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Discretionary Monetary Policy Versus Rules:
The Japanese Experience During 1986-91

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Abstract

This paper compares the hypothetical performance of various monetary policy rules with that of the discretionary policies actually pursued in Japan over the 1986-91 period. The results suggest that simple rules based on targeting growth in either the money supply, nominal income, or prices would have failed to stabilize economic variables more successfully than discretionary policies. At the same time, it appears that an indicator of monetary conditions incorporating movements in the real exchange rate and the real interest rate would have been useful in assessing the effect of current policies on future activity.

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Summary

The desirability of using rules as opposed to discretion in the conduct of monetary policy has been widely debated in both academic and applied circles. In achieving short-run stabilization objectives, rules limit the flexibility of policymakers in responding to shocks; this may be beneficial or harmful, depending on the information policymakers have and how effectively they use it. In addition, in countries where the credibility of policies is in question, rules may help to convey the longer-term objectives of policy to the private sector and thus favorably influence expectations.

This paper looks at rules versus discretion from the point of view of the Japanese experience during 1986-91. It focuses on the short-run stabilization properties of alternative policies, examining rules based on targets for growth in either the money supply, nominal income, or prices. A small macroeconomic model of the Japanese economy is simulated to generate a counter-factual outcome for each rule. When the simulation results are compared with the historical outcome, it appears that none of the rules would have been superior to the discretionary policies that Japan followed during this period. Of the rules considered, those based on targets for nominal income growth performed best. The usefulness of money targets would have been reduced by large shifts in money demand, while inflation targeting would not have caused policy instruments to respond quickly enough to shocks that affected future inflation. Finally, although simple rules would not have outperformed discretion, an indicator of monetary conditions that incorporates movements in the real exchange rate and the real interest rate would have been useful in assessing the effect of current policies on future activity and prices.

I. Introduction

The experience of high and volatile inflation in the 1970s and early 1980s in many industrial countries has led to a consensus that the appropriate long-term goal of monetary policy should be price stability, broadly defined as a low and stable rate of inflation. There is less agreement, however, on the approach monetary authorities should follow to achieve price stability. An important issue in this context is whether policies should be guided by rules or discretion.

In practice, the major industrial countries generally pursue discretionary policies; the choice of indicators and their relative importance vary with economic circumstances and prospects. In countries in the Exchange Rate Mechanism (ERM) of the European Monetary System, of course, the scope for pursuing discretionary policies is limited to some extent by the need to keep exchange rates within target bands. In spite of the dominance of discretionary policies in practice, there is continuing interest in the use of rules, in part because they make the policy process more transparent: the actions of central banks can be identified as either responses to economic developments given a fixed rule, or as changes in the underlying rule. An associated benefit is that rules may enhance the credibility of policies and thus have a favorable influence on expectations of, for instance, future inflation. ^{1/}

At the same time, rules limit flexibility in responding to economic shocks. When policymakers can identify all shocks and their probable effects, rules are unlikely to be as effective as discretionary policies. Skeptics would argue that this is not, in fact, the case, and that efforts to fine-tune policies on a discretionary basis are as likely to destabilize as to stabilize activity and prices. ^{2/} In any event, the desirability of rules will reflect, in part, the information available to policymakers and the effectiveness with which it can be processed.

This paper looks at alternative rules for monetary policy in the Japanese context. The first objective is to examine whether there are rules that can successfully stabilize inflation and output, and how they can be implemented. The second is to identify how the historical performance of the economy might have differed if such rules had been pursued. The analysis indicates that feasible rules can be derived based either on intermediate targets--such as growth in nominal income or monetary aggregates--or on an ultimate target--such as the inflation rate. Of these simple rules, the most promising involves adjusting monetary conditions in response to deviations in nominal GDP growth from target. Historical

^{1/} See the seminal work of Kydland and Prescott (1977) on the time-inconsistency of discretionary policies. Barro (1985) states the issues particularly cogently and discusses the pros and cons of alternative rules in this context.

^{2/} One of the classic statements of this position was made in Friedman and Schwartz (1963).

simulations suggest, however, that the discretionary policies actually pursued performed as well as the rules discussed in this paper.

The paper is structured as follows: the second section describes alternative rules that might be used to guide monetary policy; the third discusses how these rules could be implemented for Japan, using as a framework a small structural model of the Japanese economy; the fourth presents simulations illustrating the hypothetical performance of the Japanese economy during the 1980s and early 1990s under alternative policy rules; and the fifth presents conclusions.

II. Policy Rules: An Overview

Assuming that the long-term objective of policy is low and stable inflation, it is uncontroversial that, as a general strategy, monetary policy should be tightened when inflation rises above target; conversely, policy should be eased when inflation is below target and there are output costs associated with undershooting the inflation target. Within this general framework, however, it must be determined what exactly is meant by monetary "tightening" or "easing," and which indicators should be used to guide the stance of policy in the short to medium term.

Most policy rules that have been implemented or proposed involve the use of intermediate targets. Examples include objectives for the exchange rate, money growth, and nominal income growth. In practice, the exchange rate has been the most widely followed intermediate target. One of the original objectives of the ERM, for instance, was to limit exchange rate movements vis-à-vis the deutsche mark to facilitate the convergence of non-German members to a lower inflation rate. Money targets have been used sporadically in other industrial countries, although the experience has been mixed--no major country currently pursues strict money targeting, but money aggregates continue to be used as indicators of economic conditions. Finally, nominal income targeting has been more popular among academics than policymakers.

A relevant question, when rules have been used to guide policy, is why a target path for inflation has not been set directly, and policies adjusted in response to deviations from this path. One reason for using intermediate targets is that the short-term movements in variables such as interest rates, real output, and the exchange rate required to directly hit an inflation target are likely to be large. Indeed, to the extent that prices are insensitive in the short run to changes in monetary conditions, it may prove impossible to hit an inflation target at a point in time. The well-known problem of price stickiness is compounded by the existence of lags in the response of the economy to changes in, for instance, interest rates: the adjustments required today to fully offset a shock to prices could entail large future movements in output and prices, which would, in turn, require a sharp reversal of the initial change in interest rates. This raises the possibility that unstable dynamic cycles can be generated by an

inappropriate policy reaction function (as discussed in more detail in the next section).

The use of intermediate targets implies adjusting policy instruments in response to other variables in addition to (or in place of) inflation. For instance, a nominal income rule would incorporate, in addition to prices, movements in real output; a money target would incorporate other variables that influence money demand. From the point of view of macroeconomic stability, the desirability of responding to a wider set of variables depends on the dynamic linkages between these variables and the ultimate target of policy--inflation. In cases where the variables used as intermediate targets contain useful information about future inflation, they may lead to more forward-looking reactions of the monetary authorities. Incorporating the effects of changes in policy instruments on future (as well as current) inflation may reduce the short-run volatility of instruments and lead to more stable dynamic paths for the economy.

Of course, it is important that the use of intermediate targets be consistent with the achievement of the longer-term objectives for inflation. In this respect, the three intermediate targets mentioned above--the exchange rate, monetary aggregates, and nominal income--all provide an anchor for inflation under certain conditions. ^{1/} Principal among these is that real output growth be exogenous in the long run. In this case, the link between targets for nominal income growth and inflation is obvious. If, in addition, there is a stable money demand function, a money growth target will also tie down inflation. Finally, an exchange rate target will anchor inflation provided there is a stable long-run relationship between the real exchange rate and real output, and inflation in trading partners is appropriately anchored by their domestic policies.

Assuming an intermediate target has been chosen, the response of the policy instruments to shocks that would cause deviations from the target must also be determined. At one extreme, shocks could be completely offset. For instance, under a money rule, any tendency for money to deviate from the target would elicit a change in policy instruments sufficient to maintain money exactly on target. An alternative--and more common--approach is to only partially offset deviations from the target in the first instance. To the extent that shocks are not self-reversing, the rule would then require further adjustments in instruments to bring the intermediate target back to its desired path.

Finally, the policy instrument must be chosen that is used to control the target variable. The channel through which monetary policy affects the private-sector economy in Japan, as in most other industrial countries, is short-term market interest rates. These, in turn, reflect the degree of pressure on bank reserve positions, which is influenced by the demand for

^{1/} Examples of targets that will not typically provide such a nominal anchor in the long run are real output or interest rates.

funds and the supply of reserves by the Bank of Japan. 1/ One possible specification of a policy rule, then, involves the authorities responding to innovations in a target variable, Z , by adjusting reserve availability to achieve a desired level of short-term rates. In general terms, the reaction function can be written as:

$$RS = F(Z - Z^T) , \quad (1)$$

where RS is the short-term interest rate, $Z - Z^T$ is the deviation in the target variable from its desired path, and $F()$ is a reaction function that determines the response of interest rates.

Equation (1) leads to a natural distinction between the concept of the underlying stance of monetary policy, and changes in monetary conditions implied by a given stance. The policy stance is characterized by the desired path for the intermediate target and the parameters of the reaction function. Taking as an example a money-targeting regime, the stance would be represented by the desired growth rate of the money aggregate and the response of interest rates to deviations from the target. 2/ Changes in monetary conditions reflect the outcome in terms of interest rate movements, given the target money growth rate and the reaction function. A downturn in aggregate demand, for instance, would lead to lower interest rates and easier monetary conditions without necessarily implying a change in the policy stance. On the other hand, if the authorities decided to alter the money growth target and/or change the response of interest rates to deviations from the target, this would, in general, imply changes in both the policy stance and monetary conditions.

The term "monetary conditions" in the above formulation is identified with the level of short-term interest rates. While this is the proximate channel through which the central bank affects economic activity, it may be desirable to incorporate other variables in the reaction function, particularly those that affect future economic activity. In this way, the current reactions of the monetary authorities can anticipate potential future deviations in target variables from their desired path. Consider, for instance, a shock that puts downward pressure on the exchange rate under a nominal income target. Such a shock would tend to raise future output via

1/ Central banks typically have other tools at their disposal to influence financial markets. Examples include window guidance and credit rationing; sterilized intervention in exchange markets; and changes in the maturity structure of government debt. As these are not the principal instruments used currently by the Bank of Japan, this paper does not explore the implications of employing them in policy reaction functions.

2/ The response of interest rates under a strict money rule, where no deviations from the target were allowed, would be determined by the interest elasticity of money demand in the first instance.

higher external demand, leading to a deviation in nominal income from target. Rather than responding only when these pressures occur, it may be preferable to react at the time the exchange rate depreciates to pre-empt the future effect on activity. A forward-looking action of this type implies "leaning against the wind" by raising interest rates to offset a lower exchange rate.

Such a response can be incorporated by using a broader definition of monetary conditions in the policy reaction function. Specifically, a "monetary conditions index" (MCI) is described in the next section that reflects the estimated impact of real interest rates and the real exchange rate on future aggregate demand. The MCI, rather than the nominal interest rate, can then be adjusted in response to deviations in the intermediate target from its desired path:

$$\text{MCI} = F(Z - Z^T) . \quad (2)$$

Of course, the use of such a rule does not imply or require that the authorities can directly control both real interest rates and the real exchange rate. Rather, this index of monetary conditions would continue to be influenced through changes in short-term nominal interest rates. Thus, the MCI is not viewed as a policy instrument per se, but rather as an indicator of the degree of tightness or ease of monetary conditions; short-term interest rates are then adjusted by the authorities to achieve monetary conditions appropriate for the economic situation.

III. Alternative Policy Rules for Japan

This section makes the above discussion more concrete by developing specific rules that could be used to guide Japanese monetary policy. To put these rules in context, we first present a small model of the Japanese economy that serves as a framework for evaluating their performance.

The model, which is described in more detail in the Appendix, embodies familiar IS-IM-Phillips curve linkages. Prices are "sticky" at a point in time; thus, shocks to nominal demand are split between changes in real output and prices in the short run. Nominal shocks have no long-run effect on output, however, as deviations in output from potential result in inflation rising (or falling) over time. Ultimately, any nominal shock will be reflected in a one-for-one change in the price level, while output is determined only by productive capacity. The model parameters have, for the most part, been estimated using quarterly data from the mid-1970s. The equations can be summarized as follows, where $F()$ is a general function of its arguments, a -1 subscript indicates the first lag of a variable, $A(L)$ is a distributed lag, and Δ denotes the first difference of a variable:

$$\begin{aligned}
 \text{IS curve:} \quad & q - q^* = F(RSR_{-1}, rer_{-1}, g) \\
 \text{Phillips curve:} \quad & \Delta p = F(A(L)\Delta p, q - q^*, \Delta(q - q^*), \Delta rer) \\
 \text{Money demand function:} \quad & m - p = F(q, RS, (m - p)_{-1}) \\
 \text{Long-term interest rate:} \quad & RL = F(RS, RL_{-1}) \\
 \text{Real exchange rate:} \quad & rer = F(RLR - RLR^f) \\
 \text{Inflation expectations:} \quad & \Delta p^e = F(A(L)\Delta p) ,
 \end{aligned}$$

where:

- q = real GNP (logarithm)
- q^* = trend real GNP (logarithm)
- RS = nominal short-term interest rate
- RSR = real short-term interest rate
- rer = real effective exchange rate (logarithm)
- g = deviation from trend of real government spending to GNP ratio
- p = GNP deflator (logarithm)
- m = broad money balances (logarithm)
- RL = nominal long-term interest rate
- RLR = real long-term interest rate
- RLR^f = foreign real long-term interest rate.

In addition to these behavioral equations, a reaction function is needed for the short-term interest rate. As discussed above, it can be based on an intermediate target such as a monetary aggregate, nominal income, or the exchange rate, or it can be based on deviations in inflation from the desired level. As an intermediate target, the exchange rate is not particularly relevant for Japan, because domestic policies themselves have led to lower and more stable inflation in Japan than in trading partners. Thus, the use of exchange rate targets was not pursued in this study. The nominal income rule was further divided into two cases, depending on the instrument used to control nominal income growth. In the first, the short-term interest rate was used to respond directly to deviations in nominal income growth; in the second, the response was specified in terms of an MCI. The MCI was defined as the effect of the real interest rate and the real exchange rate on future aggregate demand, based on the estimated parameters of the IS curve. ^{1/} In this case, the short-term nominal interest rate was adjusted to yield the level of the MCI required by the policy reaction function.

^{1/} The parameters imply that a rise of 1 percentage point in the real short-term interest rate lowers real output by 1.2 percent in the long run, while a 1 percent appreciation of the real exchange rate lowers output by 0.1 percent.

For each policy rule it was necessary to specify the size of the reaction of the policy instrument to deviations from target. For instance, meeting the target exactly would imply an infinite response parameter. In practice, many parameter values led to unstable model responses, owing either to an "overshooting" or "undershooting" of the policy instrument in response to shocks. In the event, feasible values for the response parameter were identified by examining the characteristic roots of the dynamic system consisting of the model equations and alternative reaction functions.

One conclusion of this analysis is that strict observance of the targets would lead to unstable responses. This is not surprising given that, in the model considered here, interest rates have no contemporaneous impact on economic activity or monetary aggregates. Even when the model was respecified so that interest rates affect output contemporaneously, strict targeting regimes were not stable, as long as the short-run effects of interest rates and exchange rates was significantly smaller than their long-run effects. The implication is that some short-run deviations from the targets must be permitted to avoid an overshooting of the policy instrument.

The second conclusion is that adjusting the nominal interest rate in response to deviations from target would lead to unstable responses. This is because a shock that causes inflation to change initially causes the real short-term interest rate to move in the opposite direction. For instance, a supply shock that raises inflation will initially cause the real interest rate to fall, as the nominal interest rate is fixed at a point in time. This, in turn, stimulates demand and raises prices further. The "perverse" response of real interest rates tends to amplify the shock until short-term nominal rates catch up. The dynamics of this process lead, in the model considered, to an initial undershooting of nominal short-term rates followed by a later overshooting: this continues until the economy eventually explodes. The solution was to specify the policy instrument as the real short-term interest rate. With this modification, the nominal rate "jumps" on impact when expected inflation changes, leading to more stable dynamic behavior.

The third conclusion is that the most stable reaction functions are specified in terms of first differences: the change in the policy instrument depends on the deviation in the growth of the target variable from its desired path. In this framework, past deviations in the growth of the target variable from its desired path are forgotten by policymakers; no attempt is made to recoup them by engineering offsetting deviations in future periods. This approach is consistent, for instance, with the practice of permitting (symmetric) base drift in the context of money targets. The implication is that the level of prices is not tied down by the policy rule, but rather depends on the sequence of shocks that has been experienced by the economy. The long-run rate of inflation, of course, remains anchored by the growth rate for the target variable.

The analysis of the characteristic roots of the model was supplemented by an inspection of its responses to some hypothetical shocks. These included, inter alia, a change in the level of trend output, a shock to exchange markets, and an inflationary shock. Together, these simulations and the analysis of roots helped establish the most stable reaction functions. ^{1/} A response parameter of 0.5 is common across the rules using nominal income and broad money growth as intermediate targets, implying that a deviation in nominal income growth from the target path of 1 percent (quarterly rate) initially leads to a rise in the short-term real interest rate of 50 basis points. The interest rate continues to increase in subsequent quarters as long as nominal income growth remains above target. In the case of an inflation target, the required response of real interest rates was larger--a 1 percent deviation in inflation from target implied a 1 percentage point change in the real short-term interest rate. As shown in the Appendix, the model will generate stable cyclical behavior using these rules.

IV. Alternative Rules in Practice: Revisiting the 1986-91 Experience

The above policy rules were evaluated by comparing simulations over the historical period, using the actual historical data to generate the model shocks. These counterfactual results are then compared with the historical outturn resulting from the policies actually pursued. This approach has two advantages. The first is that the choice of shocks is unambiguous: they are the disturbances observed over the historical period. The second is that the performance of policy rules can be assessed against the outcome generated by discretionary policies.

A particularly interesting historical period for this analysis is the one leading up to and including the boom in asset prices and domestic demand in the late 1980s. Looked at in retrospect, an important issue is whether monetary policy should have responded sooner to events following the 1986-87 recession. In particular, relatively low interest rates through 1988 and the first half of 1989 accommodated rapid demand growth, at the same time as the real value of the yen was depreciating from its peak in late 1987. Attractive financial conditions and strong real growth led to a surge in asset prices, particularly of equities and land. By 1990, real output had risen well above its estimated potential level, and inflation (defined using the GNP deflator) had risen above 2 percent from a situation of virtual price stability in 1987-88. (Inflation as measured by the consumer price index (CPI) reached a peak of close to 4 percent in late 1990 on a year-to-year basis.) The overheating of the economy prompted a sharp tightening of monetary policy, as reflected in a rise in short-term interest rates of about 3 percentage points from mid-1989 to late 1990. More restrictive financial conditions eventually caused growth in domestic demand to fall to

^{1/} For more details, see the Appendix.

3 percent in 1991 from 5 1/2 percent in 1990; a further decline is widely projected for 1992.

How might events over this period have differed had alternative rules been used? To address this question, counterfactual outcomes were derived by simulating the model from the beginning of 1986 to the end of 1991. The rules were implemented by assuming target growth in real GDP equal to estimated trend growth, and an inflation rate equal to the 1980s average of 1 1/2 percent per year. ^{1/} The nominal income growth target was then simply the sum of these two rates. The money growth target was calculated as the sum of: target inflation; the income elasticity of money demand times target real GDP growth; and the estimated secular change in money demand as reflected in the time trend in the money demand function.

The simulation results for the two nominal income rules are compared with the actual outturn in Chart 1; those for the money growth and inflation rules are shown in Chart 2. In addition, Table 1 presents measures of the volatility of key variables using actual historical data and the simulation results.

Table 1. Japan: Performance of Alternative Monetary Policy Rules, 1986-91

| | Mean-squared Deviation of: | | | |
|---|----------------------------|-----------|--------------------------|---------------|
| | Output | Inflation | Short-term interest rate | Exchange rate |
| Observed data | 0.96 | 0.27 | 0.27 | 17.6 |
| Rule 1(a): Nominal income target with interest rate reaction function | 1.70 | 0.36 | 2.01 | 23.5 |
| Rule 1(b): Nominal income target with MCI reaction function | 0.45 | 0.34 | 2.76 | 18.8 |
| Rule 2: Broad money target with interest rate reaction function | 7.34 | 1.79 | 1.31 | 30.6 |
| Rule 3: Inflation target with interest rate reaction function | 3.81 | 0.55 | 2.01 | 29.2 |

Source: Staff estimates.

Note: Output is measured as the percent deviation from trend; inflation is the percentage point deviation from target growth; the short-term interest rate is the percentage point change from the previous period; and the exchange rate is the percent change from the previous period.

^{1/} In this respect, the choice of 1986 as a starting point satisfied two criteria: real output was close to trend at the end of 1985, while inflation was near its 1980s average. This meant that the rules were hypothetically put in place under conditions that did not deviate sharply from those that defined the target paths.

A few conclusions are immediately apparent from the charts and Table 1:

Of the four rules considered, the results for money targeting generate by far the largest deviations of output and inflation from their target paths. The explanation for this, as discussed in more detail below, is large shocks to money demand over this period.

All of the policy rules imply much greater volatility in the short-term interest rate than the discretionary policies followed by the authorities. This suggests that a disadvantage of (simple) rules is the need to use policy instruments actively to respond to innovations in the target variables.

Of the four rules considered, only nominal income targeting with an MCI reaction function leads to smaller deviations of real output from trend compared to actual policies.

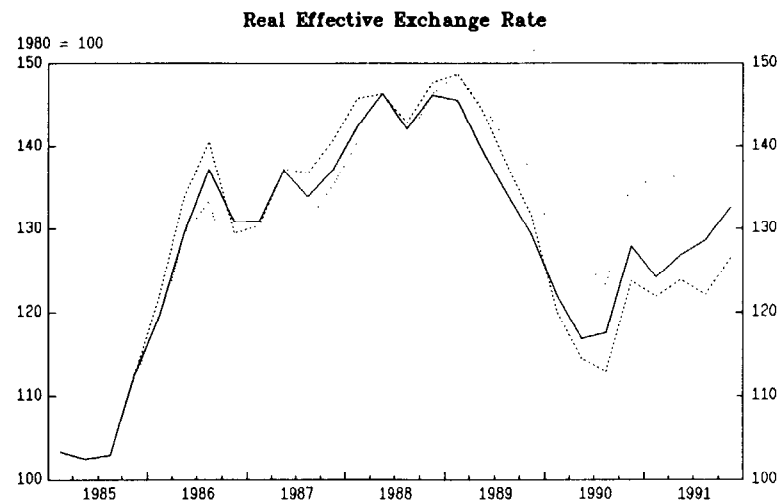
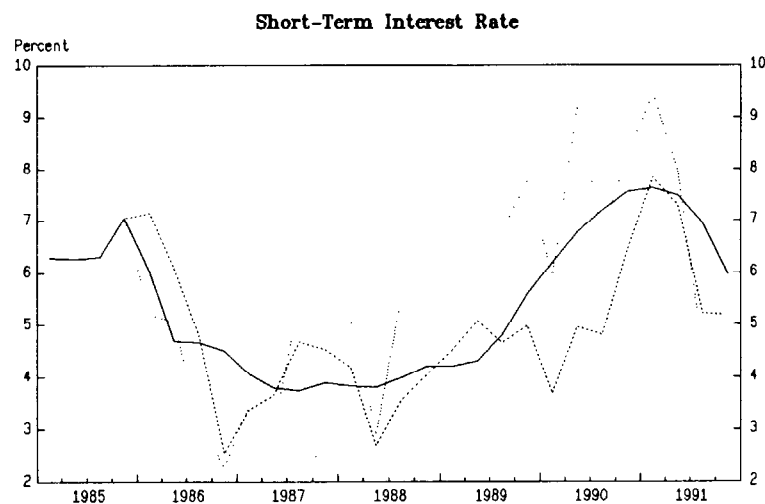
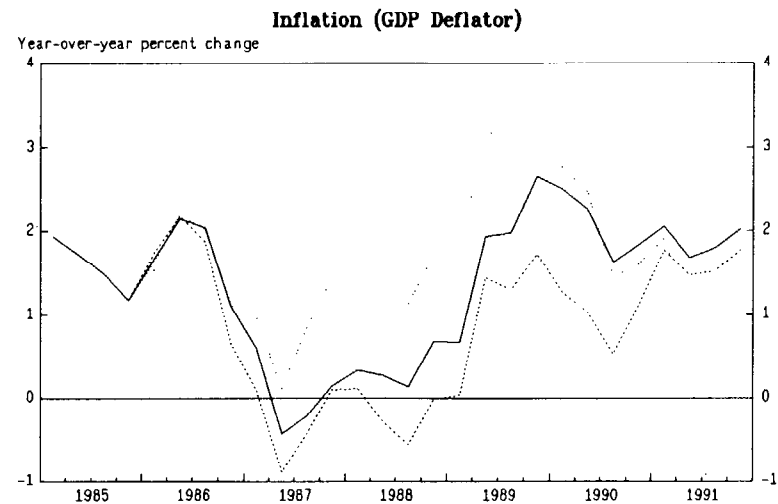
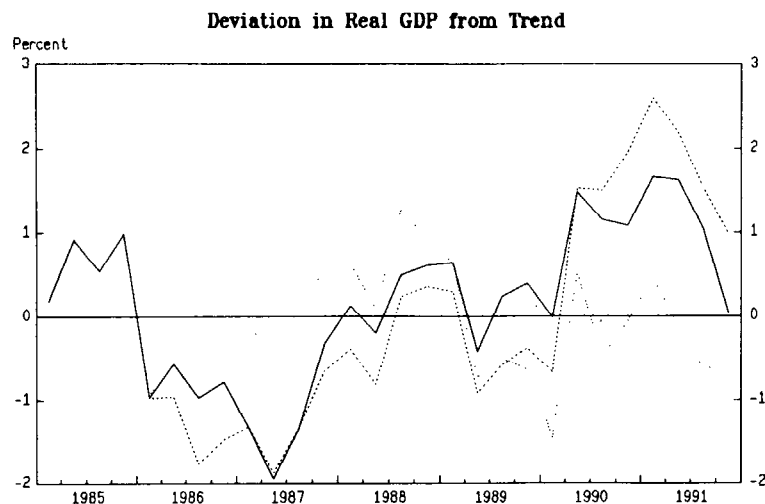
The path for the exchange rate in all of the simulations is similar to the actual outcome. This is consistent with the fact that its movements were dominated by exogenous shocks as opposed to the endogenous response to changes in interest rate differentials. ^{1/}

Looking in more detail at the paths for output and inflation, it is apparent that the results using Rule 1(a)--nominal income targeting with an interest rate reaction function--are broadly similar to the historical outcome. The 1986-87 recession would initially have been somewhat deeper because of the reaction of interest rates to the surge in inflation in the first half of 1986. This would have caused inflation to fall by slightly more in 1987-88 than was actually the case. Interest rates over the 1987-89 period would have been similar, on average, to the actual outcome--in other words, this rule would not have led to an earlier tightening of monetary conditions, or "pre-empted" the subsequent pressures on output and inflation. Indeed, through late 1989 and the first half of 1990, interest rates would have remained at 4-5 percent as opposed to the rise that was observed. This accommodative stance would have reinforced the surge in demand in 1990, causing output to rise over 2 1/2 percent above trend. Overall, this rule appears to have been roughly as successful as actual policies in stabilizing inflation, although at the expense of somewhat larger movements in real output and much greater volatility in interest rates.

Rule 1(b)--nominal income targeting with an MCI reaction function--differs from the previous rule in that it incorporates the effect of changes in the real exchange rate. For instance, strong upward pressure on the exchange rate in late 1985 and 1986 contributed to a tightening of monetary

^{1/} Estimation of the exchange rate equation over this period produces an unadjusted R^2 of 0.194, indicating that less than 20 percent of the variance in the real exchange rate is explained by movements in real interest rate differentials.

Chart 1
Japan
Simulation Results, 1986-91: Nominal Income Targets

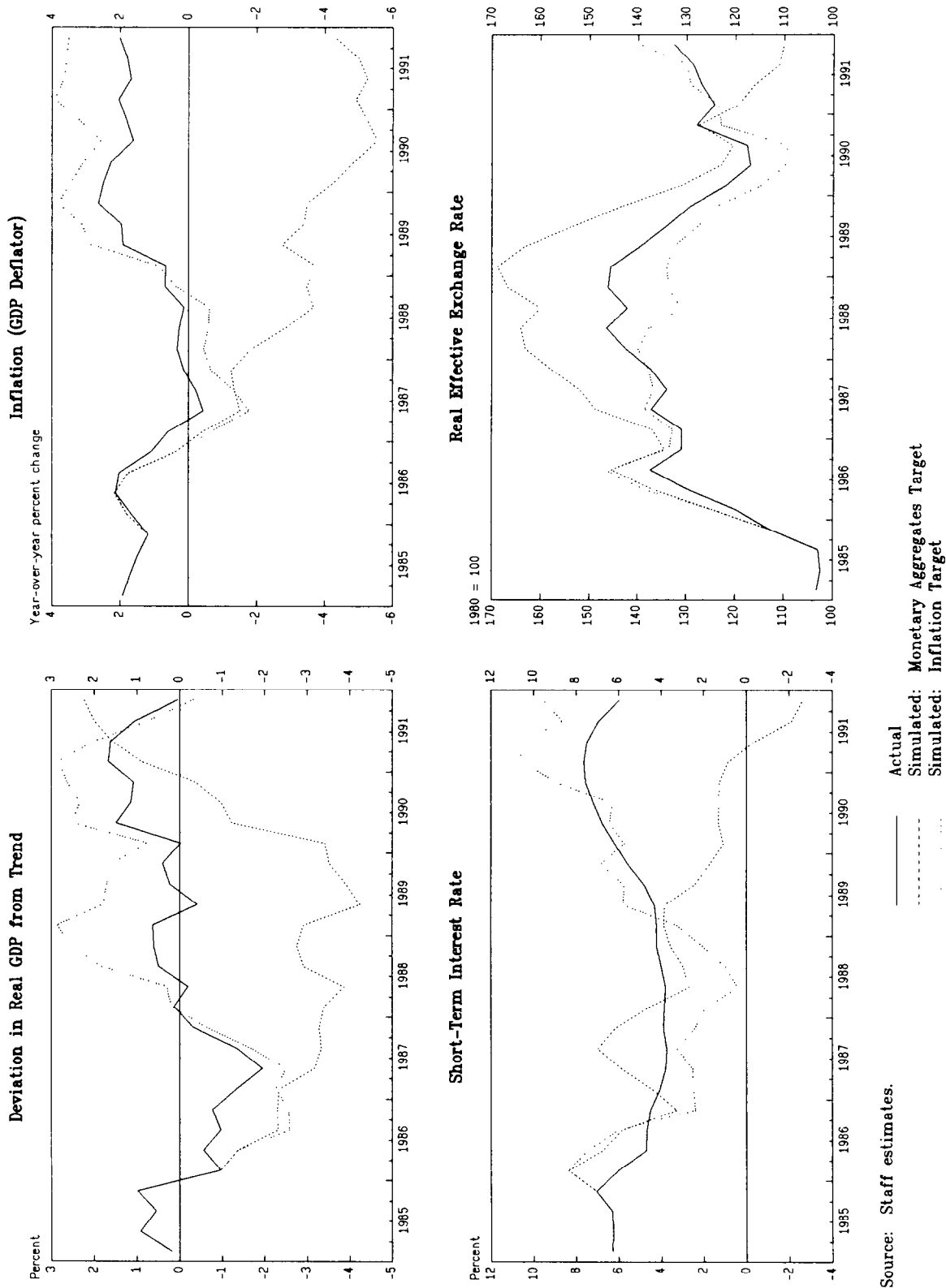


Source: Staff estimates.

——— Actual
 - - - - - Simulated: Nominal Income Target, Interest Rate Reaction Function
 Simulated: Nominal Income Target, Monetary Conditions Index Reaction Function

Chart 2
Japan

Simulation Results, 1986-91: Money and Inflation Targets



conditions. As shown in upper panel of Chart 1, the MCI rule would have offset this through an even larger decline in interest rates in 1986 than actually occurred. Lower interest rates would have moderated the appreciation of the exchange rate. The combination of lower interest rates and a weaker yen would have softened the 1986-87 recession--real output would never have fallen more than 1 percent below trend. The subsequent recovery in demand in 1988, however, would have resulted in inflation peaking at over 3 percent in 1989, as opposed to the actual peak of about 2 1/2 percent.

It is interesting to note that, during 1988-90, the MCI rule would have caused interest rates to rise sooner and by more than they in fact did. In part this reflects a higher path for inflation. Another important factor, however, is the fact that interest rates would have risen in response to the strong downward pressure on the yen, which otherwise would have caused an easing of monetary conditions. Tighter conditions, in turn, would have resulted in output remaining close to trend during 1990-91. The 1986-91 experience as a whole, then, suggests that incorporating movements in the real exchange rate in a rule for monetary policy can usefully offset shocks in exchange markets, which were relatively important over this period. Incorporating these shocks would have reduced the volatility of real output. At the same time, the MCI rule would not have reduced the volatility of inflation and would have implied much sharper swings in interest rates than actually occurred.

Turning to Rules 2 and 3, which target money growth and inflation respectively, the simulations indicate that--over the 1986-91 period--their performance is dominated by that of the nominal income rules. In the case of money targeting, in particular, the results show large and sustained deviations of real output and inflation from target. This is due to important shifts in money demand that occurred over this period. Specifically, broad money grew, on average, by over 10 percent per year during 1987-90, well above the target growth rate of about 7 percent implied by the inflation target and trend output growth. Attempting to keep money on target would have generated a large and prolonged recession from 1986 to 1990, leading to a substantial price deflation. Starting in mid-1990, the reversal of the earlier shift in money demand lowered actual money growth to almost 2 percent by the end of 1991. Under money targeting, this would have caused nominal interest rates to turn negative in 1991, and output would have soared above trend. 1/

1/ Negative nominal interest rates are, of course, unlikely to be observed in practice, as money demand would become infinitely elastic as interest rates approach zero. The perverse results in simulation occur because the short-term interest rate enters the money demand function in levels as opposed to logarithms. The distinction is not likely to be of practical significance: it is evident here because of the overall implausibility of the output and inflation paths in the money-target scenario.

Using only the inflation rate as a target variable is more satisfactory, but still is not preferred to nominal income targeting or the actual outcome over this period. Indeed, both output and inflation are more volatile under this rule. That inflation is more volatile may at first seem surprising, given that this is the variable the rule is specifically designed to control. The explanation is that shocks to other variables tend to affect inflation with a lag via their impact on real output. Nominal income rules "anticipate" the future impact on inflation by responding to current deviations in real output growth. In this sense, they can be thought of responding both to current and expected future inflation developments, where the latter are reflected in current movements in real output.

A final question is how sensitive these simulation results are to the choice of time period. In particular, the 1986-91 period featured large shocks to the exchange rate and money demand: to what extent did this tend to favor the MCI rule and penalize, for instance, the money target rule? To address this issue, the same rules were evaluated over the first half of the 1980s, a period when shocks to the exchange rate and money demand were smaller.

The results in terms of the volatility of the key variables are summarized in Table 2. For real output, they indicate that the two nominal income rules do about as well as actual policies. Money targeting does better over this period than over the 1986-91 period, while inflation targeting generates the greatest output variability. The volatility of inflation is more similar for the various rules over this period; in particular, money targeting does better than over the second half of the decade. Nevertheless, none of the rules is superior to actual policies. One area in which some rules (i.e., 1(a) and 2) perform better than actual policies is in limiting the variability of short-term interest rates, contrasting sharply with the 1986-91 experience. This was entirely due to developments in 1980, when actual short-term rates rose to over 12 percent early in the year from less than 5 percent at the beginning of 1979. They then fell sharply during the course of 1980 and early 1981 to reach about 7 percent by mid-1981. Excluding this brief episode, actual policies led to less volatile interest rates than these rules would have. Nevertheless, this experience illustrates that the observation made earlier--that rules require greater use of policy instruments--is a generalization that may not apply in all circumstances.

Table 2. Japan: Performance of Alternative Monetary Policy Rules, 1980-85

| | Mean-squared Deviation of: | | | |
|---|----------------------------|-----------|--------------------------|---------------|
| | Output | Inflation | Short-term interest rate | Exchange rate |
| Observed historical | 0.44 | 0.36 | 0.83 | 13.5 |
| Rule 1(a): Nominal income target with interest rate reaction function | 0.51 | 0.41 | 0.66 | 16.8 |
| Rule 1(b): Nominal income target with MCI reaction function | 0.49 | 0.40 | 1.59 | 16.7 |
| Rule 2: Broad money target with interest rate reaction function | 1.75 | 0.45 | 0.44 | 15.3 |
| Rule 3: Inflation target with interest rate reaction function | 3.92 | 0.55 | 1.42 | 21.3 |

Source: Staff estimates.

Note: Output is measured as the percent deviation from trend; inflation is the percentage point deviation from target growth; the short-term interest rate is the percentage point change from the previous period; and the exchange rate is the percent change from the previous period.

V. Conclusions

This paper has derived alternative rules for monetary policy in Japan, and compared their hypothetical performance over the recent historical period with the policies actually pursued. The analysis suggests that some simple rules might have been as good as discretionary policies in limiting the volatility of real output. In this context, the preferred rule involves adjusting monetary conditions, defined as the impact of interest rates and the exchange rate on aggregate demand, to deviations in nominal income growth from target. However, in terms of the variability of inflation, even the best of the simple rules fail to outperform actual policies. The use of rules also generally (but not always) implies greater volatility in policy instruments, and, in particular, short-term interest rates.

The evaluation of alternative rules also indicates that intermediate targets can play a useful role: the rule based only on the ultimate target--inflation--led to relatively volatile paths for output and inflation. The reason is that simple inflation targeting is not sufficiently forward looking to anticipate the impact of shocks to other variables on future inflation. Broad money would have been unsatisfactory as an intermediate target over the 1986-91 period because of large shifts in money demand. Over the first half of the 1980s, when money demand was more stable, this rule would have performed better. The most useful intermediate target over the period considered here, then, is nominal income growth.

In terms of guidelines for future policies, these results do not provide compelling evidence for abandoning a discretionary approach in favor of rules. Inflation targeting has undesirable properties; money targeting is not likely to be viable unless money demand becomes more stable; and nominal income targeting would not have been uniformly preferable to discretion over the historical period. In addition, the practicality of using any rule depends on the stability of behavioral relationships. Future shifts, for instance, in the response of activity to changes in interest rates, could render nominal income rules less useful than these simulations suggest. Nevertheless, there is some support for the use of an index of monetary conditions reflecting movements in both interest rates and the exchange rate as an indicator of the stance of policies. In particular, the volatility in output induced by swings in the exchange rate over the 1986-91 period might have been reduced by incorporating this information.

These conclusions regarding the desirability of rules versus discretion in the Japanese context reflect the success of the authorities in achieving and sustaining a low inflation rate using discretionary policies: the credibility of discretion in Japan is not in doubt. In countries that have been less successful in this regard, the case for using rules to establish credibility and reduce the costs of disinflationary policies may be stronger. 1/

1/ Frankel and Chin (1991), for instance, evaluate alternative policy rules under imperfect credibility; their stochastic simulations suggest that nominal income rules dominate money and exchange rate targeting.

Details of a Small Macroeconomic Model for Japan
and Analysis of Its Characteristic Roots

1. Model structure

The broad outlines of the model are described in the main text. The IS curve describes the (logarithmic) deviation in private and foreign spending on domestic output (qpr) from trend (qpr*). ^{1/} The deviation of total GNP (q) from trend equals the deviation in private spending plus the deviation from trend of the ratio of real government spending to GNP (g). The model has been estimated over the 1975 Q1-1991 Q4 period, with the exception of the IS curve, where starting the sample in 1978 Q1 yielded better results. The equations and estimated parameters are as follows (t-statistics in parentheses, where appropriate):

$$\begin{aligned} \text{qpr} - \text{qpr}^* = & 0.127 - 0.391 \cdot \text{RSR}_{-1} - 0.030 \cdot \text{rer}_{-1} + 0.0002 \cdot T \\ & (2.5) \quad (3.1) \quad (2.5) \quad (2.3) \\ & + 0.677 \cdot (\text{qpr}_{-1} - \text{qpr}^*_{-1}) \\ & (6.8) \end{aligned} \quad (\text{A.1})$$

$$q - q^* = \text{qpr} - \text{qpr}^* + g \quad (\text{A.2})$$

$$\begin{aligned} \Delta p = & 1.0 \cdot A(L) \Delta p + 0.094 \cdot (q - q^*) + 0.096 \cdot \Delta(q - q^*) + 0.034 \cdot \Delta \text{rer} \\ & (0.3) \quad (0.1) \quad (1.9) \\ & - 0.010 \cdot \Delta \text{rer}_{-1} - 0.031 \cdot \Delta \text{rer}_{-2} \\ & (0.5) \quad (1.7) \end{aligned} \quad (\text{A.3})$$

$$\begin{aligned} \Delta(m-p) = & 0.0065 + 0.210 \cdot \Delta y + 0.162 \cdot \Delta y_{-1} - 0.088 \cdot \Delta \text{RS}_{-1} - 0.096 \cdot \Delta \text{RS}_{-2} \\ & (2.6) \quad (1.4) \quad (1.1) \quad (0.7) \quad (0.7) \\ & - 0.299 \cdot \Delta \text{RS}_{-3} + 0.327 \cdot \Delta(m_{-1} - p_{-1}) \\ & (2.4) \quad (2.7) \end{aligned} \quad (\text{A.4})$$

$$\begin{aligned} \Delta \text{RL} = & 0.0004 + 0.263 \cdot \Delta \text{RS} - 0.140 \cdot (\text{RL}_{-1} - \text{RS}_{-1}) \\ & (0.4) \quad (1.8) \quad (1.6) \end{aligned} \quad (\text{A.5})$$

^{1/} Trends for both private spending and total GNP were derived by using the Hodrick-Prescott filter (see Hodrick and Prescott (1980)) to detrend the actual series over the historical period.

$$rer = 0.004 + 7.0*(RLR-RLR^e) \quad (A.6)$$

$$\Delta p_s^e = 0.00238 + 0.441*\Delta p + 0.027*\Delta p_{-1} + 0.206*\Delta p_{-2} \quad (A.7)$$

(2.4) (3.7) (0.2) (1.9)

$$\Delta p_l^e = 0.00554 + 0.458*movavg(8,\Delta p) \quad (A.8)$$

(3.7) (5.8)

$$RSR = RS/100 - 4*\Delta p_s^e \quad (A.9)$$

$$RLR = RL/100 - 4*\Delta p_l^e \quad (A.10)$$

As discussed in the main text, equation (A.1) implies that a rise of 1 percentage point in the real short-term interest rate causes real private spending to fall by 1.2 percent in the long run, while a 1 percent appreciation of the real effective exchange rate causes a 0.1 percent decline. The constraint in the inflation equation (A.3) that the coefficients on lagged inflation sum to unity implies that the model is "accelerationist": an output gap will cause inflation to rise (or fall) without bound over time. 1/ Current inflation depends on both the level and the change in the output gap, although the separate coefficients on these variables are not estimated precisely. The money demand function (A.4) is estimated in first differences, as a stable relationship in levels could not be found using this set of explanatory variables. 2/ A 1 percent rise in output causes money demand to increase by 0.6 percent in the long run, while an increase of 1 percentage point in interest rates causes a 0.7 percent decline in money demand.

The error-correction process used to describe the long-term interest rate (equation (A.5)) imposes the property that the long-term rate move one-for-one with the short-term rate over time. No equation could successfully be estimated for the real effective exchange rate based on real interest-rate differentials. This is likely due to errors in expectations of future real exchange rates, with a supporting role played by changes in pure risk premia. In the event, a value of 7.0 was imposed a priori for the parameter on the

1/ A(L) in this equation represents an 8-quarter distributed lag on inflation with coefficients that sum to unity.

2/ This equation excludes two variables used by Corker (1990) to explain money demand--household financial wealth and the "own" interest rate on money balances. Their exclusion circumvents the need to specify additional equations to describe their behavior. Equation (A.4) can be thought of as a quasi reduced form in which these variables are subsumed in activity and nominal interest rates.

real interest-rate differential, reflecting the typical duration of the long-term bond underlying RL. ^{1/} Expectations errors and risk premia changes are then subsumed in the disturbance term. Inflation expectations are modeled in (A.7) and (A.8) as functions of past observed inflation. In estimation, the CPI was used to construct real interest rates, as this yielded more robust results in the IS curve.

2. Characteristic roots

The characteristic roots of the system of equations indicate some properties of the model's responses following a shock, which vary according to the policy rule used. As the model is linear for all rules, the roots are invariant to the values of the endogenous variables. The model for each rule has a root (not shown here) exactly equal to one. This reflects the fact that the policy rules are formulated in terms of growth rates of the target variables; nothing ties down the price level and it is inherently nonstationary. This is consistent with almost all studies of the actual time-series properties of prices. In general, the roots may be either real or complex. When all of the roots are real, the endogenous variables will decay or explode monotonically following a shock, depending on whether the magnitude of the largest root is less or greater than unity. When at least one of the roots is complex, the model will exhibit cycles: the oscillations may be either damped or explosive, again depending on the magnitude of the largest root. As shown below, the largest root for all of the rules considered is complex with a magnitude less than unity, indicating that a shock to the model will generate stable cyclical behavior. The largest root in the case of the money growth target, however, is close to unity, suggesting that the cycles set in motion by a shock decay slowly. For the inflation target, the imaginary part of the associated root is larger than in the other cases, which suggests that model will exhibit shorter cycles than for the other rules. This was verified by the deterministic simulations of various shocks.

| Target | Reaction Function | Largest Characteristic Root | | |
|-----------------------------|------------------------------------|-----------------------------|----------------|-----------|
| | | Real Part | Imaginary Part | Magnitude |
| 1(a). Nominal income growth | $\Delta RSR = 0.5 \Delta(y - y^T)$ | 0.978 | 0.113 | 0.984 |
| 1(b). Nominal income growth | $\Delta MCI = 0.5 \Delta(y - y^T)$ | 0.966 | 0.124 | 0.974 |
| 2. Broad money growth | $\Delta RSR = 0.5 \Delta(m - m^T)$ | 0.991 | 0.108 | 0.997 |
| 3. Inflation | $\Delta RSR = 1.0 \Delta(p - p^T)$ | 0.967 | 0.200 | 0.987 |

^{1/} In the case of Japan, RL is the yield on a government bond with a 10-year maturity. The world long-term real interest rate was constructed as an average of real government bond yields in the United States, Germany, and the United Kingdom, using Japanese trade shares as weights.

The above rules all suppose that policymakers observe contemporaneous income and money when setting the instruments of policy. Tests were also performed to see how robust these rules were when only lagged information is available to policy-makers. ^{1/} Specifically, the current-period values for growth in nominal income, money and prices were replaced by their lagged values in the above rules. In the case of the two nominal income rules, the characteristic roots were little changed by this modification. For the other two rules, in contrast, the largest root rose above unity, indicating dynamically unstable responses. Running the simulations over the 1986-91 period using these alternative rules yielded similar results to those shown in Chart 1 for nominal income targetting, whereas the inflation and money growth rules were significantly less stable. These results suggest that the nominal income rules are more robust to information lags.

^{1/} The issue of the information available to policymakers when setting rules is addressed in McCallum (1992).

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