Bank of Canada.
On conditional rules for monetary policy in a small open economy / by Stephen S. Poloz. Sept. 1988.

BANK OF CANADA.
111

Working Paper 88-1/Document de travail 88-1

On Conditional Rules for Monetary Policy in a Small Open Economy

by Stephen S. Poloz

Bank of Canada Banque du Canada

ON CONDITIONAL RULES FOR MONETARY POLICY IN A SMALL OPEN ECONOMY

Stephen S. Poloz
International Department
Bank of Canada
Ottawa, Canada
K1A 0G9

September 1988

Paper presented at the annual meeting of the Canadian Economics Association, University of Windsor, June 1988. I would like to thank Russell Boyer and Emanuela Cardia for their comments in Windsor. I am also grateful to a number of colleagues, too numerous to mention individually, for comments on an earlier draft. The views expressed below are those of the author, and should not be attributed to the Bank of Canada.

Abstract

This paper examines the implications of shifts in emphasis in monetary policy formulation among intermediate targets for the money stock, the exchange rate and nominal income. These alternatives are considered in the context of a simple rational expectations model incorporating a generalized conditional monetary policy rule involving all three variables. By introducing policy conditionality explicitly, the analysis seeks to capture the real-world observation that monetary authorities rarely adopt simple policy rules that may be described in terms of a single variable.

Résumé

Dans cette étude, l'auteur analyse les conséquences d'une modification de l'importance attribuée aux cibles intermédiaires de masse monétaire, de taux de change et de revenu nominal dans la formulation de la politique monétaire. Cette analyse a lieu dans le cadre d'un modèle simple d'anticipations rationnelles où intervient une règle conditionnelle de politique monétaire mettant en cause les trois variables mentionnées. En introduisant explicitement cette règle conditionnelle, l'auteur cherche à appréhender le phénomène observé dans la pratique, selon lequel les autorités monétaires adoptent rarement des règles de politique qui soient simples et puissent être formalisées à l'aide d'une seule variable.

1. Introduction

This paper examines the implications of the adoption of certain conditional rules for monetary policy within the context of a simple theoretical model. A conditional rule for monetary policy is defined here as a rule in which the setting of the money supply for the current period depends on the realizations of other variables in the same period. The analysis is motivated by the observation that in practice monetary authorities rarely adopt rules for monetary policy that may be described in terms of a single variable. Central bank behaviour can more often be described as "looking at everything," perhaps with emphasis on a certain subset of variables. Moreover, the subset of variables that is emphasized in policy formulation tends to change over time and according to circumstances. While this seems a natural consequence of the complexity of central bank mandates and objective functions (and of the fact that the process by which observed data are transformed into a policy judgement defies a simple algebraic description), neither of these aspects of policy is dealt with explicitly in most of the literature.

The present paper has nothing to say about central bank mandates or about the role of central bank objective functions in determining the nature of monetary policy. It presumes that the monetary authorities will be concerned with more than the variance of real output, at least as it is determined in simple macroeconomic models.[1] Since choosing simple, univariate rules for monetary policy usually involves exchanging one sort of variance for another, the present paper begins with the assumption that the authorities will adopt a rule which lies somewhere between the various simple rules available.[2] A simple model of a small open economy with rational expectations is solved under this fairly general description of policy, and then the implications of increasing emphasis on one target variable or another (a shift in policy focus) for the variables of concern are assessed.

2. The Model and Related Studies

The model has a standard open-economy IS/LM/AS structure, given in equations (1) - (4) below:

$$(1)\quad y = b_0 - b_1(R - p^e_{+1} + p) + b_2(s + p^* - p) + u_1$$

$$(2)\quad p = b_3(y - y^N) + p^e + u_2$$

$$(3)\quad m = p + b_4 y - b_5 R + u_3$$

$$(4)\quad R = R^* + (s^e_{+1} - s) + u_4$$

---

[1]There is a sense in which only the variance of real output matters, since output is the most common measure of macroeconomic welfare and in a natural rate model the level of output is beyond the reach of the authorities, at least in the long run. However, some would argue that most models omit potentially important linkages that affect welfare. In particular, the variances of nominal and financial variables may have an effect on the level of real output or total welfare.

[2]This notion goes back to Poole (1970).

where: all variables are dated at the current period (t), except those bearing the subscript $_{+1}$, which denotes period (t+1);
lower-case symbols denote logarithms;
y = real output, and superscript 'N' denotes its natural level;
p = domestic price level;
s = nominal domestic price of foreign exchange;
R = nominal domestic rate of interest;
m = domestic money stock;
* denotes a foreign variable;
^{e} denotes a rational expectation taken in period t-1;
u_i = exogenous shocks.

Equation (1) is a standard open-economy IS equation, with real output related negatively to the real rate of interest and positively to the real domestic price of foreign exchange. Equation (2) is a Lucas aggregate supply function, which embodies the natural rate hypothesis. Equation (3) is a semi-logarithmic demand for money equation, and equation (4) represents uncovered interest parity. Each equation contains a stochastic shock assumed to be independently normally distributed with a zero mean.

The monetary authority in our model is assumed to have a complex, unspecified objective function, which it maximizes subject to a number of constraints. The most important of the arguments in its objective function is the fundamental goal of monetary policy, namely the provision of a nominal anchor. To accomplish this we restrict attention to a class of rules that involves only nominal variables. However, despite this limitation the choice of policy rule still affects economic outcomes. This is because the choice of which nominal variable, or which linear combination of nominal variables, to hold fixed in the face of exogenous shocks influences the way in which these shocks impact on the variables of concern. Thus, the relative steady-state variances of output, interest rates, exchange rates and the price level will be affected by this choice.[3]

---

[3]See Parkin (1978) for a fuller discussion of this point.

Under the assumption that a number of variables in addition to real output appear in the authorities' objective function, the problem of how to choose an optimal policy is not a simple one. Were we willing to specify such an objective function it would be a reasonably straightforward application of optimal control methods to derive the most appropriate specification of policy. Currie and Levine (1984) undertake such an exercise for a specific loss function and a parameterized model with a prespecified array of shocks. Rather than adopting their approach here, however, we simply attempt to illustrate the nature of the various trade-offs involved in shifting policy from one variable to another.

The nominal variables over which the authorities are assumed to define their intermediate policy goals are the money stock (m), the nominal exchange rate (s) and the level of nominal income (p+y).[4] We specify monetary policy in the following way. The authorities are assumed to have targets for the money stock (m^T), the nominal exchange rate (s^T) and nominal income (n^T), each of which is consistent with the other ex ante in the sense of the ex ante model solution that is implied. Divergences from these three targets are weighted arbitrarily in our general policy rule; for convenience we normalize the latter on the money stock and think of it

---

[4]We choose to exclude the price level as a target of policy because, in a world with nominal rigidities such as contracts, holding the price level fixed forces much of the adjustment to shocks onto real output, a situation which is likely to be judged suboptimal. Although such rigidities are not explicitly represented in our model, our specification of policy takes the existence of such rigidities as given. Currie and Levine (1984) find that the price-level rule outperforms the other rules considered, at least for the loss function that they ascribe to the authorities. In part this may be because their assumed loss function penalizes price and output fluctuations equally.

as the policy instrument, as follows:[5]

$$(5)\ m = m^T - b_6(s - s^T) - b_7(y + p - n^T)$$

Thus, when the exchange rate depreciates relative to its target, or nominal income rises above its target, the authorities respond by tightening policy, forcing the money supply to fall below its target level.

Equation (5) suggests that the authorities can react contemporaneously to deviations from target in all three variables, bringing about changes in the current-period money stock in response. In effect, we are assuming that the private sector is tied to its decisions for the duration of the period based on information available in period t-1, but the authorities have the opportunity to set policy within period t and can respond to some higher-frequency data relevant to the current period. Since we are assuming that the periods in our model are at least one quarter in duration, this assumption does not seem overly restrictive in terms of the exchange rate, since it is observed continuously and policy can react (through adjustments to availability of bank reserves) on a daily basis. The cumulation of these policy adjustments over the course of, for example, a quarter are represented by the money stock in our model. However, data on nominal spending are received quarterly with a substantial lag. Thus,

---

[5]Some may prefer to think of the nominal interest rate as the policy instrument. However, in our model there will be only one unique ex ante value for the interest rate, given the target money stock and the value of all other variables, so it is irrelevant which variable we think of as the policy instrument. Adding the detail necessary to capture the dynamic sequence from actual policy instruments to intermediate targets would add complexity not essential to the issues under consideration.

we suppose that the authorities can construct an unbiased forecast for nominal income (n^F) for the current quarter that incorporates some current-period information, and that they respond to deviations in that forecast from the targeted value with adjustments to the current-period setting of the money stock. Thus, we rewrite the policy rule as follows:

$$(6)\ m = m^T - b_6(s - s^T) - b_7(n^F - n^T)$$

The forecast of nominal income, n^F, might be derived from movements in an indicator variable, for example, that is published with greater frequency than nominal income itself. We suppose that this indicator variable has been found historically to move one-for-one with nominal income, on average, so that in any given period the nominal income forecast differs from actual nominal income by an independently normally distributed error with zero mean (u_5).[6]

$$(7)\ n^F = y + p + u_5$$

Using equation (7) the policy reaction function may be rewritten as follows:

$$(8)\ m = m^T - b_6(s - s^T) - b_7(y + p + u_5 - n^T)$$

[6] In practice the nominal income forecast n^F would not be adjusted one-for-one with movements in the indicator variable, but rather by some fraction that reflected the historical signal/noise ratio of the indicator.

With this characterization of policy we can calculate the effect of a shift in policy focus towards the exchange rate (an increase in b_6) or towards nominal income (an increase in b_7), either of which would necessarily entail a reduction in emphasis on the target for the money stock. A fixed exchange rate rule would imply a value of infinity for b_6, while a nominal income rule would imply an infinite value for b_7. Setting one of these conditioning parameters equal to zero results in either a conditional money stock/exchange rate or money stock/nominal income rule; setting both b_6 and b_7 equal to zero causes policy to collapse to a simple money supply rule.

These three simple rules and the continua of conditional rules that lie between them have been considered previously in the context of a small simulation model with imposed parameters by Longworth and Poloz (1986). They find support in the context of that model for the use of a nominal income rule in conducting monetary policy, particularly in terms of minimizing the variance of real output. However, the cost of this reduction in real variance is found to be an increase in the variance of such variables as interest rates and exchange rates. Using the simulation model to generate the trade-offs between the various types of variance suggests that, if the monetary authorities had normally shaped indifference curves describing preferences for variances of real output, prices and financial variables, they would choose a conditional rule in the class described above. The present paper may be seen as an attempt to generalize this analysis in a theoretical model without imposed parameters.

The choice between a money stock target and an exchange rate target has been analyzed extensively in the context of the fixed versus flexible exchange rate literature. The reader is referred to Parkin (1977), Sparks (1979), Minford (1981), and Artis and Currie (1981) for specific analyses of this issue. The latter paper examines the policy problem in a small, open-economy rational expectations model with cost mark-up pricing. The authors find that stabilization of the exchange rate provides a more stable price level than does money stock targeting, unless foreign prices are an important source of exogenous shocks. Artis and Currie advocate that money supply targets be made conditional movements in the exchange rate so as to avoid wide swings in the latter; a similar conclusion is reached in Minford (1981).

Nominal income targeting has received considerable attention in the literature recently. Some representative papers are Tobin (1980), Gordon (1985), Bean (1983), Masson (1983), Taylor (1985), West (1986), Aizenman and Frenkel (1986) and McNees (1987). While many of these authors indicate the desirability of such a rule for policy, others have emphasized the concomitant practical difficulties. McCallum (1984), for example, recommends that instead of attempting to target nominal income directly, money stock targets should be pursued conditional on the performance of nominal income. Another relevant paper is Rogoff (1985), who analyzes the optimal degree of commitment to a monetary policy rule in a model that combines elements of the literature on the time consistency of policy with standard rational expectations wage contracting models. Among other things, Rogoff shows that in some models the optimal weighting of target variables within a flexible monetary rule can suggest different policy conclusions from those based on a simple comparison of rigid single-variable targeting regimes.

Allowing non-zero values for the two policy-conditioning parameters in the policy rule described above in equation (9) seems both to follow the suggestions of McCallum (1984), Rogoff (1985) and others, and to characterize reasonably well the actual conduct of announced money supply rules. One could think of such conditionality as an additional reason for choosing a target range, rather than a precise target, for the money supply, since such a margin for error would allow the authorities to respond to movements in other variables in the short run while keeping the principal variable within its target.

3. Model Solution and Comparative Statics

In solving the model it is assumed that the exogenous variables of the model are expected to be constant. This means that under rational expectations formed in period (t-1), $x^e = x^e_{+1} = x^e_{+2}$, and so on, which results in some simplification of the solutions.

The solution for the model's endogenous variables may be expressed in the following form:

$$(9) \quad \begin{bmatrix} y' \\ p' \\ R' \\ s' \\ m' \end{bmatrix} = \begin{bmatrix} d_{11} & d_{12} & d_{13} & d_{14} & d_{15} & d_{16} & d_{17} \\ d_{21} & d_{22} & d_{23} & d_{24} & d_{25} & d_{26} & d_{27} \\ d_{31} & d_{32} & d_{33} & d_{34} & d_{35} & d_{36} & d_{37} \\ d_{41} & d_{42} & d_{43} & d_{44} & d_{45} & d_{46} & d_{47} \\ d_{51} & d_{52} & d_{53} & d_{54} & d_{55} & d_{56} & d_{57} \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \\ u_3 \\ u_4 \\ u_5 \\ R^{*\prime} \\ p^{*\prime} \end{bmatrix}$$

where $x' = x - x^e$, $y^e = y^N$ and under expectations the money supply, exchange rate and nominal income are all equal to their announced target levels. The elements of the (5x7) solution matrix (D) are given in the Appendix. Qualitatively, the solution has the following form:

$$(10)\quad \begin{bmatrix} y' \\ p' \\ R' \\ s' \\ m' \end{bmatrix} = \begin{bmatrix} + & - & - & ?^{(1)} & - & ?^{(1)} & + \\ + & + & - & ?^{(1)} & - & ?^{(1)} & + \\ + & ? & + & + & + & + & + \\ - & ? & - & + & - & + & - \\ ? & ? & ? & ? & ? & ? & ? \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \\ u_3 \\ u_4 \\ u_5 \\ R^{*\prime} \\ p^{*\prime} \end{bmatrix}$$

$^{(1)}$positive for $b_6 < b_2 b_5 / b_1$

These signs are generally as expected. However, the size of the impacts of the various shocks on the endogenous variables depends in often complex ways on the two policy parameters, b_6 and b_7. Real output responds positively to IS or foreign price shocks, and negatively to AS and money demand shocks. The response of real output to foreign interest rate or interest parity shocks (which impact the model identically) is ambiguous, depending on the weight that is placed on the exchange rate in policy formulation, hence the condition $b_6 < b_2 b_5 / b_1$. If that weight is low, output will respond positively to such a shock, because the exchange rate will depreciate and aggregate demand will expand in response, but increasing that weight forces the authorities to tighten policy more in response to such a shock and results in a decline in output. A positive error in the nominal spending forecast causes the monetary authorities to tighten policy and causes output to fall, since there was in fact no increase in output to tighten against; this effect, of course, rises with the weight that is placed on nominal spending in policy formulation and is zero under either a simple exchange rate or a pure money supply rule.

The price level reacts positively to positive IS shocks, AS shocks and foreign price level shocks, and negatively to money demand shocks. It reacts positively to foreign interest rate or interest parity shocks if there is a low weight placed on the exchange rate, but negatively if this weight is high. As with real output, a positive error in the nominal spending forecast results in a reduction in the price level if nominal income receives some weight in policy formulation.

The rate of interest rises in response to an IS shock, a money demand shock, a positive error in the nominal income forecast, a foreign interest rate or interest parity shock, and a foreign price level shock. The policy response to an AS shock is ambiguous in the model. Measured in terms of interest rate movement, policy is tightened in response to all shocks except possibly the AS shock; the impact on the money stock, however, is ambiguous in all cases. The exchange rate appreciates in response to an IS shock, a money demand shock, a positive error in the nominal income forecast or a foreign price level shock, and depreciates in response to a foreign interest rate or interest parity shock. In the presence of an AS shock the movement in the exchange rate is ambiguous.[7]

We are now in a position to analyze the implications of increasing the weight attached to the exchange rate or to nominal income relative to the money supply in policy formulation. This is done by differentiating the absolute value of the solutions to the model (the absolute value of the d_{ij} given in the Appendix) with respect to b_6 and b_7. For example, a positive derivative of the output effect of a particular shock with respect to an increase in b_6 would indicate that increasing the emphasis placed on the exchange rate would increase the absolute magnitude of the impact that particular shock typically would have on output.

The signs of the derivatives of the elements of the solution matrix D with respect to b_6 are as follows:

(11) $\text{SIGN}(\partial|D|/\partial b_6) = $

SHOCKS	u_1	u_2	u_3	u_4	u_5	$R^{*\prime}$	$p^{*\prime}$	VARIABLES
	+	?	-	-	-	-	+	y'
	+	?	-	-	-	-	+	p'
	-	-	-	+	-	+	-	R'
	-	-	-	-	-	-	-	s'
	?	?	?	?	?	?	?	m'

[7]The signs of the responses of the interest rate and the exchange rate to foreign interest rate shocks are determined from d_{36} and d_{46} by observing that they are positive for small b_6 and converge to unity and zero, respectively, as b_6 approaches infinity.

Some of the signs in equation (11) could not be determined directly from the solutions, but have been inferred. Specifically, those applying to u_2, u_3, u_4, u_5 and $R^{*\prime}$ with respect to s are based on the presumption that increasing b_6 will reduce the response of the exchange rate to all shocks. Because some of the solutions for the interest rate are similar to those for the exchange rate, the signs of the interest rate entries with respect to u_2, u_3 and u_5, which also are ambiguous, become determinate in this sense. Also, the signs of the interest rate entries with respect to u_4 and $R^{*\prime}$ are determined by examining the limiting case where b_6 approaches infinity. In this case the solution for R collapses to $R' = R^{*\prime} + u_4$; otherwise, the expressions in these two cases are of an indeterminate sign. Finally, the signs of the entries for y' and p' with respect to u_4 and R^* are negative as shown for small b_6, and ambiguous for large values of this parameter.

It is most instructive to consider the various types of shocks and the way in which increased emphasis on the exchange rate affects their impacts on the economy. Beginning with IS shocks, we find that placing increased weight on the exchange rate target leads to greater output and inflation variance, but reduced interest rate and exchange rate variance. In contrast, increasing the weight on the exchange rate causes the effects of shocks to the demand for money and to the nominal income forecast to have less impact on all variables. In the presence of foreign interest rate shocks, aiming at the exchange rate serves to reduce the response of real output, the price level, and of course, the exchange rate, at the expense of a higher interest rate variance. At the same time, emphasizing the exchange rate in policy formulation allows the effects of foreign price level shocks to have a greater impact on domestic real output and inflation. Most of these results have become standard in the macro literature.

We turn now to the implications of an increase in the weight accorded nominal income in the policy formulation process. The signs of the derivatives of the solution matrix D with respect to b_7 are as follows:

$$(12)\quad SIGN(\partial|D|/\partial b_7) = \begin{bmatrix} - & ? & - & - & + & - & - \\ - & ? & - & - & + & - & - \\ + & ? & - & + & ? & + & + \\ + & ? & - & ? & ? & ? & + \\ ? & ? & ? & ? & ? & ? & ? \end{bmatrix} \quad \begin{matrix} \text{VARIABLES} \\ y' \\ p' \\ R' \\ s' \\ m' \end{matrix}$$

$$\text{SHOCKS} \quad u_1 \quad u_2 \quad u_3 \quad u_4 \quad u_5 \quad R^{*\prime} \quad p^{*\prime}$$

As previously, the entries for y' and p' with respect to u_4 and R*' are negative for small values of b_6, and ambiguous for large values. Because the nominal income rule is less simple analytically than the exchange rate rule, there are more indeterminate results in the above matrix than encountered in the case of increasing emphasis on the exchange rate.

The results indicate that the impacts of IS shocks on real income and the price level are mitigated by the increased emphasis on nominal income, but at the expense of greater interest rate and exchange rate variability. As with the exchange rate rule, increased weight on nominal income reduces the effects of money demand shocks on the other variables. However, in this case the effects on real output and prices of errors in the nominal income forecast are magnified. Relative to the simple money rule, the effects of foreign interest rate shocks on real output and prices are reduced by increasing b_7. Shocks to the foreign price level have less impact on real output and prices as the policy weight on nominal income increases, and instead have greater impacts on interest rates and exchange rates.

Discussion

As expected, one cannot make direct inferences about optimal monetary policy from these results. The optimal policy response differs depending on the shock that arises. In specific instances where the shock is observed (a foreign interest rate shock, for example) it may be possible to rank the policies, once a loss function has been specified. However, saying more about the optimal average weights to attach to the three variables would require specifying a utility or loss function for the monetary authorities, as well as estimating the relative average importance of each of the shocks for the particular economy in question.

In the simplest case, where the authorities care mainly about the variance of real output and prices, the inferences are relatively clear: increasing emphasis on nominal spending reduces the impact of most shocks (except possibly aggregate supply shocks) on real output and prices, but increases the importance of nominal spending forecasting errors. Increased emphasis on the exchange rate tends to raise the variances of real output and prices in the presence of IS and foreign price level shocks. Thus, conditioning monetary targets on movements in nominal income in policy formulation might be helpful, on average, in reducing the variability of real output. The optimal weight to place on this variable, however, will depend on the costs associated with the increased interest rate and exchange rate variability that would accompany this shift in emphasis, and on the relative importance of the various types of shocks to the particular economy under study.

4. Concluding Remarks

This paper has investigated the solutions to a very basic open-economy model with rational expectations under a generalized conditional rule for monetary policy. The solutions reveal a number of characteristics that have become standard in the literature, despite the more realistic policy assumption. In this context, shifts in policy emphasis away from money supply targets towards exchange rate and nominal income targets were considered. As expected, it was found that the optimal weighting of these variables in policy formulation would depend both on the shock in question and on the utility or loss function of the monetary authorities. However, the nature of the trade-offs faced by policymakers was illustrated for this general case, and it was found that many of the conclusions regarding policy conditionality reached by Longworth and Poloz (1986) for a specifically parameterized simulation model could be generated in a more standard theoretical model.

The analysis also highlights to some extent the role played by data frequency in policy choice, by incorporating nominal income forecast errors. The magnitude of these errors relative to those in the demand for money equation would be a crucial factor in evaluating the various rules in practice. However, it also seems sensible to retain flexibility in the policy rules, so that when specific shocks can be discerned a specific policy response can be formulated.

APPENDIX

MODEL SOLUTION

The elements of the solution matrix D of equation (9) in the text are as follows:

$$d_{11} = k(b_5+b_6)$$

$$d_{12} = -k(b_1+b_2)(1+b_5+b_6+b_7)$$

$$d_{13} = -k(b_1+b_2)$$

$$d_{14} = k(b_2b_5-b_1b_6)$$

$$d_{15} = -kb_7(b_1+b_2)$$

$$d_{16} = k(b_2b_5-b_1b_6)$$

$$d_{17} = kb_2(b_5+b_6)$$

$$d_{21} = kb_3(b_5+b_6)$$

$$d_{22} = 1-kb_3(b_1+b_2)(1+b_5+b_6+b_7)$$

$$d_{23} = -kb_3(b_1+b_2)$$

$$d_{24} = kb_3(b_2b_5-b_1b_6)$$

$$d_{25} = -kb_7b_3(b_1+b_2)$$

$$d_{26} = kb_3(b_2b_5-b_1b_6)$$

$$d_{27} = kb_3b_2(b_5+b_6)$$

$$d_{31} = k[b_3(1+b_7)+b_4+b_7]$$

$$d_{32} = -(b_5+b_6)^{-1}[k(b_1+b_2)(1+b_5+b_6+b_7) \times (b_3(1+b_7)+b_4+b_7)-(1+b_7)]$$

$$d_{33} = -(b_5+b_6)^{-1}[k(b_1+b_2)(b_3(1+b_7)+b_4+b_7)-1]$$

$$d_{34} = (b_5+b_6)^{-1}[k(b_2b_5-b_1b_6)(b_3(1+b_7)+b_4+b_7)+b_6]$$

$$d_{35} = -b_7(b_5+b_6)^{-1}[k(b_1+b_2)(b_3(1+b_7)+b_4+b_7)-1]$$

$$d_{36} = (b_5+b_6)^{-1}[k(b_2b_5-b_1b_6)(b_3(1+b_7)+b_4+b_7)+b_6]$$

$$d_{37} = kb_2[b_3(1+b_7)+b_4+b_7]$$

$$d_{41} = -k[b_3(1+b_7)+b_4+b_7]$$

$$d_{42} = (b_5+b_6)^{-1}[k(b_1+b_2)(1+b_5+b_6+b_7) \times (b_3(1+b_7)+b_4+b_7)-(1+b_7)]$$

$$d_{43} = (b_5+b_6)^{-1}[k(b_1+b_2)(b_3(1+b_7)+b_4+b_7)-1]$$

$$d_{44} = -(b_5+b_6)^{-1}[k(b_2b_5-b_1b_6)(b_3(1+b_7)+b_4+b_7)-b_5]$$

$$d_{45} = b_7(b_5+b_6)^{-1}[k(b_1+b_2)(b_3(1+b_7)+b_4+b_7)-1]$$

$$d_{46} = -(b_5+b_6)^{-1}[k(b_2b_5-b_1b_6)(b_3(1+b_7)+b_4+b_7)-b_5]$$

$$d_{47} = -kb_2[b_3(1+b_7)+b_4+b_7]$$

$$d_{51} = k[b_6(b_3(1+b_7)+b_4+b_7)-b_7(b_5+b_6)(1+b_3)]$$

$$d_{52} = [kb_7(b_1+b_2)(1+b_5+b_6+b_7)(1+b_3)-b_7] - b_6(b_5+b_6)^{-1} \times [k(b_1+b_2)(1+b_5+b_6+b_7)(b_3(1+b_7)+b_4+b_7)-(1+b_7)]$$

$$d_{53} = kb_7(b_1+b_2)(1+b_3) - b_6(b_5+b_6)^{-1} \times [k(b_1+b_2)(b_3(1+b_7)+b_4+b_7)-1]$$

$$d_{54} = -kb_7(b_2b_5-b_1b_6)(1+b_3) + b_6(b_5+b_6)^{-1} \times [k(b_2b_5-b_1b_6)(b_3(1+b_7)+b_4+b_7)-b_5]$$

$$d_{55} = kb_7^2(b_1+b_2)(1+b_3) - b_6b_7(b_5+b_6)^{-1} \times [k(b_1+b_2)(b_3(1+b_7)+b_4+b_7)-1]$$

$$d_{56} = -kb_7(b_2b_5-b_1b_6)(1+b_3) + b_6(b_5+b_6)^{-1} \times [k(b_2b_5-b_1b_6)(b_3(1+b_7)+b_4+b_7)-b_5]$$

$$d_{57} = -kb_2[b_7(b_5+b_6)(1+b_3)-b_6(b_3(1+b_7)+b_4+b_7)]$$

where:

$$k = [b_5+b_6+(b_1+b_2)(b_4+b_7+b_3(1+b_5+b_6+b_7))]^{-1} > 0$$

References

Aizenman, J. and Frenkel J.A. "Supply Shocks, Wage Indexation, and Monetary Accommodation." Journal of Money, Credit and Banking 18(1986):304-322.

Artis, M.J. and Currie, D.A. "Monetary Targets and the Exchange Rate: A Case for Conditional Targets." Oxford Economic Papers 33(1981): Supplement, 176-200.

Bean, C.R. "Targeting Nominal Income: An Appraisal." Economic Journal 93(1983):806-819.

Corden, M. "Comments: On Monetary Targets." In Monetary Targets, edited by B. Griffiths and G.E. Wood. London: MacMillan, 1981.

Currie, D. and Levine, P. "Simple Macropolicy Rules for the Open Economy." Economic Journal 95(1984):Supplement, 60-70.

Gordon, R.J. "Using Monetary Control to Dampen the Business Cycle: A New Set of First Principles." NBER Working Paper 1210. Cambridge, Mass.: National Bureau of Economic Research, 1983.

Gordon, R.J. "The Conduct of Domestic Monetary Policy." In Monetary Policy in our Times, edited by A. Ando, H. Eguchi, R. Farmer and Y. Suzuki. Cambridge, Mass.: M.I.T. Press, 1985.

Hall, R.E. "Macroeconomic Policy Under Structural Change." In Industrial Change and Public Policy, a Symposium sponsored by the Federal Reserve Bank of Kansas City, 1983.

Longworth, D.J. and Poloz, S.S. A Comparison of Alternative Monetary Policy Regimes in a Small Dynamic Open-Economy Simulation Model. Technical Report No. 42. Ottawa: Bank of Canada, 1986.

Masson, P. Asset Stocks and the Use of Monetary and Fiscal Policies to Reduce Inflation. Technical Report No. 35. Ottawa: Bank of Canada, 1983.

McCallum, B.T. "Monetarist Rules in the Light of Recent Experience." American Economic Review 74(1984): Papers and Proceedings, 388-391.

McNees, S.K. "Prospective Nominal GNP Targeting: An Alternative Framework for Monetary Policy." Federal Reserve Bank of Boston, New England Economic Review (Sept.-Oct. 1987):3-9.

Minford, P. "The Exchange Rate and Monetary Policy." Oxford Economic Papers: 33(1981):Supplement, 120-142.

Parkin, M. "The Transition from Fixed Exchange Rates to Money Supply Targets." Journal of Money, Credit and Banking 9(1977):228-242.

Parkin, M. "A Comparison of Alternative Techniques of Monetary Control under Rational Expectations." The Manchester School 3(1978): 252-287.

Poole, W. "Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model." Quarterly Journal of Economics 84 (1970):197-216.

Rogoff, K. "The Optimal Degree of Commitment to an Intermediate Monetary Target." Quarterly Journal of Economics 100(1985): 1169-1189.

Sparks, G.R. "The Choice of Monetary Policy Instruments in Canada." Canadian Journal of Economics 12(1979):615-25.

Taylor, J.B. "What Would Nominal GNP Targeting do to the Business Cycle?" Carnegie-Rochester Series on Public Policy 22(1985):61-84.

Tobin, J. "Stabilization Policy Ten Years After." Brookings Papers on Economic Activity 1(1980):19-71.

Tobin, J. "Commentary" [on R.E. Hall, "Macroeconomic Policy under Structural Change."] In Industrial Change and Public Policy, Federal Reserve Bank of Kansas City, 1983.

West, K.D. "Targeting Nominal Income: A Note." Economic Journal 96(1986): 1077-1083.

Printed in Canada   Imprimé au Canada