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ECONOMIC STABILIZATION AND THE MONEY SUPPLY

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CONTENTS

ABSTRACT

In this report the authors discuss two types of short-run deviations in the money supply from a desired growth path: (1) a random shift in the demand for money, which should be accommodated; (2) a deviation reflecting changes in the arguments of the demand-for-money function, which would require an offsetting change in short-term interest rates from the viewpoint of stabilization policy. The focus of the study is on case two. The simulated response of aggregate demand to two such deviations of the same magnitude but differing duration is compared in two models: the latest version of RDX2 and a monetarist reduced-form model. This permits the estimation of a possible range with respect to the magnitude and timing of changes in aggregate spending due to deviations from a desired monetary growth path.

RÉSUMÉ

Dans une analyse de l'écart conjoncturel qu'on enregistre lorsque la masse monétaire s'éloigne du profil de croissance visé, les auteurs de cette étude font une distinction entre les variations aléatoires de la demande de monnaie et les variations attribuables aux déterminants de cette demande. Ils soutiennent qu'une variation du premier type devrait être entérinée purement et simplement mais que, dans le cadre d'une politique de stabilisation, une variation du second type devrait être contrecarrée par un ajustement des taux d'intérêt à court terme. À l'aide de la plus récente version du RDX2 et d'un modèle monétariste de forme réduite, les auteurs du rapport ont simulé et comparé les réactions de la demande globale à deux écarts du second type; les écarts choisis étaient de même ordre de grandeur, mais de durée différente. Ces simulations permettent de mieux juger l'ampleur des variations de la dépense globale attribuables aux écarts du taux d'expansion monétaire par rapport au profil visé ainsi que les retards avec lesquels ces variations se produisent.

1 INTRODUCTION

During the last couple of years the Bank of Canada has been placing increasing emphasis on the rate of growth of the money supply as the intermediate target for monetary policy, rather than on credit conditions measured by either the free liquid asset position of chartered banks or interest-rate levels. The central bank's influence over short-term interest rates is now geared toward achieving desired growth of the money supply consistent with the objective of stabilizing the growth of aggregate spending in the economy and, therefore, prices.

This increased emphasis on the rate of monetary expansion as a means of stabilizing aggregate spending raises the question of the destabilizing influence of short-run deviations of a monetary aggregate from the target rate of growth. In this paper we present some empirical evidence relating to the Canadian economy[1] on the effect of such deviations with respect to their magnitude and duration. In Section 2 the types of short-run deviations that might occur in the money supply are discussed. In Section 3 we present the simulation results from the two econometric models that were used to estimate the impacts of the deviations. These simulations involved short-run deviations above a target rate of monetary expansion. Any deviation of the same magnitude below the target would, in these models, produce results virtually the opposite of those presented in this paper. For the simulations we used the narrow definition of money supply, currency plus demand deposits (M1), which is the definition emphasized by the Bank of Canada when discussing target rates of monetary expansion.

2 SHORT-RUN DEVIATIONS OF THE MONEY SUPPLY FROM ITS TARGET

2.1 The Nature of the Deviations

It is well known that the central bank's control over a given monetary aggregate is not complete. In the literature, deviations from a desired growth path are commonly described as resulting from imperfect forecasts of the "money multiplier" - the relationship between the monetary base, which is under the effective control of the central bank, and the desired monetary aggregate. This approach to the money-supply process does not, however, characterize the way in which monetary policy is currently implemented in Canada. The Governor of the Bank of Canada indicated the Bank's current approach to the control of the money supply in his 1975 Annual Report to the Minister of Finance:

> Individual members of the public are, of course, free to decide for themselves how much of their financial assets to hold in the form of currency and demand deposits, but the Bank of Canada can exert a strong indirect influence on these decisions - and thus on the trend of M1 - by virtue of its ability, through its cash reserve management, to influence the level of short-term interest rates. (pp. 17-18)

Thus, conditional upon its forecast of prices and output and some assumptions about the characteristics of the demand-for-money function, the Bank of Canada seeks to achieve levels of short-term interest rates that it believes are consistent with the

target trend of M1. Given this approach to controlling the money supply, there are two basic situations in which the targeted interest rate will not generate the anticipated growth in M1.

The first situation relates to the fact that the demand for money by individual members of the public is subject to transient influences which may produce rather wide and unpredictable fluctuations in this aggregate even though output and prices are developing in the manner forecast. As one example, an interruption of mail service, by reducing the efficacy of the payments system, will typically require a temporary accumulation of money balances in order to maintain the same dollar amount of transactions. In these circumstances, altering the level of interest rates in an attempt to offset the apparent deviation of M1 from its target growth path would be inappropriate. If the interest rate were altered, there would be an unwarranted effect on aggregate spending.

Second, deviations of M1 from its target path could arise because output or prices do in fact move off the forecast track. For any given interest rates, the divergence in output or prices from the forecast will be accompanied by a divergence in M1 from its target growth path. In these circumstances, if the interest rates change in the direction required to counteract the deviation in M1 this change will also be in the direction required to counteract the apparent divergence on the income side.

Clearly then if M1 deviates from its target growth path the cause of the deviation must be determined before any action can

be taken.[2] Even in the case where action is appropriate (i.e., situation two), the policy decision may be further complicated by the well-known problem of instrument instability (Holbrook, 1972) which may preclude the use of interest rates to achieve exactly the desired target every month. Furthermore, secondary policy objectives may not be achieved if use of the interest-rate instrument is geared exclusively to the attainment of the monetary aggregate target even in the short run. However, since nominal expenditure responds with a distributed lag to changes in monetary aggregates, it may be considered appropriate to attempt to eliminate any apparent deviation of the monetary aggregate from the target over a more extended period to avoid undue disruptions in financial markets.

2.2 The Concern with Deviations

The period over which an undesired deviation in M1 from its target could be tolerated would depend upon the extent to which this deviation implies a loss of effective control of aggregate demand. This concern with the destabilizing nature of the deviations stems from the fact that the short-run and the long-run responses of some important economic variables to variations in the rate of monetary expansion are opposite in direction.

Consider for instance the case of an increase in monetary growth. This will increase the flow of spending and lending. In the goods market, increased spending will be met by a combination of increased domestic or imported supply and a liquidation of stocks, or by rationing through price increases. In the capital

market, increased lending will result in both a capital outflow and a reduction in interest rates.[3] Both a current and a capital account deficit will tend to develop, resulting in an exchange-rate depreciation (or in a balance-of-payments deficit). The exchange-rate depreciation in turn will lower the purchasing power of money directly through the higher prices of imported goods and indirectly through its effect on the prices of import-competing goods. This will be exacerbated by excess-demand pressures and by wages (the largest cost component) reacting to the increased cost of living. Until wages react, however, temporary increases in output stimulated by lower real wages will help to mitigate the deterioration in the purchasing power of money. Once wages are in line with prices, real output will return to its initial growth path, and only nominal magnitudes will be left affected. When nominal income has fully adjusted to the increase in the money supply, interest rates will return to initial levels (or go to higher levels if the rate of monetary expansion, and consequently the inflation rate, is increased permanently).

The implementation of a policy aimed at offsetting the undesired growth of the money supply will set in motion a series of lagged reactions that are essentially the opposite of those originally activated, thus negating completely the effects on nominal and real economic activity resulting from the temporary increase in the money supply. Given some self-reversing reactions (in output and interest rates for instance), the

introduction of opposite forces will generate a cyclical response in the economy.

The earlier corrective action is taken to offset the undesired deviation in the money supply, the faster the original reactions are nullified, thereby minimizing the cyclical response of the economy. Furthermore, for a given reaction lag the amplitude of the cyclical response to the unwanted deviation will be smaller the longer are the lagged reactions of nominal GNE to changes in the money supply.

2.3 Simulating the Effects of Short-Run Deviations

The sort of deviation from a desired monetary growth path that can be considered destabilizing for aggregate spending depends critically on (i) the duration of the deviation, and (ii) the time lag involved in the response of nominal GNE to changes in the money stock. To estimate the lagged response of nominal GNE to short-run deviations in the money supply, we have used two quarterly econometric models: RDX2 (Bank of Canada, 1976), a very detailed structural model of the Canadian economy; and a "monetarist" reduced-form model described in the Appendix to this report. By comparing the simulation results of these two very different models, a possible range can be estimated with respect to the magnitude and timing of changes in aggregate spending due to deviations from a desired monetary growth path.

Two simulations were conducted with both models. The first simulation involves allowing M1 to rise gradually 5 percent above its desired level and stay there for only 2 quarters before the

monetary authorities correct for this deviation and return to the desired stock. The second simulation permits M1 to rise above its target level again by 5 percent but maintains this differential for 6 quarters before a correction for this deviation is made. The quarterly pattern of the deviation in M1 from its control in both of these simulations is summarized in Table 1. By comparing the results of these two simulations, we can better understand the consequences of a given divergence of M1 from a target growth path for differing lengths of time.

Table 1 ALTERNATIVE SHOCKS TO M1 OF DIFFERING DURATION

Simulation quarter	Percentage difference of M1 from control level		Deviation of M1 growth rate from control	
	Simulation 1	Simulation 2	Simulation 1	Simulation 2
1	2.5	2.5	2.50	2.50
2	3.75	3.75	1.25	1.25
3	5.0	5.0	1.25	1.25
4	5.0	5.0	0	0
5	3.75	5.0	-1.25	0
6	2.5	5.0	-1.25	0
7	0	5.0	-2.50	0
8	0	5.0	0	0
9		3.75		-1.25
10		2.5		-1.25
11		0		-2.50
12		0		0

These simulations might be seen as a departure from the spirit of our discussion, in Section 2.1, of the nature of short-run deviations of M1 from its target. We agree. A more

realistic scenario would involve the use of a reaction function modelling the central bank's influence on interest rates and would leave M1 to be determined endogenously using a demand-for-money function. We would thus be in a position to simulate the reaction of the central bank to a deviation of M1 from the target resulting from a difference between the actual and the forecast path of prices or output, or to a deviation resulting from a shift in the demand for money. But the volatility thereby introduced into the path of actual M1 in relation to its control value would not give as clear a picture of the profile of the deviation of M1 from target. We believe that the destabilizing nature of short-run deviations of the money supply is better illustrated by concentrating on a given pattern of M1 rather than by focussing on the manner in which the central bank might react to such deviations. We realize, of course, that the cost of this approach may be a rather implausible interest-rate scenario. This is certainly the case with RDX2 and this could be the case with the monetarist model, had we appended an inverted demand-for-money function to calculate the implied interest-rate movements.

Before reporting on the simulations, however, it may be useful to indicate how they relate to our earlier discussion of the nature of short-run deviations of M1 from target.

As regards the first case - a shift in the demand for money with output and prices "on target" - it is in fact the inappropriate alteration of the interest-rate setting rather than the observed divergence in M1 that sets off the shock to income.

However, this situation can be visualized as an inappropriate shift in M1 to the extent that interest rates are adjusted to prevent the M1 movement justified by the shift in money demand. Hence, this case can be captured through simulations of shifts in M1. Indeed, with the monetarist model, because aggregate expenditure is directly linked to actual M1, this case cannot be captured otherwise. In RDX2, since monetary influences are funneled into the real sector primarily through interest rates, a reduction in the demand for money will have virtually the same effect on aggregate spending as a deviation in the supply of M1; only the impact on the banking sector will differ. Thus the response of aggregate expenditure in the simulations can be interpreted as resulting from a temporary reduction in the demand for money which is not accommodated by the central bank. The same response would occur in the case of a permanent 5 percent reduction in the demand for money which is only accommodated after a recognition lag.

For the second case - a movement of M1 in response to a shift in output or prices from the forecast path - it is certainly true that there is, unlike the first case, an observed deviation in M1 that is inappropriate from the viewpoint of stabilization policy.

3 EMPIRICAL RESULTS

3.1 RDX2

The recently revised version of RDX2 was used, employing the

flexible exchange-rate option. We exogenized real federal government current nonwage expenditures (GCNWF/PGCNWG) to stress the pure monetary policy impact without any countercyclical offset from this source. The central bank reaction function was dropped, and the demand-for-money (M1) equation was renormalized to yield the short-term interest rate (RS) given an exogenous supply of money.

In RDX2 an autonomous increase in currency and demand deposits will reduce the average yield on 1 to 3-year Government of Canada bonds (RS), because only under this condition will the public be willing to sell its bonds to the banking system and build up its cash position. However, because the public is rather slow to adjust its portfolio, there will be an initial overshooting of RS. In both simulations the maximum impact on RS is felt in the first simulation quarter when it decreases by 160 basis points (see Tables 2 and 3).

Furthermore, there will be a rearrangement of the public's holdings of other financial assets, but to trace through this adjustment is beyond the scope of this paper. On balance there will be an expansion of the whole banking system[4], with the rise in deposits initially balanced on the asset side by an increase in earning liquid assets. This will then increase the supply of loans. With a lower return on liquid assets (RS), the interest rate on prime business loans (RPRIME) will fall, which then reduces the rates on nonpersonal term and notice deposits in chartered banks (RNPT), and on personal deposits in chartered

Table 2 THE EFFECT OF A SHORT-RUN DEVIATION FROM A TARGET GROWTH RATE FOR M1
Difference From Control Level
(percentage unless otherwise indicated)

SIMULATION 1		RDX2					Monetarist model			
Simulation quarter	Shock to M1	Gross national expenditure			Exchange rate ($C/$US)	Short-term * interest rates	Gross national expenditure			Velocity** of M1
		Value	Volume	Price			Value	Volume	Price	
1	2.5	.08	.13	-.05	.74	-1.60	.20	.14	.06	-.20
2	3.75	.12	.21	-.09	1.32	-1.06	.53	.35	.17	-.28
3	5.0	.24	.27	-.03	1.81	-1.30	.99	.64	.35	-.36
4	5.0	.44	.37	.07	1.92P	- .74	1.50	.91	.58	-.31
5	3.75	.63	.41	.22	1.38	.23	1.92	1.07	.83	-.16
6	2.5	.76P	.44P	.33	.75	.12	2.21 P	1.11 P	1.09	-.02
7	0.0	.66	.23	.43	-.33	1.26	2.25	.92	1.31	.21
8	0.0	.68	.16	.51P	-.71	-.13	2.18	.66	1.51	.21
9	0.0	.51	.09	.42	-.77	-.02	2.00	.33	1.66	.19
10	0.0	.33	-.03	.36	-.62	-.09	1.72	-.04	1.76	.16
11	0.0	.15	-.10	.24	-.41	-.02	1.33	-.44	1.78P	.13
12	0.0	.01	-.19	.20	-.18	-.04	.93	-.80	1.75	.09
13	0.0	-.10	-.24	.14	-.03	-.04	.56	-1.08	1.66	.05
14	0.0	-.20	-.32	.11	-.01	.06	.28	-1.24	1.54	.03
15	0.0	-.24	-.30	.06	-.08	-.03	.13	-1.27	1.41	.01
16	0.0	-.30	-.34	.04	-.17	-.03	.06	-1.20	1.28	.01
17	0.0	-.32	-.35	.02	-.27	-.01	.07	-1.06	1.14	.01
18	0.0	-.36	-.35	0.0	-.39	.06	.07	-.91	.99	.01
19	0.0	-.32	-.27	-.05	-.45		.08	-.76	.84	.01
20	0.0	-.36	-.26	-.10	-.44	-.04	.08	-.61	.69	.01
21	0.0	-.36	-.23	-.13	-.42	-.02	.08	-.46	.55	.01
22	0.0	-.35	-.19	-.17	-.37	-.02	.08	-.33	.42	.01
23	0.0	-.31	-.12	-.19	-.29	-.03	.09	-.20	.29	.01
24	0.0	-.31	-.08	-.23	-.20	-.02	.09	-.09	.18	.01
25	0.0	-.26	-.03	-.23	-.09	-.02	.09	.01	.08	.01
26	0.0	-.21	.04	-.25	.04	-.03	.09	.10	-.01	.01
27	0.0	-.15	.08	-.23	.17	0.0	.09	.18	-.09	.01
28	0.0	-.08	.15	-.22	.30	.01	.09	.24	-.16	.01

* Absolute difference of average yield on Government of Canada bonds, 1-3 years.
** Absolute difference of velocity.
P Peak impact.

Table 3 THE EFFECT OF A SHORT-RUN DEVIATION FROM A TARGET GROWTH RATE FOR M1
Difference From Control Level
(percentage unless otherwise indicated)

SIMULATION 2		RDX2					Monetarist model			
Simulation quarter	Shock to M1	Gross national expenditure Value	Volume	Price	Exchange rate ($C/$US)	Short-term * interest rates	Gross national expenditure Value	Volume	Price	Velocity** of M1
1	2.5	.08	.13	-.05	.74	-1.60	.20	.14	.06	-.20
2	3.75	.12	.21	-.09	1.32	-1.06	.53	.35	.17	-.28
3	5.0	.24	.27	-.03	1.81	-1.30	.99	.64	.35	-.36
4	5.0	.44	.37	.07	1.92P	-.74	1.50	.91	.58	-.31
5	5.0	.70	.50	.19	1.74	-.55	2.02	1.14	.86	-.27
6	5.0	.95	.67	.28	1.57	-.83	2.53	1.32	1.20	-.22
7	5.0	.96	.60	.35	1.35	-.72	3.01	1.42	1.57	-.18
8	5.0	1.20P	.68P	.51	1.16	-.78	3.43	1.43P	1.97	-.14
9	3.75	1.15	.56	.58	.57	.27	3.67	1.29	2.35	0.0
10	2.5	1.13	.47	.66	.09	.06	3.68P	.97	2.68	.12
11	0.0	.88	.21	.67	-.79	1.26	3.33	.42	2.90	.32
12	0.0	.79	.08	.72P	-.97	-.15	2.87	-.17	3.05	.28
13	0.0	.55	-.04	.58	-.94	-.05	2.35	-.73	3.11P	.23
14	0.0	.22	-.28	.50	-.83	-.03	1.84	-1.21	3.09	.18
15	0.0	-.01	-.35	.34	-.70	-.05	1.35	-1.59	2.99	.13
16	0.0	-.26	-.51	.25	-.57	-.08	.92	-1.85	2.82	.09
17	0.0	-.42	-.60	.19	-.52	-.06	.55	-1.99	2.60	.05
18	0.0	-.60	-.72	.13	-.60	.08	.28	-2.01	2.34	.03
19	0.0	-.62	-.65	.02	-.71	-.06	.13	-1.90	2.07	.01
20	0.0	-.74	-.69	-.06	-.80	-.09	.07	-1.69	1.79	.01
21	0.0	-.78	-.67	-.11	-.88	-.04	.07	-1.42	1.52	.01
22	0.0	-.81	-.64	-.17	-.98	.10	.08	-1.15	1.25	.01
23	0.0	-.72	-.47	-.26	-.98	-.04	.09	-.89	.98	.01
24	0.0	-.78	-.41	-.36	-.89	-.06	.09	-.64	.74	.01
25	0.0	-.72	-.31	-.41	-.74	-.04	.10	-.41	.50	.01
26	0.0	-.68	-.20	-.48	-.55	-.05	.10	-.19	.29	.01
27	0.0	-.60	-.10	-.50	-.31	-.04	.10	0.0	.10	.01
28	0.0	-.52	.03	-.55	-.05	-.02	.10	.16	-.07	.01

* Absolute difference of average yield on Government of Canada bonds, 1-3 years.
** Absolute difference of velocity.
P Peak impact.

banks (RPD). This is followed by a fall in rates for one-year deposits in trust companies (RTTL) and for non-chequable savings deposits in trust and mortgage loan companies (RSTL). In addition the short-term paper rate (R90) falls.

The decrease in RS reduces long-term rates in RDX2 through the equations for the term structure of interest rates. Average yields on 3 to 5-year Government of Canada bonds (RMS), 5 to 10-year bonds (RML), and bonds 10 years and over (RL) all decline due to the fall in RS. The average yield on RL, for example, drops by a maximum of 47 basis points in the third simulation quarter of both simulations. Finally, the conventional mortgage rate (RMC) falls as a result of the drop in RL.

This decline in short-, medium- and long-term interest rates affects both the foreign exchange market and components of final domestic demand in RDX2 (see Tables 2, 3, 4 and 5). In the foreign exchange market there is a pronounced and very quick depreciation of the Canadian dollar in response to the decline in short-term interest rates which produces an outflow of capital. The maximum depreciation is two cents in the third and fourth quarter of both simulations. This depreciation in turn affects the import and export components of real GNE and bears the main responsibility for setting up the price impact. The exchange rate contributes directly to the GNE implicit price deflator by affecting export prices, and it contributes indirectly through the increased cost of imported consumer goods by activating a wage-price spiral.

Table 4 THE EFFECT OF A SHORT-RUN DEVIATION FROM A TARGET GROWTH RATE FOR M1, USING RDX2
Difference From Control Level
(percentage unless otherwise indicated)

SIMULATION 1

Simulation quarter	Shock M1	Final domestic demand			Net exports		Long-term interest rate[3] (RL)	Supply price of capital[4] (RHOR)	Chartered bank total assets (ABT)	Chartered bank $Cdn. earning liquid assets (ABELCD)	Federal gov't National Accounts balance (+ surplus)[1] (CBALF)	Corporate profits before taxes (YC)	Personal income (YP)
		Value	Volume	Price	Value[1]	Volume[2]							
1	2.5	.19	.11	.08	-1.82	8.14	-.45	-.41	2.52	8.02	10.22	.58	-.03
2	3.75	.28	.13	.15	-3.14	18.28	-.37	-.32	3.73	10.07	10.52	.60	.06
3	5.0	.43	.19	.24	2.06	26.34	-.47	-.39	5.06	13.00	15.86	1.50	.10
4	5.0	.56	.23	.33	-1.71	24.55	-.33	-.27	5.11	11.69	19.70	2.34	.25
5	3.75	.63	.23	.40	16.73	30.43	-.05	.0	3.62	6.12	22.70	3.61	.33
6	2.5	.71	.28	.43	10.48	15.65	-.03	.06	2.55	3.73	27.05	3.67	.43
7	0.0	.62	.23	.39	-6.16	-20.00	.32	.39	.08	-4.04	20.64	3.62	.39
8	0.0	.58	.22	.36	-21.70	-43.42	-.01	.15	.19	-.68	27.06	3.14	.39
9	0.0	.41	.13	.28	-22.76	-41.76	0.0	.15	.19	.27	17.98	1.84	.34
10	0.0	.25	.02	.23	-18.04	-36.42	-.03	.08	.21	.95	11.96	.61	.27
11	0.0	.09	-.07	.16	-9.17	-21.79	-.03	.04	.16	1.15	3.36	-.69	.18
12	0.0	-.07	-.15	.08	2.81	-6.11	-.04	-.06	.14	1.49	-4.65	-1.72	.12
13	0.0	-.14	-.19	.05	8.62	3.43	-.05	-.10	.10	1.58	-10.82	-2.62	.07
14	0.0	-.20	-.21	.01	8.64	4.07	-.02	-.08	.03	1.40	-14.78	-2.86	0.0
15	0.0	-.27	-.23	-.04	11.88	6.60	-.05	-.07	-.01	1.22	-15.51	-3.48	-.04
16	0.0	-.29	-.22	-.07	14.47	7.42	-.05	-.03	-.03	1.02	-18.08	-3.24	-.11
17	0.0	-.34	-.23	-.11	11.15	2.84	-.04	.01	-.06	.67	-21.19	-3.35	-.13
18	0.0	-.37	-.23	-.14	5.31	-4.90	-.02	.06	-.09	.40	-22.47	-2.65	-.18
19	0.0	-.37	-.20	-.17	1.28	-7.61	-.03	.04	-.06	.39	-20.03	-2.59	-.18
20	0.0	-.36	-.17	-.19	.70	-8.39	-.03	.02	-.03	.58	-20.79	-2.17	-.24
21	0.0	-.38	-.15	-.23	-2.22	-9.02	0.0	.01	-.03	.68	-21.38	-2.00	-.24
22	0.0	-.35	-.11	-.24	-6.21	-11.22	.01	.0	-.02	.81	-21.98	-1.57	-.25
23	0.0	-.32	-.07	-.25	-7.28	-8.72	.01	.0	-.01	.87	-19.07	-1.64	-.23
24	0.0	-.27	-.02	-.25	-5.11	-4.49	.01	.0	.01	.96	-18.71	-1.27	-.25
25	0.0	-.20	.04	-.24	-6.92	-2.18	0.0	.0	.02	.93	-13.18	-.66	-.22
26	0.0	-.15	.07	-.22	-5.22	3.58	-.01	.01	.04	.84	-9.42	-.35	-.20
27	0.0	-.09	.10	-.19	-5.85	5.83	-.01	.01	.04	.71	-5.97	.13	-.16
28	0.0	-.01	.12	-.13	-3.57	10.46	-.01	.01	.04	.58	-.44	.79	-.13

1. Millions of current dollars.
2. Millions of 1961 dollars.
3. Average yield on Government of Canada bonds 10 years and over.
4. Absolute difference.

Table 5 THE EFFECT OF A SHORT-RUN DEVIATION FROM A TARGET GROWTH RATE FOR M1, USING RDX2
Difference From Control Level
(percentage unless otherwise indicated)

SIMULATION 2

Simulation quarter	Shock M1	Final domestic demand			Net exports		Long-term interest rate[3] (RL)	Supply price of capital[4] (RHOR)	Chartered bank total assets (ABT)	Chartered bank $ Cdn. earning liquid assets (ABELCD)	Federal gov't National Accounts balance (+surplus)[1] (CBALF)	Corporate profits before taxes (YC)	Personal income (YP)
		Value	Volume	Price	Value[1]	Volume[2]							
1	2.5	.19	.11	.08	- 1.82	8.14	-.45	-.41	2.52	8.02	10.22	.58	-.03
2	3.75	.28	.13	.15	- 3.14	18.28	-.37	-.32	3.73	10.07	10.52	.60	.06
3	5.0	.43	.19	.24	2.06	26.34	-.47	-.39	5.06	13.00	15.86	1.50	.10
4	5.0	.56	.23	.33	- 1.71	24.55	-.33	-.27	5.11	11.69	19.70	2.34	.25
5	5.0	.73	.29	.44	22.28	40.62	-.27	-.19	4.87	10.47	28.29	4.14	.34
6	5.0	.90	.39	.51	28.85	46.63	-.34	-.21	5.06	11.69	37.55	4.80	.49
7	5.0	1.05	.45	.60	20.58	32.19	-.31	-.13	5.07	11.61	42.71	5.87	.50
8	5.0	1.13	.47	.66	3.54	14.54	-.33	-.09	5.07	12.26	50.85	5.94	.69
9	3.75	1.04	.40	.64	- 4.99	-6.10	-.04	.17	3.70	6.91	43.17	5.43	.69
10	2.5	1.00	.36	.64	-36.78	-24.01	-.05	.15	2.68	4.53	43.75	4.53	.70
11	0.0	.78	.24	.54	-23.20	-50.85	-.30	.47	.21	-3.30	32.11	3.92	.58
12	0.0	.61	.15	.46	-27.97	-60.61	-.04	.12	.30	.52	31.82	2.47	.55
13	0.0	.37	.03	.34	-19.69	-48.08	-.04	.11	.26	1.60	14.42	.42	.45
14	0.0	.12	-.12	.24	-20.01	-48.41	-.05	.06	.21	2.08	1.95	-1.66	.31
15	0.0	-.12	-.24	.12	- 3.52	-25.47	-.07	.01	.08	1.92	-8.45	-3.76	.18
16	0.0	-.33	-.33	0.0	11.23	-8.83	-.09	-.06	0.0	1.91	-19.01	-4.89	.05
17	0.0	-.48	-.41	-.07	16.45	-1.27	-.09	-.08	-.12	1.58	-31.20	-6.17	-.06
18	0.0	-.60	-.46	-.14	12.40	-6.92	-.06	-.04	-.21	1.19	-39.57	-5.77	-.19
19	0.0	-.69	-.46	-.23	12.59	-5.22	-.08	-.04	-.20	1.14	-40.60	-6.62	-.24
20	0.0	-.72	-.42	-.30	19.17	-2.25	-.08	-.01	-.17	1.18	-45.45	-5.75	-.38
21	0.0	-.80	-.42	-.38	12.68	-7.72	-.05	.03	-.19	.89	-51.06	-5.67	-.41
22	0.0	-.82	-.40	-.42	2.06	-20.21	.01	.09	-.22	.64	-54.07	-4.67	-.48
23	0.0	-.80	-.30	-.50	- 3.71	-20.42	-.02	.07	-.16	.84	-47.91	-5.05	-.46
24	0.0	-.74	-.21	-.53	- 1.42	-16.62	-.01	.04	-.10	1.15	-49.94	-4.26	-.55
25	0.0	-.68	-.14	-.54	-10.36	-14.88	0.0	.02	-.05	1.21	-44.53	-3.37	-.53
26	0.0	-.62	-.05	-.57	-15.28	-12.90	0.0	.05	-.01	1.15	-42.08	-2.75	-.53
27	0.0	-.53	.02	-.55	-18.77	-7.57	0.0	.03	.03	1.08	-35.21	-2.32	-.50
28	0.0	-.38	.09	-.47	-12.01	5.55	0.0	.04	.04	.93	-28.06	-1.24	-.48

1. Millions of current dollars.
2. Millions of 1961 dollars.
3. Average yield on Government of Canada bonds 10 years and over.
4. Absolute difference.

However, this depreciation feeds through with a considerable lag to both export prices and final-domestic-demand prices.[5] Therefore as the exchange rate returns to its control level, in response to the action taken to return the money supply to its control level, less disturbance feeds into the wage-price spiral. The longer the corrective action is delayed the greater is the disturbance feeding into this spiral. Indeed, wages and prices reached their peaks 4 quarters earlier in the simulation where the money supply was brought back quickly to its control level.

The components of domestic demand that are most affected by a reduction in RS are residential construction and business non-residential investment. The major impact is in the housing market where the greater availability of mortgage funds generated by a general expansion of the portfolio of lending institutions stimulates residential investment. In RDX2 a fall in RS results in an increase in total bank assets (ABT), life insurance assets (ALI) and trust company assets (ATL). In turn this increase in assets increases the mortgage approvals of each of these institutions. Mortgage approvals will also increase because the mortgage rate has decreased less than other rates.

The decline in RS affects business non-residential investment through the fall in the long-term interest rate (RL) which causes a reduction in the real supply price of capital (RHOR). This drop in RHOR reduces the imputed rental price for machinery and equipment (RCME) and non-residential construction (RCNR), which in turn increases the corresponding desired capital/output ratios KMEY and KNRY. Finally, these latter

changes increase investment in machinery and equipment and non-residential construction.

Since nominal income reacts with a lag to the money supply, the sharp adjustment back to the desired growth path of M1 that we simulated produces a sudden change in velocity. With a rather slow portfolio adjustment for the demand for money, this abrupt increase in velocity triggers an increase of 126 basis points (above control) in short-term interest rates (RS) in the same quarter in which M1 returns to its control level (see Chart 1).[6] This increase in turn has a significant impact on the exchange rate and on expectations in the foreign exchange market. Before returning to its control level the Canadian dollar appreciates, setting in motion a series of reactions opposite in direction to those described above for the initial depreciation of the Canadian dollar. The net effect of this appreciation is a temporary reduction in aggregate spending below control levels (see Chart 1).

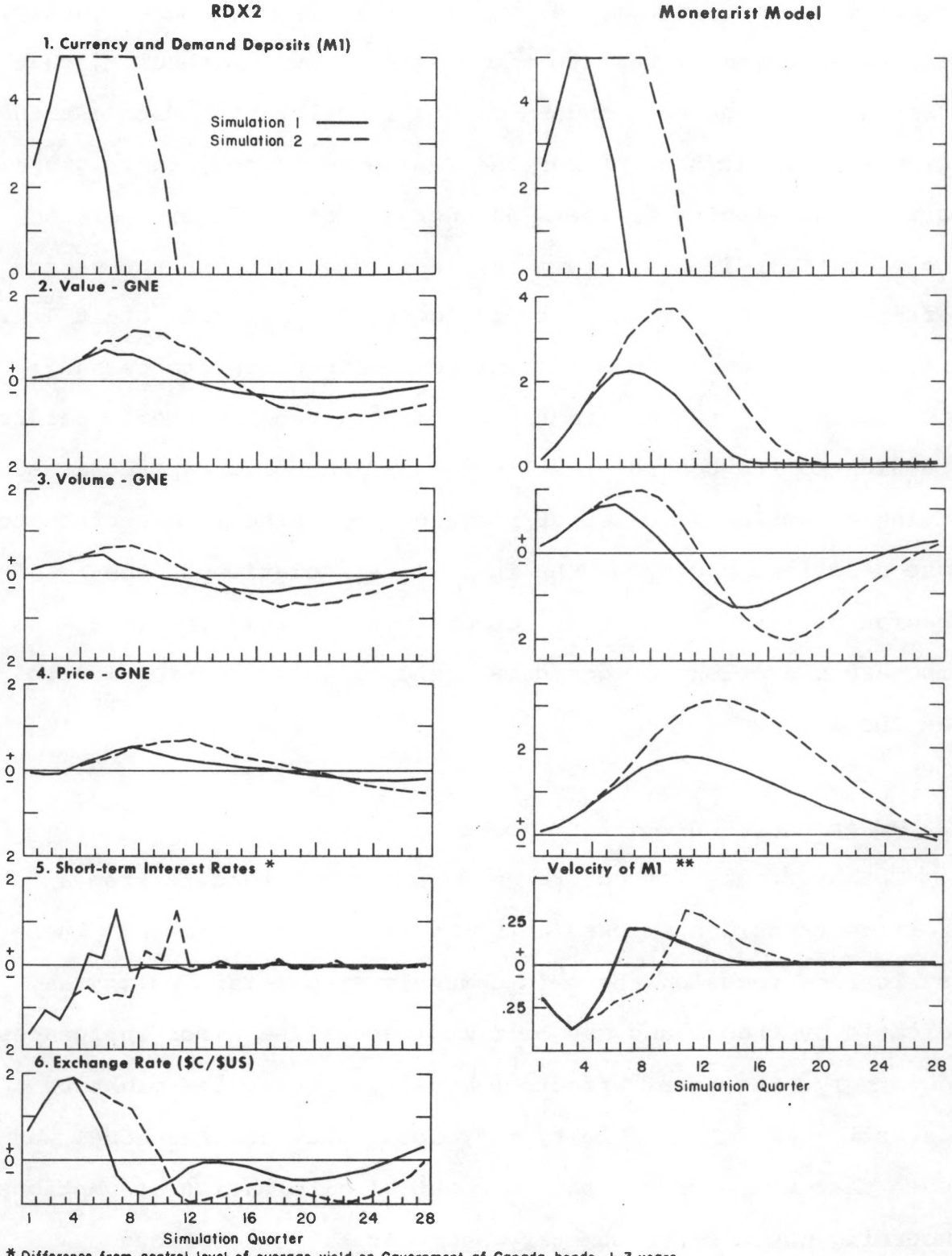
3.2 Monetarist Reduced-Form Model

The particular structure of RDX2 largely results from a priori restrictions imposed on it by the model builders. These restrictions focus on the main channels of monetary policy as indicated by theory and may omit many so-called minor influences. Accordingly, the total effect of monetary aggregates might be underestimated. It was felt, therefore, that another model was needed that would give a fair account of alternative assumptions concerning the role of monetary aggregates. The obvious

Chart 1

EFFECT OF A SHORT-RUN DEVIATION FROM A TARGET GROWTH RATE FOR M1

Shock Minus Control as Percentage of Control



* Difference from control level of overage yield on Government of Canada bonds, 1-3 years.
** Difference from control level.

alternative was the St. Louis monetarist model (Andersen and Carlson, 1970). Because it is a reduced-form model, it is not tied to any specific theory; it measures the relative importance of the money supply, along with chosen autonomous forces (in our case fiscal policy and exports), in the determination of nominal spending. A linear reduced-form model, however, has the drawback that its parameters only measure the average relative contribution of the chosen determinants of nominal spending regardless of the particular economic conditions. Moreover, the correlation method used in econometric research can only rate actual contributions as they occur; thus it is largely dependent on the variability of the exogenous variables. A structural model is not subject to this limitation to the same extent because it imposes theoretical restrictions on some coefficients. These drawbacks must be kept in mind when the results of the two models are compared.

The model used in these simulations is loosely called monetarist because the importance of the money supply in the determination of nominal spending is overwhelming, and because the influence of monetary policy on the volume of real activity is only temporary; in the long run the adjustment falls entirely on prices. We calculated a 2 to 3-quarter lag between M1 and nominal GNE and an 8-quarter lag between M1 and prices. This is consistent with Friedman's often-quoted findings (Friedman, 1972) and with results previously reported by Jevons in the 1860s. This model is described in the Appendix. There is no interest-rate equation in this model, but there are shifts in velocity

produced by a lagged reaction of nominal GNE to changes in monetary aggregates. With an interest-elastic demand for money, these changes in velocity will imply corresponding changes in interest rates.

The peak impacts on aggregate spending of both simulations are approximately three times larger in the monetarist model than in RDX2 (see Tables 2 and 3 and Chart 1). In terms of the timing responses, both models estimate that aggregate spending will peak in quarter 6 in simulation 1, whereas in simulation 2 aggregate spending peaks in quarter 8 for RDX2 and quarter 10 for the monetarist model. Most of these differences are a result of the impact on prices; both the magnitudes and the time paths of the price responses of the two models differ substantially. The monetarist model implicitly embodies an expectations-augmented Phillips curve with long-run price homogeneity of wages (or factor costs) in first differences. This implies that the rate of change of prices depends on the current and lagged values of the rate of resource utilization (see Laidler, 1973). In RDX2, on the other hand, the rates of change of prices and wages depend on the current and lagged changes in real economic activity. Furthermore, in RDX2 prices respond quickly to the return of the money supply to its desired level because of the resulting appreciation of the exchange rate.

The time path of the simulated response of real GNE to deviations in M1 of differing duration is, however, almost identical in the two models. A correlation coefficient of 95 percent has been calculated between the responses of the two

models. The peak impacts occur in the same quarter and the troughs are reached in broad synchronization. In the monetarist model, the downward phase of the cycle is both more pronounced and of longer duration than the upward phase. This will trigger a new cycle (the second peak is only about one-third of the first) since, for a given nominal income growth, the downward pressures on prices developed during the downward phase of the cycle will stimulate the volume of production.

When the relative magnitudes of the cyclical responses of each model under the two simulations are compared, the monetarist model again gives broadly the same results as RDX2 (see Table 6). If the deviation of M1 from control persists for only 6 quarters (simulation 1), the peak impact on nominal GNE in both models will be only 60 percent of what it would be if the deviation were to last 10 quarters (simulation 2). The monetarist model estimates that the peak price impact of simulation 1 is 40 percent less than for simulation 2. However for RDX2, given its shorter lag on prices, only 30 percent of the price impact of simulation 2 can be prevented if M1 is brought back on track one year earlier.

In the monetarist model the volume of production is affected with a shorter lag than are prices. This model can therefore be used to illustrate that when action is taken after a given reaction lag, to offset an undesired deviation in the growth of the money supply, the amplitude of the cyclical response of a variable will decrease as the distributed lag from money to this variable increases. For example, when corrective action is taken

after one year to eliminate an unwanted deviation in M1 the peak impact on real GNE is 75 percent of what it would have been had the deviation been allowed to persist indefinitely. For nominal GNE, however, this ratio is just over 50 percent and for prices it is just over 40 percent because the distributed lags are longer.

Table 6 PEAK EFFECT ON GROSS NATIONAL EXPENDITURE AS A PERCENTAGE OF THE MAXIMUM DEVIATION IN M1

	RDX2			Monetarist model		
	Value	Volume	Price	Value	Volume	Price
Simulation 1	15.2	8.6	10.2	45.0	22.2	35.6
Simulation 2	24.0	13.6	14.4	73.6	28.6	62.2
Peak in simulation 1 as a percentage of peak in simulation 2	63.3	63.2	70.8	61.1	77.6	57.2

4 SUMMARY

Since the economy adjusts with a lag to changes in monetary aggregates, then the faster action is taken to return to the desired monetary growth path, the smaller is the economy's cyclical response to unwanted deviations in the money supply. To provide some estimate of the relationship between the duration of a deviation and its economic significance, we simulated the effects of a divergence of M1 from its target path by a given

amount for differing lengths of time. Our simulations were done using the latest version of RDX2 and a reduced-form monetarist model so that a range could be established.

The simulation results clearly indicate that the magnitude of the cycle varies directly with the time elapsed before corrective action is taken. The cycle in both RDX2 and the monetarist model is about two-thirds larger if the correction is delayed by one year. With this delay, the peak effect on the volume of production amounts to between 15 and 30 percent of the percentage deviation of the money supply.

The lags operating on aggregate demand are almost exactly the same in both RDX2 and the monetarist model, but the price effects differ significantly. In RDX2 price levels broadly follow the cyclical pattern of production, whereas in the monetarist model price changes react to the accumulated pressure of excess demand through the cycle and engineer the cyclical response of the volume of production.

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APPENDIX

A CANADIAN MONETARIST MODEL: A SUMMARY

1. The Model

The reduced-form model used in this study is basically an extension of the monetarist model developed at the Federal Reserve Bank of St. Louis (Andersen and Carlson, 1970). It centres on two equations estimated over the sample period 4Q56-4Q75.

$$\frac{DY}{LY} = \underset{(a)}{.4\ W1}\left(\frac{DM1}{LM1}\right) + \underset{(b)}{1.5\ Z2}\ \frac{D(X+G)}{LY} - \underset{(c)}{1.0\ Z2}\ \frac{D(G+FES)}{LY} + .6 \qquad (1)$$

$$\frac{DP}{LP} = \underset{(d)}{.3}\left(\frac{DY}{LY}-n\right) + \underset{(e)}{.7\ W2}\left(\frac{DP}{LP}\right) - \underset{(f)}{.06}\ LGAP \qquad (2)$$

where

Y is nominal GNE,

P is the GNE deflator,

M1 is currency and demand deposits,

FES is full employment surplus for all levels of government,

X is nominal exports of goods and services,

G is total nominal government expenditures (National Accounts basis),

GAP is excess capacity as a percentage of actual output,

n is growth rate of capacity output,

D&L are first difference and lag operators respectively.

W&Z2 are weighted moving average operators (Z2: 2nd degree Almon),

a to f identify the coefficients for Table A1.

Table A1 ESTIMATION RESULTS (OLS)

Sample period	Equation*	Sum of coefficients (standard error of sum) Constant	a / M1	b / X	c / FES	d / Y	e / P	f / GAP	a^1 / M1	$\bar{R}^2$	DW	see	V**
4Q56-4Q71	1-GNE	.68 (.31)	.388 (.17)	1.40 (.34)	-1.15 (.47)					.310	2.30	1.03	
	1a-GNE	.43 (.35)		1.26 (.37)	-1.28 (.50)				.881 (.30)	.296	2.37	1.04	
	2-PGNE	.86 (.28)				.22 (.05)	-.04 (.28)	-.10 (.03)		.399	1.90	.48	.245
4Q56-4Q71	1-GNE	.50 (.25)	.407 (.13)	1.48 (.27)	-1.01 (.39)					.486	2.29	1.01	
	1a-GNE	.33 (.28)		1.36 (.31)	-1.03 (.39)				.839 (.14)	.463	2.35	1.04	
	2-PGNE	.24 (.14)				.30 (.05)	.72 (.09)	-.06 (.03)		.690	2.01	.57	.512

* The equation numbers and the coefficients (or sums of coefficients distributed over 6 quarters) appear as in the text.

** V is the ratio of Var(DP/P)/Var(DY/Y).

Addition of the near identity:

$$\frac{DGAP}{LGAP} = n - \frac{DY}{LY} + \frac{DP}{LP}$$

yields the following forecast of real output:

$$\frac{DGAP}{LGAP} = -.06\ LGAP - .7\ \left(\frac{DY}{LY} - W2\ \left(\frac{DP}{LP}\right) - n\right) .$$

The inclusion of both government expenditures and the full employment surplus in the expenditure equation relaxes the constraint that the balanced-budget multiplier must equal zero. It is then free to take on the positive value posited by theory. It is significant that no nominal crowding-out effects are estimated.[7] It may be worth noting that the low coefficient on the money stock does not necessarily imply a high income elasticity of the demand for money; rather it may result from the fact that fiscal variables and export receipts are fixed in nominal terms. Since different rates of growth of the money supply result in different rates of price increase, this equation implies a change in fiscal policy that (partly) offsets monetary policy. For exports, the case is more complicated. It is true that in a pure monetary simulation with a flexible exchange rate export prices expressed in domestic currency should vary with other prices. But in practice the exchange-rate response to monetary changes will cause temporary disruptions in relative prices. It follows then that the sum of coefficients on M1 really represents a partial rather than the total effect on nominal GNE; to capture the total effect, the equation was re-

estimated using the procedure proposed by DeLeeuw and Kalchbrenner (1969).

$$\frac{DY}{LY} = a'W1\ \frac{DM1}{LM1} + b\ Z2\ \frac{[D(X+G) - L(X+G)\ \frac{DP}{LP}]}{LY} + c\ Z2\ \frac{[D(FES+G) - L(FES+G)\ \frac{DP}{LP}]}{LY} \qquad (1a)$$

Assuming that the effect of money on GNE eventually falls entirely on prices, we expect the sum of coefficients on money to be about one, and the coefficients on other variables to remain unchanged. We also expect a longer lag on money to account for a lag in these price feedbacks. The results corroborate these expectations. The sum of coefficients on money is not significantly different from 1, and the average lag increases from 2.6 to 3.9 quarters when the end-point restriction is moved from 6 to 10. The export multiplier falls marginally from the neighbourhood of 1.5 to about 1.4, while the FES coefficient is relatively unchanged.

The price equation is a simplification and a generalization of the St. Louis-model equation which is a natural extension of the work by David Laidler (1973) and Robert Lucas (1973). Lagged unemployment rates do not interact with lagged inflation rates when the price-expectation process is modelled, and the equation is free from the restriction that the coefficients on the gap and on the rate of growth of nominal expenditure are equal. A desirable property of this equation is that the sum of coefficients on the rate of growth of nominal expenditure and on

lagged price changes is one. This indicates full adjustment of price expectations and, therefore, real crowding out. When the recent price history is included in the sample period this condition is met by the data. Finally, assuming unit price elasticity of aggregate demand (as implied in this two-equation system) and unit elasticity of substitution between labour and capital, it can be shown that the coefficient on nominal demand should be equal to one minus the production elasticity of labour. This coefficient represents the percentage price increase that results from a 1 percent change in nominal demand when both the productive capacity and factor costs (price expectations and demand pressure) are held constant; it typically represents a movement along the supply curve (Scarth, 1976).

2. Empirical Results

In Table A1 we present the estimated coefficients for two overlapping sample periods (4Q56-4Q71 and 4Q56-4Q75), the first excluding, the second including, recent inflationary experience.[8] It can be seen that most coefficients are consistent with expectations and that these equations describe rather well the behaviour of aggregate spending in the Canadian economy. The change in the estimated sum of coefficients on lagged prices when the current inflationary episode is not included in the sample period is disturbing. However, this result is not atypical. The period is marked by stable inflationary expectations, which are captured by the constant term of the equation. This has been observed before. Faced with a similar problem when dealing with

the U.K. experience, Laidler (1976) proposed a new type of adaptive expectations process whereby the stability of expectations is assured by the stability of external conditions under a fixed exchange-rate regime.

Given the abundant literature on the differing effects of monetary policy under fixed and flexible exchange-rate regimes, it is admittedly simplistic to fit this model over a period which includes both.[9] Moreover, no particular account is taken of the openness of the Canadian economy besides the inclusion of export receipts as another autonomous source of income in the GNE equation.

3. Apologies

We do not intend to hold this model against the Monetarists as representing their views. It shares with all St. Louis-type models the implication that changes in velocity due to monetary causes are temporary[10], whereas changes due to random disturbances are cumulative. This is highly contrary to the spirit of monetarism. The Monetarists are not unaware that the growth rate of GNE responds to all sorts of short-run influences besides money. But they argue that, unless accommodated by marked changes in the growth rate of money, these swings should have a cumulative effect (in interest rates?) that would eventually force nominal spending back on the growth path determined by monetary policy. Because they are estimated in first differences, no St. Louis model to date (except recent developments by Andersen [1975]) incorporates this feature. They

specify no equilibrium or desired value for velocity, let alone a function relating desired velocity to the expected rate of price changes. In these models, monetary changes are a sufficient but not a necessary condition for changes in nominal spending.[11] It follows that they are particularly ill adapted to calculate the extent to which a stable rate of growth of money supply could reduce the major upswings and downswings in the economy. However, for the limited purpose of this study, this model, which we loosely label monetarist for the three reasons that it gives a predominant role to money, it satisfies the "natural rate hypothesis" and it has received ample moral support from the Monetarists, represents a fair alternative to RDX2.

FOOTNOTES

[1] Corrigan (1973) has made a similar study of the U.S. economy.

[2] A further distinction must be made between pure random shifts in the demand for money and errors arising from omitted variables, which may affect spending. Variables are omitted (e.g., the price of various capital assets) because of their high collinearity with those included in the demand-for-money equation. When this collinearity is more tenuous, it may look as if the demand for money has changed, when in fact monetary impulses are only being transmitted temporarily to the real sector via different channels. If no allowance is made for this second possibility, the appropriate variable to control would be $(M1-e) = f(p, y, r)$, where e is the residual in the demand for money, rather than M1. In this case the observed value of M1 has little meaning once past values of this aggregate have been used to yield a satisfactory estimate of the demand-for-money function. The major concern of the authorities becomes a particular relationship between prices (p), real income (y), and interest rates (r) such that $f(p, y, r) = M1target$. The Monetarists, on the other hand, emphasize a more complete portfolio adjustment and the need to effectively control M1, rather than a truncated function $f(p, y, r)$.

[3] This sequence of events must be altered when the monetary expansion is engineered through open-market operations. Money-market rates and external capital flows are affected first and increased spending results from lower interest rates.

[4] This result is not the same as that of Clinton and Masson (1975). Their monthly model supports the general presumption that the reaction of term deposits to a change in short-term interest rates may at times be positive instead of negative, as in the case of M1, if the rates paid on these deposits change enough in relation to other market rates.

[5] But it feeds without a lag into import prices. Initially, therefore, importers and producers using imported intermediate goods will see their profit margins declining. The total domestic value added thus falls, explaining the initial effect in the GNE deflator (see Tables 2, 3).

6 This is the price we have to pay for using a renormalized demand-for-money function with a long adjustment lag (5 quarters). Basically we have:
$\Delta M1 = .2[\,1.5\ PGNE + .6\ YGNE - .01 RS(ANFLIQ) - M1_{-1}\,] + .2\,\Delta\ ANFLIQ$
Renormalized on RS this gives:
$RS = [\,1.5\ PGNE + .6\ YGNE + \Delta ANFLIQ - 5\,\Delta\,M1 - M1_{-1}\,]/.01\ ANFLIQ$
The pattern of $5\Delta M1 + M1_{-1}$ calculated using Table 1 reproduces almost exactly the pattern of the interest-rate response.

7 Obviously, it is impossible to estimate a crowding-out effect using a 2nd degree Almon lag with both the end point and the slope at the end point constrained to zero. This choice is based upon preliminary regressions in which the data were free to accept or reject nominal crowding out. They systematically rejected it.

8 The changes in the definition of M1 that followed the 1967 Bank Act may be responsible for a structural shift in the coefficients of the nominal-spending equation. This question, which takes us beyond our present purpose, is the subject of further investigation on the reduced-form model.

9 As far as the expenditure equation is concerned the statistical evidence does not support the hypothesis of structural changes related to the exchange-rate regime.

10 Velocity will resume its long-run trend in due course, if the long-run price homogeneity condition is satisfied. It can be seen, however, that this condition is almost but not quite achieved in this model. It is not significantly rejected either, and it might be worthwhile to transgress a deeply rooted monetarist taboo and re-estimate the expenditure function in real terms.

11 On the assumption that non-monetary disturbances in aggregate spending should be only temporary, St. Louis expenditure equations should display a strong negative autocorrelation among the residuals. This is barely supported by the Durbin Watson statistic (2.3). However, this statistic pertains only to the first order autocorrelation, while, if the theory is correct, the autocorrelation should be of higher order. Box-Jenkins analysis of the residuals is not conclusive. The autocorrelation coefficients are negative for numerous orders but they are small and insignificant. We have not been successful, in our current research, in showing that money is a necessary condition for changes in expenditure. Gould and Nelson (1974) reached a similar conclusion from their analysis of the stochastic structure of velocity in the United States.

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