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Note: the results are in the Appendix.

INTERNATIONAL NOMINAL TARGETING (INT):
A PROPOSAL FOR OVERCOMING OBSTACLES TO POLICY COORDINATION

by

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Abstract

The paper reviews the obstacles to successful international macroeconomic policy coordination, and then offers a proposal for coordination that is designed to have the best chance of overcoming these obstacles: an international version of nominal GNP targeting. There are three sorts of obstacles to coordination: uncertainty, enforcement, and inflation-fighting credibility. Enforcement is always a problem for coordination, but the problem is particularly great in the presence of uncertainty. This is partly because it is difficult to verify compliance if the "performance criteria" by which compliance is monitored are not directly enough under the control of the authorities, and partly because a country may end up regretting ex post the criterion that it agreed to ex ante if the criterion is not directly enough related to the target variables about which it ultimately cares. For example, a country that commits to a narrow range for the money supply may regret the commitment if a shift in velocity occurs.

The "dynamic-inconsistency" of inflation-fighting has been offered as a third reason why policy-makers would be better off renouncing period-by-period coordination of discretionary policy-making. But the way to establish inflation-fighting credibility is to precommit to some nominal anchor. The paper argues that International Nominal Targeting (INT) is the best choice for nominal anchor, as well as the best choice for the performance criterion by which compliance with international agreements can be monitored. Nominal GNP (or, better yet, nominal demand) is superior to other candidates such as M1 as a candidate for the nominal variable on which policy-makers should focus, because it is far more robust to velocity shifts and other uncertainties. (An Appendix demonstrates the theoretical results.)

I. Introduction: The Gains from Policy Coordination

International macroeconomic policy coordination has been a popular topic of research in the academic community at least since the early 1980s. The central theorem regarding the economic gains from policy coordination has very strong implications for the design of the international monetary system. It says that countries will in general be better able to attain their economic objectives if they set their policies jointly than if they set them independently. (The alternative noncooperative equilibrium, in which each country independently sets its own policies, taking the policies of the others as given, is termed the Nash equilibrium.) The theorem would appear to be a strong argument why policy-makers should go ahead and set up the machinery for regular meetings and cooperative setting of macroeconomic policies.

Beginning in September 1985, with the Plaza Agreement among the G5 Finance Ministers, international coordination became popular in the policy-making community as well. Although that Agreement concerned only the exchange value of the dollar, the process of cooperation was formalized and broadened to include the rest of macroeconomic policy management as well, at the Tokyo Summit meeting of G7 leaders in May 1986.

Just at the time that international coordination has

caught on among policy-makers, however, academic economists have turned skeptical.¹ They have come up with a variety of obstacles to coordination, a variety of points that invalidate the universality of the theorem that coordination must always leave countries better off. These obstacles fall into three categories: enforcement of compliance with any given agreement, inflation-fighting credibility of monetary policy, and uncertainty.

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 an international version of targeting nominal GNP (or aggregate demand), called INT, for International Nominal Targeting.² It is designed to have a better chance of overcoming the three kinds of obstacles to coordination than the current system founded by the G-7 at Tokyo. A key element of the proposal is that it could begin with only a very small sacrifice of national macroeconomic sovereignty -- with very wide bands around the target -- could build up trust and confidence in the institution slowly, and thus progress to higher degrees of

¹ Beginning, at the public level, with Feldstein (1983, 1988)

² The INT proposal appears in brief form in Frankel (1988b). Frankel (1989a) offers a longer version of the proposal.

coordination if desired.

The essence of the argument for the need for coordination is that in general there are international externalities or spillover effects. If these externalities did not exist, i.e., if each country was unaffected by changes in other countries, then the decentralized noncooperative solution would be optimal; 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].³

One cannot know whether or what kind of coordination is desirable without first knowing the nature of the externalities. Is the Nash noncooperative equilibrium too contractionary, because of a proclivity toward "beggar-thy-neighbor" policies? Then joint expansion is called for. This

³ If floating exchange rates insulated each country from the other's disturbances, then there would be no spillover and thus no need for coordination. But they do not. In addition to the spillover point, the standard formulation also contains a second technical qualification to the theorem that countries can better attain their economic objectives if they coordinate policies. 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; issues of conflict and cooperation among countries do not arise. In practice, countries seldom feel that they have enough degrees of freedom to be able to attain their optima.

was the logic of the "locomotive theory" that gave rise to the 1978 Bonn Summit.⁴ Or, on the other hand, is the existing equilibrium overly inflationary? In that case joint discipline would be called for. This is the apparent motivation underlying the European Monetary System.

Other kinds of externalities are possible. Perhaps the problem is that 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. This problem was thought by some to characterize major industrialized countries in the 1980s. Or perhaps the problem, rather than "competitive appreciation," is "competitive depreciation," as was feared at Bretton Woods in 1944 on the basis of the experience of the 1930s. Such externalities, if important, would point to a need for coordination schemes that gave more emphasis to exchange rate stability than does the proposal developed in this paper, schemes like those of McKinnon (1984, 1988), Williamson (1983), and Williamson and Miller (1987, 1988). If, on the other hand, the problem is thought to be overly contractionary or overly expansionary monetary policy, then a switch toward a regime of greater exchange rate

⁴ The history of the Bonn Summit and the rest of the annual meetings of the leaders of the G-7 countries is given in Putnam and Bayne (1987).

stability may exacerbate the problem, by increasing the degree of international transmission of disturbances.

One premise of the INT proposal is that the relevant externalities concern the overall degree of expansion of macroeconomic policies, i.e., whether monetary and fiscal policies are too tight or too loose. Questions regarding the proper mix of monetary and fiscal policy, and the resulting real interest rate, are not addressed by the plan.⁵

It could be objected 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 U.S. budget and trade deficits. But I agree with Feldstein (1983) that this disequilibrium was not a "coordination failure," that the U.S. Administration did not to any extent pursue the policies it did as a result of insufficient expansion by trading partners. Indeed the Administration did not even want Europe and Japan to expand, until after 1985. No international bargain would have brought about a U.S. fiscal correction. Only a recognition by the Administration and Congress of the link between their fiscal policies and the trade deficit (together with the political will necessary to

⁵ Such questions are equally well described by Section II of the paper, the review of the obstacles to coordination (except for the obstacle of inflation-fighting credibility, which applies only to questions of overall economic expansion).

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.⁶

⁶ Such thoughts are supported by the findings in Frankel and Rockett (1988) and Frankel (1988) that the gains from coordination are usually smaller than the gains from the United States discovering the true model and unilaterally adjusting its policies accordingly.

II Obstacles to International Policy Coordination

II.1 Problems of enforcement and the G-7 indicators

As already mentioned, the obstacles to implementing a successful regime of macroeconomic policy coordination are of three sorts: enforcement, time-consistent inflation-fighting credibility, and uncertainty. Difficulties of enforcement and credibility have received the most attention from economists.

Even when a coordination package guarantees that each country will be better off than it would be in the non-cooperative equilibrium, the country will be able to do better still if it unilaterally deviates from the agreement. If the agreement consists of 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).

When we say that the country will be able to do better by deviating from the agreement, this refers to the short-run and holds under the assumption that the other countries keep their policies as agreed. In future periods, the other countries will presumably retaliate by also abandoning the agreement.

Economists have probably over-emphasized the difficulties

of enforcement.⁷ Norms for behavior ("peer pressure" in the language of Treasury official David Mulford after the Tokyo Summit,⁸ or the formation of "reputations" in the language of economic theory) may be sufficient to enforce compliance, provided two conditions are met. (1) The agreement must specify explicitly what is required of each party, in terms of observable economic variables. It is hard enough to enforce a clear-cut agreement, because each party has an incentive to cheat; 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 on an agreement in any given period would give a country only small short-term gains over the cooperative equilibrium, relative to a larger potential future loss (when the cooperative agreement breaks down) of the gains over the Nash noncooperative 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.

At the Tokyo Summit of May 1986, it was decided that the

⁷ Kenen (1987, 31-36) thinks so. Holtham and Hughes Hallett (1987, 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."

⁸ Quoted in Funabashi (1988, 131).

Finance Ministers of the G-5 countries, or thenceforth the G-7, would focus in their meetings on a set of 10 "objective indicators": the growth rate of GNP, interest rate, inflation rate, unemployment, ratio of the fiscal deficit to GNP, current account and trade balances, money growth rate, international reserve holdings, and exchange rate. No pretense was made that the members would rigidly commit to specific numbers for these indicators, in the sense that sanctions would be imposed on a country if it deviated far from the values agreed upon. But the plan did include the understanding that "appropriate remedial measures" would be taken whenever there developed significant deviations from the "intended course." This language would seem to suggest that the indicators are not intended to be merely national forecasts, that the system is intended to include some substantive bargaining over policies, rather than only the exchange of information. The current G-7 system could be viewed as an attempted case of the small-scale coordination where just a little national macroeconomic sovereignty is sacrificed, a necessary stage for building confidence before moving on to more binding forms of coordination.

The G-7 list of indicators is not especially well-suited to the desirable conditions for workable coordination stated above. It is difficult to imagine a G-7 meeting, for example,

applying moral censure to one of its members for having experienced a higher rate of real growth during the year than had been agreed upon in the preceding meeting, or a lower rate of inflation.

The main problem with the list is that it is too long to be practical. When each country has 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 (1988, 22) note that one possible argument in favor of choosing a single indicator is the point 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 then only progress to commitments to multiple variables when and if sufficient political consensus and confidence has developed to justify that degree of sacrifice of sovereignty.

The list of indicators has been further discussed, and trimmed down, at subsequent G-7 meetings. By the time of the

Venice Summit in June 1987, the list had apparently been reduced to six indicators: growth, inflation, trade balances, government budgets, monetary conditions, and exchange rates.⁹

Treasury Secretary James Baker, however, in October 1987 told the IMF Annual Meeting 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...." At the Toronto Summit of June 1988, "the G-7 countries welcomed the addition of a commodity price indicator and the progress made toward refining the analytical use of indicators."¹⁰

The second problem with the G-7 indicators is that they are kept secret. It is somewhat difficult to reconcile optimistic statements that some amount of substantive coordination is already taking place with the fact that G-7 meetings do not publicly announce the targets agreed to for the indicators. How can any pressure be brought to bear on countries that stray from the agreed-upon targets (whether it is moral suasion, embarrassment, the effect on long-term reputations, or outright sanctions) if the targets themselves are not made public?

To take a recent example, in the Baker-Miyazawa Agreement

⁹ This list appeared in comments to the press by the U.S. Treasury's Assistant Secretary David Mulford. Funabashi (1988).

¹⁰ IMF Survey, September 26, 1988, p.292.

reached in San Francisco in September 1986 [subsequently broadened to include Germany and the others at the Louvre in February 1987], the Japanese apparently agreed to a fiscal expansion in exchange for a promise from the U.S. Treasury Secretary that he would stop "talking down" the dollar (plus the usual U.S. 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, 1988). 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 G-7 guards with tremendous secrecy the values of the indicators, even more so than the central banks guard the secrecy of their foreign exchange market interventions. Theory says that the success of a target zone, for exchange rates for example, is enhanced when speculators are made aware of the boundaries.¹¹ Why does the G-7 keep the targets secret?

One possible answer is that the members do not want to lose face when the economic variables subsequently break outside the target band. This answer fits in well with one's suspicion that the G-7 meetings may in fact reach no substantive agreements, but find it politically useful to issue communiqués nevertheless; the communiqués are

¹¹ See Krugman (1988) for the application of the latest "smooth pasting" technology to this problem.

sufficiently vague that each member can interpret them to his own advantage.¹²

Thus two conclusions have emerged from the need to monitor performance criteria in order to enforce compliance with any agreement. (1) It would be better for the agreement to focus on one variable than 10 or 11. (2) The targets for the variable should be made public. We will develop below further desirable characteristics for the variable to be chosen as performance criterion.

¹² It is clear from Funabashi (1988) 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-upon 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 his own views.

II.2 Problems of inflation-fighting credibility

A number of the problems that arise in international policy-making occur in the context of domestic policy-making as well. One of those is the need to set monetary policy in such a way as to keep the public's expectations of inflation low. One way that monetary policy-makers can do this is to pre-commit to a rule, though the commitment must be credible or, in modern theoretical parlance, "dynamically-consistent."¹³

Macroeconomic policy-making is always a tradeoff between the advantages of rules on the one hand, and discretion on the other. In the past, writers concerned with either one of the two problems often simplistically assumed away the other. If the aim is to maximize economic welfare (a function of output and inflation) only for a given period, 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 one's abilities beforehand to respond to developments in the economy? If one ignores the possibility of short-run disturbances, on the other hand,

¹³ A time-consistent or dynamically-consistent regime is one that manages to prevent the monetary authorities from breaking whatever commitment to monetary discipline they have proclaimed, where they otherwise might have an incentive to do so, in the future. For recent surveys of the rules vs. discretion debate and the implications of the time-consistency literature, see Barro (1986), Fischer (1988a), and Rogoff (1987).

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 precommitting 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. On the one hand, if the political system's policy-making process is allowed to optimize on a purely short-run basis, the outcome will be over-expansion. Thus some degree of longer-term commitment to resist inflationary temptations is indicated, even if it is a decision to insulate the Central Bank from the political process rather than formal commitment to a nominal anchor or rule.¹⁴ On the other hand, in a world where new

¹⁴ While Milton Friedman has justifiably had more influence on this issue than one human being is usually able to have, there have long been two aspects of his campaign against the Federal Reserve Board that are 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 Fed to do precisely what he accuses them 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 U.S. 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 the U.S. Congress, than under the control of elitist central bankers like Paul Volcker. It is particularly ironic that, when a member of the monetarist Shadow Open Market Committee finally became Treasury Under-Secretary for Monetary Affairs in the early 1980s, his view

disturbances come along, it is important that the government retain at least some ability to respond to stabilize the economy. The solution is some degree of commitment, but less than 100 per cent, to some nominal anchor.¹⁵

The second of the existing critiques of international coordination, after the problem of enforcement, is the point made by Ken Rogoff (1985a). If governments set up the machinery for joint welfare maximization period-by-period, the cooperative equilibrium in each period is likely to entail a greater degree of expansion, as at the Bonn Summit of 1978. Countries may find this joint expansion advantageous within any given period, but in the long run it will undermine the 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 pre-commit to less inflationary paths.

It is important to realize that the introduction of longer-term issues of credibility, time-inconsistency and pre-commitment, can just as easily run in favor of coordination as

that the money growth rate was dangerously high was overruled by a Treasury Secretary and White House who sought to pressure the Fed for faster money growth leading up to the 1984 election.

¹⁵ Rogoff (1985b) shows that some intermediate degree of commitment to a target is optimal for monetary policy.

against it. If the perceived externality or shortcoming of the Nash noncooperative equilibrium is that it is overly expansionary, then the coordination equilibrium, even when arrived at on a period-by-period basis, will entail less expansion, not more. This is sometimes argued to be the basis underlying the European Monetary System. The rhetoric that Schmidt and Giscard originally used in proposing the EMS in the late 1970s suggested that they were doing so because the United States was neglecting its duty to supply to the world the public good of a stable, non-inflating, currency. Ten years later, many observers of the EMS have decided that its success lies precisely in giving inflation-prone countries like Italy and France a credible nominal anchor for their monetary policies.¹⁶ Committing to an exchange rate parity or band vis-a-vis a hard-currency country like 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.

In the case of the EMS, there is an asymmetry. It is accepted that Germany is simply known to place very large weight on price stability, due to its history or for whatever other reasons. The weaker-currency countries can then peg to

¹⁶ For example, Giavazzi and Pagano (1988).

the "greater mark area", if they wish to import inflation-fighting credibility.¹⁷ In the case of proposals for worldwide coordination, there is no presumption that the United States (the natural "Stackleberg" leader) in fact has as much inflation-fighting credibility as Germany and Japan. Thus there is no automatic presumption that year-by-year coordination would lower the average world inflation rate rather than raise it.

The implication of the credibility issue is that a scheme for coordination is more likely in the long-run to produce gains if the plan has the national governments making, not just commitments to each other on a period-by-period basis, but also some degree of commitment to a nominal anchor on a longer term basis. There are four nominal variables on the G-7 list of indicators: money, the price level, the price of gold, and the exchange rate. We will develop grounds for choosing among candidates for the nominal variable around which coordination should focus. We will argue that the optimal variable is one that does not even appear on the G7

¹⁷ There is a close analogy with the idea in Rogoff (1985b) 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 given level of output.

list at all, nominal GNP.

An 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 policy-making, so long as it is greater than zero and less than infinity.¹⁸ But whatever the degree of precommitment to a nominal target, nominal GNP (or nominal demand) makes a more suitable target than the four other nominal variables that have been proposed: the money supply, the price level, the price of gold, or the exchange rate.

The general argument has been made well by others.¹⁹ In the event of disturbances in the banking system, disturbances in the public's demand for money, or other disturbances affecting 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 is divided equi-proportionately between an increase in

¹⁸ Analogously, in the context of international coordination, we take as given by the political process the degree of commitment to coordination.

¹⁹ Tobin (1980), Gordon (1985), Hall (1985), Taylor (1985) and McCallum (1987, 1988ab), for example, argue in favor of targeting nominal GNP in the closed-economy context. The idea also has proponents in the United Kingdom: Bean (1983), Meade (1984) and Brittan (1987). Miller and Williamson (1987, 7-10) propose targeting nominal demand as part of their "blueprint" for exchange rate target zones.

the price level and a fall in output. For some countries, this is roughly the split that a discretionary policy would choose anyway.²⁰ In general, fixing nominal GNP will not give precisely the right answer, depending on the weights on inflation and real growth in the objective function. But if the choice is among the available nominal anchors, nominal GNP gives an outcome characterized by greater stability of output and the price level. The Appendix begins by showing that a nominal GNP target strictly dominates a money supply target, in the sense of minimizing a quadratic loss function, regardless how important inflation-fighting credibility is. [The second half of the Appendix shows 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, the Federal Reserve, citing large velocity shifts, decided beginning in late 1982 to allow M1 to break firmly outside their pre-announced target zone. M1 grew 10.3 per cent per year from 1982:II to 1986:II. Some observers have suggested that the

²⁰ In 1974, Switzerland can be given as an example of a country that chose to take the adverse supply shock almost entirely in the form of lost income and employment, in order to restore price stability, Sweden as an example of a country that chose to take it almost entirely in the form of inflation, in order to preserve output and employment, and the United States as an example in between.

Fed was following a general policy of targeting nominal GNP.

For four years the monetarists decried the betrayal of the money growth rule, and warned that a major return of inflation was imminent. Nobody can doubt, in retrospect that the Fed chose the right course. Even with the recovery that began in 1983 and continued through the four years and beyond, nominal GNP grew more slowly than the money supply: 8.0 per cent per year. Thus velocity declined at 2.3 per cent per year, in contrast to its past historical pattern of increasing at roughly 3 per cent a year. If the Fed had followed the explicit monetarist prescription of rigidly pre-committing to a money growth rate lower than that of the preceding period, such as 3 per cent, and velocity had followed the same path, then nominal GNP would have grown at only 0.7 per cent a year. This number is an upper bound, because with even lower inflation than occurred, velocity would almost certainly have fallen even more than it did. The implication seems clear that the 1981-82 recession would have lasted another five years!

The arguments as to why nominal GNP dominates such variables as the money supply, as a candidate for nominal anchor to domestic economic policy, apply even more strongly to international economic policy. The reason is that uncertainty, though it is a problem for policy-makers in the

closed-economy context, is a greater problem in the open-economy context, as we shall now see.

II.3 Problems of uncertainty

The third of the existing critiques of international coordination, after the problem of enforcement and the problem of inflation-fighting credibility, is the problem of uncertainty.

There are three things that a country ideally needs to know before it even can enter negotiations with other countries on coordinated policy changes. (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 does each unit change in the domestic macroeconomic policy variables (and the foreign) 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. We specify here a function of three target variables, although we could as easily have more or fewer.

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

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

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. We will refer to two policy instruments: the money supply, m (in log form), and government expenditure g (as a percentage of GNP).

The marginal welfare effects of changes in these policy variables are then given by:

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

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

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

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

$$(2^*) \quad dW^*/dm = (y^*)y_{m^*}^* + w_{x^*}^*(x^*)x_{m^*}^* + w_{p^*}^*(p^*)p_{m^*}^*$$

$$(3^*) \quad dW^*/dg = (y^*)y_{g^*}^* + w_{x^*}^*(x^*)x_{g^*}^* + w_{p^*}^*(p^*)p_{g^*}^*$$

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

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

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 , etc. If we wished to solve for the optimum, we would set these derivatives equal to zero (with the target variables (y), (x), etc., first expressed as linear functions of the policy variables m , g , etc.). In the Nash noncooperative equilibrium [in which each country takes the other's policies as given], we would need only equations (2), (3), (4*) and (5*) for the solution. Each country ignores the effect that its policies have on the other country, so equations (4), (5), (2*) and (3*) do not enter. Indeed this is precisely the standard reason why the noncooperative equilibrium is sub-optimal. These cross-country effects enter only in the determination of the cooperative solution.

Before they decide on a policy change, policy-makers must at least know the sign of the corresponding derivative. Equation (2), or any other of the eight derivatives above, neatly illustrates the three kinds of uncertainty. First is uncertainty about the initial position, the variables, y , x and p .²¹ Position uncertainty in turn breaks down into three

²¹ Uncertainty about the position where the economy would be in the absence of policy changes is the same thing as uncertainty regarding the disturbance terms in the model of the economy, such as the disturbances in the Appendix to this paper. The Appendix, though it considers uncertainty in an open economy, deals only with a country's unilateral policy-

parts: (a) uncertainty about the current value of the target variable in question²²; (b) uncertainty over how the target variables are likely to move during the forthcoming year or more in the absence of policy changes, the "baseline forecast";²³ and (c) uncertainty as to the location of the optimum value of the target variable.²⁴

The point is clear. The policy-maker's estimates of the current values of y , x or p in his country could easily be off by several percentage points in either direction, which could 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)-(5). Thus it is entirely

making problem. In this section we are considering the problems that uncertainty creates for coordination per se.

²² For example, Mankiw and Shapiro (1986) find that the standard deviation of the revision from the preliminary estimate of the real growth rate to the final number is 2.2 percentage points.

²³ Kenen and Schwartz (1986) have studied the accuracy of current-year forecasts by the IMF World Economic Outlook for the last fifteen years. They find that the root mean squared error among the Summit Seven countries is 0.773 percentage points for real growth and 0.743 percentage points for inflation. These prediction errors, relatively small, are in themselves large enough to reverse the signs of the derivatives of the welfare function equations (2)-(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 the effects of monetary and fiscal policy peaking in the second year in the case of output, and not reaching a peak within six years in the case of the price level or current account. See Bryant et al (1988).

²⁴ Economists disagree as to the correct estimate of the natural rate of unemployment or the level of potential output, for example.

possible that the country could ask its partners in negotiations to expand, or that it could 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 the U.S. policy-makers, looking at the available economic data, concluded that insufficient growth in the world economy was the problem of the time. 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 fighting inflation was the top priority, not promoting real growth. A natural way of interpreting the view -- widely held in Germany at least -- that the results of the Bonn-coordinated expansion turned out in retrospect to have been detrimental, is 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.²⁵

The second sort of uncertainty present in the equations is uncertainty regarding the proper weights w_x and w_p to put on

²⁵ 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 ex post to be more inflationary than expected.

the target variables in the objective function.²⁶ This issue is even more subjective than the issue of the optimal values of the target variables. In a society where the weights that individual actors place on inflation (or the current account) vary from zero to infinity, the likelihood must be judged 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 putting insufficient weight on fighting inflation, for example, can have the same effect as underestimating the baseline inflation rate: the policy-maker in coordination exercises 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 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 policy-makers who had agreed to coordinated reflation at the Bonn Summit of 1978 had put insufficient weight on the objective of price stability.

²⁶ One way to obtain estimates for the weights is to follow Oudiz and Sachs (1986), who assume that as of 1984 policy-makers were optimizing their objective functions in a Nash equilibrium, and infer the welfare weights that 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 policy-makers are assumed to have.

The third sort of uncertainty pertains to the policy multipliers, the derivatives y_m , y_g , etc., in equations (2)-(5*), telling the effect of changes in the money supply and government expenditure on the target variables. 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. One way of seeing this is to note the tremendous variation in multipliers according to different schools of thought, or even according to different estimates in models of "mainstream" macroeconomists. They cannot all be correct, and it seems highly probable that no single model is in fact exactly right.²⁷

It is possible to illustrate the potential range of multiplier estimates in some detail. In a recent exercise conducted at the Brookings Institution, 12 leading econometric models of the international macroeconomy simulated the effects of specific policy changes in the United States and in the

²⁷ The German view that the 1978 Bonn Summit entailed joint reflation which, in retrospect, was inappropriate has been used above to illustrate two possible kinds of uncertainty: uncertainty about the baseline forecast (the unanticipated oil shock of 1979) or 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 (1980).

rest of the OECD.²⁸ The models participating were the Federal Reserve Board's Multi-Country Model, the European Economic Community's Compact model, the Japanese Economic Planning Agency model, Project Link, 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. The variation in the estimates is large, not just in magnitude but also in sign. The effect of fiscal or monetary expansion on domestic output and inflation is usually at least of the positive sign that one would expect. [Even here there are exceptions as regards inflation: the VAR, Wharton and Link models sometimes show expansion causing a reduction in the CPI, probably due to effects via markup pricing.] But disagreement among the models becomes much more common when we turn to the international effects.

The areas of greatest disagreement among the econometric models regarding international transmission are not the same as one might expect from the theoretical literature. A U.S. fiscal expansion is transmitted positively to the rest of the OECD in 10 out of 11 models, and an expansion in the other countries is transmitted positively to the United States in 9 out of 10 models, whereas in theory fiscal transmission can

²⁸ See the volume edited by Bryant et al (1988).

easily be negative.²⁹ The greatest amount of disagreement occurs, rather, 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.

On the one hand, the monetary expansion raises income and therefore imports. On the other hand, it depreciates the currency, which tends to improve the trade balance. [In the Mundell-Fleming model the net effect on the current account must be positive.³⁰] It turns out that a U.S. monetary expansion worsens the current account in 8 out of 11 models, and a monetary expansion in the other OECD countries worsens their current accounts in 5 out of 10 models. [In most models the rest of the Mundell-Fleming transmission mechanism is reversed as well: the foreign current account and foreign income rise rather than fall.]

What happens if U.S., European and Japanese policy-makers proceed with coordination efforts despite disagreements such as these? In Frankel and Rockett (1986, 1988) and Frankel (1988), we use the Brookings simulations [and the welfare weights from Oudiz and Sachs] to consider the possibilities when governments coordinate using conflicting models.

²⁹ For example, if capital mobility is sufficiently low and a depreciation of the domestic currency is contractionary for the foreign country.

³⁰ A reduction in interest rates causes a net capital outflow which, under a floating exchange rate, implies an increase in the current account balance.

Countries will in general 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 other is willing to go along with the package. The actual effects depend on what the true model is. If we consider ten possible models, there are 1,000 combinations of models that can be used to represent the beliefs of the U.S. policy-makers, the beliefs of non-U.S. policy-makers, and reality. We find that 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, as against losses in 327 and no effect in 134.

Thus, even assuming that there are no problems of enforcement and no intertemporal problems of inflation-fighting credibility, 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. This could be the outcome if the baseline level of output turns out to be different than expected, or if the optimum level (e.g., potential output) turns out to be different than expected, or if a foreign expansion of monetary policy turns out to have a

different effect on domestic output than expected.

But uncertainty greatly complicates the enforcement problem as well. Recall our earlier conclusion that to enable compliance to be monitored, the agreement must involve the explicit setting of observable performance criteria.

In the first place, policy-makers do not have direct control over the variables that we refer to as their "policies." Central banks cannot determine the money supply precisely, because of disturbances within the banking system or in the wider economy's demand for money. Nor can a specific policy-maker who is engaged in international negotiations determine his country's fiscal policies precisely. For this reason, it can be difficult to hold policy-makers accountable for deviations of the policy variables from the cooperative bargain that they agree to.

In the second place, ex ante uncertainty means that there will be some states of the world in which the temptation to cheat is especially great because the country turns out ex post to lose a lot from abiding by the agreement (relative to unilaterally violating the agreement, and perhaps also relative to never having made the agreement to begin with). In such circumstances, the short-run gains from abrogating may outweigh the longer-term gains from continued cooperation.

For the parties to be held accountable, the variables

that they commit to must, to the maximum extent possible, be both observable and under the control of government authorities, and in particular under the control of those authorities involved in the international negotiations. It is for this reason that when the International Monetary Fund negotiates a "letter of intent" with the Finance Minister of a borrowing country, the "performance criteria" that are agreed upon 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 like the broad money supply, let alone the ultimate target variables like inflation. Otherwise, the national authorities could always claim that a subsequent failure to satisfy a performance criterion was beyond their control.

It is not essential that the variables be under the precise short-run control of the authorities, especially if compliance with the agreement is only to be checked on a basis of, say, once a year at annual reviews by the IMF ("Article IV Consultations") 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, and that the lags in the relationship not be too long. When

the variable begins to deviate seriously from the agreed-upon range, the policy-makers begin to adjust the policy instruments accordingly. Then the policy-maker at the end of the year can be held accountable for any large deviations from the agreement.

The next necessary condition on the variables to which policy-makers commit pulls the opposite direction from the condition that the variables be not too far outside the control of government authorities. The variables specified by an agreement must at the same time be closely enough tied to the target variables in the ultimate objective function that if there turns out to be an unexpected disturbance in one of the economic relationships [or if one of the multipliers belonging to an agreed policy change turns out to be different than expected], the country will not be drastically harmed. If the country commits to a specific number for the monetary base or the money supply, and there are shifts in the money multiplier or velocity that 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 the need to prolong the 1981-82

recession for another four years for the sake of an international agreement predicated on an erroneous forecast of velocity?

There must also be a similar link between the variables that each party commits to and the other country's target variables. A country will not be as impressed when its partner sticks to its money growth target if this turns out to be disadvantageous to it (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).

We noted earlier that the G-7 list of indicators is too long for agreements to be enforceable. Perhaps the true list has been, or will be, winnowed down to a smaller number of indicators? No item on the list is a good candidate to be the single variable on which negotiation under a future coordination regime would focus. Each would seem to be dominated by nominal GNP (or nominal demand). We consider each in turn. Real output, employment, inflation and the trade balance are less directly affected by policy instruments than is nominal GNP, aside from the fact that focussing exclusively on any one would destabilize the others. This leaves the money supply, fiscal policy, the exchange rate, the interest rate, reserves, and the price of gold.

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 the price level than is nominal GNP. (That step is the existence of shifts in velocity, as discussed above and demonstrated in the Appendix.) Furthermore we have now seen that 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 it is a less suitable choice of focus for international coordination, even, than for domestic policy-making.

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 policy-makers than is the money supply. Among G-7 countries, the inability to control the budget deficit has been most striking in the case of the United States in the 1980s. Feldstein (1987, p. 23-24) offers a reason 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 a legislative agreement between the President and the Congress.

Exchange rate policy is of course a very large topic in itself. But we can note some difficulties with the exchange rate being the single indicator that G-7 countries commit to in policy-coordination agreements. If the dollar/mark rate 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 means that one country would have to sit out, presumably the United States, which is not what is wanted.³¹ Countries could commit to certain targets for their foreign exchange intervention, or more generally to monetary and fiscal policies, which in theory would determine the exchange rate. But -- as already noted -- the link from macroeconomic policies to the exchange rate is fraught with even greater uncertainty than the link to output and inflation, even if one were to assume that the exchange rate might have as great a claim to being in the objective function as the other target variables.

³¹ Miller and Williamson (1987) address the n-1 problem.

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 that goes with stabilizing the exchange rate is to be saddled with a monetary policy that destabilizes the overall price level, relative to a regime of stabilizing nominal GNP. Within this framework, to opt for a fixed exchange rate regime, one has to put tremendous weight on the exchange rate objective. (One has to be prepared to argue that a ten percent fluctuation in the exchange rate causes greater trouble than a ten per cent fluctuation in the price level.) The only other way out would be to assume that much of the disturbances in the exchange rate equation will disappear when the regime changes, rather than having to be accommodated by the money supply.³²

As for the remaining three indicators on the G-7 list, the interest rate, international reserves, and the price of gold, the last 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 the analytical point that shifts in the demand function for gold, and in the other economic

³² Miller and Williamson (1987, 54-55; 1988) do precisely this: 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.

relationships that link it to the target variables that we ultimately care about, are even more unstable than shifts in the demand for money or the demand for foreign exchange, and are likely to remain so in the future. The Appendix's demonstration of the superiority of choosing nominal GNP as the target applies vis-a-vis the price of gold just as much as vis-a-vis the price of foreign exchange. The general point is that in a world where there are frequent shifts in demand among money, foreign currency, and gold, to stabilize any one variable 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 the price of other mineral or agricultural commodities, is not a good indicator in the sense of an early warning signal as to the likely future course of a true target variable, namely the overall price level.³³ In this sense such prices belong with the money supply, the interest rate and the yield curve, and many other leading indicators, on the list of variables that policy-makers may want to monitor on a short-term basis in attempting to hit their targets, whether under a regime of coordination (e.g., International Nominal GNP Targeting),

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. (E.g., Frankel and Hardouvelis, 1985.)

decentralized national policy-making with some commitment to a nominal anchor (e.g., regular nominal GNP targeting), or complete discretion.

In short, if coordination is to begin -- on a scale that is small, but goes beyond the stage of mere rhetoric -- by some degree of commitment to a single variable, then nominal GNP (or nominal demand) would seem to dominate each of the eleven indicators that the G-7 has apparently been discussing as the natural candidate for that variable.

III How International Nominal GNP Targeting (INT) Would Work

The INT framework laid out in Frankel (1988b, 1989a) is a very simple one. The G-7 Ministers in their negotiations would focus, not on the 10 or 11 indicators currently on their list, but rather 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 rates of growth, 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, say within a band of plus-or-minus 2 per cent.

In the first stage, i.e., the early 1990s, there would be no explicit enforcement mechanism. But the targets would be publicly announced, and if a country's rate of growth of nominal demand turned out to err significantly in one direction or the other, the fact would be noted disapprovingly at the next G-7 meeting. This does not happen under the current system. If the first stage were successful, a future stage might add another variable or two to the list, or might even commit countries firmly to specific policy responses in the event that their 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 advantage of focussing on nominal demand is the assumption that when the cooperative equilibrium entails expansion, countries need to be discouraged from the temptation to accomplish the expansion of output through net foreign demand, for example through protectionist trade measures, as opposed to domestic demand. In some years the cooperative equilibrium may entail contraction rather than expansion, and then a nominal GNP target might 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, which points to nominal demand as the superior choice.³⁴

Countries could attain their nominal GNP or nominal demand targets through any of several routes. One possibility, for example, is the Williamson-Miller (1987) "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 rate³⁵). But at least one serious problem arises if fiscal policy is explicitly specified as the policy instrument with which countries are expected to attain the nominal demand targets that they agreed to. When their economies stray away from the target the authorities will claim that it is not politically possible to adjust fiscal policy quickly. Such claims will be completely credible, because they will generally be true.³⁶

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 that part going to inventories as suggested by Gordon (1985).

³⁵ The Miller-Williamson blueprint also specifies that the G-7 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 is similar to Part (a) of my proposal. It is my part (b), cooperative yearly setting of each country's nominal demand target, to be attained primarily through monetary policy, that differs the most from their plan [aside from my leaving exchange rate stability aside as a separable issue].

³⁶ For attempts to evaluate empirically the stabilizing properties of the blueprint plan, see Miller and Williamson (1988) and Frenkel, Goldstein and Masson (1988, 33-49).

An agreement is more likely to stick if monetary policy is specified as the policy instrument that countries are expected to use, rather than fiscal policy. Even if fiscal policy is assumed to be no more subject to lags and political encumbrances than is 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 that policy instrument that has a relatively greater effect on it (Mundell, 1962). I agree with Boughton (1989) that under modern conditions of floating exchange rates, which work to decrease the effectiveness of monetary policy with respect to the trade balance and increase the effectiveness of fiscal policy, this means assigning fiscal policy to the trade balance target and monetary policy to the domestic target.

What is the precise instrument of monetary policy that should be adjusted when nominal demand drifts away from the

Frenkel and Goldstein (1986) survey target zone proposals. Miller and Williamson also consider a floating rate regime and the McKinnon (1984) proposals to use monetary policy to target the aggregate money supply -- or in a later version the aggregate price level -- among the G-3 countries. McKibbin and Sachs (1988) also compare these regimes. As yet, I am not aware of empirical work evaluating the likely outcome if countries cooperatively set nominal GNP targets [and use monetary policy to attain them].

target? The monetary base or level of unborrowed reserves would be better than the broader monetary aggregates because the central bank controls them more directly. (The short-term interest rate is another possible instrument.) McCallum (1988, 15) has suggested a specific feedback rule in the context of closed-economy policy-making that might do well here. His proposal is that for each one per cent that nominal GNP deviates from its target in a given quarter, the monetary base be expanded an additional .25 per cent over the subsequent quarter. He suggests setting a trend growth rate in the target of 3 per cent per year, and subtracting from this the average growth rate of base velocity over the preceding four years. An alternative possibility would be to replace the 3 per cent target with "a number to be negotiated for each member of the G-7 each year, with a planned long-run tendency of 3 per cent."

The central bank would be better able to hit its annual nominal demand target if it was allowed to respond to other available information, besides just the most recent monthly figure for nominal demand itself. Ben Friedman (1984, 183-84), for example, shows that such indicators as the money supply and the stock of credit can be used to predict more accurately deviations from a nominal income target. Many other "leading indicators" could be added to the list,

including a number of the ones from the G-7 list of 11. The conclusion seems to be that it would be better in practice to leave the means of attaining the nominal demand target up to the national authorities, rather than requiring that they follow a particular rule like 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 -- over targeting money, the exchange rate, or the price of gold -- 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 compared to other proposals.

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APPENDIX

A comparison of discretion and three alternative rules

In this appendix we compare four possible policy regimes: (1) floating exchange rates, with full discretion by national policy-makers (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. [In the case of each of the possible nominal anchors, proponents sometimes have in mind a target zone system; the assumption of a rigid rule makes the analysis simpler.³⁷] The approach, incorporating the advantages both to rules and discretion, follows Rogoff (1985b) and Fischer (1988a), who in turn follow Kydland and Prescott (1977) and Barro and Gordon (1983).

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 (or they could be the actual and expected inflation rates, respectively), and u a supply disturbance, with all variables expressed as logs.

³⁷ Rogoff (1985b) warns that the welfare-ranking among the candidate variables for rigid targeting need not be the same as the welfare-ranking among the candidate variables for partial commitment.

Output and the Price Level in the Objective Function

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

$$(A2) \quad L = a p^2 + (y - ky^*)^2,$$

where a is the weight assigned to the inflation objective, and we assume that the lagged or expected price level relative to which p is measured can be normalized to zero. We impose $k > 1$, which builds in an expansionary bias to discretionary policy-making.

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

1. Discretionary policy

Under full discretion, the policy-maker each period chooses 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 rational expectations,

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

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

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

From (A2), the expected loss function then works out 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,

while the second represents the effect of the supply disturbance after the authorities have chosen the optimal split between inflation and output.

2. Money rule

To consider alternative regimes, we must be explicit about the money market equilibrium condition. (In case 1, it was implicit 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 v uncorrelated with u .) If the authorities pre-commit 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 , namely 0. 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 with the Aggregate Supply relationship (A1), the equilibrium is given by

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

Substituting into (A2), the expected loss function is

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

The first term is smaller than the corresponding term in the

discretion case, because the pre-commitment 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 how big a weight (a) is placed on inflation-fighting.

3. Nominal GNP rule

In the case of a nominal GNP rule, the authorities vary the money supply in such a way as to accommodate velocity shocks. (A10) is replaced by the condition that $p + y$ is constant. The solution is the same as in case 2, but with the v disturbance dropped. Thus the expected loss collapses from (A12) to:

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

This unambiguously dominates the money rule case. It is still not possible, without knowing $\text{var}(u)$ or (a) , to say that the rule dominates discretion. 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 Central Bank Chairman to a mere loss of reputation if he misses the target rather than a firing squad. But it seems clear that, to whatever extent the country chooses to commit to a nominal anchor, nominal GNP dominates the money supply as

the candidate for anchor.

Adding the Exchange Rate (or 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 it 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 (A2) with:

$$(A14) \quad L = a p^2 + (y - ky^*)^2 + c s^2,$$

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; we say nothing of prediction) 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. Our equation is simply:

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

(We assume that e is uncorrelated with the other disturbances.)

Though our primary interpretation of s is as the spot price of foreign currency, a second possible interpretation of s in what follows is as the spot price of gold. It is hard to see why the price of gold should enter directly into the objective function, even more so than the exchange rate; but this simply biases our results in favor of the position of the gold bugs.

From (A9),

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

We assume that the same Aggregate supply relationship holds as before, equation (A1).

So we can write the loss function (A14) as:

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

We proceed as before to consider possible regimes.

1. Discretion

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

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

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

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

Substituting into (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 Money rule

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

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

The additional s term is the only difference from (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 with discretion depends on the various magnitudes.

3 Nominal GNP rule

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 ten per cent 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.

4 Exchange rate (or gold) rule

Again, the authorities can't affect y in long-run equilibrium. But now it is the exchange rate that they peg in such a way that $E_p = 0$, which from (A16) is $s = 0$. The expected price level is then given by

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

From (A1),

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

From (A14),

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

The coefficient on $\text{var}(e)$ is $(a+b^2)$, as compared to the coefficient c in the expected loss (A24) under the nominal GNP rule. We made the point above that e shocks in practice dwarf u shocks. Reasoning on this basis, even if v shocks are also small and $a=c$ (the objective function puts no greater weight on a 10 per cent fluctuation of the price level than on a 10 per cent fluctuation of the exchange rate), which is extremely conservative, the expected loss from fixing s is 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 we allow for v shocks (which are probably in 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 it receiving heavy weight directly in the objective function even more difficult to make. In short, the nominal GNP rule seems to dominate all three of the other candidates for nominal target, the money supply, the exchange rate, and

the price of gold.

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