highly restricted and clearly fall in the second category. To an increasing extent too, with capital controls effectively dismantled, France and Italy will fall in this category (although these currently continue to announce money targets).

The Nordic countries have adjustable pegs; they also still have some controls over capital movements. This has given them a limited capacity to control their money aggregates and hence nominal income. However, the capital controls are being gradually dismantled; moreover, they may shortly join the EMS.

From about the mid 1970s the United Kingdom has announced target bands for the growth in one or more money aggregates. Over the years, however, as the significance of some money aggregates became distorted and as exchange rate targeting assumed increasing importance, money stock targeting has been gradually deemphasized. A recent description in an IMF study of U.K. monetary policy [(Batten et al (1990)] asserts "a range of indicators other than monetary aggregates such as the exchange rate, indicators of the real economy, estimates of real interest rates, the behavior of markets in financial and other assets and the current course of nominal GDP have also been used more recently as guides for the stance of monetary policy." Also in the same study, to quote, "the principal objective of U.K. monetary policy is to influence the growth of GDP over the medium term as a means of achieving price stability." The U.K.'s acceptance, now, of the exchange rate obligations of the EMS will impose even tighter restrictions on its monetary policy.

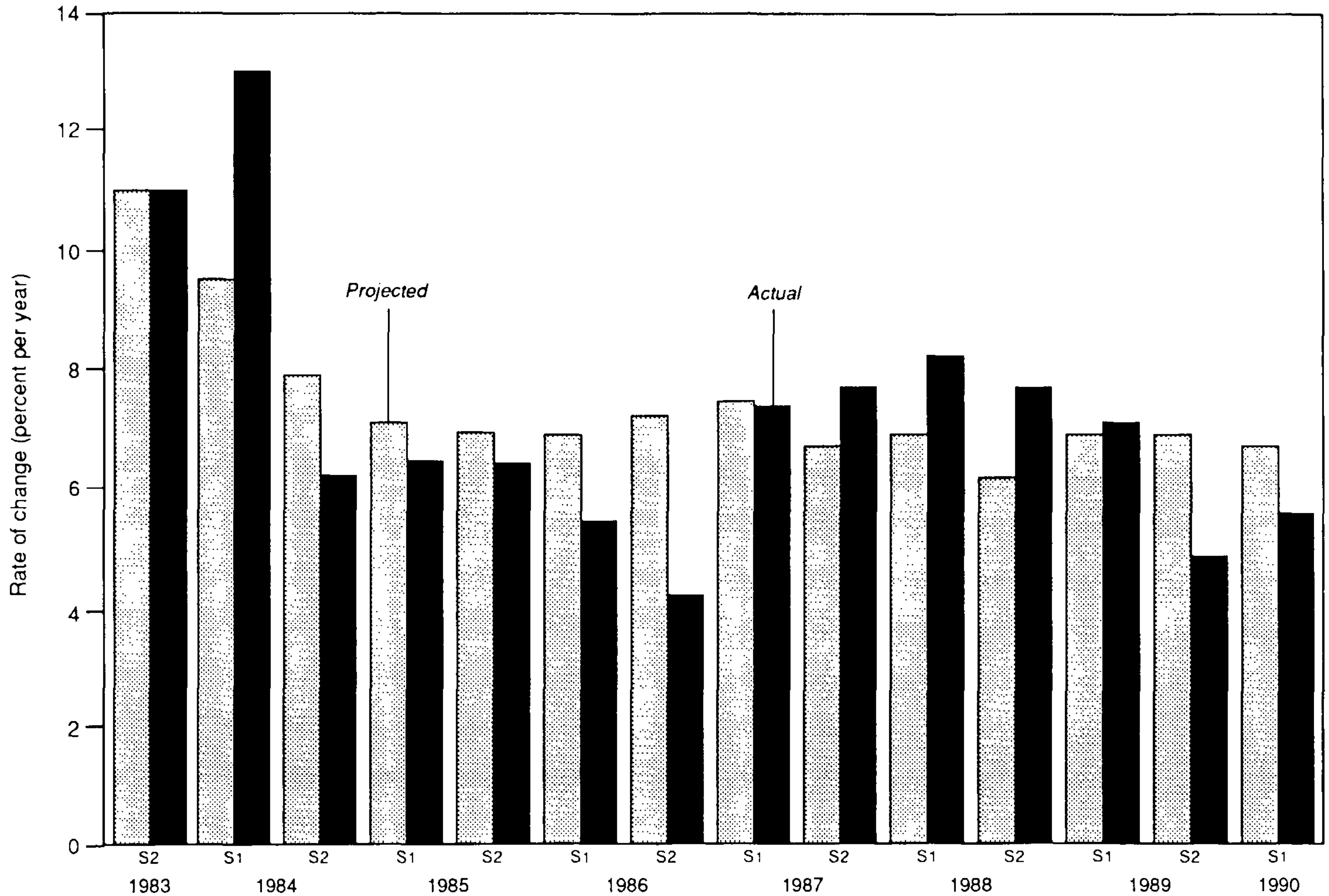
Australia and New Zealand both switched to a flexible rate regime, the first in 1983 and the second in 1985. Between 1977 and 1985 Australia announced money growth targets; however, the policy was discontinued in early 1985 in favor of an 'eclectic' approach, under which the authorities were to look at a whole range of indicators in determining the stance of policy. Despite some recent overt disenchantment with this strategy, policy remains eclectic; monetary policy is currently guided by trends in activity, inflation the current account and the exchange rate. In 1988, New Zealand adopted a strategy of using monetary policy to achieve a target rate (ultimately zero) of inflation over the medium run.

Canada also abandoned, in 1982, a policy of announcing money growth targets and, as in Australia, adopted an eclectic approach. More recently, as in New Zealand, it has moved to a strategy where the interest rate is being used to achieve, over the medium run, price stability.

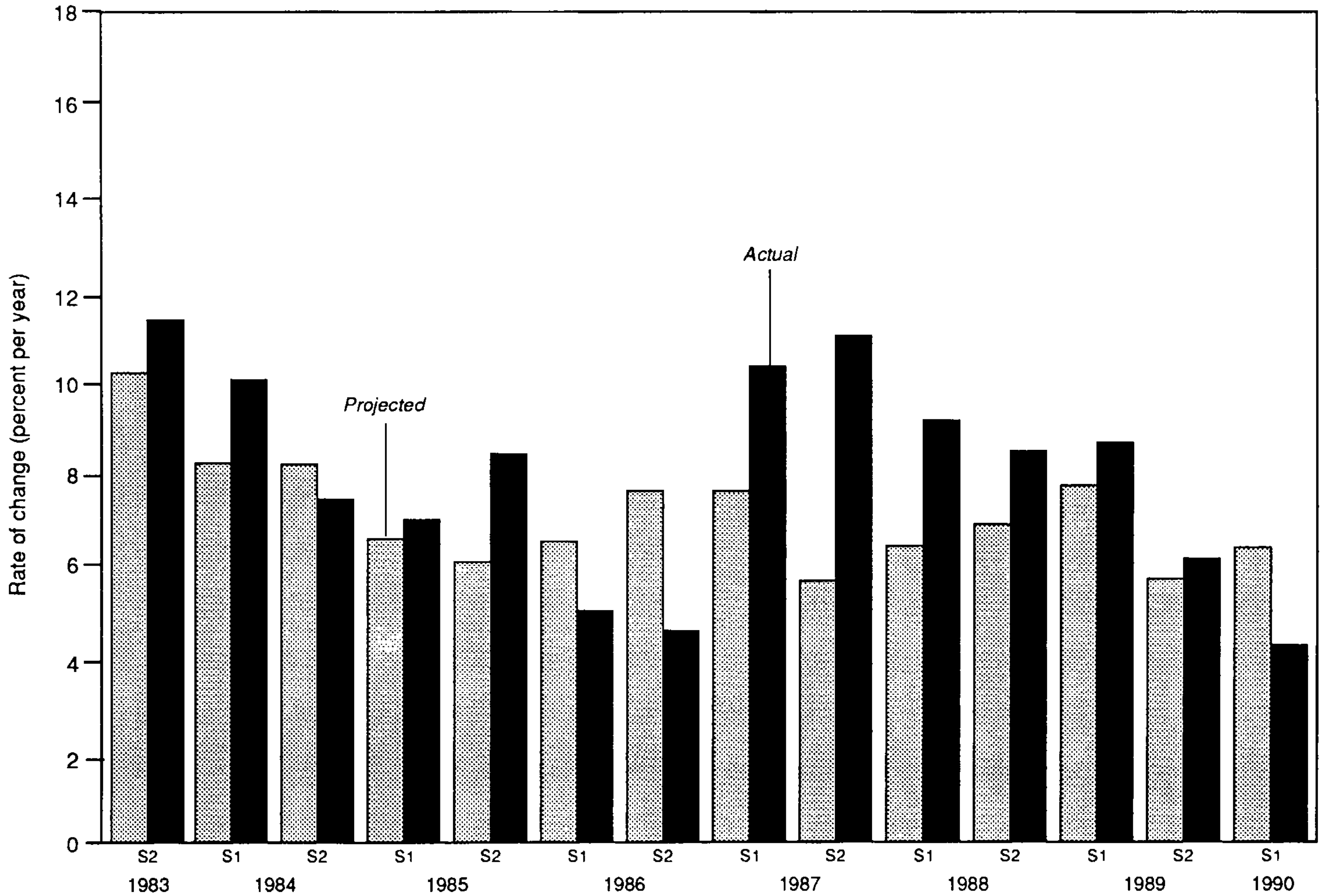
Switzerland has announced a single-point target growth in a money aggregate since 1975. Switzerland is the closest to a 'purist' monetarist strategy (the target growth in Mo having remained nearly stationary since 1982). This target is set with an eye primarily on achieving price stability.

Japan also announces a projected (target) growth in a broad money aggregate (M2 + CD). Although policy is eclectic the most important target remains inflation.

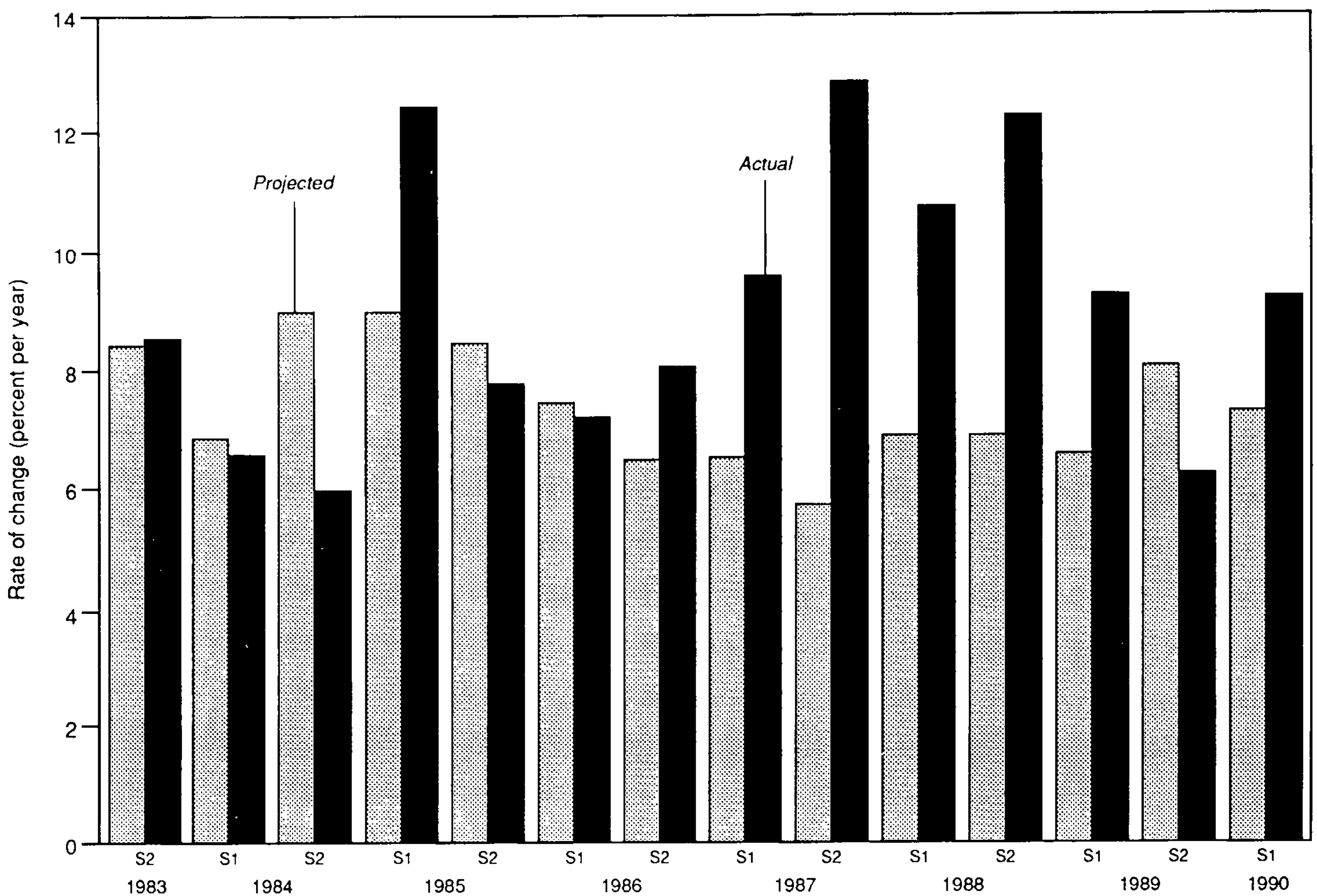
United States
(GNP growh rates)



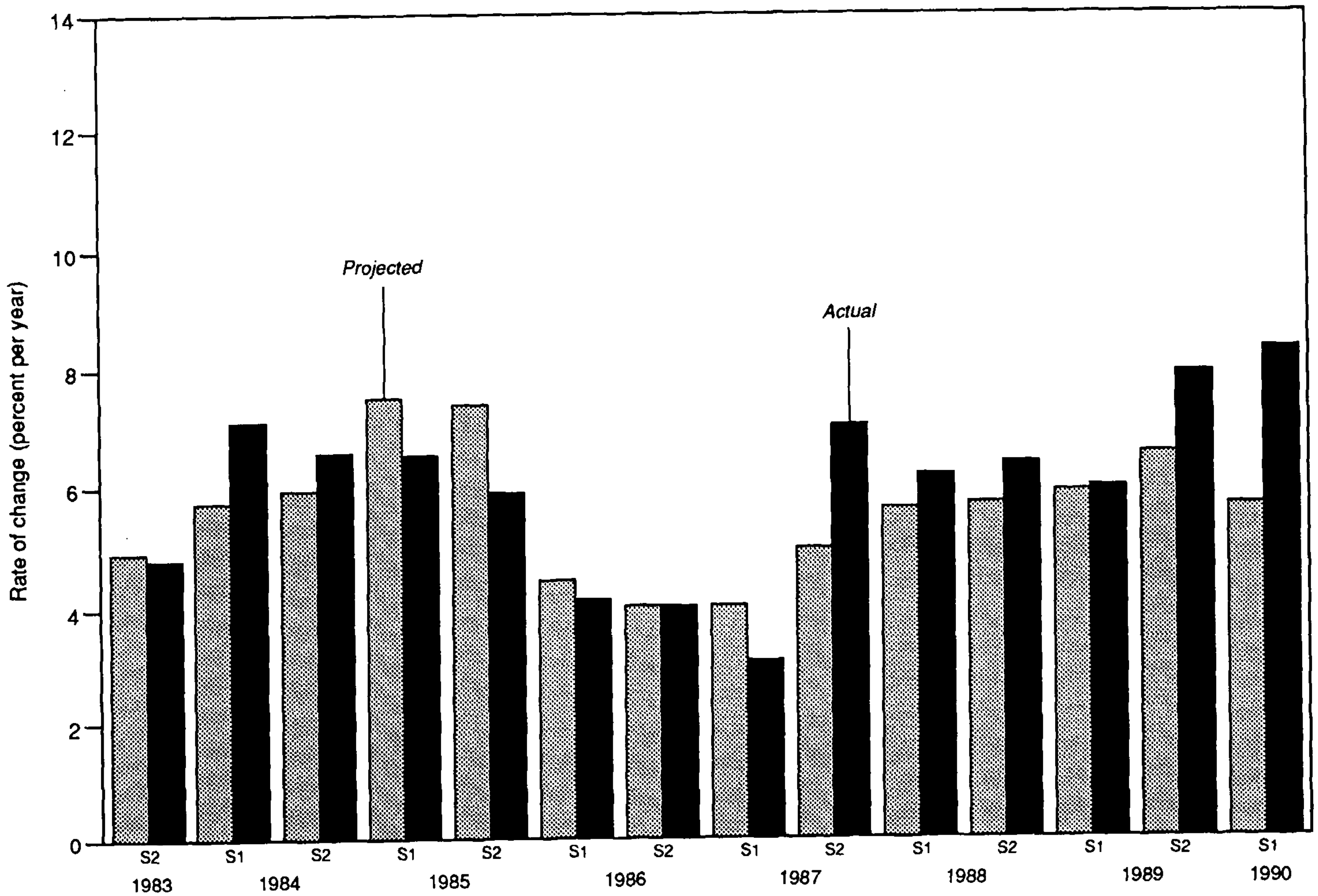
Canada
(GNP growh rates)



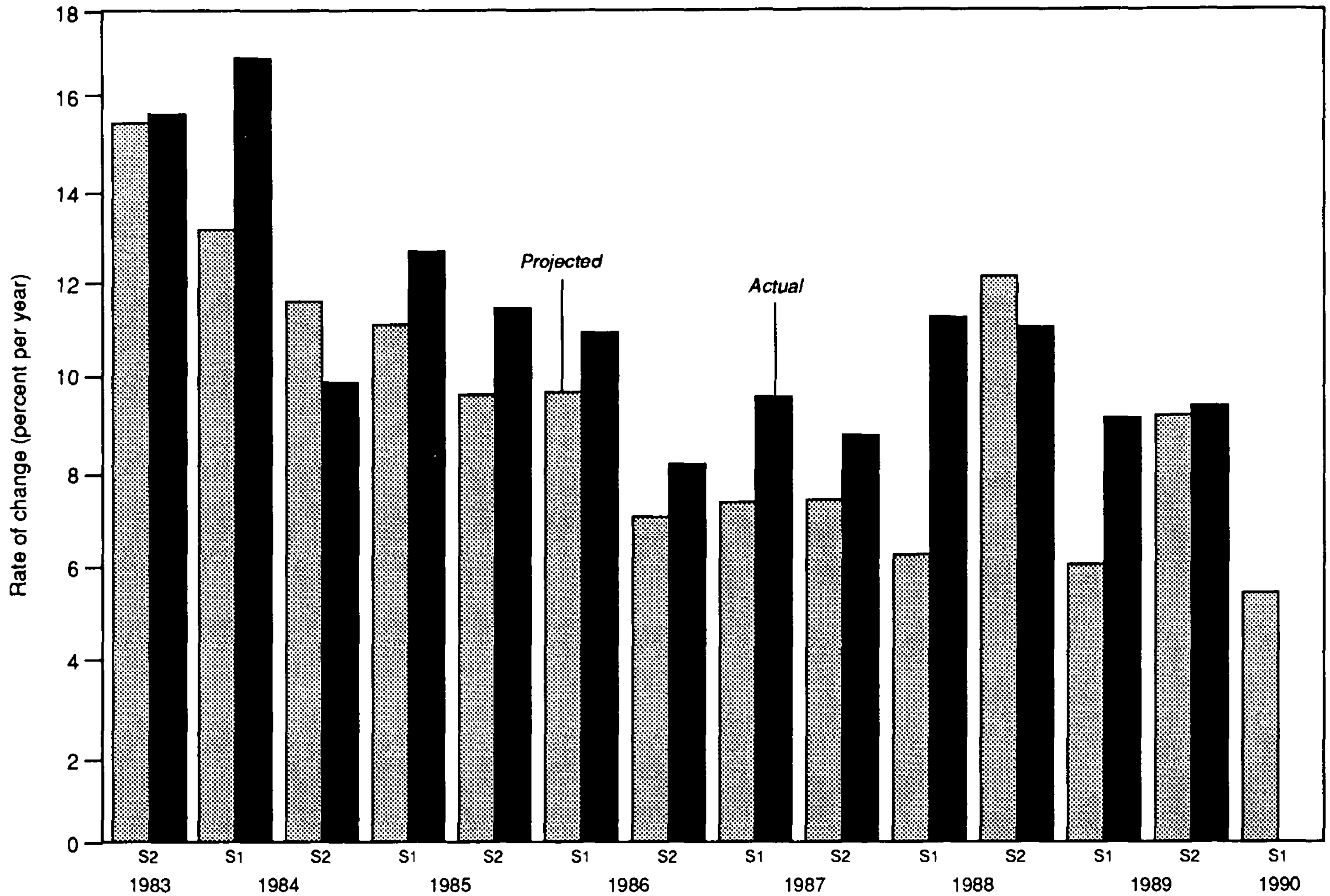
United Kingdom
(GNP growh rates)



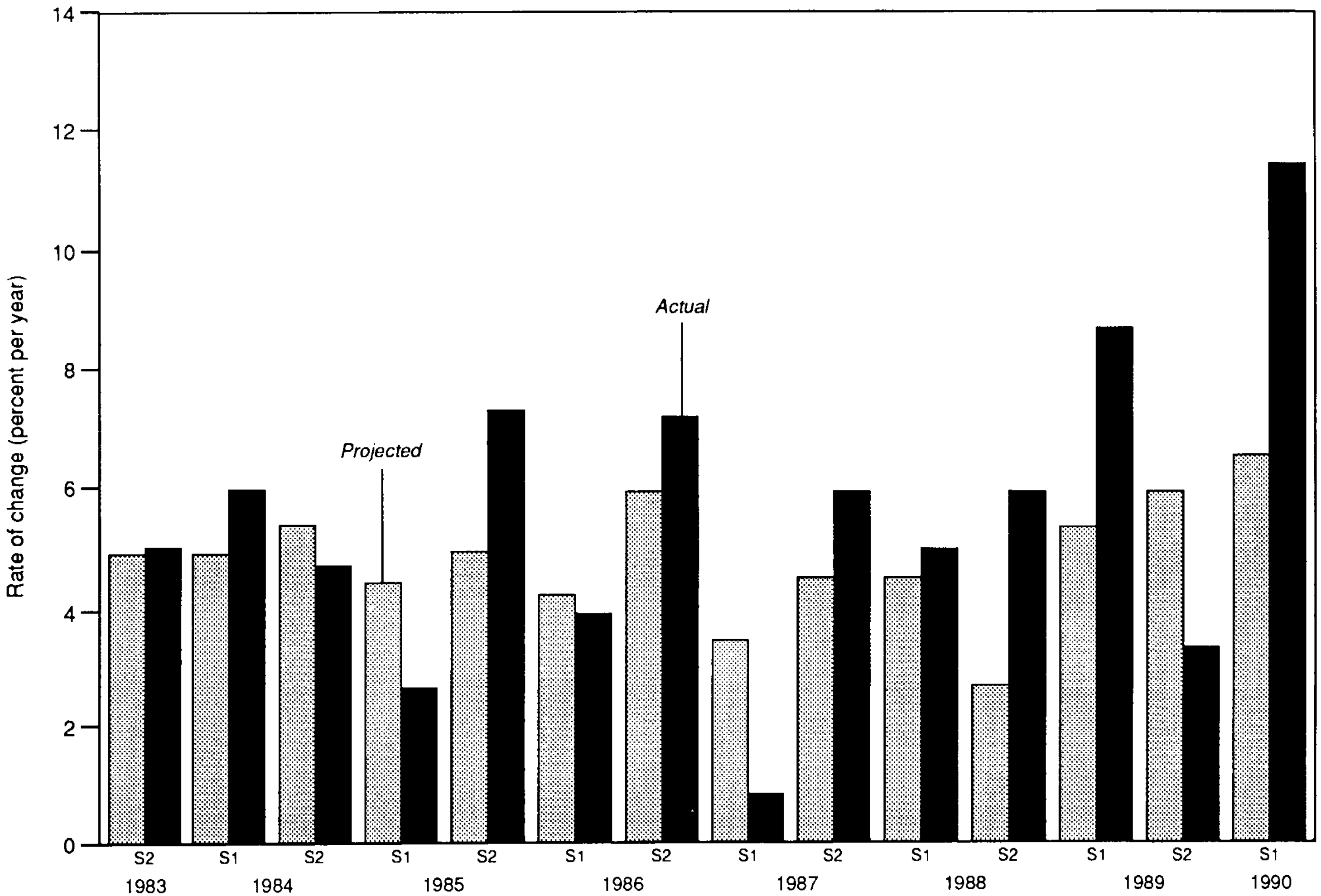
Japan
(GNP growh rates)



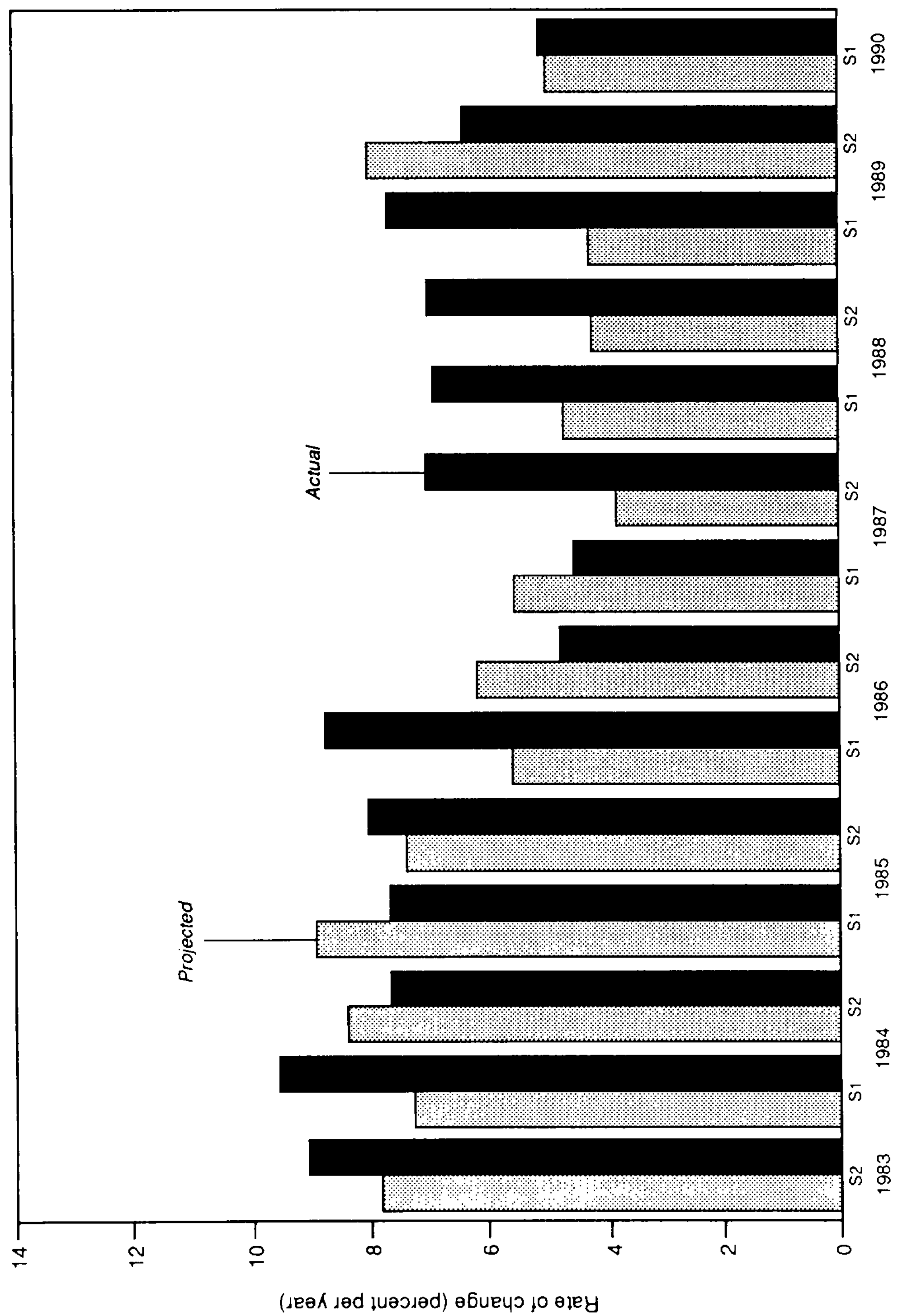
Italy
(GNP growh rates)



Germany
(GNP growh rates)



France
(GNP growth rates)



Germany, too, announces a target range for the growth in a broad money aggregate. A fair summary of German monetary policy is to say that in the setting of targets it is primarily guided by inflation and to a lesser extent the level of activity, but, on occasion as well, exchange rate trends have influenced actual monetary outcomes.

The United States continues to announce target bands in the growth of some money aggregates. U.S. policy is also eclectic, emphasizing inflation, level of activity and, possibly very occasionally, the exchange rate. An interesting feature here is that since 1980 the Federal Reserve has supplied estimates of a nominal GNP growth which is supposed to be consistent with monetary policy objectives.

To summarize, if we exclude all countries with pegged or semi-pegged exchange rates, we are still left with a number of countries, including of course the G3, with the <u>capacity</u> to target nominal income. How dramatic is such a change? To illustrate how different is a <u>money stock target strategy</u> (as practiced in some countries) from a nominal income strategy?

Suppose, first, at one extreme we have a Friedmanite rule, with a constant money growth year in year out. This constitutes the sharpest contrast with a nominal income strategy. No country, however, not even Switzerland, follows anything like a strict Friedmanite rule, in the sense of disregarding trends in velocity.

Next, consider the case where for each period a single point target money growth is announced; however, each period the money growth is set in line with a target growth of nominal income. The only difference in strategy here occurs <u>within</u> the period; obviously the <u>shorter</u> the period the smaller the difference.

Now suppose we allow a money growth band (a more common procedure) but the central rate is set to achieve only a nominal income growth target. Provided the band is accommodative there is now no real difference between the two strategies. Monetary policy can move within the band to achieve nominal income objectives. If, however, nominal income is just one of the targets, the strategies are differentiable.

To conclude, the more frequent the adjustment in the money stock targets, the greater the weight attaching the nominal income targets in the setting of policy, the closer in spirit are the strategies. No country actually follows a nominal income strategy as we have defined it: periodic monetary adjustment with an eye <u>solely</u> on trends in actual (or projected) nominal income in relation to target nominal income.

Some of the problems raised above (notably under 3 and 4 can be resolved, in principle at any rate, by econometric work. These studies would also reveal how different a nominal income strategy is from monetary strategies actually pursued.

VII. Econometric Evidence on Nominal Income Targeting

1. Introduction

The survey of the literature and our own investigations have revealed two key areas on which econometric work might be able to throw some light. First, how does a nominal income monetary rule perform compared to other defined strategies? Second, how should assignment be undertaken? In a multiple target-instrument context, if nominal income is adopted as a target which instrument, if one only, should be used to monitor the target?

How does one proceed econometrically? There are several approaches.

Historical reruns

One way to attack the problem is to undertake, with an estimated econometric model, a rerun of history, over a particular period of time, assuming alternative policy strategies (i.e., with a different design of a monetary, fiscal, exchange rate policy package) had been adopted. This, in principle, then allows us to compare the performance of the alternative packages against one another as well as against the actual historical policies adopted. To illustrate with a very simple example.

$$yn = \alpha_1 G - \alpha_2 r + \alpha_3 Y + \alpha_4 yn_{-1} + \epsilon_1 \qquad (6.1)$$

$$r = -\alpha_5 M + \alpha_6 yn + \epsilon_2 \qquad (6.2)$$

$$yn = \left|\frac{\alpha_1}{1+\alpha_2\alpha_6}\right| G + \left|\frac{\alpha_2\alpha_5}{1+\alpha_2\alpha_6}\right| M - \left|\frac{\alpha_3}{1+\alpha_2\alpha_6}\right| Y + \left|\frac{\alpha_4}{1+\alpha_2\alpha_6}\right| yn_{-1} - \frac{\alpha_2}{1+\alpha_2}\epsilon_2 + \frac{1}{1+\alpha_2}\epsilon_1 \qquad (7.3)$$

where yn is nominal income, G is 'fiscal' policy, r is the interest rate Y is an exogenous nonpolicy variable, M is the money stock, ϵ_1 and ϵ_2 are respectively goods and money market serially uncorrelated residual errors.

Equations 6.1 and 6.2 are goods and money market equations, and 6.3 is the reduced-form equation. The historical movement of yn can of course be exactly explained by the actual levels of the two policy instruments G and M, the nonpolicy variable Y, lagged nominal income and importantly by the two error terms (ϵ_2 and ϵ_1). In principle it would be possible to undertake a simulation of yn with a different policy package for G and M. Thus the performance of actual polices, given the historical distribution of Y, ϵ_1 and ϵ_2, can be compared to alternative policies.

Simulations with 'historical' disturbances

Suppose we are interested in the behavior of yn with a changed policy for M only. To evaluate the performance of an alternative M policy one may need to keep G neutral, since the actual behavior of G may distort the evaluation of M. We can thus do a simulation with the same historical errors (ϵ) and Y but with G held neutral, while at the same time M can be allowed to vary. This amounts to comparing pure alternative strategies for M (unadulterated by G) given the historical disturbances (Y and ϵ).

Simulations with a different package of disturbances

ϵ followed a particular historical evolution. A simulation could be undertaken with a different distribution of disturbances (i.e., weights attaching to ϵ_1 and ϵ_2) and to Y).

Different policy strategies in the face of individual disturbances

An econometric model can be simulated for different policy strategies in the face of individual disturbances, e.g., we might ask, how yn behaves in the face of ϵ_1 or ϵ_2 individually and given Y for a particular policy strategy?

General comments on econometric testing

(1) Econometric models may and do differ substantially in structure and sophistication (see Frankel (1988)). Hence there may be wide divergences in the evaluation of policy strategies.

(2) Estimated behavioral equations in the models are not the same, hence not only are the coefficients and lag structures different but so are the unexplained residuals. A historical package of residuals will thus convey something different in each model.

(3) In the evaluation of a policy strategy it may not be appropriate to assume that the relevant distribution of disturbances is the historical one. What is clearly more relevant in the expected distribution in the future. Hence the importance of simulations of type 3 and 4 above.

(4) An advantage of the piece-meal approach represented by the type 4 simulation is that it allows a more careful analysis of how different policy strategies perform in the face of particular types of disturbances. It also conforms more with, and allows one to confirm or otherwise, theoretical analyses.

(5) A typical econometric simulation of a policy strategy with some feedback from an economic variable requires some specification of a reaction coefficient. The coefficient ultimately used emerges only after considerable experimentation has been undertaken (notably with ex post data not available ex ante). This may inject some potential bias in favor of the policy strategy, at least for historical simulations (not, however, for post sample simulations). Moreover, most econometric simulations of alternative strategies do not take account of information lags, data corrections, in defining a reaction function.

(6) The treatment of expectations is always a troublesome feature of any simulation exercise. Frequently, rational expectations are assumed; in reality this is not likely to hold, which means 'errors' will appear in the equation residuals. Suppose too, a new policy rule were introduced; how much time should one allow the public to learn the new rule and incorporate it in its expectations structure?

It is thus readily seen that the econometric method does not necessarily provide the final answers to any evaluation of a policy strategy. This will be confirmed below in our review. We are thus inevitably led to the conclusion that moving from 'simple' theory to sophisticated econometrics is like moving "out of the frying pan into the fire."

2. Alternative simple monetary rules

We review here the econometric tests undertaken of alternative simple monetary rules, including one which targets nominal income.

McCallum and Taylor

McCallum (1987) and Taylor (1985) perform similar exercises both for the United States and for similar periods but they appear to reach quite different conclusions.

McCallum provides a perfect application of the methodology employed above. He first estimates a structural equation for the United States (1954.1 to 1985.4)

$$\Delta yn = 0.00749 + 0.257\Delta yn_{-1} + 0.487\ \Delta bt + \epsilon \qquad (6.4)$$

where the variables are in logs and b stands for base money.

Next he uses a policy reaction function for base money of the form

$$\Delta bt = 0.00739 - 1/16[(ynt_{-1} - ynt_{-17}) - (bt_{-1} - bt_{-17})] + \lambda_2(ynt_{-1}* = ynt_{-1}) \qquad (6.5)$$

where the first bracketed expression represents the 4-year average change in base velocity while the last expression represents the deviation of nominal income from its target path. 0.00739 reflects the 3 percent annual growth rate. λ_2 is the reaction coefficient described earlier.

McCallum evaluates several alternative monetary rules, applying the criterion of the root-mean-square error of nominal income from its target path of 3 percent growth. The strategies are: actual monetary policy (in 6.4 the actual percent change in base money growth is used) a Friedman-type zero base money growth , the case where $\lambda_2 = 0$ and (his preferred rule) the case where $\lambda_2 = 0.25$. He finds his rule performs best (He does, however, introduce numerous provisos). (For an application to Germany of McCallum's rule see Scheide (1989) and for a commentary see Loef (1989), see also McCallum (1988).

Taylor estimates a two equation system for the United States which he interpretes as dynamic aggregate supply and demand functions. The data is annual and the period covered, 1954-83, is very similar to McCallum's. He then simulates the effects of a variety of nominal income rules. Importantly, he concludes that "nominal GNP rules that focus solely on the growth rate could worsen business-cycle fluctuations by always causing the economy to overshoot its equilibrium after shocks."

Frenkel-Goldstein-Masson (FGM) and McKibbin-Sachs (MS)

FGM (1989) carry out simulations of alternative policy strategies, similar to those discussed in the theoretical sections, using the IMF Multimod. From our perspective two simulations are of particular interest. They report root mean square deviations for a number of key variables (corresponding to our own) for three simple rules: a money target; a nominal income target monetary rule (where the interest rate is allowed to respond contemporaneously to the gap between the target level of income and the actual level of income); and an asymmetrical fixed rate regime (where the U.S. is assumed to sterilize). In a first simulation they use historical shocks (74-85) while holding fiscal policy neutral. (This simulation corresponds to our type 2 simulations described above.)

They report results for the United States, Japan and Germany. Nominal GNP targeting is unambiguously superior in all three countries to money stock targeting (although the difference is not in general very large) in relation to real GNP, inflation and the real effective exchange rate. Its performance, however, is mixed in comparison with fixed rates.

In a second simulation they generate shocks from a much longer historical base (now 40 years against 12 years above). The results are substantially less favorable to the nominal income strategy. The results are very mixed; in the United States, at any rate, the strategy is in general inferior on most counts to both a money stock strategy and a fixed rate strategy.

MS (1989), using the McKibbon-Sachs Global Model (MSG), evaluate three simple rules: A fixed money growth rule, a monetary policy rule which targets nominal income in each country and a symmetrical fixed exchange rate rule. They report results for individual disturbances, thus facilitating comparison with our own theoretical analysis. Through these simulations fiscal policy is held neutral. The three disturbances are an oil price shock, a money demand shock (originating in one of the G3 countries) and a real demand shock (again originating in one of the G3 countries). They also report standard deviations of a number of key variables (of which output, inflation and the real exchange rate are of primary interest to us).

Consider a money demand shock originating in the United States. Output-inflation real exchange rate standard deviations are easily the lowest for nominal income targeting in all three countries (but not, however, quite zero as in our model). The worst performer on these fronts is regime 1 (as indeed in our own analysis).

Consider now a real demand shock in the United States.

In terms of output-price standard deviations the nominal income strategy in general is again the best performer in all three countries. In the United States the fixed rate regime is now the worst performer. Abroad, the first regime is the worst performer. Finally, in terms of real exchange rate standard deviations the nominal income regime performs relatively poorly. These rankings are very similar to those we arrived at in our theoretical analysis.

Finally, for an oil price shock (the closest to our productivity shock) a nominal income strategy has mixed results.

Are the FGM results, only marginally, if at all, in favor of nominal income targeting, inconsistent with the MS results which are substantially more supportive? The apparent differences could be due to any number of factors: the differences in the way the reaction functions are formulated (superficially similar 'strategies' are in fact represented a little differently), differences in the underlying model, differences in the distribution of disturbances (a strong weight in MS attaching to oil-productivity disturbances would generate a less favorable outcome).

Pauly and Peterson (1990) use the GEM Model (as in CW) to compare two monetary strategies in the face of two types of shocks. The two strategies are the model responses to the shocks (effectively an inflation targeting rule using the interest rate as the instrument) and an optional nominal income feedback rule. The shocks are an oil price shock and a U.S. reduction in defense spending. The results are mixed and difficult to summarize in a few words, depending as they do on both the loss function and on the individual disturbance.

We note here too some results in this general vein in Taylor (1989). Taylor, using his own multi-country model, also evaluates alternative simple monetary strategies. Briefly, his basic comparison is between, on the one hand, a flexible rate regime where central banks use interest rate policy to stabilize the price level and, on the other hand, a fixed rate regime where central banks adjust the "world" interest rate, again to stabilize the price level. He finds that flexible rates work better "according to almost all measures of internal economic stability." More relevant to our study he, later, substitutes a nominal income for a price target (in the flexible rate regime) and finds that performance improves further. However, he also finds that optimal weights attaching to price and output are not necessarily unity.

3. Assignment rules

The basic comparisons here are between the WM blueprint, the BGS reverse assignment and the 'historical' performance. There are four econometric studies that bear on this: FGM (1989) Currie and Wren-Lewis; (CW) (1989); MS (1989); and Edison et al (EMW (1987)). These are briefly reviewed below.

FGM

These exercises are extensions of those reported above for 'historical' and 'generated' shocks (drawn from a longer sample). They compare the blueprint with the reverse assignment. In the blueprint they have the difference between the short interest rate and the base rate responding to competitiveness and as well to the gap between world income and its target value. At the same time they have government expenditure, relative to base, responding to domestic absorption relative to its base. In the reverse assignment the interest rate is allowed to react to absorption while government expenditure responds to the current account, all relative to base.

The results are very similar for historical and generated shocks. In general, on the key variables (output, inflation and the real effective exchange rate) the blueprint outperforms the reverse assignment.

CW

The CW strategy is closest to FGM.

Econometric simulations are undertaken for the G3, with the National Institute Global Econometric Model (GEM) over the years 1975-86.

The target growth of nominal domestic demand depends on the inflation rate gap (the difference between actual and target inflation) a 'constant' productivity growth, capacity utilization and the deviation of the current account from its target. The Blueprint is represented as follows. The real interest rate is allowed to respond to the deviation of actual from the target growth of 'world' nominal demand and to the difference between the actual and target real exchange rate (competitiveness). Government expenditure responds to the national deviations between actual and the target growth of nominal demand. The reverse assignment has government expenditure responding to the deviation of the current account from its target and to the deviation of the growth of nominal income from its target (where the target growth in nominal income is defined as in the target growth in absorption (with the last term--the current account deviation dropped). At the same time the real interest rate is now set to respond to nominal income deviations from its target path. These representations are the closest in spirit to the WM blueprint.

There are some innovative features of this study worth highlighting. First, the policy reaction functions are expressed in both proportional and integral form (e.g., the change in the real interest rate responds to the level of nominal income gap as well as to the change in the nominal income gap). Second, they use an explicit loss function, assigning welfare losses to deviations of capacity utilization, inflation, government expenditure and, most importantly, the real exchange rate from their desired path. They choose particularly weights for each of the targets, but do experiment with different weights for the real exchange rate target. Third, the reaction coefficients are "chosen so as to minimize the objective function"

The simulations are designed to evaluate the relative performance of the Blueprint, the reverse assignment and history. Their conclusions are easily summarized: "Both schemes improved welfare compared to history over this period but the gains associated with ..(the blueprint).. were generally larger and more substantial," and "our model suggested that fiscal policy had a comparative advantage over monetary policy in directly controlling demand at a national level."

Thus, although the model is different, the methodology used is different and the design of policies different, this study in essense agrees with FGM that the blueprint outperforms the reverse assignment.

MS

MS evaluate a large number of policy proposals, including some simple rules noted above. One proposal is what they call the Blueprint; however, they have difficulties simulating the blueprint, as conceived by W.M. They allow the computer to figure out the most appropriate assignment; it turns out that the best results are obtained when fiscal policy is primarily linked to the real exchange rate and monetary policy primarily linked to nominal income, especially so for U.S. money demand and real demand shocks. So this study, if anything, appears to be critical of the W.M. blueprint, and appears to endorse the reverse assignment.

Edison et al (EMW)

EMW use the multicountry model of the Federal Reserve Board to undertake a number of simulations for the period 1976(1) to 1985(4). They evaluate variations of a target zone proposal against history. One simulation has the short-term interest rate in the large countries respond to real exchange rate deviations, while at the same time fiscal policy is used to hold "real GNP at its baseline level." The results, for the blueprint, are mixed but on the whole, satisfactory. However, attention needs to be drawn to the very unorthodox way in which fiscal policy is assumed to work in this representation of the blueprint.

VIII. Conclusion

We began by reviewing in some detail the literature on nominal income targeting. We then undertook some independent analysis first for the small country, next for the large country. Finally we summarized the empirical evidence bearing on nominal income targeting.

Our independent investigations modified and extended the theoretical literature in five ways. First, the models used were distinctive. Second, some simplistic assumptions made in the literature about the monetary adjustment process were modified. Third, we extended the analysis to the large country case. Fourth, the regimes with which we compared a nominal income strategy were richer and more varied than those found in the literature. Finally, we extended the traditional loss functions to accommodate real exchange rate and real interest rate variations.

For the small country case there were three principal conclusions:

(1) In relatively simple models of the monetary adjustment process, if contracts are unindexed, disturbances are temporary and correctly perceived to be so, nominal income targeting (using monetary policy) appears to have an advantage over either money stock targeting or a fixed rate regime for domestic expenditure and money demand disturbances, as well as for all external disturbances, particularly so if output-inflation are the primary targets of policy.

(2) In general a monetary nominal income rule appears to be superior to a wage nominal income rule.

(3) We also identified circumstances when a nominal income strategy had very little, if any, comparative advantage:

(a) When contracts are indexed.

(b) With unindexed contracts for a productivity disturbance.

(c) When the nominal income target is missed.

(d) When monetary policy is set with a lag and there is a 'forecast error'.

(e) When the authorities' loss function attaches considerable importance to real exchange rate-interest rate objectives.

For the large (two country) case we compared five regimes (including two varieties of the nominal income strategy) for a variety of expenditure, monetary and productivity disturbances. Our conclusions were that the final rankings of the regimes in each of the countries depended on:

(1) The type of disturbance (expenditure, monetary, productivity).

(2) The country origin of the disturbance (whether it originates in one or in the other).

(3) The country loss function (the importance each country attaches to the target variables).

(4) The particular structural model used (notably in this context the coefficients in the behavioral equations).

(5) Institutional conditions (notably whether contracts are indexed or otherwise).

Finally, we noted many difficulties in the econometric evaluation of a nominal income strategy. In general, it turns out that this evidence is largely inconclusive.

A minimal 'medium-run' model to rationalize BGS

A2.1. $ya = \alpha_1(e + pdb - pda) - \alpha_2 ra + \alpha_3 gra + \alpha_7 yb$

A2.2. $yb = -\alpha_1(e + pdb - pda) - \alpha_2 rb + \alpha_3 grb + \alpha_7 ya$

A2.3. $moa = ya + pda - \alpha_5 ra$

A2.4. $mob = yb + pdb - \alpha_5 rb$

A2.5. $ra = rb = rw$

A2.6. $ya = \alpha_6(1 - \alpha_{15})(pda - e - pdb)$

A2.7. $yb = \alpha_6(1 - \alpha_{15})(pdb - pda + e)$

A2.8. $CAa/Xoa = \alpha_{20}(e - pda + pdb) - (ya - yb)$

Notation

Subscripts a and b stand for countries A and B, respectively

y = output

rw = world interest rate

r = interest rate

gr = real government expenditure

pd = home price

e = exchange rate (units of A's currency per unit of B's currency)

m = money stock

CA/Xo = current account deflated by initial exports.

The model presented in equations A.2.1 - 2.8 is a medium-run version of the small country model presented in Section II. It too assumes that wages are fully indexed to the consumer price index, which again is a weighted average of home and export price. This allows us to arrive at A.2.6 and 2.7, respectively. There is a single world interest rate (rw). The principal difference between the small country and the large country case is that the latter has the capacity to change the world interest rate and hence its nominal income by changing government expenditure. See also Section V.

The solutions take the following form

A2.9. $(y + pd)a = \pi_1 gra + \pi_1 grb + \pi_2 moa \quad \pi_3 mob$

A2.10. $(y + pd)b = \pi_1 gra + \pi_1 grb + \pi_2 mob + \pi_3 moa$

A2.11. $rw = \pi_6 gra + \pi_6 grb + \pi_5 moa + \pi_5 mob$

A2.12. $(CA/Xo)a = -\pi_8 gra + \pi_8 grb + \pi_{10} moa + \pi_{10} mob$

where $\pi_1 > 0 \quad \pi_6 > 0 \quad \pi_8 > 0$

$\pi_2 = 1 \quad \pi_3 = \pi_5 = \pi_{10} = 0$

$\pi_8 > 0$

Technical Representation of Each Regime

Regime 1: Flexible rates with a target money stock (unindexed contracts)

$\pi_7 = \pi_8 = 0$; $ma = m\bar{a}$; $mb = m\bar{b}$; $\pi_3 = \pi_6 = 0$; $\pi_2 = \pi_4 = 1$; $\pi_1 = \pi_5 = 0$. We have nine equations: 4.1, 4.2, 4.3, 4.5, 4.7, 4.10, 4.11, 4.14, and 4.15 which determine ya, yb, pda, pdb, pa, pb, ra, rb, and e (wa = wb = 0).

Regime 2: Flexible rates with a symmetrical monetary rule to target nominal income (unindexed contracts)

$\pi_7 = \pi_8 = 0$; $\pi_3 = \pi_6 = 0$; $\pi_2 = \pi_4 = 1$; $\pi_1 = \pi_5 = 0$. Replace 4.3 by

4.3a. ya = -pda and 4.5 by

4.5.a. yb = -pda;

mas and mab are then endogenous

Equations 4.1, 4.2, 4.3a, 4.5a, 4.7, 4.10, 4.11, 4.14, 4.15 solve for ya, yb, pda, pdb, pa, pb, ra, rb, and e (wa = wb = 0).

Regime 3: Flexible rates with a symmetrical wage rule linked to nominal income

$\pi_2 = \pi_4 = 0$; $\pi_3 = \pi_6 = 1$; $\pi_7 = \pi_8 = 0$

Equations 4.1, 4.2, 4.3, 4.5, 4.7, 4.10, 4.11, 4.14, 4.15 determine ya, yb, pda, pdb, pa, pb, ra, rb, and e (wa = wb = 0).

Regime 4: A symmetrical fixed rate regime (unindexed contracts)

$\pi_7 = \pi_8 = \infty$; $\pi_3 = \pi_6 = 0$; $\pi_2 = \pi_4 = 1$; $\pi_1 = \pi_5 = 0$; mas = -mbs. From 4.3, 4.5 and 4.7 we can obtain

4.3b. $ya + pda - 2\alpha_5 rb + u_2a = yb - pdb - u_2b$

4.1, 4.2, 4.3b, 4.7, 4.10, 4.11, 4.14, 4.15 determine ya, yb, pda, pdb, pa, pb, ra, and rb (wa = wb = 0).

Regime 5: An asymmetrical fixed rate regime (unindexed contracts)

A is assumed to fully sterilize, so A's money stock is exogenous, B's in endogenous.

$\pi_7 = 0$; $\pi_8 \to \infty$; $\pi_3 = \pi_6 = 0$; $\pi_2 = \pi_4 = 1$; $\pi_1 = \pi_5 = 0$.

4.1, 4.2, 4.3, 4.7, 4.10, 4.11, 4.14, 4.15 determine

ya, yb, pda, pdb, pa, pb, ra, and rb (wa = wb = 0).

The text also extends the analysis to variations on these base regimes. For example, our regime 2a is one where A adopts a monetary rule to target nominal income but B does not. To arrive at solutions, regime 2 is modified by replacing 4.5a by 4.5. Now B's money stock is fixed while A's is endogenous.

For indexed contracts we have $\pi_2 = \pi_4 = \pi_1 = \pi_5 = 1$; and $\pi_3 = \pi_6 = 0$, so wa = pa and wb = pb.

GNE or GNP as the Target?

The question was raised in the text as to whether GNE or GNP should be the appropriate target. In this Annex we undertake some very preliminary investigation of this question, using a framework similar to that used in Sections III and IV.

Many approaches are possible here; we, however, choose to compare two strategies, one where GNE is stabilized (perfectly) by means of fiscal policy, the other (as in Sections III and IV) where GNP is stabilized by means of monetary policy. The analysis of the latter has already been undertaken in some detail.

The methodology is not too dissimilar from that adopted in Sections III and IV. We can take regime 1 as the starting point but now ask what will happen to nominal income and national expenditure. If nominal income rises (falls) monetary policy is tighter (easier) sufficiently to stabilize nominal income; if national expenditure increases (falls), fiscal policy tightens (eases) now sufficiently to stabilize national expenditure.

Assuming the current account is initially in balance, we can rewrite the national product identity as:

A5.1. $$ya + pda = (expr + pa) + h_1\ CA/Xo$$

where ya, pda, expr and pa are in log, CA/Xo is the current account deflated by initial exports (Xo) and h_1 is the ratio of initial nominal exports to nominal GNP,expr is real national expenditure, pa the deflator for real expenditure.

The authorities target expr + pa, so that can be set at zero. At the same time, we can write

A5.2. $$\frac{CA}{Xo} = \pi_2(e+pdb-pda) - ya+yb$$

where π_2 is the Marshall-Lerner condition. Substituting into A5.1 we have

A5.3. $$ya = \frac{h_1\pi_2}{1+h_1}(e+pdb) - \frac{1+h_1\pi_2}{1+h_1}pda + \frac{h_1}{1+h_1}yb$$

We now add the money market equations (setting ma = 0 and $\alpha_4 = 1$)

A5.4. $$0 = ya+pda-\alpha_5 ra + u_2 a$$

and

A5.5. $ra = rb - e$

Finally, we have the aggregate supply equation (wa = 0).

A5.6. $ya = \alpha_6 pda + \frac{\alpha_6}{k_1} u_3 a$

Substituting A5.5 into A5.4 gives us three equations A5.3, A5.4, A5.6 to solve for ya, pda and e.

In a few words, what are the key differences between the two regimes? If GNE is targeted the economy is completely insulated in all respects from a domestic expenditure disturbance, whereas, as we have seen, if nominal income is targeted, while price-output are insulated, there are real exchange rate-interest rate effects. So a GNE target is, perhaps self-evidently, superior.

By contrast, a nominal income strategy is a perfect insulator for a domestic money demand disturbance, while a GNE strategy has both real and price effects. So a nominal income strategy is superior.

Finally, for all disturbances from abroad a nominal income strategy insulates home output and prices perfectly. In these respects it is unambiguously superior to a GNE strategy which impacts on both output and prices. However, insofar as real exchange-rate real interest rate effects are concerned, comparisons are more difficult to make.

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