

# **International Nominal Targeting (INT): A Proposal for Overcoming Obstacles to Policy Coordination (\*)**

**Jeffrey A. Frankel**

University of California, Berkeley

The central theorem about the economic gains from international policy coordination which has very strong implications for the design of the international monetary system is that if countries in general set their policies jointly they will be better able to attain their economic objectives than if they set them independently. (The alternative non-cooperative equilibrium, in which each country independently sets own policies, taking the policies of the others as given, is its termed the Nash equilibrium). The coordination theorem appears to be a strong argument for policy makers to set up the machinery for regular meetings and cooperative setting of macroeconomic policies, and the entire issue has been a popular research topic in the academic community since at least the early 1960s.

Since September 1985, when the finance ministers of the Group of five (G5) countries struck their *Plaza Agreement*, international coordination has become popular in the policy making community as well. Although that agreement concerned only the exchange value of the dollar, it formalized the process of cooperation, which was broadened to include the rest of macroeconomic policy management

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*Advise:* the numbers in square brackets refer to the Bibliography in appendix.

at the Tokyo Summit meeting of The Group of seven (G7) leaders in May 1986.

Just as international coordination has caught on among policy makers, however, some academic economists have turned skeptical (at the public level, beginning with Feldstein [10] [11]). They have come up with a variety of obstacles to coordination, points that invalidate the universality of the theorem that coordination must always leave countries better off. These obstacles fall into three categories: the enforcement of compliance with any given agreement, the inflation-fighting credibility of monetary policy, and uncertainty.

Consequently, this paper begins with a review of the obstacles to successful coordination. It then takes the more constructive route of offering a modest proposal for the form that successful coordination might take. The proposal is for an international version of targeting nominal GNP (or aggregate demand) that I call international nominal targeting (NIT) (1). It is designed to have a better chance of overcoming the three kinds of obstacles to coordination than the current system established by the G7 leaders at Tokyo. A key element of the proposal is that it could begin with nations' sacrificing only a very small amount of national macro-economic sovereignty — that is, with very wide bands around the target. Trust and confidence in the institution could build slowly, and then nations could progress to higher degrees of coordination if they so desired.

The essence of the argument for the need for coordination is the existence of international externalities or spillover effects. If they did not exist — that is, if each country were unaffected by changes in other countries — the decentralized, non-cooperative solution for obtaining economic objectives would be optimal, and there would be little role for international meetings or a supranational institution to coordinate policies (just as there would be little role for government intervention in the domestic economy if domestic markets functioned competitively and without externalities). If, for example, floating exchange rates insulated each country from others' disturbances, there would be no need for coordination. Since this sort of insulation

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(1) The INT proposal appears in brief form in FRANKEL [15] and in a longer version in FRANKEL [16].

does not exist, spillover occurs, and so, says the theory, coordinations preferable to non-cooperation (2).

One cannot know, however, whether or what kind of coordination is desirable without first knowing the nature of the externalities. Is the Nash non-cooperative equilibrium too contractionary because of a proclivity toward beggar-thy-neighbor policies? Then joint expansion is called for. (This was the logic of the “locomotive theory” that gave rise to the 1978 Bonn Summit meeting (3). Or is the existing equilibrium overly inflationary? In that case, joint discipline is called for. (This is the apparent motivation underlying the founding of the European Monetary System — EMS). Perhaps the problem is “competitive appreciation”. Each country seeks by its policy mix to raise real interest rates, attract capital inflows, and appreciate its currency, thereby reducing the consumer price index for any given level of output and employment. Or perhaps it is “competitive depreciation” (as was feared at Bretton Woods in 1944 on the basis of the experience of the 1930s). If either of the last two such externalities is important, it points to a need for coordination schemes that give more emphasis to exchange rate stability than does the proposal developed in this paper, for schemes like those of McKinnon [35] and [36], Williamson [46], and Williamson and Miller [47], [38]. Yet if the problem is thought to be monetary policy that is overly contractionary or expansionary, then a switch toward a regime of greater exchange rate stability would likely exacerbate the problem by increasing the international transmission of disturbances.

One premise of the INT proposal is that the relevant externalities concern the overall degree of expansion of macroeconomic policies — that is, monetary and fiscal policies are too tight or too loose. The plan

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(2) The standard formulation of the Theorem contains a second technical qualification for the optimality of coordination. Each country must have more economic objectives (such as trade balance equilibrium, output equal to the full employment level, and zero inflation) than it has independent policy instruments (such as monetary and fiscal policy). If each has as many instruments as targets, then each can offset the actions of the others so as to attain its optimum and issues of conflict and cooperation among countries do not arise. In practice, countries seldom feel that they have enough freedom to be able to attain their optimum positions.

(3) The history of the Bonn Summit and the other annual meetings of the leaders of the G7 countries is given in PUTNAM and BAYNE [41].

does not address the proper *mix* of monetary and fiscal policy or the resulting real interest rate (4).

Some people object that a plan for using monetary policy to target nominal GNP would have done little to prevent the major disequilibrium that arose in the early 1980s, the US budget and trade deficits. But I agree with Feldstein [10] that this disequilibrium was not a failure of coordination, — that the US government did not pursue the policies it did as result of insufficient expansion by its trading partners. (Indeed, until after 1985, the administration did not even want Europe and Japan to expand). No international bargain would have brought about a US fiscal correction. Only a recognition by the administration and the Congress of the link between their fiscal policies and the trade deficit (together with the political will necessary to make difficult budget choices) would have done so. By the same token, neither INT nor any other proposals for coordination should now be allowed to distract attention from the point that the most important policy changes to be made in the coming decade can be made unilaterally by the United States (5).

## 1. Obstacles to International Policy Coordination

As already mentioned, the obstacles to implementing a successful regime of macroeconomic policy coordination are of three sorts: enforcement, the need for time-consistent inflation-fighting credibility, and uncertainty. In this section, I deal in turn with each and related topics.

### 1.1 *Problems of Enforcement and the G7 Indicators*

Difficulties of enforcement and credibility have received the most attention from economists. Even when a coordination package guar-

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(4) Such questions are described by the next section of this paper in its review of the obstacles to coordination (except in the discussion of inflation-fighting credibility, which applies only to questions of overall economic expansion).

(5) Such thoughts are supported by the findings in FRANKEL and ROCKETT [19] and FRANKEL [14] and [15] that the gains from coordination would usually be smaller than the gains from the United States' discovering the true model and unilaterally adjusting its policies accordingly.

antees that each member country will be better off than it would be in the non-cooperative equilibrium, a country will be able to do better still if it unilaterally deviates from the agreement. If the agreement calls for joint expansion, for example, an individual country may be tempted to hold back somewhat and let its partners bear the burden of expansion (that burden being a trade deficit or a depreciation of the currency).

It is worth recalling, however, that saying a country will be able to do better by deviating from the agreement refers to the short run and holds under the assumption that the other countries keep their policies as agreed. In future periods, those other countries will presumably retaliate by also abandoning the agreement. Thus, economists have probably overemphasized the difficulties of enforcement (6).

Norms for behaviour — “peer pressure” in the language of US Treasury official David Mulford after the Tokyo Summit (quoted in Funabashi [23], p. 131), or the formation of “reputations” in the language of economic theory — may be sufficient to enforce compliance with an agreement, provided it meets two conditions: 1) the agreement must specify explicitly what is required of each party in terms of observable economic variables. Since each party has an incentive to cheat, it is hard enough to enforce a clear-cut agreement; enforcement is hopeless if the parties have not even spelled out what is required of them; 2) the constraints embodied in the agreement must be specified in such a way that unilateral cheating in any given period would give a country a short-term gain that is small relative to the potential future loss (when the cooperative agreement breaks down) of the grains over the Nash non-cooperative equilibrium.

If these two conditions are met, it is unlikely that one country will cheat just because it can gain a bit more over the cooperative equilibrium.

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(6) KENEN ([29], pp. 31-6) thinks so. HOLTHAM and HUGHES HALLETT ([28], p. 130) agree: economists have perhaps focused on moral hazard problems because of their interesting logical character rather than because of their empirical importance. It seems likely that uncertainty and model disagreement are greater obstacles to international cooperation.

At the Tokyo *Summit* of May 1986, it was decided that the finance ministers of the G5 countries (thenceforth, the G7 countries) would focus in their meetings on a set of ten “objective indicators”: the growth rate of GNP, the interest rate, the inflation rate, unemployment, the ratio of the fiscal deficit to GNP, the current - account and trade balances, the money growth rate, international reserve holdings, and exchange rates (7).

The list was further discussed and somewhat trimmed down at subsequent G7 meetings. By the time of the Venice Summit in June 1987, it had apparently been reduced to six indicators: growth, inflation, trade balances, government budgets, monetary conditions, and exchange rates (8). Nevertheless, US Secretary of the Treasury told the annual meeting of the International Monetary Fund (IMF) in October 1987 that: «the United States is prepared to consider utilizing, as an additional indicator in the coordination process, the relationship among our currencies and a basket of commodities, including gold». And at the Toronto Summit of June 1988: «the G7 countries welcomed the addition of a commodity price indicator and the progress made toward refining the analytical use of indicators» (*IMF Survey*, September 26, 1988, p. 292).

At no time have the 67 members made any pretense that they will rigidly commit themselves to specific numbers for the indicators — not in the sense that sanctions will be imposed on a country if it deviates far from the values agreed upon. But the plan does include the understanding that “appropriate remedial measures” will be taken whenever there develops significant deviations from the “intended course”. This language seems to suggest that the indicators are not intended to be mere national forecasts and that the system is intended to include some substantive bargaining over policies, rather than be simply an exchange of information. Thus the current G7 system can be viewed as an attempt at small-scale coordination sacrificing just a

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(7) The story of the Tokyo Summit is recounted in both PUTNAM and BAYNE [41] and FUNABASHI [23].

(8) This list did not appear in the official communique but rather in comments to the press by US Assistant Secretary of the Treasury David Mulford. FUNABASHI ([23], esp. 130 ff.) offers a fascinating account of the machinations of the G7 mechanism from 1985 to 1987.

little national macroeconomic sovereignty, a necessary stage for building confidence before moving on to more binding forms of coordination.

The G7 list of indicators, be it six or ten, is not, however, especially well suited to workable coordination described above. It is difficult to imagine a G7 meeting applying moral censure to one of its members for, say, having experienced a higher rate of real growth or a lower rate of inflation during the year than had been agreed on in the previous meeting.

The main problem with the list is that it is too long to be practical. When each country has six or ten indicators but only two or three policy instruments, it is virtually certain that the indicators will give conflicting signals. Thus, the national authorities will feel little constraint on their setting of policy instruments. Frenkel, Goldstein, and Masson ([21], p. 22) note that one argument for choosing a single indicator is that when multiple indicators send conflicting signals, authorities can hide behind the confusion. They also observe that multiple indicators can encourage "overcoordination"; setting a single indicator allows each country to retain some degree of freedom in setting its monetary and fiscal policies. In this light, a serious coordination scheme might *begin* in the 1990s by setting only one indicator and progress to commitments to multiple variables only when and if sufficient political consensus and confidence has developed to justify more sacrifice of sovereignty.

Another problem with the G7 indicators is that they are kept secret. It is difficult to reconcile optimistic statements about the amount of substantive coordination already taking place with the fact that G7 meetings do not publicly announce the agreed targets for the indicators. How can any pressure (be it moral persuasion, embarrassment, effect on long-term reputation, or outright sanctions) be brought to bear on countries that stray from targets that have not been made public?

To take a recent example, in the *Baker-Miyazawa Agreement* reached in San Francisco in September 1986, the Japanese apparently agreed to a fiscal expansion in exchange for a promise from the US Treasury secretary that he would stop "talking down" the dollar, plus the usual US promise to cut the budget deficit. In the months that

followed, each side viewed the other as not fully living up to the agreement. (The episode is described in Funabashi [23]). But it was difficult for anyone to verify the extent of compliance because the precise terms of the original agreement had not been public.

Indeed, the G7 guards the values of the indicators with even more secrecy than the central banks guard their foreign exchange market interventions. Theory says that the success of a target zone is *enhanced* when speculators are made aware of the boundaries (9). Why then does the G7 keep them secret? A possible answer is that the members do not want to lose face if their economic variables subsequently break outside the target band. (This answer fits in well with the suspicion that the G7 meetings may, in fact, reach no substantive agreements but nevertheless find it politically useful to issue communiques, the public announcement being sufficiently vague that each member can interpret them to its own advantage (10).

Thus, the need to monitor performance criteria in order to enforce compliance with any coordination agreement suggests two conclusions about the current G7 system: 1) it would be better for the agreement to focus on one variable than on six or ten or eleven; and 2) the targets for the variable should be made public.

Below, I will develop further desirable characteristics for that variable.

## 1.2 Problems of Inflation-Fighting Credibility

A number of the problems that arise in international policymaking occur in the context of domestic policymaking as well. One of them is the need to set monetary policy so as to keep the public's expectations of inflation low. One way that monetary policymakers can do this is to precommit themselves to rules of

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(9) See KRUGMAN [30] for the application of the latest "smooth pasting" technology to this problem.

(10) It is clear from FUNABASHI [23] that the various members held differing views as to which indicators were most important, what responses were called for if indicators strayed from the agreed-on path, and how binding the agreement should be. It is also clear that each was able to interpret the *Plaza* and *Louvre Agreements* afterwards so as to reflect its own views.

monetary discipline. To be useful, that commitment must be credible or, in modern theoretical parlance, “dynamically consistent” (11).

Macroeconomic policymaking is always a trade-off between the advantages of rules and of discretion. In the past, writers concerned with either of the two problems often simplistically assumed away the other. If the aim is to maximize economic welfare (a function of output and inflation) for a given period only, ignoring long-run implications for expected inflation, discretion can be shown to be unambiguously superior to rules; after all, how can one possibly gain by agreeing to limit beforehand the ability to respond to developments in the economy? If, on the other hand, one ignores the possibility of short-run disturbances, rules can be shown to be unambiguously superior to discretion in a long-run equilibrium; macroeconomic policy cannot affect output in the long run anyway and precommitment to a nominal anchor can reduce expected inflation and thereby reduce actual inflation.

It should be clear by now that neither extreme in the debate represents the complete correct answer. If the political system’s policymaking process is allowed to optimize on a purely short-run basis, the outcome will be overexpansion. Thus, some degree of longer-term commitment to resisting inflationary temptations is indicated, even if it is a decision to insulate the central bank from the political process rather than to adhere formally to a nominal anchor or rule (12). Yet in a world where new disturbances do come along, it

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(11) A “dynamically consistent” or “time-consistent” regime is one that manages to prevent the monetary authorities from breaking the commitment to monetary discipline where they otherwise might have an incentive to do so in the future. For recent surveys of the rules-versus-discretion debate and the implications of the time-consistency literature, see BARRO [1], FISCHER [12], and ROGOFF [44].

(12) That Milton Friedman has had more influence on this issue than one human being is usually able to have is justifiable. Nevertheless, two aspects of his campaign against the Federal Reserve Board have long been puzzling. First, his argument against discretion in monetary policy-making is largely based on the analysis in Friedman and Schwartz that the Federal Reserve made the Depression of the 1930s much worse than it otherwise would have been by “allowing” the *M1* money supply to fall. Yet in recent decades he has campaigned for the Federal Reserve to do precisely what he accuses it of doing in the 1930s: set a firm target for the monetary base, rather than for *M1*. The second, even more puzzling aspect is that Friedman and his fellow monetarists claim to believe that US money growth would be slower and more stable if monetary policy were placed more under the control of the democratic political process, via the Treasury or

is important that the government retain at least some ability to respond to stabilize the economy. The solution is commitment of *some* degree but less than 100% to some nominal anchor (13).

### 1.3 *Coordination and Inflation in the Long Term*

An important critique of international coordination is the point made by Kenneth Rogoff [42]: if governments set up the machinery for joint welfare maximization period by period, as they did at the Bonn Summit of 1978, the cooperative equilibrium in each period is likely to entail more expansion than would otherwise be present. Countries may find this joint expansion advantageous within any given period, but in the long run it will undermine governments' inflation-fighting credibility and result in a higher inflation rate for a given level of output. In the Rogoff view, renouncing the machinery of coordination is one of the ways that governments can credibly precommit themselves to less inflationary paths.

It is important to realize that the introduction of longer-term issues of credibility, time-inconsistency, and precommitment can just as easily run in favor of coordination as against it. If the perceived externality or shortcoming of the Nash noncooperative equilibrium is that it is overly expansionary, then the coordination equilibrium, even if arrived at period by period, will entail less expansion, not more. This is sometimes argued to be the basis underlying the European Monetary System. The rhetoric that Helmut Schmidt and Valéry Giscard d'Estaing used in originally proposing the EMS in the late 1970s suggested that they were doing so because the United States was neglecting its duty of supplying to the world the public good of a stable, non-inflating currency. Ten years later, many observers of the EMS (for example, Giavazzi and Pagano [25]) have decided that its

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the US Congress, than under the control of elitist central bankers such as Paul Volcker. It is particularly ironic that when a member of the monetarists' Shadow Open Market Committee finally became undersecretary of the Treasury for monetary affairs in the early 1980s, his view that the money growth rate was dangerously high was overruled by the Treasury and the White House, who sought to pressure the Federal Reserve for faster money growth in the period leading up to the 1984 election.

(13) ROGOFF [43] shows that some intermediate degree of commitment to a target is optimal for monetary policy.

success lies precisely in giving inflation-prone countries such as Italy and France a credible nominal anchor for their monetary policies. Commitment to exchange rate parity or a band vis-à-vis a hard-currency country such as Germany constitutes precisely the sort of time-consistent, low-inflation policy sought by those who worry that central bankers left to their own discretion will be overly expansionary.

The case of the EMS does, however, offer an asymmetry. It is an accepted fact that Germany — because of its history or some other reason — places very heavy weight on price stability. Thus, the weaker-currency countries can import inflation-fighting credibility by pegging themselves to the greater mark area (14). In contrast, there can be no presumption that the United States (the natural “Stackleberg” leader) has as much inflation-fighting credibility as do Germany and Japan. Thus proponents of worldwide coordination cannot automatically presume that year-by-year coordination would lower the average world inflation rate, rather than raise it.

#### *1.4 The Choice of a Nominal Anchor*

The implication of the credibility issue is that a scheme for coordination is more likely to produce long-run gains if it has national governments committed not just to each other period by period but also, in some degree, to a nominal anchor for a longer term. The G7 list of indicators includes four nominal variables: money, the price level, the price of gold, and the exchange rate. I will develop grounds for choosing the nominal variable on which coordination should focus and argue that the optimal one is nominal GNP, a variable that does not even appear on the G7 list.

The appendix to this paper considers the problem formally. It makes no judgment on the desirable degree of precommitment to a nominal target, in the context of either domestic or international

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(14) There is a close analogy here with the idea in ROGOFF [43] that if a particular individual — say, Paul Volcker — is known to have extreme aversion to inflation, then the country can gain by appointing him as central banker, even if the country's objective function puts less weight on fighting inflation; his tight-money credibility will reduce the public's expectations of inflation and in long-run equilibrium will produce a lower level of actual inflation for any level of output.

policymaking, so long as it is greater than zero and less than infinity (15). The important point is that nominal GNP (or nominal demand) makes a more suitable target than the four nominal variables in the G7 list.

The general argument has been made well by others (16). In the event of disturbances in the banking system, in the public's demand for money, or in other mechanisms that affect the demand for goods, a policy of holding nominal GNP steady insulates the economy; neither real income nor the price level need be affected. In the event of disturbances to supply, such as the oil price increases of the 1970s, the change can be divided equally between an increase in the price level and a fall in output. (For some countries, equal shares is roughly the split that a discretionary policy would choose anyway (17). In general, fixing nominal GNP will not give *precisely* the right answer unless the objective function puts precisely equal weights on inflation and real growth. But where if the choice is among the available nominal anchors, nominal GNP will give an outcome characterized by the greatest stability of output and the price level. As demonstrated at the beginning of the appendix, a nominal GNP target strictly dominates a money supply target, in the sense of minimizing a quadratic loss function, regardless of how important inflation-fighting credibility is. The appendix goes on to show that a nominal GNP target also dominates an exchange rate or price-of-gold target (unless extraordinarily high weight is placed on the objective of stabilizing the exchange rate or price of gold).

To take an example from recent history, in late 1987, the US Federal Reserve, citing large velocity shifts, decided to allow *M1* to

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(15) Analogously, I take as given by the political process the degree of commitment to coordination.

(16) GORDON [26], HALL [27], TAYLOR [45] and McCALLUM [32], [33] and [34], for example, argue in favour of targeting nominal GNP in the closed-economy context. The idea also has proponents in the United Kingdom: BEAN (1983), MEADE [37] and BRITTON [5]. MILLER and WILLIAMSON ([47, pp. 7-10] propose targeting nominal demand as part of their blueprint for exchange-rate target zones.

(17) Switzerland can be given as an example of a country that chose to take the adverse supply shock of 1974 almost entirely in the form of lost income and employment in order to restore price stability. Sweden was a country that chose to take it almost entirely in the form of inflation, in order to preserve output and employment. The United States fell in between.

break well outside of the previously announced target zone. From the second quarter of 1987 to the second quarter of 1986, *M1* grew 10.3% per year, leading some observers to suggest that the Federal Reserve was following a general policy of targeting nominal GNP. The monetarists were furious. For four years, they decried the betrayal of the money growth rule and warned that a major return of inflation was imminent. In retrospect however, nobody can doubt that the Federal Reserve had chosen the right course. Even with the recovery that began in 1983 and continued through the four years and beyond, nominal GNP grew at 8.0% per year — more slowly than the money supply. Thus, velocity declined at 2.3% per year, in contrast to its past historical pattern of increasing at roughly 3% a year. If the monetary authorities had followed the monetarist prescription of rigidly pre-committing themselves to a money growth rate lower than that of the preceding period — say, 3% — and velocity had followed the same path, then nominal GNP would have grown much less — at only 0.7% a year in the example. In fact, this number is an upper bound. With lower inflation than occurred, velocity would almost certainly have fallen even more than it did, and the recession of 1981-1982 would have lasted another five years!

### *1.5 Problems of Uncertainty*

The argument that nominal GNP dominates such variables as the money supply as a candidate for a nominal anchor applies to international economy policy even more strongly than to domestic policy. The reason is that uncertainty, though it is certainly a problem for policy makers in a closed economy, is an even greater problem in an open economy.

Before a country can enter negotiations with other countries on coordinated policy changes, it needs to know three things: 1) what is the initial position of the domestic economy relative to the optimum values of the target variables?; 2) what are the correct weights to put on the various possible target variables?; 3) what effect will each unit change in the domestic and the foreign macroeconomic policy variables have on the target variables; that is, what is the correct model of the world economy?

These three elements follow simply from the algebraic expression for the economic objective function (18):

$$(1) \quad W = (1/2)(y^2 + w_x x^2 + w_p p^2)$$

$$(1a) \quad W^* = (1/2)(Y^{*2} + w_{x^*} x^{*2} + w_{p^*} p^{*2})$$

where  $W$  is the quadratic loss to be minimized,  $Y$  is output (expressed in log form and relative to its optimum),  $x$  is the current account (expressed as a percentage of GNP and again relative to its optimum),  $p$  is the inflation rate,  $w_x$  is the relative weight placed on the current account objective,  $w_p$  is the relative weight placed on the inflation objective, and an asterisk, (\*), denotes the analogous variables for the foreign country.

There are two policy instruments: the money supply,  $m$  (in log form), and government expenditure,  $g$  (as a percentage of GNP). For the home country, the marginal welfare effects of changes in these policy variables are then given by

$$(2) \quad dW/dm = (Y)Y_m + w_x(x)x_m + w_p(p)p_m$$

$$(3) \quad dW/dg = (Y)Y_g + w_x(x)x_g + w_p(p)p_g$$

$$(4) \quad dW/dm^* = (Y)Y_{m^*} + w_x(x)x_{m^*} + w_p(p)p_{m^*}$$

$$(5) \quad dW/dg^* = (Y)Y_{g^*} + w_x(x)x_{g^*} + w_p(p)p_{g^*}$$

and it the foreign country:

$$(2a) \quad dW^*/dm = (Y^*)Y_m^* + w_{x^*}(x^*)x_m^* + w_{p^*}(p^*)p_m^*$$

$$(3a) \quad dW^*/dg = (Y^*)Y_g^* + w_{x^*}(x^*)x_g^* + w_{p^*}(p^*)p_g^*$$

$$(4a) \quad dW^*/dm^* = (Y^*)Y_{m^*}^* + w_{x^*}(x^*)x_{m^*}^* + w_{p^*}(p^*)p_{m^*}^*$$

$$(5a) \quad dW^*/dg^* = (Y^*)Y_{g^*}^* + w_{x^*}(x^*)x_{g^*}^* + w_{p^*}(p^*)p_{g^*}^*$$

where the policy multiplier effect of money on output is given by  $Y_m$ , the effect of money on the current account by  $x_m$ , and so on. To solve

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(18) The specification here is a function of three target variables. One could as easily have more or fewer.

for the optimum, one can set these derivatives equal to zero, with the target variables,  $y$ ,  $x$ , and so on first expressed as linear functions of the policy variables  $m$ , and  $g$ . For the Nash non-cooperative equilibrium (in which each country takes the other's policies as given), only equations (2), (3), (4a), and (5a) are needed for the solution. Each country ignores the effect that its policies have on the other country, so equations (4), (5), (2a), and (3a) do not enter the mode. Indeed, this is precisely the reason the non-cooperative equilibrium is suboptimal. These cross-country effects enter only in the determination of the cooperative solution).

Before deciding on a policy change, policymakers must at least know the sign of the corresponding derivative. Equation (2), like all the eight derivatives above, neatly illustrates the three kinds of uncertainty. The first is uncertainty about the initial position of  $y$ ,  $x$ , and  $p$  (19). Position uncertainty, in turn, breaks down into three parts: 1) uncertainty about the current value of the target variable in question (20); 2) uncertainty over the baseline forecast — how the target variables are likely to move during the forthcoming period (usually a year or more) in the absence of policy changes (21); and 3) uncertainty about the optimum value of the target variable (22).

The point is clear. Policymakers' estimates of the current values

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(19) Uncertainty about the position of the economy in the absence of policy changes is the same thing as uncertainty about the disturbance terms in the model of the economy, such as the disturbances in the appendix to this paper. That appendix, though it considers uncertainty in an open economy, deals only with a country's unilateral policy-making problem. In this section, I am considering the problems that uncertainty creates for coordination per se.

(20) This uncertainty is a genuine concern. MANKIW and SHAPIRO (1986) find that the standard deviation from the preliminary estimate of the real growth rate to the revised final number is 2.2 percentage points.

(21) KENEN and SCHWARTZ (1986) have studied the accuracy of current-year forecasts in the IMF, *World Economic Outlook* for the last 15 years. They find that the root mean squared error among the G7 countries is 0.773 percentage points for real growth and 0.743 percentage points for inflation. These prediction errors, although relatively small, are large enough to reverse the signs of the derivatives of the welfare function equations (2) to (5). Errors would presumably be much larger for the horizons of two years or more that are probably most relevant for policymaking. Many major international econometric models show that the effects of monetary and fiscal policy peak in the second year for output and not until more than six years for the price level or current account. See BRYANT *et AL.* [7]

(22) Economists disagree about the correct estimates of, for example, the natural rate of unemployment and the level of potential output.

of  $y$ ,  $x$ , or  $p$  in their own countries could easily be off by several percentage points in either direction, enough to flip the signs of the corresponding three terms — any one of which could change the sign of the derivative of the objective function — in each of equations (2) through (5). Thus, it is entirely possible that the country could ask its partners to expand or agree to a partner's request that it itself expand when these changes would, in fact, move the economy in the wrong direction.

To take one historical example, in the late 1970s, US policymakers, looking at the available economic data, concluded that the problem of the time was insufficient growth in the world economy. This assumption was the basis of the 1978 *Bonn summit agreement* for coordinated expansion with Japan and Europe, (Germany in particular). By the end of the decade, the consensus had become that the top priority was fighting inflation, not promoting real growth. A natural way of interpreting the view — widely held in Germany at least — that the result of the Bonn-coordinated expansion turned out in retrospect to have been detrimental in that unanticipated developments, particularly the large increase in oil prices associated with the sudden Iranian crisis of 1979, moved the world economy to a highly inflationary position where expansion was no longer called for (23).

The second sort of uncertainty present in the equations is uncertainty regarding the proper weights,  $w_x$  and  $w_p$ , to put on the target variables in the objective function (24). This problem is even greater than the problem of assigning optimal values to the target

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(23) Another unexpected development in the late 1970s was the downward shift in the demand for money in the United States. This disturbance, like the oil shock, meant that the planned growth rate of money turned out to be more inflationary than expected.

(24) One way to obtain estimates for these weights is to follow OUDIZ and SACHS [41], who assume that as of 1984, policymakers were optimizing their objective functions in a Nash equilibrium and infer the welfare weights they must have had in order to produce the observed outcomes for output, inflation, and the current account. The estimates turn out to be very sensitive to such things as the model of the economy that the policymakers are assumed to have used. (To equate the inferred weights with the actual rates, as Oudiz and Sachs do, requires not only that the policymakers were indeed seeking to optimize in a Nash equilibrium in that particular year but also that they knew the correct model, the correct weights, and the correct position of the economy relative to the optimum.)

variables. In a society in which the weights that individual actors place on inflation (or the current account) vary from zero to infinity, the likelihood is very high that any given government is using weights that differ from the “correct” ones that would follow from any given criterion. One can see from the equations that, for example, putting insufficient weight on fighting inflation has the same effect as underestimating the baseline inflation rate; thus, the coordinating policymaker may ask his trading partners to adopt expansionary policies when contractionary policies are in fact called for. This is precisely the mistake that, by 1980, some people concluded had been made by the United States. From the viewpoint of the Republicans who were elected to the presidency in that year or the Social Democrats who came to power in Germany two years later, the policymakers who had agreed to coordinated “reflation” at the Bonn Summit of 1978 has put insufficient weight on the objective of price stability.

The third sort of uncertainty pertains to the policy multipliers, the derivatives  $Y_m$ ,  $Y_g$ , and so on in equations (2) to (5a), which reflect the effect on the target variables of changes in the money supply and government expenditure. Any given government is likely to be using policy multipliers that differ substantially from the “true” ones and that may even be incorrect in sign. Consider the tremendous variation in multipliers according to different schools of thought and even according to different estimates in the models of mainstream macroeconomists. They cannot all be correct, and it seems highly probable that no single model is exactly right (25).

It is possible to illustrate in some detail the potential range of multiplier estimates. In a recent exercise conducted at the Brookings Institution, 12 leading econometric models of the international macro-

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(25) The German view that the 1978 Bonn Summit entailed joint “reflation” that was, in retrospect, inappropriate was used above to illustrate, alternatively, uncertainty about the baseline forecast (the unanticipated oil shock of 1979) and uncertainty about the objective function (the proper weight to be placed on inflation versus growth). A third possible interpretation is model uncertainty: the Germans believe that the slope of their aggregate supply curve turned out to be steeper than they, or at least the Americans, thought it would at the time. This interpretation is plausible if one believes that the German labor market is characterized by a high degree of real wage rigidity, as was pointed out by BRANSON and ROTEMBERG [4].

economy simulated the effects of specific policy changes in the United States and in the rest of the OECD (Bryant *et Al.* [7]) (26).

The variation in the estimates was large, not just in magnitude but also in sign. The effect of fiscal or monetary expansion on domestic output and inflation was, however, usually at least of the positive sign that one would expect (27). Disagreement among the models became much more common when it came to the transmission of international effects, although the areas of greatest disagreement were not those the theoretical literature might have led one to expect. For example, US fiscal expansion was transmitted positively to the rest of the OECD in 10 out of 11 models and an expansion in the other countries was transmitted positively to the United States in 9 out of 10, whereas in theory fiscal transmission can easily be negative (28). The greatest amount of disagreement was on the effect of a monetary expansion on the domestic current account and, therefore, on the foreign current account and output level. There are two conflicting effects here: the monetary expansion raises income and therefore imports, but it also depreciates the currency, which tends to improve the trade balance (29). It turned out that a US monetary expansion worsened the current account in 8 out of 11 models and a monetary expansion in the other OECD countries worsened their current accounts in 5 out of 10 models (30). Despite disagreements such as these, what happens if US, European, and Japanese policymakers proceed with coordination efforts? Frankel

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(26) The models used were the Federal Reserve Board's Multi-Country model, the European Economic Community's Compact model, the Japanese Economic Planning Agency model, the *Project Link* model, Patrick Minford's Liverpool Model, the McKibbin-Sachs Global model, the *Sims-Litterman Var model*, the OECD's Interlink model, John Taylor's model, the Wharton Econometrics model, and the *Data Resources, Inc. model*.

(27) Even here, there were exceptions when it came to inflation. The *Var*, *WHARTON*, and *LINK* models sometimes showed expansion as causing a reduction in the CPI (probably because of effects via markup pricing).

(28) For example, if capital mobility is sufficiently low and a depreciation of the domestic currency is contractionary for the foreign country.

(29) In the Mundell-Fleming model, the net effect on the current account must be positive because reduction in interest rates causes a net capital outflow, which under a floating exchange rate implies an increase in the current-account balance.

(30) In most of the models, the rest of the Mundell-Fleming transmission mechanism was also reversed: that is, the foreign current account and foreign income rose, rather than fell.

and Rockett [19] and Frankel [14] and [15] use the Brookings simulations and the welfare weights from Oudiz and Sachs [40] to consider the possibilities when governments coordinate but use conflicting models. In general, countries will be able to find a package of coordinated policy changes that each believes will leave it better off, even though each has a different view of the effects and thus may not understand why the others are willing to go along with the package. The actual effects depend on what the true model is. If one considers 10 possible models, 1,000 combinations can be used to represent the beliefs of the US policymakers, the beliefs of non-US policymakers, and reality. Monetary coordination results in gains for the United States in 546 cases, losses in 321 cases, and no effect on the objective functions (to four significant digits) in 133 cases. Coordination results in gains for the rest of the OECD countries in 539 cases, losses in 327, and no effect in 134.

Thus, a cooperative package of policy changes that each country thinks will benefit it could, *ex post*, easily turn out to make things worse rather than better. The baseline level of output may differ from what is expected, or the optimum level (of, for example, potential output) may vary from the anticipated level, or a foreign expansion of monetary policy may turn out to have an effect on domestic output that is different from what expected.

Moreover, uncertainty greatly complicates the enforcement problem. Recall the earlier conclusion that to enable compliance to be monitored, the agreement must involve the explicit setting of observable performance criteria. Two comments must now be made. First, policymakers do not have direct control over the variables that referred to here as "their policies." Central banks cannot determine the money supply precisely because it may be subject to disturbances within the banking system or in the wider economy's demand for money. Nor can specific policymakers in international negotiations determine their country's fiscal policies precisely. For this reason, it can be difficult to hold policymakers accountable if the policy variables deviate from the cooperative bargain.

Second, *ex ante* uncertainty means that there will be some countries that face an especially great temptation to cheat because they turn out *ex post* to lose a lot from abiding by the agreement (a lot

relative to unilaterally violating the agreement and perhaps also relative to never having made it to begin with). In such circumstances, the short-run gains from abrogating may outweigh the longer-term gains from continued cooperation.

Thus, for the parties to be held accountable, the variables to which they commit their countries must, to the maximum extent possible, be both observable and under the control of government authorities — in particular under the control of those authorities involved in the international negotiations (31). Otherwise, the national authorities can always claim that a failure to satisfy a performance criterion was beyond their control. It is not, however, essential that the variables be under the precise short-run control of the authorities, especially if compliance with the agreement is to be checked, say, once a year at annual IMF review or at summit meetings of the heads of state or twice a year at meetings of the finance ministers. It is essential only that there be an unambiguous sign to the relationship between the policy instruments that *are* under direct control and the variable to which the parties commit themselves and that the lags in the relationship not be too long. When the variable begins to deviate seriously from the agreed-on range, the policymakers should begin to adjust their policy instruments accordingly. Then they can be held accountable at the end of the year for any large deviations from the agreement.

The next condition on the variables to which policymakers must commit themselves pulls in the opposite direction. The variables specified by the agreement must be tied closely enough to the target variables in the ultimate objective function so that if there is an unexpected disturbance in one of the economic relationships (or if one of the multipliers turns out to be different from what was expected), the country will not be drastically harmed. If for example, a country commits itself to a specific number for its monetary base or the money

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(31) It is for this reason that when the International Monetary Fund (IMF) negotiates a letter of intent with the finance minister of a borrowing country, the "performance criteria" that are agreed on tend to be variables directly under the control of the authorities, such as the growth rate of the monetary base, rather than variables that are harder to control, such as the broad money supply, let alone the ultimate target variables such as inflation.

supply and subsequent shifts in the money multiplier or velocity translate that number into a severe and needless recession, it is obvious that the country will be sorely tempted to break its commitment. Just imagine if the Federal Reserve's short-lived public commitment in the early 1980s to a regime of a low and stable *M1* growth rate had been made as part of an international agreement. Would the American public have accepted prolonging the 1981-1982 recession for another four years for the sake of an international agreement predicated on an erroneous forecast of velocity?

There must be a similar link between the variables that party commits itself to and the *other* countries' target variables. If partners stick to their money growth targets, another country will not be much impressed if the continued commitment turns out to be disadvantageous to itself (for example, because a disturbance moves it to the overly inflationary side of full employment or because the partner's money growth turns out to be transmitted negatively rather than positively).

### 1.6 *The Choice of Indicators: A Reprise*

As noted earlier, the G7 list of indicators is too long to be useful for enforcing an agreement. Could it be winnowed down to a practical number? There seems little point in doing so since no item on the list is a good candidate to be the single variable on which negotiation under a future coordination regime would focus.

1. - Real output, employment, inflation, and the trade balance are less directly affected by policy instruments than is nominal GNP; moreover, focusing exclusively on any one of them would destabilize the others.

2. - The money supply is more under the control of the authorities (at least on an annual basis) but is much less directly linked to target variables; it is one unambiguous step further away from the two fundamental target variables of real output and price level than is nominal GNP. (That step is the existence of shifts in velocity, as discussed above and demonstrated in the appendix). Furthermore, as shown above, the effects of money on all three target variables

(output, price level, and trade balance) in the other country are completely ambiguous in sign. Thus, the money supply is an even less suitable choice of focus for international coordination than for domestic policymaking.

3. - Fiscal policy is more easily linked to the foreign target variables (or would be if the high-employment deficit were used as the indicator). But it is less directly under the control of the policymakers than is the money supply. Among the G7 countries, the inability to control the budget deficit has been most striking in the case of the United States in the 1980s. Feldstein (1987, pp. 23-4) suggests why the United States will never be able to participate in serious international bargaining over fiscal policy: «A primary reason why such macroeconomic policy coordination cannot work as envisioned is that the United States is constitutionally incapable of participating in such a negotiation. The separation of powers in the American form of government means that the Secretary of the Treasury cannot promise to reduce or expand the budget deficit or to change tax rules. This power does not rest with the President or the administration but depends on legislative agreement between the President and the Congress».

4. - Exchange rate policy is, of course, a very large topic. But one can easily note some difficulties with its being the single indicator that G7 countries commit themselves to instabilizing policy coordination agreements. If, say, the dollar rate deutsche mark begins to stray outside the announced target zone, which of the two governments should suffer sanctions or a loss in reputation? The “*n*-1 problem” (Miller and Williamson [47]) means that one country — presumably the United States — would have to sit out, which is not what is wanted. Countries could commit themselves to certain targets for their foreign exchange intervention, or more generally to monetary and fiscal policies that in theory would determine the exchange rate. But, as already noted, the link between macroeconomic policies and the exchange rate is fraught with even greater uncertainty than the link between output and inflation.

One must thus raise the question of whether the exchange rate has as great a claim as the other target variables to being in the

objective function. In the second part of the appendix to this paper, the exchange rate is added in to the objective function along with output and the price level. It is shown that the penalty for stabilizing the exchange rate is being saddled with a monetary policy that destabilizes the overall price level relative to what happens with a regime of stabilizing nominal GNP. Thus, to opt for a fixed exchange rate regime, one must put tremendous weight on the exchange rate objective. (Such a person must be prepared to argue that a 10% fluctuation in the exchange rate causes greater trouble than a 10% fluctuation in the price level). The only other way out is to assume that when the regime changes, much of the disturbance in the exchange rate equation will disappear rather than having to be accommodated by the money supply (32).

5. - Of the remaining three indicators on the G7 list (the interest rate, international reserves, and the price of gold) the price of gold is the only one that has been proposed as a candidate for the sole variable around which countries should coordinate. Proponents of a central role for gold do not seem to appreciate that shifts in the demand function for gold and in the other economic relationships that link it to the target variables are even more unbalancing than shifts in the demand for money or the demand for foreign exchange, and that they are likely to remain so in the future. The appendix's demonstration of the superiority of choosing nominal GNP over the price of foreign exchange applies just as much vis-à-vis the price of gold. In a world where there are frequent shifts in demand among money, foreign currency, and gold, stabilizing any one of these variables means allowing the shifts to be transmitted more forcefully to the rest of the economy.

This does not mean that the price of gold (or of other minerals or agricultural commodities) is not a useful indicator in the sense of being a good early warning signal of the likely future course of the

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(32) MILLER [39] and WILLIAMSON ([47], pp. 54-5; do precisely this; they assume that there is a large "fad" component to exchange rate fluctuations under the current floating regime, and that it would disappear under their target zone proposal. The idea is not absurd. But it certainly stacks the deck in an empirical comparison of the two regimes.

overall price level, which is the true target variable (33). In this sense, such prices belong with the money supply, the interest rate, the yield curve, and many other leading indicators on the list of variables that policymakers may want to monitor on a short-term basis in attempting to hit their targets, whether under a regime of coordination, decentralized national policymaking with some commitment to a nominal anchor, or complete discretion.

In short, if coordination is to go beyond the stage of rhetoric to a small-scale commitment, which mean some degree of international commitment to a single variable, then nominal GNP (or nominal demand) dominates each of the indicators that the G7 have apparently been discussing as the natural candidate for that variable.

## **2. - How International Nominal GNP Targeting (INT) Would Work**

The INT framework laid out in Frankel [15], [16] is a very simple one. The G7 ministers would focus their negotiations not on the 10 or 11 indicators currently on their list but on nominal demand (defined as nominal GNP minus the balance on goods and services). At each meeting the national authorities would: *a*) commit themselves, without any obsessively great degree of firmness, to target growth rates (or ranges) for the level of nominal GNP for five years into the future, and *b*) commit themselves, with somewhat greater firmness, to targets for their countries' levels of nominal demand for the coming year.

In the first stage, — that is, the early 1990s, there would be no explicit enforcement mechanism. But the targets would be publicly announced, and if a country's growth rate of nominal demand turned out to have erred significantly in one direction or the other, the fact would be noted disapprovingly at the next G7 meeting. (This does not happen under the current system). If this first stage was successful, a future stage might add another variable or two to the list, or countries

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(33) Indeed, there is some evidence that the prices of gold and other commodities react instantaneously to changes in expectations regarding whether monetary policy will be tight or loose in the future (FRANKEL and HARDOUVELIS, [18]).

might even commit themselves firmly to specific policy responses if a level of nominal demand begins to stray from the year's target.

A plan that called for targeting nominal GNP, rather than nominal demand, might be more readily and more widely understood and thus might stand a better chance of succeeding politically. The advantages of focusing on nominal demand is the assumption that when the cooperative equilibrium entails expansion, countries need to be discouraged from the temptation to accomplish the growth of output through net foreign demand (for example, through protectionist trade measures) as opposed to domestic demand. In some years, the cooperative equilibrium might entail contraction rather than expansion, and then a nominal GNP target could be preferable to a nominal demand target. But it is usually thought that the political pressure for protectionist trade remedies is greater in recessions than in expansions, a fact that points to nominal demand as the superior choice (34).

### 2.1 *Monetary Policy or Fiscal Policy?*

Countries could attain their nominal GNP or nominal demand targets through any of several routes. One possibility is the Williamson and Miller [47] blueprint, which assigns fiscal policy in each country the responsibility for attaining a nominal demand target (and assigns monetary policy in each country responsibility for the exchange rate) (35). But at least one serious problem could arise with explicitly specifying fiscal policy as the instrument with which countries are expected to attain the nominal demand targets that they agreed to. If an economy strays from the target, the authorities will claim that it is not politically possible to adjust fiscal policy quickly. Such claims will

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(34) Besides subtracting from total GNP that part going to the foreign sector (the trade balance) it might also be a good idea to subtract the part going to inventories, as suggested by GORDON [26]).

(35) The Miller-Williamson blueprint also specifies that the G7 should set the *average* level of their interest rates so as to attain a target for the *aggregate* level of their GNPs. This part of their plan cooperative is similar to the first part of my proposal. It is my second part cooperative yearly setting of each country's nominal demand target, to be attained primarily through monetary policy — that differs the most from the Miller-Williamson plan (aside from my setting exchange rate stability aside as a separable issue).

be completely credible — in fact, they will generally be true (36). Thus, an agreement is more likely to stick if monetary policy, rather than fiscal policy, is specified as the policy instrument countries are expected to use.

Even if fiscal policy is assumed to be no more subject to lags and political encumbrances than monetary policy, there is another reason for assigning monetary policy to the nominal demand target. If countries also pursue trade balance targets (and it seems that they do, whether or not they should), then the classic assignment problem is relevant. The general rule is to assign responsibility for the trade balance target to the policy instrument that has a relatively greater effect on it (Mundell, [39]). I agree with Boughton [3] that under modern conditions of floating exchange rates, which work to decrease the effectiveness of monetary policy and to increase the effectiveness of fiscal policy with respect to the trade balance, following that rule means assigning fiscal policy to the trade balance target and monetary policy to the domestic target.

## *2.2 Consideration of Specific Instruments*

What is the precise instrument of monetary policy that should be adjusted when nominal demand drifts away from the target? The monetary base or level of unborrowed reserves would be better than the broader monetary aggregates because the central bank controls the former more directly. For the same reason, the short-term interest rate is another possible instrument.

Working in the context of closed-economy policymaking McCallum ([33], p. 15) has suggested a specific feedback rule that might do well here. His proposal is that for each percentage point that nominal GNP deviates from its target in a given quarter, the monetary

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(36) For attempts to evaluate empirically the stabilizing properties of the blueprint plan, see MILLER and WILLIAMSON [39] and FRENKEL, GOLDSTEIN, and MASSON ([21, pp. 33-49). FRENKEL and GOLDSTEIN [20] survey target zone proposals. Miller and Williamson also consider a floating rate regime and the MCKINNON [36] proposals to use monetary policy to target the aggregate money supply — or in a later version, the aggregate price level — among the G3 countries. MCKIBBON and SACHS [35] also compare these regimes. I am not aware of empirical work evaluation the likely outcome if countries cooperatively set nominal GNP targets and use monetary policy to attain them.

base be expanded an additional 0.25% over the next quarter. He also suggests setting a trend growth rate in the target of 3% per year and subtracting from this the average growth rate of the base velocity over the preceding four years. An alternative possibility is to replace the 3% target with «a number to be negotiated for each member of the G7 each year, with a planned long-run tendency of 3%».

The central bank would be better able to hit its annual nominal demand target if it was allowed to respond to information in addition to the most recent monthly figure for nominal demand itself. Ben Friedman ([22], pp. 183-4), for example, shows that indicators such as the money supply and the stock of credit can be used to increase the accuracy of predictions of deviations from a nominal income target. One could add many other leading indicators including a number of the those from the G7 list. The conclusion seems to be that it would be best to leave the means of attaining the nominal demand target up to the national authorities, rather than requiring that they follow a particular rule such as McCallum's.

On the other hand, it would be desirable to go beyond the proofs in the appendix, which demonstrate the superiority of targeting nominal GNP only when one knows the policy multipliers and takes as given the ability of the authorities to hit their targets. The evident next step is to try out the INT proposal, using simulations of one or more econometric models of the world macroeconomy, to see how it fares relative to other proposals.

**A Comparative Analysis of NIT Targeting  
and Other Policy Coordination Regimes**

This appendix compares four possible policy regimes: 1) floating exchange rates, with full discretion by national policymakers (the current regime); 2) a rigid money supply rule; 3) a rigid nominal GNP rule, and 4) a rigid exchange rate (or price of gold) rule (37). The approach, which incorporates advantages to both rules and discretion, follows Rogoff [43] and Fischer [12], who, in turn, followed Kydland and Prescott [31] and Barro and Gordon [2].

Throughout, we assume an aggregate supply relationship:

$$(A1) \quad y = y^* + b(p - p^e) + u$$

where  $y$  represents output,  $y^*$  potential output,  $p$  the price level,  $p^e$  the expected price level, and  $u$  a supply disturbance, with all variables expressed as logs. Notice that, alternatively,  $p$  and  $p^e$  could be the actual and expected inflation rates respectively.

**1. - Output and the Price Level in the Objective Function**

We begin without the exchange rate. The loss function is simply:

$$(A2) \quad L = ap^2 + (y - ky^*)^2$$

where:  $a$  is the weight assigned to the inflation objective. We assume that the lagged or expected price level relative to which  $p$  is measured

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(37) The proponents of each of these nominal anchors of ten have in mind a target zone system, not a rigid rule. The assumption of rigid rules is used here only to make the analysis simpler.

can be normalized to zero. We impose  $k > 1$ , which builds in an expansionary bias to discretionary policymaking.

$$(A3) \quad L = ap^2 + [y^*(1 - k) + b(p - p^e) + u]^2$$

### 1.1 Discretionary Policy (Case 1)

Under a regime of full discretion, the policymaker chooses in each period aggregate demand so as to minimize that period's  $L$ , with  $p^e$  given.

$$(A4) \quad (1/2) dL/dp = ap + [y^*(1 - k) + b(p - p^e) + u]b = 0.$$

$$(A5) \quad p = [-y^*(1 - k)b + b^2p^e - bu] / [a + b^2]$$

Under the assumption of rational expectations:

$$(A6) \quad p^e = Ep = -y^*(1 - k)b/a$$

So we can solve equation (A5) for the price level:

$$(A7) \quad p = -y^*(1 - k)[b/a] - ub/[a + b^2]$$

From equation (A2), we then work out the expected loss function to:

$$(A8) \quad EL = (1 + b^2/a)[y^*(1 - k)]^2 + [a/(a + b^2)] \text{ var}(u).$$

The first term represents the inflationary bias in the system, and the second represents the effect of the supply disturbance after the authorities have chosen the optimal split between inflation and output.

### 1.2 Money Rule (Case 2)

In considering alternative regimes, we must be explicit about the money market equilibrium condition. (It was implicit in *Case 1* that

the money supply,  $m$ , was the variable that the authorities were using to control demand.)

$$(A9) \quad m = p + y - v$$

where  $v$  represents velocity shocks. (We assume that  $v$  is not correlated with  $u$ .) If the authorities precommit themselves to a fixed money growth rule, in order to reduce expected inflation in long-run equilibrium, then they must give up on affecting  $y$ . The optimal money growth rate is the one that sets  $E_p$  at the target value for  $p$ , which is zero. Thus, they will set the money supply,  $m$ , at  $E_y$ , which in this case is  $y^*$ . The aggregate demand equation thus becomes:

$$(A10) \quad p + y = y^* + v.$$

Combining this equivalence with the aggregate supply relationship, equation (A1), the equilibrium is given by:

$$(A11) \quad y = y^* + (u + bv) / (1 + b), \quad p = (v - u) / (1 + b)$$

Substituting into equation (A2), we find that the expected loss function is:

$$(A12) \quad EL = (1 - k)^2 y^{*2} + [(1 + a) \text{var}(u) + (a + b^2) \text{var}(v)] / (1 + b)^2$$

The first term is smaller than the corresponding term in the discretion case because the precommitment reduces expected inflation. But the second term is probably larger because the authorities have given up the ability to respond to money demand shocks. Which regime is better depends on how big the shocks are and on the size of the weight,  $a$ , placed on inflation-fighting.

### 1.3 Nominal GNP Rule (Case 3)

In the case of a nominal GNP rule, the authorities vary the money supply in such a way as to accommodate velocity shocks. In other

words, equation (A10) is replaced by the condition that  $p + y$  is constant. The solution is the same as in Case 2, but the  $v$  disturbance is dropped. Thus, the expected loss collapses from equation (A12) to:

$$(A13) \quad EL = (1 - k)^2 y^{*2} + [(1 + a) / (1 + b)^2] \text{var}(u)$$

This, outcome unambiguously dominates the result of the money rule case. Without knowing  $\text{var}(u)$  or  $(a)$ , however, it is still not possible to say that this rule dominates the outcome of the discretion case. It is quite likely, especially if the variance of  $u$  is large, that an absolute commitment to a rule would be unwisely constraining. Hence, the argument for a target zone rather than a single number, and for subjecting the chair person of the central bank to a mere loss of reputation, rather than a firing squad, if he or she misses the target. Yet it seems clear that, to whatever extent the country chooses to commit itself to a nominal anchor, nominal GNP dominates the money supply as the candidate for the anchor.

## 2. - Adding the Exchange Rate (or the Price of Gold) to the Objective Function

We reconsider here a likely objection to choosing nominal GNP or nominal demand as the focus of international coordination: that doing so neglects the exchange rate. The alternative of setting monetary policy so as to stabilize the exchange rate will not look attractive unless the exchange rate enters the objective function, perhaps indirectly via the consumer price index or the trade balance. Here we confront the argument head on and include the exchange rate directly in the loss function, along with output and the price level. Thus, we replace equation (A2) with

$$(A14) \quad L = ap^2 + (y - ky^*)^2 + cs^2,$$

where  $s$  is the spot exchange rate measured relative to some equilibrium or target value and  $c$  is the weight placed on exchange rate stability *per se*.

There is no point in specifying an elaborate model of the exchange rate. All the empirical results say that most of the variation in the exchange rate cannot be explained (even *ex post*) by measurable macroeconomic variables and thus can only be attributed to an error term that we here call  $e$ . But we must include the money supply in the equation; otherwise, we do not allow the authorities the possibility of affecting the exchange rate. Thus, the equation is simply:

$$(A15) \quad s = m - y + e$$

where  $e$  is assumed to be uncorrelated with the other disturbances. (Though our primary interpretation of  $s$  is as the spot price of foreign currency, a second possible interpretation of this variable in what follows is as the spot price of gold. It is hard to see why that price should enter directly into the objective function, even more so than the exchange rate, but this simply biases our results in favour of the position of the gold bugs.)

From equation (A9), we can achieve by situation:

$$(A16) \quad s = p - v + e$$

We assume that equation (A1), the aggregate supply relationship, holds as before. So we can write the loss function equation (A14), as

$$(A17) \quad L = ap^2 + [(1 - k)y^* + b(p - p^e) + u]^2 + c(p - v + e)^2$$

Now we proceed as before to consider possible regimes.

### 2.1 Discretionary Policy (Case 1)

We add the exchange rate to equation (A4).

$$(1/2) dL/dp = ap + [y^*(1 - k) + b(p - p^e) + u]b + c(p - v + e) = 0$$

Then:

$$(A18) \quad p = [-y^*(1-k)b + b^2p^e - bu + c(v-e)] / [a + b^2 + c].$$

The rationally expected  $p$  is given by  $p^e = Ep$ :

$$(A19) \quad p^e = -(1-k)by^* / (a + c)$$

Substituting into equation (A19) yields:

$$(A20) \quad p = -(1-k)y^*[b/(a+c)] + [c(v-e) - bu] / [a + b^2 + c]$$

The loss function is:

$$(A21) \quad EL = [(1-k)y^*]^2[(a + b^2 + c)/(a + c)] + \{ (a + c) \text{var}(u) + c(a + b^2)[\text{var}(v) + \text{var}(e)] \} / (a + b^2 + c)$$

## 2.2 Money Rule (Case 2)

As when we considered a money rule before, the authorities set  $m$  at  $y^*$ , so that expected inflation is zero and equation (A10) applies. Thus, the same solution — equation (A11) for  $y$  and  $p$  — also applies. The exchange rate is given by substituting the solution for  $p$  from equation (A11) into equation (A16):

$$(A22) \quad s = e - [(u + bv) / (1 + b)]$$

The additional  $s$  term is the only difference from equation (A12) in the expected loss function:

$$(A23) \quad EL = [y^*(1-k)]^2 + [(1 + a + c) / (1 + b^2)] \text{var}(u) + [(a + b^2 + cb^2) / (1 + b^2)] \text{var}(v) + (c) \text{var}(e)$$

Again the comparison of this outcome with that of a policy of discretion depends on the various magnitudes.

### 2.3 Nominal GNP Rule (Case 3)

When the monetary authorities are able to vary  $m$  so as to keep  $p + y$  constant, the velocity shocks,  $v$ , drop out. The expected loss function becomes:

$$(A24) \quad EL = [y^*(1 - k)]^2 + [(1 + a + c) / (1 + b^2)] \text{var}(u) + c \text{var}(e)$$

As before, the nominal GNP rule unambiguously dominates the money rule.

In practice, the  $e$  shocks in the exchange rate equation are very large. They certainly dwarf the  $u$  shocks in the aggregate supply equation. (The exchange rate often moves 10% in a year without corresponding movements in the money supply or other observable macroeconomic variables; try to imagine similar movements of real output.) If the weight  $c$  on the  $s$  target is substantial, then the last term in the expected loss equation may be important.

### 2.4 Exchange Rate or Price of Gold Rule (Case 4)

If the authorities fix the exchange rate, they again cannot affect  $y$  in long-run equilibrium. But now it is the exchange rate that they peg in such a way that  $Ep = 0$ , which from equation (A16) means  $s = 0$ . The ex post price level is then given by:

$$(A25) \quad p = v - e.$$

From equation (A1):

$$(A26) \quad y = y^* + b(v - e) + u$$

From equation (A14):

$$(A27) \quad EL = (a + b^2) \text{var}(\nu - e) + [y^*(1 - k)]^2 + \text{var}(u).$$

The coefficient on  $\text{var}(e)$  is  $(a + b^2)$ , compared with the coefficient  $c$  in the expected loss, equation (A24), under the nominal GNP rule. The point was made above that in practice  $e$  shocks dwarf  $u$  shocks. Continuing this reasoning, even if  $\nu$  shocks are also small and  $a = c$  (the objective function puts no greater weight on a 10% fluctuation of the price level than on a 10% fluctuation of the exchange rate — which is an extremely conservative assumption — the expected loss from fixing  $s$  will be greater than the expected loss from fixing nominal GNP. The reason is that under an exchange rate rule,  $e$  shocks are allowed to affect the money supply and therefore the overall price level. Once one allows for  $\nu$  shocks (which are probably between  $u$  and  $e$  shocks in magnitude), the case for nominal GNP targeting is even stronger. One would have to put extraordinarily high weight on the exchange rate objective to prefer an exchange rate rule.

Under the secondary interpretation of  $s$  as the price of gold, rather than the price of foreign exchange, the  $e$  shocks are likely to be at least as large, and the argument for its receiving heavy weight directly in the objective function, is even more difficult to make. In short, the nominal GNP rule seems to dominate all the other candidates for nominal target: the money supply, the exchange rate, and the price of gold.

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