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Exchange and Trade Relations Department

Monetary Control: A Comparison of the U.S. and Canadian Experiences, 1975-1979

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Summary

This paper examines why the interest rate approach to monetary control was, on the surface, more successful in Canada than in the United States, during the 1975-79 period. This is done by examining whether the central banks' monetary control procedures differed in some fundamental way or if the difference lay in the structure of the money demand.

The analysis is presented in two parts. In the first section, a simple money market model is presented in which the central bank uses a monetary aggregate intermediate target and an interest rate operating target, with a reaction function relating the two targets. Since, with interest rate targeting, the effective money supply function incorporates only the behavior of the central bank, it is possible to abstract from institutional differences in the money supply processes and to make a direct comparison of the behavior of the two central banks. Monthly money demand and money supply models for the United States and Canada are then estimated. The results suggest that Canada's apparently better record during the 1975-79 period is not attributable to a greater responsiveness of the monetary policy reaction function to monetary growth. While both models show a positive feedback effect to the interest rate of deviations in money from target, the magnitudes are very small within a given month, implying highly elastic money supply functions. Both central banks also apparently stressed interest rate stability. Thus, neither country appears to have been very aggressive in offsetting short-run changes in money.

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In contrast, the behavior of money demand appears to be considerably different in the two countries. Probably as a result of the absence of regulation Q type interest rate ceilings in Canada, the estimated long-run interest elasticity of money demand in Canada is three times as large as that estimated for the United States during the period examined. As a result, for a given deviation in monetary growth from target, an equal adjustment of the target interest rate in the two countries would lead to a greater response of money demand in Canada. Further, given the reaction function, for a given spending disturbance or shift in money demand, the greater the interest elasticity of money demand, the higher the degree of monetary control. Thus, during the 1975-79 period, the Bank of Canada's apparent relative success in achieving its monetary targets may have been due less to the operating procedure than to the behavior of money demand.

While the examination of the impact of monetary growth on the long-run goals of monetary policy is beyond the scope of this paper, it has been shown that the more elastic is money demand, the less effective will monetary policy be in offsetting recessionary and inflationary pressures. Thus, while the Bank of Canada may have been relatively successful in achieving its monetary targets, the relatively higher interest elasticity of Canadian money demand may have acted to weaken the positive effects of this control.

I. Introduction

In response to the worldwide inflation problems of the 1970s, central banks in a number of major industrialized countries altered their techniques for conducting monetary policy. The common element underlying these new approaches is the view that success in dealing with inflation requires better control of monetary aggregates. At the same time, considerable controversy remains as to the best method of achieving closer control over money. During much of the 1970s, the Federal Reserve employed an interest rate approach to monetary control. Dissatisfaction with the performance of this system led to the adoption of a reserves approach to monetary control in October 1979.

In this paper we re-examine the Federal Reserve's experience with an interest rate approach to monetary control during the 1975-79 period by comparing these procedures to those used by the Bank of Canada. From 1975 until 1982, the Bank of Canada published money supply targets and employed an interest rate operating procedure in attempting to achieve these targets. Unlike the Federal Reserve, however, the Bank of Canada experienced considerable success in hitting its monetary targets and was able to lower monetary growth over time. The purpose of this paper is to examine why an interest rate approach to monetary control apparently succeeded in Canada but not in the United States. Do the control procedures of the central banks differ in a fundamental way or is the behavior of money demand very dissimilar in the two countries? The impact of monetary policy on long-run goal variables is, however, beyond the scope of this paper.

The analysis is divided into two parts. In the first section, we examine the structure of a simple money market model in which the central bank uses a monetary aggregate as the intermediate target and employs an interest rate as the operating target; the model also specifies a reaction function, or feedback mechanism, relating the two targets. Since the effective money supply function in a model with interest rate targetting incorporates only the behavior of the central bank, it is possible to make a direct comparison of the behavior of central banks across countries, abstracting from institutional differences in the money supply process. Then, in the next section, we estimate monthly models of money demand and money supply for both the United States and Canada. Comparison of the interest elasticities of money demand and supply between the two countries provides information as to the reason for Canada's better record of monetary control.

II. Modeling Central Bank Behavior

Generally speaking, central banks undertake monetary policy actions with the ultimate purpose of achieving desired values for long-run goals such as full employment, price stability, economic growth, and balance of payments equilibrium. From the standpoint of day-to-day decisions and operations, however, it is difficult to focus on these objectives because of delayed availability of information and because policy actions affect these variables with a considerable lag. As a result, policymakers focus their attention on short-run targets which they can observe more frequently and influence more directly than the ultimate goal variables.

The choice of short-run monetary policy targets can be divided conceptually into two stages. First, policymakers choose an "intermediate target," a variable that is thought to be closely linked to the goal variables but which is not controlled precisely over a short period of time. Second, policymakers choose an "operating target," which is closely linked to the intermediate target and which can be controlled with considerable precision over a short period of time. 1/

As shown by Poole and Pierce and Thomson, the choice of intermediate and operating targets depends importantly on the types of disturbances causing the goal variables to deviate from their desired values. 2/ The widespread adoption of monetary aggregates as intermediate targets in recent years reflects policymakers' increased emphasis on controlling inflation. Such an emphasis is consistent with the view that real spending disturbances and supply-side disturbances rather than financial disturbances are the principal causes of inflation. 3/

While the use of monetary aggregates as intermediate targets has gained wide acceptance, the choice of an operating target continues to be controversial. The debate as to whether an interest rate or a reserve aggregate is a superior operating target is part technical and part ideological with monetarists generally favoring reserve targets and Keynesians generally advocating interest rate targets. Despite the Federal Reserve's much publicized shift from an interest rate operating target to a nonborrowed reserves operating target, central banks in countries such as Canada, West Germany, and the United Kingdom continue to operate through interest rates in attempting to achieve their intermediate targets.

1. Interest rate targeting

In order to compare the U.S. and Canadian experiences with the use of interest rate operating targets, it is useful to develop a simple model of the money market which incorporates central bank behavior. A

1/ A good discussion of this two-stage process can be found in Friedman (1975). Friedman and others have questioned the efficiency of using this two-stage targeting procedure. See also Friedman (1977); and Bryant (1980), especially pp. 278-333.

2/ Poole (1970); Pierce and Thomson (1972).

3/ For a more complete discussion, see Sellon and Teigen (1981).

standard model consists of the following five equations:

(1) $M^D = a_0 - a_1 r + a_2 Y$ Money Demand

(2) $FR = f_0 - f_1 r$ Free Reserves

(3) $RR = \lambda M$ Required Reserves

(4) $NBR = RR + FR$ Reserves Identity

(5a) $NBR = NBR^*$ Central Bank Reaction Function with Nonborrowed Reserves Target

Equation (1) describes the public's demand for money balances. Money demand is a decreasing function of the interest rate (r) and an increasing function of income (Y). The desired holdings of free reserves (FR) (excess reserves minus borrowings) are taken to be a decreasing function of the interest rate. Required reserves (RR) are a fixed fraction (λ) of money balances. Nonborrowed reserves (NBR) are equal to required reserves plus free reserves. In the standard model, nonborrowed reserves are usually considered to be the operating target of the central bank. With NBR set equal to its target value, NBR*, equations (2), (3), (4), and (5a) can be combined to obtain a money supply function.

$$(6) \quad M^S = \frac{NBR^* - f_0}{\lambda} + \frac{f_1}{\lambda} r$$

which incorporates the behavior of both the banking sector and the central bank. The model consisting of equations (1) and (6) is illustrated in Figure 1.

When the central bank uses an interest rate as an operating target, however, the structure of the model is considerably different. Instead of (5a), we have (5b) describing central bank behavior,

$$(5b) \quad r = r^*.$$

Now, the structure of the model is recursive, rather than simultaneous. With income assumed to be exogenous, the target interest rate r* determines money balances from equation (1) and free reserves from equation (2). The quantity of nonborrowed reserves supplied by the central bank is now endogenous to the system and is derived from equation (4). With an interest rate operating target, the effective money supply function is given by equation (5b) rather than equation (6) and is shown as M^{S*} in Figure 1.

Under interest rate targeting, the model has two interesting properties. First, the central bank fully accommodates the public's demand for money. Thus, to the extent that the central bank maintains a target interest rate in the face of changing money demand, it relinquishes short-term monetary control. Second, any change in the behavior of the banking system is completely offset by central bank actions. For example, if banks increase their desired holdings of free reserves, the central bank will increase nonborrowed reserves sufficiently to maintain the target interest rate. More generally, factors affecting the slope or intercept of the M^S curve in Figure 1 are not permitted to have an impact on the interest rate or the equilibrium quantity of money.

In practice, under an interest rate operating procedure, the central bank does not keep the target interest rate unchanged. Rather, the target interest rate may be adjusted when money growth deviates from its desired path or when additional information on the goal variables becomes available. A more realistic model of interest rate targeting should incorporate a reaction function or feedback mechanism relating the target interest rate to deviations of money from its target and to information on the behavior of the long-run goals. Equation (7) describes the general from of such a relationship,

$$(7) \quad r^* = \gamma_0 + \gamma_1(M-M^*) + \gamma_2 Z.$$

According to equation (7), the target interest rate r* is adjusted as money deviates from its target (M*) and in response to incoming information about the economy (Z). Variables included in Z might be measures of the recent unemployment and inflation experience, income growth, or movements in the country's exchange rate.

Combining equations (5b) and (7), we obtain an effective money supply function under an interest rate target procedure which incorporates a central bank reaction function.

$$(8) \quad M^S = \frac{\gamma_2 Z - \gamma_0 + \gamma_1 M^*}{\gamma_1} + \frac{r}{\gamma_1}$$

Figure 2 illustrates the form of the money supply function under interest rate targeting. In the simple case where the interest rate target is fixed, the effective money supply function, M^S_1, is completely elastic at the target interest rate r*. In contrast, when the interest rate target is changed in response to deviations of money from target, the effective money supply function, M^S_2, has a positive slope. Thus, unlike the fixed target case, the central bank does not fully accommodate changes in the demand for money.

FIGURE 1

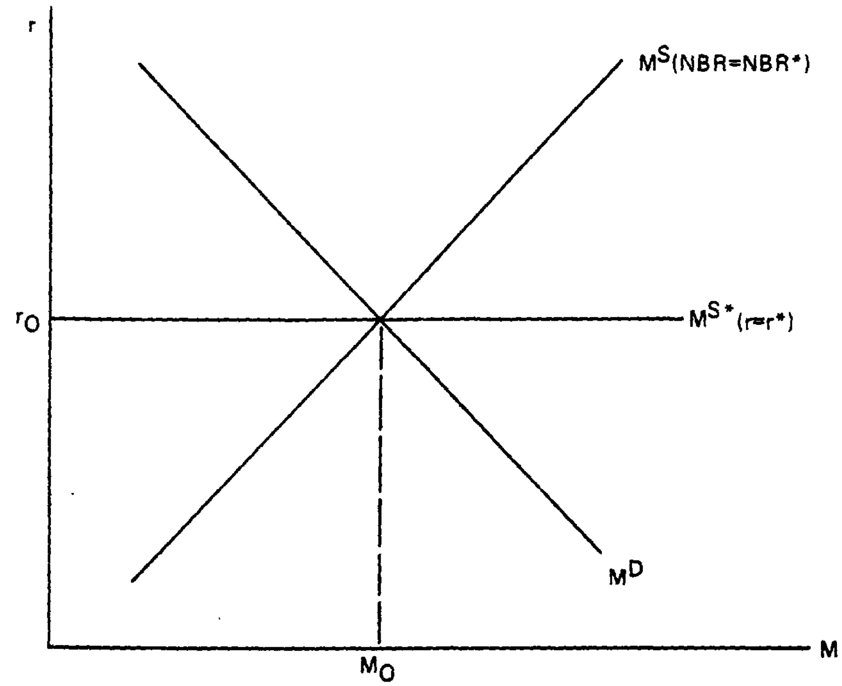
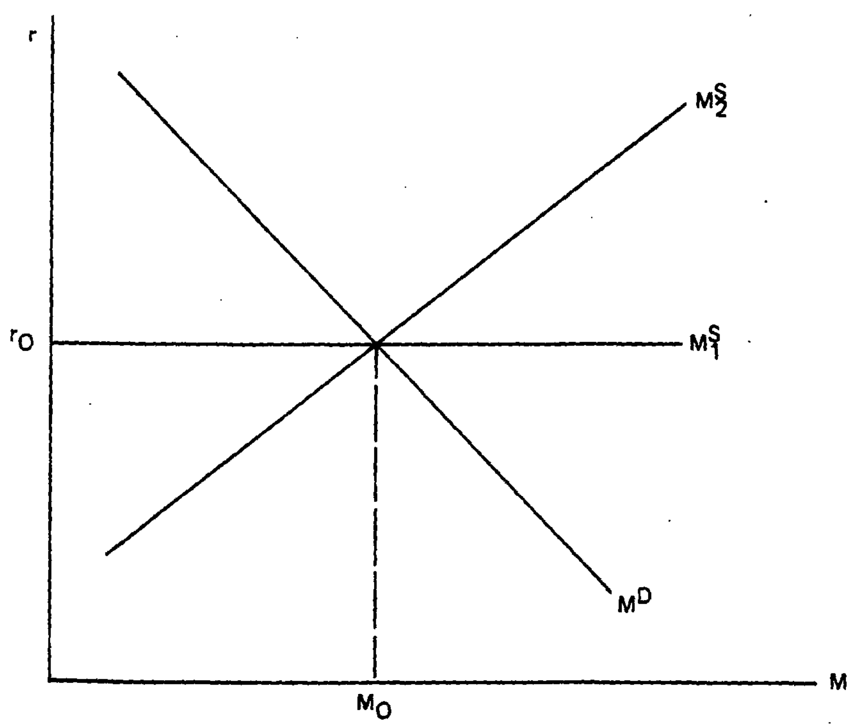


FIGURE 2



In addition, comparison of equations (6) and (8) shows that the effective money supply function under interest rate targeting includes only parameters describing the behavior of the central bank. As in the simple interest rate targeting case, banks' demand for free reserves and other institutional factors are not involved in the determination of the interest rate and quantity of money. As a result of this property of the effective money supply function, under interest rate targeting it is possible to make a cross-country comparison of central bank behavior while abstracting from the detailed institutional structure of the respective banking systems. 1/

2. Implications for monetary control

Generally speaking, the degree of monetary control achieved under an interest rate operating procedure depends upon the types of disturbances affecting the money market, the interest elasticity of the demand for money, and the responsiveness of the central bank's interest rate target to undesired money growth. Since a monetary aggregate intermediate target is appropriate in dealing with the inflationary consequences of real spending disturbances and supply disturbances, we will confine our attention to these types of shocks.

A comparison of relative monetary control in two countries using an interest rate operating procedure rests, then, on a comparison of the relative interest elasticities of money demand and effective money supply. For a given spending or supply-side disturbance which causes an unanticipated change in the demand for nominal money balances, monetary control will be greater the larger the feedback response from money growth to the interest rate target and the more interest elastic is the demand for money balances.

These results are illustrated in Figures 3a and 3b. The slope of the effective money supply functions in Figure 3a reflects the response of the central bank's interest rate target to deviations in money from target. A steeper slope indicates a stronger feedback response. Thus, for a given shift in money demand from M^D to $M^{D'}$, the steeper money supply curve results in better monetary control. Figure 3b shows the effect of differing money demand elasticities with a given money supply function. In this case, for a given money demand shift, monetary control is greater as the demand for money is more interest elastic.

1/ This statement needs to be qualified in two respects. First, it is not meant to imply that institutional differences do not matter, but rather, that these differences would be found in the parameters determining central bank behavior, the γ's in equation (8). If commercial bank behavior has an impact on interest rates and money, it does so because the central bank chooses not to offset this behavior. Of course, this statement, in turn, implies that the central bank can hit its operating target. Second, this model abstracts from such complications as multiple interest rates, multiple monetary aggregate targets, differential reserve requirements, and interest rate ceilings. When these factors are considered, institutional differences between countries could show up in the form of the money demand function.

In the following section, we estimate a simple money demand and supply model for both the United States and Canada. One possible explanation for Canada's better record on monetary control is a greater willingness to change short-term interest rates in response to deviations in money from target. If this is the case, one might expect to find a more inelastic effective money supply function for Canada than for the United States. Alternatively, some part of the improved monetary control in Canada may be a result of a greater interest elasticity of money demand.

III. Empirical Analysis

1. Background on U.S. and Canadian targeting procedures

Before beginning a detailed discussion of the empirical analysis, it is useful to describe some of the similarities and differences characterizing U.S. and Canadian monetary control procedures during the 1975-79 period. 1/ The broad outline of the procedures in the two countries is quite similar. Policymakers begin with a desired performance of the principal goal variables such as inflation and unemployment. Desired values for these ultimate targets of policy are then translated into money growth targets. Finally, using a simple money demand framework, policymakers identify a level of short-term interest rates that is thought to be consistent with desired money growth. Short-run policy actions are directed at maintaining the interest rate target until new information on money growth or the goal variables suggests that the interest rate target should be changed. 2/

During the 1975-79 period, both the Federal Reserve and the Bank of Canada employed a narrowly defined monetary aggregate, M1 (currency and demand deposits), as an intermediate target. 3/ The long-run target ranges and actual money growth rates for both countries are shown in Table 1. Both countries lowered the target ranges over time in an attempt to reduce the trend rate of monetary growth. At the same

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1/ The 1975-79 period is the only period in which both countries used an interest rate operating target and a monetary aggregate intermediate target and for which published money targets exist. Both countries began publishing long-run monetary targets in the second quarter of 1975. The Federal Reserve shifted from an interest rate operating target to a reserves operating target in October 1979. The Bank of Canada abandoned this basic approach in late 1982.

2/ A discussion of Federal Reserve procedures can be found in Federal Reserve Bulletin, May 1976, pp. 411-21; and Lombra and Torto, (1975). For a summary of the Canadian procedures, see Annual Report of the Governor, Bank of Canada, Ottawa, Ontario, especially 1975 and 1976; also see Courchene (1979).

3/ During this time period, the Federal Reserve set targets for several monetary aggregates. At times, some weight was placed on the broader aggregates. For the purpose of this paper, however, M1 is the only aggregate considered.

FIGURE 3a

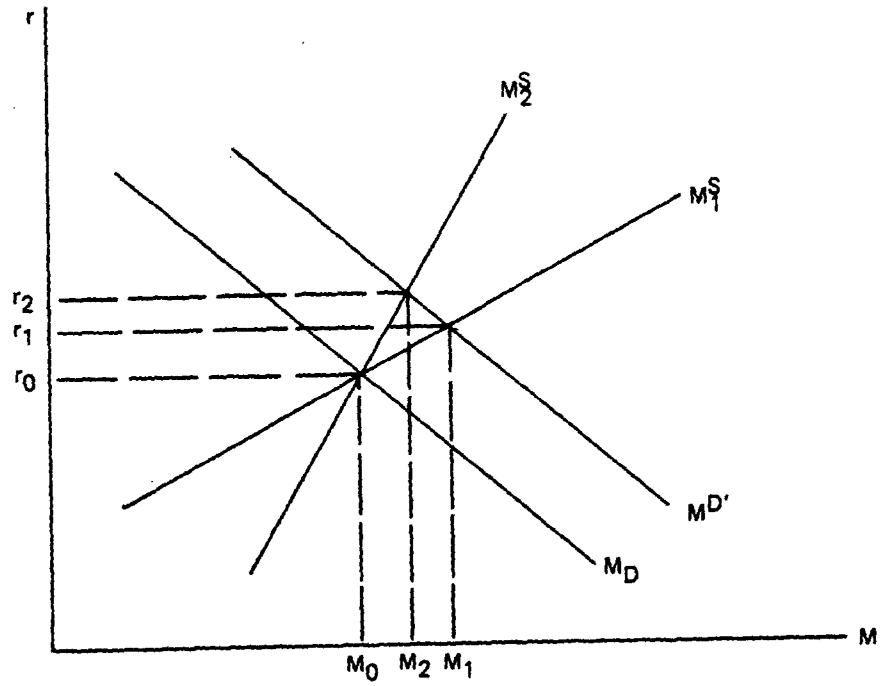

FIGURE 3b

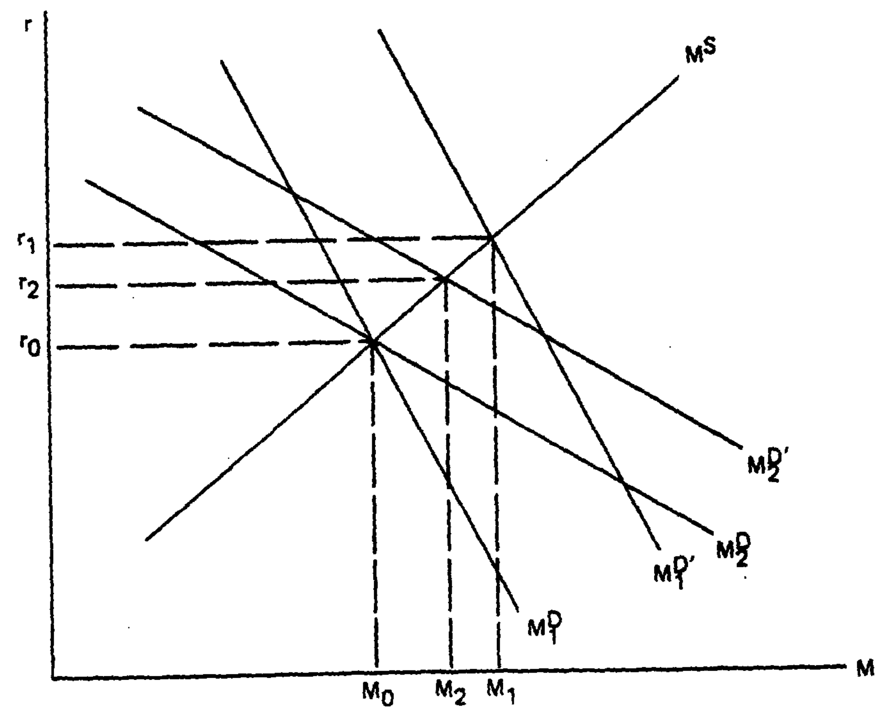

Table 1. Monetary Targets and Actual Money Growth (M1), 1975-79
For the Unites States and Canada

(In percent)

Period	Target	Actual Money Growth
I. United States		
1975:QII-1976:QII	5.0-7.0	5.4
1975:QIV-1976:QIV	4.5-7.0	5.8
1976:QIV-1977:QIV	4.5-6.0	7.7
1977:QIV-1978:QIV	4.0-6.5	7.2
1978:QIV-1979:QIV	3.0-6.0	5.4 1/
II Canada		
1975:QII-Feb./Apr. 1976	10-15	11.0
Feb./Apr. 1976-1977:QII	8-12	7.8
June 1977-June 1978	7-11	9.2
June 1978-1979:QII	6-10	8.0

1/ Federal Reserve changed operating procedures October 1979.

time, it is clear that the Canadian target ranges were somewhat wider than the U.S. ranges, and permitted higher monetary growth.

One important difference between the two countries can be found in the mechanism for setting and revising these monetary targets. In Canada, the long-run targets were maintained for an extended period of time. The desired rate of monetary growth determined the midpoint of the target ranges. The ranges were typically not revised until it appeared that the trend rate of monetary growth had stabilized near the midpoint of the current range. 1/

In contrast, in the United States the long-run targets were frequently revised, resulting in a so-called "base-drift" problem. 2/ That is, the base period from which the target growth rates were measured was continually updated so that it was difficult to maintain consistency between sets of targets over time. Furthermore, in the United States, the long-run targets were not an ongoing constraint on short-run policy decisions. Instead, short-run decisions were based on a series of two-month growth ranges set at monthly FOMC meetings. To the extent that these short-run money objectives were related to the long-run targets, they were also subject to "base drift."

At the operating level, both countries employed interest rate targeting as a means of controlling money. In the United States, day-to-day open market operations were directed at maintaining a target federal funds rate that was thought to be consistent with the short-run money growth targets. The manager of the open market account had some discretion in adjusting the target funds rate when money growth deviated from target. Larger movements in the interest rate target, however, required FOMC approval.

In Canada, operating procedures were somewhat less structured. Instead of attempting to precisely control a specific short-term interest rate, policymakers tended to focus attention on a set of short-term interest rates or on general money market conditions. Reserves would be added or removed as necessary to move short-term rates in the direction consistent with achieving money growth objectives. Officials of the Bank of Canada generally viewed the 90-day commercial paper rate as representative of short-term interest rates.

2. General form of the model

The general form of the model used for both the United States and Canada consists of a money demand function and an effective money supply function,

$$(9) \quad M^D_t = \alpha_0 - \alpha_1 r_t + \alpha_2 Y_t + \alpha_3 M_{t-1}$$

$$(10) \quad r_t = \gamma_0 + \gamma_1 (M_t - M^*_t) + \gamma_2 Z + \gamma_3 r_{t-1}$$

1/ A more detailed discussion of the Canadian procedures can be found in Sellon (1982).

2/ For a discussion of this problem, see Poole (1976).

Equation (9) is a standard, partial adjustment money demand function with money demand depending on a short-term interest rate, income, and lagged money. In Equation (10), the short-term interest rate used as an operating target depends upon the deviation of money from target, a set of exogenous variables Z, and the lagged value of the interest rate. Inclusion of Z in the reaction function indicates that the central bank does not react blindly to deviations of money from target. Forecasts of the ultimate goal variables such as inflation and unemployment or the country's exchange rate may enter into the decision to adjust the interest rate target. Similarly, the central bank may place some weight on interest rate variability as well as monetary control. For this reason, the lagged interest rate also appears in the reaction function.

Since information on goal variables such as inflation and unemployment is available only with a lag, policymakers frequently rely on forecasts of these variables. As these forecasts are not generally available to researchers, the following section describes a method for generating forecasts of the variables to be included in Z.

3. Forecasts of goal variables

In this paper, forecasts of the long-run goal variables entering the central bank's reaction function are generated in such a way as to allow consistent estimates of the reaction function coefficients. The basis of this approach is to assume that policymakers forecast "consistently." 1/ A "consistent" forecast means a prediction process which takes account of information which does improve upon the predictions that can be made solely on the basis of the past values of a variable. Further, it is assumed that the way in which these observations on additional variables affect the forecast of the goal variable is the same as the manner in which these variables affect the actual values of the goal variable.

The consistent expectation of a variable, Z, is the expectation of that variable conditional on the information set relevant to that variable which is employed by the policymaker. In general;

$$\tilde{Z}_t = E(Z_t | \Omega^Z_{t-1})$$

where Ω^Z_{t-1} is the available information set used in forecasting Z. More specifically, our measure for a predictor $\tilde{Z}$ will be the one period-ahead prediction using a regression equation of the form,

$$(11) \quad Z = \Phi_0 + \Phi_1 W_1^Z + \Phi_2 W_2^Z + \cdots \Phi_n W_n^Z$$

1/ For a discussion of this procedure, see Abrams, Froyen, and Waud (1980).

where the sample period for the regression is the 60-month period ending with T-1; the W_i^Z, $i=1...n$, are elements of Ω^Z_{t-1}, and the Φ_i's are parameters to be estimated.

For the United States, predictors were created for three variables: unemployment ($\tilde{U}$), inflation ($\tilde{P}$), and the effective dollar devaluation ($\tilde{D}$), using equation (11). The predetermined variables, W_i^Z, were chosen to include a set of major variables which almost any theoretical model would indicate as influencing the Z's. These variables are listed in Table 2. With the exception of lagged values of the dependent variable, all variables enter the forecast equation with a single lag, since no observation for the current month is assumed to be available. 1/

Table 3 gives the correlation coefficient between the predicted and actual values for unemployment, inflation, and the dollar devaluation.

Table 2. Predetermined Variables used to Generate Predictors for Goal Variables

United States	Canada
Nominal personal income	Nominal gross national expenditure
Unemployment rate	Unemployment rate
Inflation rate (CPI)	Inflation rate (CPI)
Exchange rate (effective devaluation of the dollar)	Exchange rate (U.S. dollar price of Canadian dollar)
Federal funds rate	90-day commercial paper rate
Government expenditure	Government expenditure
Government revenue	Government revenue
Money supply (M1)	Money supply (M1)
Treasury bill rate	Total reserves
	U.S. unemployment rate
	U.S. personal income

1/ The choice of a 60-month time period is arbitrary. Tests creating additional observations of the vector of lagged variables from Table 2 did not improve the fit of the forecasting equations. An example may clarify how the predictors were generated. First, a regression of the form of equation (11) was estimated from period 1 to period T where the W's are lagged values of the dependent and predetermined variables. Then, a forecast is made for Z in period T + 1. This prediction becomes the first element in the $\tilde{Z}$ vector. The sample period is then moved ahead to include the periods 2 to T + 1 and the basic regression is re-estimated. A second forecast of Z is made for period T + 2 and this becomes the second element of $\tilde{Z}$. The remaining values of the predictor are generated in the same manner.

As can be seen from the table, with the exception of the inflation rate, the forecasts are closely correlated with the actual values. Because of low correlation between the actual and predicted inflation rates, it can be argued that there would be little reason for the monetary authority to react to an inflation forecast which is so unreliable.

Table 3. Correlation Coefficients Between Predictors and Actual Values

Predictor	Correlation Coefficient
I. United States	
Unemployment rate ($\tilde{U}$)	0.97
Inflation rate ($\tilde{P}$)	0.60
Effective dollar devaluation ($\tilde{D}$)	0.94
II. Canada	
Unemployment rate ($C\tilde{U}$)	0.90
Inflation rate ($C\tilde{P}$)	0.12
Exchange rate ($C\tilde{E}$)	0.96

Three predictors were also tested in the Canadian model: unemployment ($C\tilde{U}$), inflation ($C\tilde{P}$), and the exchange rate ($C\tilde{E}$) expressed as the U.S. dollar in terms of Canadian dollars. Forecasts for these variables were generated using a single lag of a vector of predetermined variables listed in Table 2 and three lagged values of the dependent variable. The major difference between the Canadian and U.S. vectors of predetermined variables in Table 2 is that the Canadian set includes key U.S. economic variables.

For the Canadian model, the correlations between actual and forecasted values of the predictor variables are shown in Table 3. The correlations for unemployment and the exchange rate are quite high. The low correlation between actual and predicted inflation may indicate a severe errors-in-variables problem in the predictor. On the other hand, the monthly Canadian inflation rate may, in fact, be difficult to predict accurately. If this is the case, there would be little reason to expect policymakers to react to this forecast.

4. Estimation of the U.S. model

The specific form of the model for the United States is given in equations (12) and (13),

$$(12)\quad LRM1_t = b_0 + b_1 LRY_t + b_2 LFFR_t + b_3 DUMATS_t + b_4 MSHIFT_t + b_5 LRM1_{t-1} + e_t$$

$$(13)\quad LFFR_t + a_0 + a_1 LMM_t^* + a_2 L\tilde{U}_t + a_3 L\tilde{P}_t + a_4 L\tilde{D}_t + a_5 LFFR_{t-1} + \hat{e}_t$$

where L is logarithm and ~ indicates a consistent predictor. The public's demand for real money balances (RM1) depends upon real income (RY), the Federal funds rate (FFR), and a lagged dependent variable. DUMATS is a dummy variable set equal to 1.0 beginning in November 1978 to account for the impact of ATS accounts. MSHIFT is a dummy designed to remove the effect of the shift in money demand from March 1974 through November 1976. The expected signs on the coefficients are: $b_2, b_3, b_4 < 0$; and $b_1, b_5 > 0$.

In the reaction function, equation (13), the Federal funds rate (FFR) is a function of the predictors for unemployment ($\tilde{U}$), inflation ($\tilde{P}$), and the dollar devaluation ($\tilde{D}$), the lagged Federal funds rate, and the deviation of money (M) from its target value (M*). M* is the desired level of money for the current month implied by the midpoint of the two-month growth rate adopted at the previous month's FOMC meeting. The expected signs for the coefficients are: $a_2, a_4 < 0$; and $a_1, a_3, a_5 > 0$.

Table 4 presents parameter estimates for equations (12) and (13) for the period from June 1975 through September 1979. The model was estimated using an instrumental variables procedure with the constant term, lagged dependent variables, and the other exogenous variables in the model used as instruments.

The estimated parameters of the money demand function are quite similar to those found elsewhere in the literature. The elasticity of real money demand with respect to real income is 0.21 in the current month and 0.86 in the long run. The short-run interest elasticity of money demand is 0.027, while the long-run elasticity is 0.11. The coefficient on the lagged money stock is 0.755, implying an adjustment speed of approximately 25 per cent.

Table 4. Simultaneous Estimates of the
U.S. Money Demand and Money Supply Equations,
June 1975-September 1979

Money Demand Equation (LRM1 dependent)		Money Supply Equation (LFFR dependent)	
intercept	-0.229 (-2.337)	intercept	2.723 (2.940)
LRY	0.211 (3.518)	LMM*	1.396 (2.338)
LFFR	-0.027 (-3.304)	$\tilde{LD}$	-0.550 (-2.981)
DUMATS	-0.010 (-2.800)	$LFFR_{t-1}$	0.892 (18.783)
MSHIFT	-0.293 (-2.836)		
$LRM1_{t-1}$	0.755 (12.558)		
Standard error	0.00037		0.036
N =	52		52

t-statistics in parentheses.

Turning to the estimation of the reaction function, equation (13), the results in Table 4 indicated a small feedback effect from money to the Federal funds rate target. The elasticity of the federal funds rate with respect to deviations of money from target is positive and significant. Thus, for every 1 per cent deviation in the monthly money supply from the midpoint of the two-month tolerance range, the funds rate was increased by 1.396 per cent (approximately .09 percentage points with an average funds rate of 6.50 per cent). In addition, the large coefficient on the lagged dependent variable, 0.89, suggests a strong preference for interest rate stability during this period. Thus, when money deviated from target, only 10 per cent of the interest rate change needed to restore desired money growth would occur in a given month.

Of the three predicators used, only the coefficient on the forecast dollar devaluation, $\tilde{D}$, is significant and of the expected sign. The results indicate a short-run elasticity of the funds rate with respect to the expected devaluation of -.55. The significance of this coefficient should, at least partially, stand in contrast to the argument of the U.S. "benign neglect" of the dollar during this period.

Neither the inflation predictor nor the unemployment predictor was significant. Both predictors were eliminated from the final form of the model and so are not reported in Table 4. In the case of the inflation predictor, the insignificance may be the result of the quality of the predictor, since its correlation with the observed inflation rate, 0.60, is rather low. Alternatively, since the use of a money intermediate target is appropriate for a long-run goal of controlling inflation, predicted inflation may be subsumed in the use of a money target. 1/ Similarly, the insignicance of forecast unemployment may be due to current information on $\tilde{U}$ being incorporated into the setting of the short-run target, M*.

5. Estimation of the Canadian model

The specific form of the model for Canada is given in equations (14) and (15),

$$(14)\quad LCM1_t = b_0 + b_1LCCP_t + b_2LCY + b_3CPOD1_t + b_4CPOD2_t + b_5CPOD3_t + b_6CPOD4_t + b_7CM1SHIFT_t + b_8LCM1_{t-1} + e_t$$

$$(15)\quad LCCP_t = a_0 + a_1LCMM_t + a_2L\tilde{CU}_t + a_3L\tilde{CP}_t + a_4L\tilde{CE} + a_5LCCP_{t-1} + e'_t$$

where L is logarithm and ˜ indicates a consistent predictor. In the case of Canada, a nominal specification of money demand provided more reasonable parameter estimates than a real specification. In equation (14), the demand for nominal money balances (CM1) depends upon the 90-day commercial paper rate (CCP), income (CY, GNE interpolated from quarterly data), four postal strike dummies (CPOD1 to CPOD4), a dummy variable to capture the effects of the adoption of more sophisticated cash management practices of Canadian corporations in 1976 and 1977, and a lagged dependent variable. 2/ The expected signs of the coefficients are $b_1, b_7 < 0$ and $b_2, b_3, b_4, b_5, b_6, b_8 > 0$.

1/ Given the poor quality of the inflation predictor, a number of lagged variables using the actual inflation rate were tried, without success.

2/ A discussion of recent financial innovation in Canada is contained in Landy (1980).

In the reaction function, equation (15), the dependent variable is the Canadian 90-day commercial paper rate (CCP). The paper rate is a function of the deviation of the current month's level of money from the midpoint of the long-run range (CMM*); the predictors for unemployment ($C\tilde{U}$), inflation ($C\tilde{P}$), and the Canadian-U.S. exchange rate ($C\tilde{E}$); and the lagged value of the Canadian paper rate. Unlike the Federal Reserve, during this period the Bank of Canada did not publish short-run money targets. Thus, for Canada, the target variable used is the midpoint of the long-run range. The lagged Canadian commercial paper rate is included as a measure of the Bank of Canada's desire for interest rate stability. The expected signs on the coefficients are: $a_1, a_3, a_5 > 0$; and $a_2, a_4 < 0$.

Table 5 contains parameter estimates for equations (14) and (15) for the period June 1975-September 1979. The model was estimated using the same instrumental variable procedure as in the U.S. model. The most interesting characteristic of the Canadian money demand function, equation (14), is the interest elasticity of money demand. The short-run elasticity in the Canadian equation is 0.065, approximately two and one-half times as large as the U.S. elasticity reported in Table 4. Moreover, with a slightly slower speed of adjustment in the Canadian equation, the long-run interest elasticity of money demand in Canada is three times as large as the corresponding U.S. elasticity. 1/

The difference in the interest elasticities in the two countries has been attributed to the absence of Regulation Q type interest rate ceilings in Canada. 2/ In Canada, unlike the United States, market interest rates were paid on short-term savings balances. As a result, when market interest rates rose in Canada, funds were shifted from transactions accounts to savings accounts, a process that did not occur in the United States.

Turning to the estimation of the reaction function for the Bank of Canada, equation (15), the results in Table 5 indicate a small but significant feedback effect from money to the interest rate operating target. The elasticity of the Canadian commercial paper rate to short-run deviations of money from target is 1.08, somewhat smaller than the corresponding elasticity for the United States. 3/ In addition, the coefficient on the lagged interest rate is of a magnitude similar to the corresponding coefficient in the U.S. reaction function. This

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1/ These results are similar to other studies of the demand for money in Canada. For a summary of recent studies, see Marothia and Phillips (1982).

2/ Freedman (1982).

3/ The smaller size of the coefficient for Canada as compared to the United States may be partially attributable to the use of an interest rate with a longer maturity (the 90-day commercial paper rate versus the overnight Federal funds rate). Generally, one might expect a smaller change in a longer term rate to be necessary to hit a given money growth target.

Table 5. Simultaneous Equation Estimates of the Canadian Money Demand and Money Supply Equations: June 1975-September 1979

Money Demand (LCM1 dependent)		Money Supply (LCCP dependent)	
intercept	-1.358	intercept	0.510
	(-1.419)		(1.718)
LCCP	-0.065	LCMM*	1.077
	(-1.936)		(3.044)
LCY	0.303	LC$\tilde{U}$	-0.158
	(2.901)		(-1.416)
CPOD1	0.059	LC$\tilde{E}$	-0.277
	(7.061)		(1.784)
CPOD2	0.003	LCCP$_{-1}$	0.913
	(0.341)		(1.956)
CPOD3	0.020		
	(2.276)		
CPOD4	0.016		
	(1.729)		
CM1SHIFT	-0.037		
	(1.445)		
LCM1$_{-1}$	0.779		
	(10.656)		
Standard error	.0078		.035
N =	52		52

t-statistics in parentheses.

suggests that in both countries, the interest rate target was adjusted relatively slowly over time in an attempt to return money to target.

Of the various predictors used in the Canadian reaction function, only the forecast of the exchange rate approached significance at the 5 per cent level. While the unemployment predictor was of the correct sign and of reasonable magnitude, the inflation predictor was sufficiently poor to be dropped from the final estimation. 1/

6. Implications for monetary control

In the model of central bank behavior presented above, two factors were singled out as important determinants of monetary control. For a given change in money demand, monetary control improves with the willingness of the central bank to change its interest rate target, that is, the more interest inelastic is the effective money supply curve. Monetary control is also improved, the more interest elastic is money demand.

The empirical results for the United States and Canada presented in this paper suggest that Canada's better record of monetary controls during 1975-79 is not attributable to a greater responsiveness of the interest rate target to undesired money growth. Both the U.S. model and the Canadian model show a significant positive feedback effect from deviations in money from target to the interest rate. The magnitude of this effect within a month, however, is very small in both countries so that the effective money supply functions are very elastic. In addition, during 1975-79 both countries appear to have attached considerable weight to interest rate stability. For both countries, the interest rate target was adjusted from month to month so as to eliminate only about 10 per cent of the deviation of money from target. Thus, neither country appears to have been very aggressive in offsetting short-run changes in money.

In contrast, the behavior of money demand appears to be considerably different in the two countries. The empirical results indicate that the long-run interest elasticity of money demand in Canada is three times as large as the U.S. interest elasticity. Thus, for a given disturbance which causes money growth to deviate from target, an equal adjustment of the target interest rate in the two countries would lead to a greater response of money demand in Canada.

In conclusion, while the Bank of Canada was quite successful in achieving its monetary targets using an interest rate operating procedure during 1975-79, this paper suggests that this success may have been due less to the operating procedure than to the behavior of money demand. While the examination of the impact of monetary growth on the long-run goals of monetary policy was beyond the scope of this

1/ As in the U.S. model, a variety of lagged values of the actual Canadian inflation rate was used in place of the inflation predictor, also without success.

paper, it has been shown that the more elastic is money demand, the less effective will monetary policy be in offsetting recessionary and inflationary pressures. 1/ Thus, while the Bank of Canada may have been relatively successful in achieving its monetary targets, the relatively higher interest elasticity of Canadian money demand may have acted to weaken the positive effects of this control.

1/ Vernon (1977).

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