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THE IMPACT OF THE BALANCE OF PAYMENTS ON
THE CANADIAN MONEY SUPPLY (1962-70)

A Dissertation
Presented to
the School of Graduate Studies
of
Carleton University

In Partial Fulfillment of
the Requirements for the Degree
Doctor of Philosophy
in the Department of
Economics

September 1973

by
Robert C. ^{Cornelius}Kamp

7

The undersigned recommend to the Faculty
of Graduate Studies acceptance of the thesis
"The Impact of the Balance of Payments on the
Canadian Money Supply (1962-70)" submitted by
Robert Cornelius Kamp, M.A. (Economics), in
partial fulfilment of the requirements for
the degree of Doctor of Philosophy.

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ABSTRACT

This dissertation investigates the ties between the Canadian monetary sector and the American economy. The basic framework of analysis is an aggregate model of the Canadian economy. The task of the model is to show the effect of various economic disturbances in the United States on the Canadian economy and specifically on the monetary sector.

Such an approach has been used before but so far its success in providing an explanation of the role of international developments in the Canadian monetary sector has been rather limited. One of the reasons for this is that there was no attempt to incorporate the objectives of the central bank into the analysis. Taking this into account, provides three new avenues of study. First it shows that foreign disturbances affect the monetary sector and the economy in different ways depending on what the goal of the Bank of Canada happens to be. In other words, the manner in which a disturbance influences the economy is identified with a particular monetary policy objective. This has important implications for the evaluation of monetary policy because it permits one to determine what is the objective of the monetary authority - a piece of information which is seldom if ever made public.

A second avenue relates to the means by which the disturbances are transmitted to the monetary sector. The model demonstrates

that the monetary transfer mechanism depends on the type of policy objective which is operative. Therefore once the goal is identified, the transmission mechanism is known: a necessary piece of information in the formulation of a successful stabilization policy.

The final avenue concerns the quantitative impact of disturbances under the different policy goals. By including the policy goals in the model it is possible to show that the sensitivity of the economy to the external developments depends on the objective pursued. One is therefore able to evaluate a particular goal in terms of whether it increases or decreases the influence of exogenous disturbances.

An empirical test of the model demonstrates that the Bank of Canada was following a policy which minimized the fluctuations in foreign exchange reserves throughout the fixed exchange rate period. This was particularly true during the ceiling period. Outside the years of the ceiling, a milder form of this policy was used. Having identified the objective, evidence is presented to show that the monetary transmission mechanism during this time was the open market operations of the central bank. The consequence of this policy was that the Canadian economy and the monetary sector in particular was more sensitive to external economic disturbances than if monetary policy had been inactive.

CHAPTER I

Studies concerned with the sensitivity of the Canadian economy to developments outside her borders lost their novelty some time ago. The correspondence between the level of economic activity in Canada and the United States has been measured and catalogued quite extensively by Chambers [5] [6], Hay [18] and Rosenbluth [34] [35]. In spite of the familiarity generated by these endeavours, much has yet to be learned on how the external disturbances are transmitted to the Canadian economy. Until the transmission mechanisms are uncovered, the task of combatting the effects of outside disturbances will remain a bothersome problem to the Canadian policy maker.

Suggesting possible linkages between the two economies is not difficult. The high degree of foreign ownership and the presence of a common mass media to shape ideas and attitudes are but a few. Where the problems arise is in defining how each one of these linkages functions and then determining how they can be controlled to enhance national welfare. The scope of this paper is confined to only one of the ways in which disturbances are transmitted--the balance of payments.

One facet of the balance of payments link, the trade account, has received a fairly exhaustive treatment by Chambers [5] [6] and Rosenbluth [34] [35]. If this were the major channel of conducting foreign disturbances to the Canadian economy one would expect movements in exports to lead Gross National Expenditure. While this is often the case neither the reverse sequence nor a simultaneous change is uncommon.¹ This result does not discount the importance of the trade account but it does call for an investigation of additional aspects of the balance of payments.

Since the level of economic activity is subject to monetary as well as real forces,² it is important to consider the changes in the domestic monetary sector which emanate from fluctuations in the balance of payments. In this vein, it is interesting to note that historically the most important sources of changes in the Canadian money supply have been the monetary base and the banks' reserve ratio.³ More significant in terms of the present study is the finding that during the years 1961-69, the monetary base was the dom-

¹K.A.J. Hay, "Money and Cycles in Post Confederation Canada," Journal of Political Economy, LXXV (June, 1967), p. 263.

²For the seminal work in this area see Milton Friedman and Anna Schwartz [13]. An investigation of the Canadian situation is provided by Hay [19].

³K.A.J. Hay, "Determinants of the Canadian Money Supply 1875-1958," Carleton Economic Papers, Department of Economics, Carleton University (Ottawa: 1968), p. 17. (Mimeographed.)

inant factor.⁴ The relevance of this lies in knowledge that the monetary base is subject to the influence of both the Bank of Canada and the balance of payments. While the conditions necessary for Hume's specie-flow mechanism to operate may not be present today, there is some question as to how well the Bank of Canada is able to insulate the money supply from economic disturbances abroad.⁵ Certainly no pronouncement of the Bank of Canada would harbour such doubts, but the mere observation of a significant correspondence in the timing and amplitude of cycles in the Canadian and American money supplies encourages one to investigate the matter more fully.⁶ Indeed it is this issue of how the balance of payments affects the monetary sector that is the nub of this study.

As should be evident from the preceding discussion, the requisite for such an inquiry is a model of the Canadian economy which is linked by both real and monetary transmission mechanisms to economic disturbances outside the country. In this regard it is helpful to review some of the models employed in previous investi-

⁴K.A.J. Hay, "A Model of the Canadian Money Supply." Paper read before the meetings of the Canadian Economics Association, St. John's, Newfoundland, June 1971, Table 3.

⁵For instance R. A. Mundell [29] has provided a theoretical argument against feasibility of a sterilization policy.

⁶Hay, Money and Cycles . . ., p. 271. A strong relationship between the two money supplies in terms of changes in the stock and growth rates was found by Glenn Jenkins [23] (especially Part II, pp. 3-4).

gations of economic interdependence. A prominent feature of these models as well as the one utilized in the present analysis is the absence of any consideration of adjustments in investors asset portfolios. This simplification is justified on the grounds that the primary concern is with the short-run implications of exogenous disturbances and government stabilization policies. Those interested in the portfolio adjustment approach should see Floyd [11] [12] and McKinnon [28].

The idea of economic interdependence in the context of the two country model has enjoyed textbook familiarity for many years. Although this has been extended somewhat as in Metzler's classic article [27], the basic conclusions regarding the effect of real disturbances in one economy on the balance of trade and economic activity of another have remained virtually intact. Although this type of model contributes to our understanding of international economic linkages, the omission of monetary considerations involves serious limitations as noted above. An important contribution in meeting this shortcoming is Mundell's model [29]. As well as dealing with the effects of real foreign disturbances, he incorporates a money supply which has both foreign and domestic determinants when the exchange rate is fixed. The model cogently demonstrates that, placed in an environment of fixed exchange rates and interest elastic capital flows, a small economy will be unable to pursue an independent monetary policy. Any attempt by the central bank to neutralize the effects of changes in foreign exchange reserves will only exacerbate the effects

of the initial disturbance in the balance of payments by increasing the volume of international capital flows. This in turn results in a continuous expansion or contraction of international reserves which cannot be sustained indefinitely. Monetary authorities must either permit a change in the money supply or alter the exchange rate. These predictions were affirmed in an econometric study of the Canadian economy by Rhomberg [33] (see especially pp. 15-21).

Other economies dominated by large foreign sectors have also exhibited monetary sectors which are highly sensitive to external developments. Niehans [30] has shown that in the absence of speculative capital flows, the import surplus is a good proxy determinant of the Swiss interest rate. This result is based on an underlying model in which the import surplus, acting through international reserves, is an important argument in the money supply function while at the same time is related to the demand for money through a positive association with the level of output.

These latter studies appear to argue that there should be a positive relationship between the money supply and foreign exchange reserves during Canada's most recent experience with fixed exchange rates (1962-1970). However preliminary work based on this approach does not substantiate this expectation. In fact little or no relationship has been found between official reserves (gold and foreign exchange reserves) and the money supply.⁷

⁷Identical conclusions were reached by Hay [17].

Failure to observe the predicted relationship between these two variables is perhaps not too startling given the time period which is involved. For purposes of the years 1961-70, the models have largely excluded the goals and constraints faced by an integral part of the Canadian-American economic scene--the policy maker. The significance of the official intervention is brought out in a closely related study by Caves and Reuber [14]. After discovering a strongly integrated North American capital market during the flexible exchange rate period, they attempted to extend their analysis to cover the years of the fixed rate as well. The results of this extension were dismal. They attributed the inability of their model to explain the operation of North American capital markets under the fixed exchange rate to American balance of payments policies and the subsequent Canadian government reactions.⁸

Indeed there have been many significant developments during these eight years. They include two serious exchange crises in 1962 and 1967-68, several American policies directed at remedying the balance of payments situation such as the interest equalization tax in 1963 and a series of corporate guidelines in 1965 and 1966. Canada was able to obtain partial exemptions from these balance of payments

⁸Richard E. Caves and Grant L. Reuber, "International Capital Markets and Canadian Economic Policy Under Flexible and Fixed Exchange Rates, 1952-69," Department of Economics, Research Report 7125, The University of Western Ontario (London, Ontario: 1971), pp. 20, 21 and 26.

measures but this was at the cost of maintaining a ceiling on official reserves from 1963 to 1968. In addition to this there was a major revision of the Canadian Bank Act in 1967. From this it is readily apparent that omission of the policy maker or more specifically his goals and constraints from the analysis would introduce a serious defect.

One of the methods utilized to remedy this is the reaction function. Essentially what it does is relate changes in monetary policy to changes in various indicators of economic performance. The expected signs of the relationships are determined by the goals of the monetary authority.⁹ The most familiar study of this type for Canada is Reuber's background paper for the Royal Commission on Banking and Finance [32]. His reaction function used the money supply as the indicator of monetary policy while various measures of unemployment prices and growth were used as performance indicators. On the basis of his statistical results (1949-61) he concluded that the monetary policy discouraged unemployment, encouraged growth and tolerated moderate price increases. Hay [17] attempted to apply the same reaction function to the years 1961-68 which covered a portion of the fixed exchange rate period. None of Reuber's performance monitors proved significant. The conclusion drawn from this was that prices and unemployment were not relevant policy objectives for this

⁹As one might expect these are not readily available to the public except in terms of the most meaningless generalities. For further discussion of this problem see Chapter III below.

period. A second reaction function which included balance of payments considerations was then tried. (Notice that this modification introduces external developments as determinants of the money supply.) This form did nothing to improve the performance of the price and unemployment variables.¹⁰ One of the major problems of this study involved the interpretation of the relationships which emerged between the policy instruments and the performance indicators.

This problem of assigning theoretical relationships is fundamental to the whole reaction function approach. It is virtually impossible to argue a priori what the sign of the performance variables should be. In the first place if this technique is to give valid insight into the workings of monetary policy, it should be based on a precise statement of the central bank's objectives. This is not readily available as it is not in the Bank's interest to reveal this (see Chapter III below). Thus even if a particular relationship between the policy and performance indicators were observed, how is it possible with this framework to know whether or not this is equally consistent with an alternate goal? A negative relationship between the price level and the money supply may not be exclusive to a policy objective of price stability. No unequivocal conclusion about policy objectives can stand until the peculiar effects of this policy can be specified and tested.

A second bothersome aspect connected with interpretation of statistical results concerns the situation where no significant re-

¹⁰ Hay, "A Model of the Canadian Money Supply," pp. 14-18.

lationship appears. Should this be taken to mean that the particular goal represented by the variable was not in effect? Suppose the central bank experienced an unqualified success in combatting fluctuations in the level of unemployment. The absence of a statistical relationship which would then be observed should certainly not be taken as evidence that the level of unemployment was ignored by the monetary authority.

In short the single equation reaction function makes it extremely difficult to know what hypothesis is being examined and even more difficult to interpret the statistical results. It becomes quite apparent that if the objectives and constraints of policy are to be incorporated into the analysis they must be introduced via a complete model of the economy.

The final but crucial factor necessary in an analysis of foreign disturbances and their impact on the economy concerns the specific type of disturbance involved. This notion is set out very clearly by Cooper [9]. He demonstrates that the course of developments within the economy depends not just on external disturbances but also on whether these disturbances are of a monetary or expenditure nature.¹¹ It therefore becomes important for the model to specify different types of foreign disturbances rather than using some aggregative concept like changes in official reserves.

To summarize, an investigation of international economic in-

¹¹Richard N. Cooper, "Macroeconomic Policy Adjustment in Interdependent Economies," Quarterly Journal of Economics, LXXXIII (February, 1969), pp. 8-9.

terdependence must look at the mechanisms by which foreign disturbances are transmitted to the domestic economy. Although the case of Canada and the United States proffers many possible linkages, a great deal is yet to be learned as to how the transmission mechanisms operate so that the adverse effects of the disturbances can be effectively avoided. Taking the balance of payments as the primary linkage, both the real and monetary facets of this mechanism must be probed. The transmission of disturbances to the Canadian monetary sector which has so far been the least successfully exploited research area of the balance of payments linkages is the focus of the present study.

While historically the Canadian monetary sector has exhibited a close relationship with its American counterpart, efforts to identify the probable linkages have been singularly unsuccessful for Canada's most recent experience with a fixed exchange rate. This failure may be ascribed to two major deficiencies in the existing studies. First the objectives and constraints of monetary policy have not been incorporated into a model which includes all sectors of the economy. Since official intervention was so prevalent during this period, the absence of these considerations has seriously coloured the results of these efforts. The second deficiency centers on the fact that foreign disturbances have usually been 'entered' via some aggregate measure. By specifying the disturbances individually the associated linkage and impact can be more successfully diagnosed.

The model developed in the following chapter, while highly aggregative, enlists the above requisites. These modifications promise to generate a more complete knowledge of the way in which external events affect the Canadian monetary sector.

CHAPTER II

A. THE MODEL

This chapter specifies a theoretical framework for analysing how exogenous disturbances act through the balance of payments to affect the Canadian monetary sector. The model presented involves a high degree of aggregation, but because of two features it is able to generate several interesting hypotheses on the nature of the mechanism by which economic disturbances are transmitted internationally and the conduct of monetary policy in an open economy.

The first feature of the model centers on its ability to distinguish between different types of exogenous disturbances in the foreign as well as the domestic sectors. As a result it is possible to determine the impact of particular foreign disturbance on the economy as a whole and the monetary sector in particular. The second important characteristic of the model is that it includes explicitly the constraints faced by the monetary authority as set out by its policy objectives. This permits one to analyse the disturbances and their effects in a particular policy environment.

An idea of the wealth of cases which can be analysed is

given by the matrix format of Figure I.

		Exogenous Disturbances		
		1	2	3
Policy Environment	A	A1	A2	A3
	B	B1	B2	B3
	C	C1	C2	C3
	D	D1	D2	D3
	E	E1	E2	E3

Figure I.

Possible Effects of Exogenous Disturbances on the
Economy Under Various Policy Environments

This illustrates clearly that the impact which disturbance 1 will have on the economy will be conditioned by the type of policy which the monetary authority is following. For instance if 1 represents a change in foreign income, the effect that this has on the economy will differ if the central bank is pursuing an anti-inflationary policy, say B, than if it is pursuing an expansionary policy, D.

Before examining the structural form of this model, several underlying assumptions should be made explicit.

First, since the Canadian economy is small in relation to those of her major trading partners, the possibility of internal developments having repercussions abroad is ignored.

A second and more far reaching assumption concerns the distinction between the real and nominal values of the variables. Throughout the analysis this distinction is ignored. Thus when discussing a change in the level of national income there is no means of demonstrating how much of this is reflected by a change in prices and how much by a change in output. This naturally constitutes a serious deficiency for a short run analysis. The decision to follow this route is not cavalier but rather emerges from being faced with an as yet unsettled debate. Several articles deal specifically with this issue (Friedman [14] [15] and Claassen [8]) but none provide a definite answer. Since the specifics of the controversy lie outside the focus of this paper, one must be satisfied with a next best solution.

It is also assumed that expectations play no role in determining output and interest rates. This was done because again this concept has not yet been successfully integrated into an acceptable macro-economic framework. One benefit arising from this assumption is that one is able to make comparisons with existing empirical studies and therefore evaluate the special features of the present analysis.

Finally it is important to note that the model deals with equilibrium in the context of flows. This means that the focus is

on the process of individuals adjusting their holdings of assets in order to reach a steady-state equilibrium. However, the steady-state equilibrium itself is not examined. This absence of concern for complete stock adjustment would be unacceptable in a long run study, but the short run horizon of this analysis makes the implications of this approach less severe.

1. List of Variables

- Y = Gross Domestic Product
- f = Private domestic absorption
- i = Domestic short term interest rate
- Y_F = Foreign Gross Domestic Product
- i_F = Foreign short term interest rate
- G = Domestic government expenditure on goods and services
- L = Demand for money
- M_s = Money supply
- γ = Central bank holdings of domestic bonds
- R = Official holdings of foreign exchange
- C^* = Private domestic excess demand for domestic bonds
- C = Net foreign demand for domestic bonds
- Z^* = Foreign demand for domestic bonds
- Z = Domestic demand for foreign bonds
- T = Balance of trade

2. The Structural Equations

Equilibrium in the goods market is depicted by

$$Y - f(Y, i, Y_F) - G = 0 \quad (1)$$

$$f_Y > 0, f_i < 0, f_{Y_F} > 0^1$$

Private domestic absorption indicated by f exhibits the standard behavioural pattern. Absorption is related positively to income but negatively to interest rates. The latter relationship arises from the substitution between bonds and goods in consumption and investment. Foreign income operates through a change in exports to create a positive association with domestic absorption. [Throughout the analysis the change in domestic absorption is held equal to the change in the balance of trade for a given change in foreign income. (i.e. $f_{Y_F} = T_{Y_F}$ see below)]

For simplicity, taxes are not included in the model so that government expenditure, G , is financed through the sale of bonds.²

The monetary sector is capsulized in equation 2

$$L(Y, i) - M_s(\gamma, R, i) = 0 \quad (2)$$

$$L_Y > 0, L_i < 0, M_{s_\gamma} > 0, M_{s_R} > 0, M_{s_i} > 0$$

The demand for money, shown by the first term, takes the

¹The symbols f_Y , f_i etc. denote the partial derivatives. The first letter indicates the function under consideration while the subscript specifies the variable which is changing.

²Notice that G can represent any type of autonomous expenditure.

conventional format arguing that demand is positively related to income and negatively related to the interest rate.³ The supply of money is a function of the central bank's bond holdings, the official holdings of foreign exchange and the rate of interest. This offers no departure from the standard approach other than that it assumes that open market operations are the most important instrument of monetary policy. A rationale for this assumption is provided in Appendix II-2.

The model takes into account two types of bonds, domestic and foreign. These are considered close substitutes for each other and can be held in both countries. The flow equilibrium condition for the domestic bond market is given by

$$\gamma - \gamma_{t-1} - G + C^*(i, Y) - C^*_{t-1} + Z^*(i, i_F, Y_F) - Z^*_{t-1} = 0 \quad (3)$$

$$C^*_i > 0, C^*_Y < 0, Z^*_i > 0, Z^*_{i_F} < 0, Z^*_{Y_F} > 0$$

The central bank enters this market through its open market operations $\gamma - \gamma_{t-1}$. Since government finances its expenditures through the sale of bonds, G registers a negative sign. The excess demand of domestic residents (banks and non banks) is positively related to the domestic interest rate. Domestic income produces an

³Notice this does not constitute the Keynesian demand for money function as it uses the current interest rate as opposed to the expected interest rate postulated by Keynes. Given that work on the expected rate of interest is still in a primitive state and since it is desirable to compare the results of this study with the work of other researchers in the field, the convention of using the current rate of interest is adopted here.

ambiguous result because an increase in income will both increase demand and the issuance of bonds.

Foreigners also participate in the market. This demand is positively related to the domestic interest rate but negatively related to the foreign interest rate because of the substitutability between the two securities. Furthermore as foreign income rises, more domestic bonds are demanded.

A balance of payments equation brings together the net foreign demand for domestic goods and bonds as set out by

$$T(Y, Y_F) + C(i, i_F, Y, Y_F) - C_{t-1} - (R - R_{t-1}) = 0 \quad (4)$$

$$T_Y < 0, T_{Y_F} > 0, C_i > 0, C_{i_F} < 0, C_Y < 0, C_{Y_F} > 0$$

The trade balance depicted by the first term responds negatively to domestic income and positively to foreign income via imports and exports.⁴

The capital account summarized by the second term of equation

⁴ Another possible argument in the balance of trade term would be the Canadian interest rate. This would enter positively as it is negatively related to the absorption of imports. A model presented by H.G. Johnson [24], considers this possibility. In the solution of his model Professor Johnson lets the partial equal zero. This resolves a number of ambiguities which develop if it is included.

The importance of interest rates in the balance of trade rests on the case where the country is highly dependent on imports for investment goods. As the significance of this category of imports has been evidencing a decline, interest rates have been omitted as an explanatory variable. See B.W. Wilkinson [36], especially pp. 24, 25.

4 shows the net foreign demand for domestic securities. This is derived from

$$C(i, i_F, Y, Y_F) = Z^*(i, i_F, Y_F) - Z(i, i_F, Y) \quad (5)$$

$$\begin{aligned} C_i &> 0, C_{i_F} < 0, C_Y < 0, C_{Y_F} > 0, Z^*_i > 0, Z^*_{i_F} < 0, Z^*_{Y_F} > 0 \\ Z_i &< 0, Z_{i_F} > 0, Z_Y > 0 \end{aligned}$$

where Z^* is the foreign demand for domestic bonds and Z is the domestic demand for foreign bonds. The partials of Z are analogous to those of Z^* which were explained above. In interpreting the partials for C it can be seen that an increase in i will cause an increase net foreign demand for bonds as both foreigners and nationals shift to domestic bonds. An increase in domestic income increases expenditures on goods and both types of securities which decreases net foreign demand. An analogous argument explains the signs of the partials with respect to foreign interest rates and income.⁵ When the C term is placed in the context of the balance of payments equation the above results are expressed in terms of net international capital flows.

In a fixed exchange rate environment, any non zero balance on the trade and capital accounts is exactly offset by a change in official holdings of foreign exchange, $R - R_{t-1}$, so that equation 4

⁵The signs of the partials with respect to foreign and domestic income would be reversed if concern were with a longer time horizon. In this instance attention would be directed at movements of direct as opposed to portfolio investment. For an example of a model using this approach see H.G. Johnson [24].

is always satisfied.

Returning to equations 1-3 it is important to note that these excess demand functions are interrelated because domestic residents are subject to a budget constraint. That is, the sum of domestic excess demand for domestic goods, foreign goods, money, domestic bonds and foreign bonds must equal zero. This can be expressed in terms of flows as

$$f + G - Y - T + \gamma - \gamma_{t-1} - G + C^* - C^*_{t-1} + Z - Z_{t-1} + L - L_{t-1} - (M_s - M_{s_{t-1}}) \equiv 0 \quad (6)$$

With the aid of this budget constraint it is possible to eliminate one of the excess demand equations for equilibrium in two markets implies equilibrium in the third. Thus the bond equation may be deleted giving a system of three equations (1, 2 and 4).

Accepting this basic structure, the task now centers on generating a series of testable hypotheses of how the various disturbance terms which are included affect the level of economic activity.

A brief glance at the model reveals that the exogenous variables consist of either a domestic policy instrument (γ) or domestic and foreign economic disturbances (G, Y_F, i_F).⁶ What is necessary now is to discover the relationship between the disturbance variables and the endogenous variables which reflect the level of economic activity (Y, i, R, M_s, C, T). The policy variables enter with the explicit purpose of establishing the environment and constraints which will alter these relationships

⁶Recall that G serves as an indicator of any change in autonomous domestic absorption as well as fiscal policy.

according to the particular objective of the policy makers. All of this is brought out in the following section which develops the comparative statics of the model.

B. THE COMPARATIVE STATICS OF THE MODEL

Case 1. The Impact of Exogenous Disturbances When Monetary Policy is Inactive

Differentiating equations 1, 2 and 4 totally and rearranging the terms so that the policy and disturbance variables are on the right hand side, enables the equations to be expressed in the following matrix notation.

$$\begin{pmatrix} 1-f_Y & -f_i & 0 \\ L_Y & A_i & -Ms_R \\ B_Y & C_i & -1 \end{pmatrix} \begin{pmatrix} dY \\ di \\ dR \end{pmatrix} = \begin{pmatrix} f_{Y_F} dY_F + dG \\ Ms_Y d\gamma \\ -B_{Y_F} dY_F - C_{i_F} di_F \end{pmatrix}$$

$$\text{where } B_Y = T_Y + C_Y < 0,$$

$$B_{Y_F} = T_{Y_F} + C_{Y_F} > 0 \text{ and}$$

$$A_i = L_i - Ms_i < 0.$$

Solving this system for dY , di and dR ; then collecting terms, produces a system of three equations in three unknowns.

$$\begin{aligned} dY = \frac{1}{\Delta} & \left[(Ms_R C_i - A_i) dG - f_i Ms_Y d\gamma \right. \\ & + \left((Ms_R C_i - A_i) f_{Y_F} - Ms_R f_i B_{Y_F} \right) dY_F \\ & \left. - Ms_R f_i C_{i_F} di_F \right] \end{aligned}$$

(7)

$$\begin{aligned}
di = \frac{1}{\Delta} & \left[(L_Y - M_S B_Y) dG - (1 - f_Y) M_S \gamma d\gamma \right. \\
& + \left. \left((L_Y - M_S B_Y) f_{Y_F} - M_S (1 - f_Y) B_{Y_F} \right) dY_F \right. \\
& \left. - M_S (1 - f_Y) C_{i_F} di_F \right] \quad (8)
\end{aligned}$$

$$\begin{aligned}
dR = \frac{1}{\Delta} & \left[(L_Y C_i - B_Y A_i) dG - \left(B_Y f_i - C_i (1 - f_Y) \right) M_S \gamma d\gamma \right. \\
& + \left. \left((L_Y C_i - B_Y A_i) f_{Y_F} - A_i (1 - f_Y) + f_i L_Y B_{Y_F} \right) dY_F \right. \\
& \left. - A_i (1 - f_Y) + f_i L_Y C_{i_F} di_F \right] \quad (9)
\end{aligned}$$

$$\begin{aligned}
\text{where the determinant, } \Delta, &= M_S \left[C_i (1 - f_Y) + B_Y f_i \right] \\
&- (1 - f_Y) A_i - L_Y f_i > 0
\end{aligned}$$

This system of equations determines the changes in domestic income, interest rates and official holdings of foreign exchange which emanate from movements in autonomous domestic expenditures, foreign income and foreign interest rates.⁷ The following subsections examine the relationships between these two sets of variables under the assumption that the central bank takes no policy measures against any exogenous disturbance.

a. A Change in Foreign Income

Consider first the effect of a change in foreign income on domestic income when all other exogenous variables are held constant.

⁷The impact of these disturbances on capital flows, the money supply and the balance of trade are derived below from the structural equations.

TABLE II-1

The Impact of Exogenous Disturbances When Monetary Policy is Inactive

	Y_F	Exogenous Disturbance i_F	G.
Open Market Policy	$\frac{dY}{dP} = 0$	$\frac{di_F}{dP} = 0$	$\frac{dG}{dP} = 0$
Impact on the Economy			
Y	$\frac{dY}{dP} = -\frac{1}{\Delta} \Delta Y_F > 0$	$\frac{dY}{di_F} = \frac{1}{\Delta} (M_R C_1 C_2) < 0$	$\frac{dY}{dG} = \frac{1}{\Delta} (M_R C_1 - A_1) > 0$
i	$\frac{di}{dP} = -\frac{1}{\Delta} \Delta i_F > 0$	$\frac{di}{di_F} = \frac{1}{\Delta} M_R C_1 (1 - f_Y) > 0$	$\frac{di}{dG} = \frac{1}{\Delta} (L_Y - M_R B_Y) > 0$
R	$\frac{dR}{dP} = -\frac{1}{\Delta} \Delta R_F > 0$	$\frac{dR}{di_F} = -\frac{1}{\Delta} C_1 [L_Y f_1 + A_1 (1 - f_Y)] < 0$	$\frac{dR}{dG} = \frac{1}{\Delta} (L_Y C_1 - B_Y A_1) > 0$
M	$\frac{dM}{dP} = -\frac{1}{\Delta} \Delta M_F > 0$	$\frac{dM}{di_F} = -\frac{M_R}{\Delta} \frac{1}{i_F} L_Y f_1 + L_1 (1 - f_Y) < 0$	$\frac{dM}{dG} = \frac{1}{\Delta} M_R (L_Y C_1 - L_1 B_Y) + L_Y A_1 > 0$

$$\Delta = M_R [C_1 (1 - f_Y) + B_Y f_1] - (1 - f_Y) A_1 - L_Y f_1 > 0$$

$$\phi = C_1 f_Y - f_1 B_Y > 0$$

$$\theta = C_Y (1 - f_Y) + f_Y f_1 (1 - f_Y) + B_Y (1 - f_Y) + L_Y (1 - f_Y) < 0$$

*For the derivation of this result see Appendix II-1.

Solving equation 7 for dY/dY_F gives

$$\frac{dY}{dY_F} = \frac{1}{\Delta} (M_S \delta - A_i f_{Y_F}) > 0 \quad (10)$$

where $\delta = C_i f_{Y_F} - B_{Y_F} f_i > 0$

By the assumptions regarding the partial derivatives of the behavioral functions examined above, dY/dY_F takes on a positive value. This of course is a standard result arguing that an increase in foreign income will improve the balance of trade which will provide both a real and monetary stimulus to domestic income, causing it to rise.

A summary of the relationships between the various exogenous variables and their endogenous counterparts is set out in Table II-1. The disturbance terms are listed horizontally while the endogenous variables are listed vertically. (Notice that these results obtain only when the monetary authority makes no effort to counter the effects arising from these disturbances: $d\gamma$ is assumed to be zero.)

This result, along with the other multipliers showing the impact of the exogenous disturbances on the economy when monetary policy is inactive, is summarized in Table II-1. The effects of a particular disturbance on income, the interest rate, official reserves, and the money supply can be found by moving down the appropriate column.

Since the results are fairly standard, they require only passing comment. For instance foreign income exerts a positive influence on official holdings of foreign exchange.

This reflects a general improvement in the balance of payments in the event of a rise in foreign income. In the absence of any countervailing monetary policy this means the money supply will increase as borne out by the positive sign of dM_s/dY_F . Domestic interest rates fall in the face of rising foreign income which means that the increase in the supply of money arising from the improvement in the balance of payments is greater than the increase in demand brought about by a higher level of income.

Unequivocal statements regarding the developments in capital and current accounts were not obtained. The capital account is subject to the positive influence of a higher foreign income and the negative influence of lower domestic interest rates and higher income. The current account has similar conflicting pressures in the form of higher domestic and foreign income.

b. A Change in Foreign Interest Rates

The second type of disturbance to be analysed is a change in foreign interest rates. A summary of the adjustments which this induces in the economy is given in column 2 of Table II-1.

When foreign interest rates increase there will be a capital outflow which will reduce the level of foreign exchange reserves and the money supply as evidenced by the negative signs for dR/di_F and dM_s/di_F . The decrease in the money supply produces an increase in interest rates which in turn leads to a decline in income. Because of this the trade account will improve; but the overall deterioration of the balance of payments indicates that the higher foreign

interest rates more than offset the influence of lower income and higher interest rates at home so that the capital account deteriorates.

c. A Change in Autonomous Domestic Expenditures

The last disturbance entertained is a change in autonomous spending. Although the following exposition only considers government spending, identical results obtain for autonomous changes in consumption or investment expenditures.

Intuitively it would seem that an increase in net government spending would produce an increase in both income and the interest rate. The particular relationships verifying this expectation are straight-forward and set out in Table II-1, column 3. The impact on the balance of payments is ambiguous because while the increase in interest rates attracts foreign capital, the higher income generates a capital outflow and weakens the balance of trade. If capital flows were relatively more sensitive to income than the interest rate, there would be an unequivocal capital outflow which would reinforce the deterioration in the trade account to produce an over-all decline in the international payments position and a loss of foreign exchange reserves.

The ambiguity present in the foreign sector is also present in the monetary sector. Since both income and interest rates rise, it is not possible to determine the net impact on the money supply.

This completes the analysis of how various disturbances affect the domestic economy in the absence of a policy response by

the monetary authority. In view of the commitment by government to counter large fluctuations in economic activity, the results obtained would seem to be somewhat irrelevant.

A more interesting and fruitful approach is to examine the influence of these same disturbances when the monetary authority is using open market operations to achieve a specific goal.⁸ Initially four different goals were investigated: a constant level of foreign exchange reserves, a constant Canada-United States interest differential, a constant money supply and a constant level of national income. After viewing these possible objectives in light of the institutional setting and official statements of the 1962-70 period, there was a clear indication that only the constant reserves, constant interest rate differential and constant money supply were pertinent and therefore lend themselves to empirical testing. Consequently only these three cases are examined below. The 'no policy' situation discussed above will aid in the exposition of these cases as well as providing a standard for comparisons.

Case 2. The Impact of Exogenous Disturbances when Open Market Operations are Employed to Maintain a Given Level of Foreign Exchange Reserves

a. A Change in Foreign Income

In order to determine the relationship between foreign and domestic income under this policy constraint, equation 9 is solved

⁸The simultaneous presence of fiscal policy operations and goals can also be handled but they are not considered in detail here.

for $d\gamma/dY_F$ when $dR = di_F = dG = 0$. The resulting expression is

$$\frac{d\gamma}{dY_F} = \frac{1}{M_S \gamma \Delta_1} (L_Y \delta - \lambda i \theta) > 0 \quad (11)$$

This shows the change in the central bank's holdings of bonds necessary to keep the level of foreign exchange reserves constant. To determine how the open market operation alters the effects of the exogenous disturbances on the economy, this expression is substituted into equations 7 and 8. Solving these for dY/dY_F and di/dY_F respectively gives the impact on income and interest rates. From here it is a simple matter of substitution into the structural equations to determine the effects on the other monitors of economic activity. The results are shown in the first column of Table II-2.

A quick comparison of these results with those presented in the first column of Table II-1 reveals that the directional impact of American income on income interest rates and the money supply remain unchanged. The reasoning behind this is straightforward. A rise in American income will introduce the same pressures on the economy as before. This time however the central bank will respond with an expansionary monetary policy (equation 11) in order to prevent foreign exchange reserves from rising. Interestingly enough, the increase in the monetary base which is produced is greater than that which occurs when reserves were permitted to increase as in the previous case⁹ (see Table II-1). It follows that the resultant changes

⁹The proof follows from the fact that $M_{S_R} = M_S \gamma$ therefore $M_S \gamma \Delta_1 < \Delta$.

TABLE II-2
The Impact of Exogenous Disturbances When Monetary Policy
Holds Foreign Exchange Reserves Constant

	Y_F	Exogenous Disturbance i_F	G
Open Market Policy	$\frac{dY_F}{d\Delta} = -\frac{1}{M_2} \frac{\Delta}{\Delta_1} (L_1 \delta - \lambda_1 \theta) > 0$	$\frac{dY_F}{di_F} = -\frac{C_{1F}}{M_2} \frac{\Delta}{\Delta_1} L_1 x_1 + \lambda_1 (1 - x_1) < 0$	$\frac{dY}{dG} = \frac{1}{M_2} \frac{\Delta}{\Delta_1} (L_1 C_1 - B_1 A_1) < 0$
Impact on the Economy	$\frac{dY_F}{dY} = -\frac{\delta}{\Delta} \frac{\Delta}{\Delta_1} > 0$	$\frac{dY_F}{di_F} = -\frac{f_1 C_{1F}}{\Delta_1} \frac{\Delta}{\Delta_1} < 0$	$\frac{dY}{dG} = -\frac{C_1}{\Delta_1} \frac{\Delta}{\Delta_1} > 0$
	$\frac{dY_F}{dY} = -\frac{\theta}{\Delta} \frac{\Delta}{\Delta_1} < 0$	$\frac{dY_F}{di_F} = -\frac{C_{1F}(1-x_1)}{\Delta_1} \frac{\Delta}{\Delta_1} > 0$	$\frac{dY}{dG} = -\frac{B_1}{\Delta_1} \frac{\Delta}{\Delta_1} > 0$
	$\frac{dM_2}{dY} = -\frac{1}{\Delta} \frac{\Delta}{\Delta_1} \left[\theta \left(L_1 \delta - \lambda_1 \theta \right) + \frac{1}{\Delta_1} \frac{\Delta}{\Delta_1} \right] > 0$	$\frac{dM_2}{di_F} = -\frac{1}{\Delta_1} \frac{\Delta}{\Delta_1} \left[L_1 x_1 + \lambda_1 (1 - x_1) \right] < 0$	$\frac{dM_2}{dG} = \frac{1}{\Delta_1} \frac{\Delta}{\Delta_1} (L_1 C_1 - L_1 B_1) > 0$
	$\frac{dY_F}{dY} = -\frac{1}{\Delta} \frac{\Delta}{\Delta_1} \frac{1}{\Delta_1} \frac{\Delta}{\Delta_1} < 0$	$\frac{dY_F}{di_F} = -\frac{1}{\Delta_1} \frac{\Delta}{\Delta_1} \frac{1}{\Delta_1} \frac{\Delta}{\Delta_1} > 0$	$\frac{dY}{dG} = \frac{1}{\Delta_1} \frac{\Delta}{\Delta_1} \frac{1}{\Delta_1} \frac{\Delta}{\Delta_1} < 0$

$$\Delta_1 = B_1 f_1 + C_1 (1 - x_1) > 0$$

$$\delta = C_1 x_1 - f_1 B_1 > 0$$

$$\theta = C_1 x_1 (1 - x_1) + f_1 x_1 (1 - x_1 + B_1) > 0$$

in the money supply, income and interest rates will also exceed the changes evidenced under the conditions of an inactive monetary policy. Although this cannot be shown explicitly for income and the money supply, a comparison of the two expressions for the change in interest rates readily demonstrates that the decrease is greater under the constant reserves policy.

Of course the most distinguishing characteristic between the two cases is that this case calls for a change in the central bank's bond holdings but no change in the level of foreign exchange reserves.

Since the directional movements of income and interest rates correspond with those of the preceding case, the foreign sector again offers ambiguous results. The trade balance may move in either direction. All that can be said is, that because reserves remain constant the changes in the trade and capital accounts must be equal in magnitude but opposite in sign.

b. Changes in Foreign Interest Rates and
Autonomous Domestic Expenditures

The results of these two disturbances are summarized in columns 2 and 3 of Table II-2. Notice that as with a change in foreign income, the directional change produced by these disturbances is identical to that produced in the 'no policy' environment. Once again a difference in the magnitude of change can be evidenced.

In the event of a change in foreign interest rates a comparison with the results in Table II-1 shows that the change in the level

of income, the interest rate, the monetary base, and the money supply are all greater when the monetary authority is acting to keep the level of foreign exchange reserves constant.

When the disturbance is a change in net government expenditures under this policy objective, the direction of monetary policy and therefore the change in the money supply becomes uncertain. The equivocal nature of the policy expression is indicated by

$$\frac{dY}{dG} = \frac{(L_Y C_1 - B_Y A_1)}{M_s \gamma \Delta_1} \neq 0 \quad (12)$$

Depending on whether or not the tendency to lose reserves due to higher income outweighs the tendency to gain reserves due to higher interest rates, monetary policy will be tight or easy.

Before passing on to the other cases, it is interesting to examine the two solutions just covered for the insights they offer on existing empirical work of the period under study as well as a few of the hypotheses they propose. Many of the investigations of the fixed exchange rate era in Canada have posited foreign exchange reserves as the mechanism for transmitting external economic disturbances to the monetary sector. (In terms of the analysis here this means the 'no policy' solution provides the relevant framework.) Typically the empirical tests of this have found little or no evidence of this relationship. Such a finding carries with it the inference that foreign disturbances either have no direct link to the money supply or that they are transmitted via some other channel. As the latter appears to be the more interesting and plausible alternative,

it bears further investigation. A first step in this investigation is to determine what can be gleaned from the constant exchange reserves solution.

During most of the time that Canada was maintaining a fixed exchange rate, there was a ceiling on official holdings of foreign exchange so that the constant reserves objective would seem more palatable than the 'no policy' option. If this objective were pursued successfully there would be no expectation of an association between official reserves and the money supply. On the other hand there is a prediction that foreign disturbances and the money supply will be related. Indeed it was found that this relationship would be stronger in this setting than when monetary policy is inactive. (In fact the economy as a whole is much more sensitive to foreign disturbances under the present case.) The transmission device is however not the level of foreign exchange reserves but rather the central bank. A closer examination of these questions will be entertained in the following chapters.

The next section looks at the case where the central bank has the objective of maintaining the existing Canada-United States interest differential.

Case 3. The Impact of Exogenous Disturbances When Open Market Operations are Employed to Maintain a Given Interest Rate Differential

The constant interest differential objective of monetary policy has frequently been considered as an important determinant of Canadian monetary policy. This stems from a dependence on

capital inflows to offset a chronic trade account deficit.

The constraint is imposed on the model in an analagous manner to that used in Section 2. Assuming that $di - di_F$, equation 8 can be solved for $d\gamma$. The latter is then substituted into equations 7 and 9 and from these the impact of the disturbances on the various domestic economic indicators emerges. Each disturbance is examined individually below. A summary of the results is presented in Table II-3.

a. A Change in Foreign Income

If the central bank is able to satisfy the requirements of this objective, there can be none of the domestic interest rate effects on absorption or capital flows observed in the previous cases. This means that the only factor affecting national income will be the change in exports so that the positive relationship between foreign and domestic income is maintained.

Developments in the foreign sector are not quite as well defined. An increase in foreign and domestic income produces an increase in both exports and imports so that it would seem that the trade account could move either way. However since it has been assumed $f_{Y_F} = T_{Y_F}$ an unambiguous improvement is registered. Likewise the capital account is subject to the opposing influences of foreign and domestic income (see Table II-3, column 1). Unfortunately this ambiguity cannot be resolved. Whatever the change in capital account the balance of payments position will be enhanced. The latter is in-

licated by the accumulation of foreign exchange reserves.

In Case 1 above when monetary policy was inactive, an increase in foreign income brought about a reduction in domestic interest rates. If the central bank wishes to prevent a widening of the interest differential, it must therefore sell bonds to the chartered banks so that dY/dY_F will be negative. This contractionary move must be smaller than the expansion of the monetary base attributable to the increase in foreign exchange reserves, because the increased demand for money arising from higher incomes must be accommodated. This is evident from the expression showing the increase in the money supply.

There are several features of these results which distinguish them from those of the preceding cases. The most obvious is of course the interest rate which does not change. Another is that monetary policy moves in the opposite direction to what it would if the policy objective were a constant level of reserves. Finally the influence of foreign income on trade and capital accounts is unambiguously determined. Unfortunately no conclusion on the size of the changes relative to the previous cases is forthcoming.

b. A Change in Foreign Interest Rates

Unlike the above disturbances, a change in foreign interest rates carries with it a change in domestic interest rates if the differential is to be maintained. For this reason a rise in foreign interest rates will necessitate an equal increase in domestic rates which will reduce domestic income. This in turn will lower imports

and improve the balance of trade (see Table II-3, column 2).

The rise in foreign interest rates, domestic interest rates and the fall in domestic income subjects the capital account to counteracting forces and produces an ambiguous result. This means that the overall change in the balance of payments and foreign exchange reserves is also indeterminate. However the money supply will contract because at the new equilibrium the interest rate is higher and the level of income is lower. For example, if reserves rise, the reduction in the money supply must be brought about by open market sales of securities.

The equivocal results which were generated reduce the basis for comparison with the previous cases. However the expressions showing the change in income and the money supply do point out that the effect of foreign interest rates on these two variables is greater than under a policy of constant reserves which in turn was shown to be greater than the 'no policy' situation.

The ambiguities noted above can be resolved if one assumes that $C_i = -C_{i_F}$. This produces the following:

$$\frac{dC}{di_F} = \frac{C_Y f_i}{1 - f_Y} > 0 \quad (13)$$

$$\frac{dR}{di_F} = \frac{B_Y f_i}{1 - f_Y} > 0 \quad (14)$$

$$\frac{dY}{di_F} = \frac{1}{M_{s_Y}(1 - f_Y)} \left[L_Y f_i + (1 - f_Y)A_i - M_{s_R} B_Y f_i \right] < 0 \quad (15)$$

(Note the expressions for $\frac{dY}{di_F}$, $\frac{dT}{di_F}$ and $\frac{dM_s}{di_F}$ are unchanged)

This special case of the constant interest differential rule is rather interesting for it argues that a rise in foreign interest rates precipitates a capital inflow and an increase in foreign exchange reserves. This is a consequence of the contraction of national income arising from the tight money policy.

The modification also permits a comparison of change in monetary policy necessary to effect this result in relation to that required to hold foreign exchange reserves constant. If the Bank wishes to keep the interest differential constant, the size of the open market operation must be larger.

c. A Change in Government Expenditures

Net government expenditures show a direct relationship with domestic income. An expansionary fiscal policy would therefore increase national income causing both current and capital accounts to deteriorate. The contractionary influence from the loss of foreign exchange reserves will be more than offset by an expansionary monetary policy. This is necessary to keep the interest rate constant and so maintain the differential. The explicit statements of these relationships are given in column 3 of Table 11-3.

A change in government expenditures under the present policy objective produces a directional change in income which agrees with the previous two cases. Comparing the relative magnitudes of these changes indicates that the present adjustment is larger than either of

the former policy situations. Furthermore the present policy rule generates an unambiguous decrease in foreign exchange reserves in contrast to the no-policy alternative. Similarly the relationship with the money supply which was ambiguous in the previous cases is now positive.

Over-all this disturbance-policy rule combination has produced no startling results with regard to the signs of the relationships. What is interesting is the increased sensitivity of the economy to changes in foreign interest rates and autonomous domestic spending when this policy objective obtains.

The next section investigates the policy goal of keeping the money supply constant.

Case 4. The Impact of Exogenous Disturbances When Open Market Operations are Employed to Keep the Money Supply Constant.

This policy objective provides the setting in which monetary policy attempts to sterilize all changes in the money supply arising from sources other than the central bank. The new policy is introduced in the same manner as above. The resulting indicator of monetary policy for each disturbance is given in the first row of Table II-4.

a. A Change in Foreign Income

Like the previous cases examined, a rise in foreign income increases domestic income. A comparison of this expression on Table II-4 with those obtained under the preceding policy goals, only reveals that the increase in this instance falls short of that

TABLE II-4
The Impact of Exogenous Disturbances When Monetary Policy
Holds the Money Supply Constant

	Y_F	Exogenous Disturbance i_F	G
Open Market Policy	$\frac{dY_F}{dY} = \frac{1}{M_R \Delta_2} [M_R (L_1 \delta - L_2 \theta) + L_1 \epsilon_Y M_R]$	$\frac{dY_F}{di_F} = -C_{1F} > 0$	$\frac{dY}{dG} = \frac{1}{M_R \Delta_2} [L_1 (M_R C_1 + M_R) - L_1 M_R B_1] \lesseqgtr 0$
Impact on the Economy	$\frac{dY_F}{dY} = \frac{L_1 Y_F}{\Delta_2} > 0$	$\frac{dY_F}{di_F} = 0$	$\frac{dY}{dG} = \frac{L_1}{\Delta_2} > 0$
	$\frac{dY_F}{dY} = -\frac{L_1 Y_F}{\Delta_2} > 0$	$\frac{dY_F}{di_F} = 0$	$\frac{dY}{dG} = \frac{L_1}{\Delta_2} > 0$
	$\frac{dR}{dY_F} = \frac{1}{\Delta_2} (L_1 \theta - L_2 \delta) > 0$	$\frac{dR}{di_F} = C_{1F} < 0$	$\frac{dR}{dG} = \frac{1}{\Delta_2} [B_1 Y_F - C_1 L_1] \lesseqgtr 0$
	$\frac{dC}{dY_F} = \frac{1}{\Delta_2} [C_{1F} (1 - \epsilon_Y) + C_2 Y_F] - L_1 (C_1 Y_F - \epsilon_1 C_2 Y_F) \lesseqgtr 0$	$\frac{dC}{di_F} = -C_{1F} < 0$	$\frac{dC}{dG} = \frac{1}{\Delta_2} (L_1 C_1 - L_1 C_2) \lesseqgtr 0$
	$\frac{dT}{dY_F} = \frac{Y_F}{\Delta_2} [L_1 (1 - \epsilon_Y + \epsilon_1) + \epsilon_1 L_1] > 0$	$\frac{dT}{di_F} = 0$	$\frac{dT}{dG} = \frac{L_1 Y_F}{\Delta_2} < 0$

$$\Delta_2 = L_1 Y_F + L_2 (1 - \epsilon_Y) < 0$$

$$\delta = C_1 Y_F - \epsilon_1 B_1 Y_F > 0$$

$$\theta = C_2 Y_F (1 - \epsilon_Y) + \epsilon_1 Y_F (1 - \epsilon_Y + B_1) > 0$$

when the interest differential is being maintained. Further quantitative comparisons cannot be made.

In contrast to the results obtained in Cases 1 and 2 the increase in income causes a rise in domestic interest rates. This observation is in keeping with the present objective, for each of the previous cases evidenced an increase in the money supply in conjunction with this disturbance. If this development is prevented by the central bank, a rise in interest rates is inevitable.

Turning now to the impact on the foreign sector finds the balance of trade showing an improvement. The status of capital flows are however uncertain because of the opposing forces set up by the increases in foreign income, domestic income and interest rates. Given the rise in domestic interest rates an improvement seems likely, but this is an empirical matter.

The over-all improvement in the balance of payments is clear from the increase in the level of foreign exchange reserves. Unfortunately the size of this increase cannot be distinguished from the no-policy or constant interest differential cases. For these results to occur monetary policy must be contractionary. The explicit statement of this,

$$\frac{dY}{dY_F} = \frac{1}{\Delta_2} \left[M_{sR} (L_Y \delta - L_1 \theta) + L_Y f_{Y_F} M_{s1} \right] < 0 \quad (16)$$

shows that the open market operations offset the positive influence of the reserve inflow plus any tendency for the money supply to increase through higher interest rates.

To sum up then, the most significant characteristic of these re-

sults in relation to the previous cases (outside the constant money supply) is the positive relationship between foreign income and domestic interest rates.

b. A Change in Foreign Interest Rates

If a sterilization policy is followed when there is an increase in foreign interest rates, the only sector of the economy affected would be the capital account. In response to the higher foreign interest rates capital would leave the country causing a loss of foreign exchange reserves. The negative effect of this on the money supply would be just offset by an expansionary monetary policy. Thus the decrease in capital account and the level of foreign exchange reserves along with the increase in the central bank's bond holdings have an equal absolute value of C_{i_F} (see Table II-4). The activities of the central bank prevent any change in income, interest rates and the trade account.

The decline in foreign exchange reserves is greater than when no policy is undertaken (Case 1) as evidenced by a comparison between the respective expressions for dR/di_F . This discovery has a significant bearing on the feasibility of this policy goal in the environment created by the ceiling on foreign exchange reserves. It would seem difficult for the monetary authority to adopt a policy which would provide maximum insulation for the money supply but at the same time expose foreign exchange holdings to fluctuations which would be larger than if no offsetting action were undertaken at all. Because comparisons of reserve movements between this policy objective and that for a constant interest differential are ambiguous, a more definite statement

in this regard is not possible.

c. A Change in Government Expenditures

The results obtained for a rise in net government expenditures (see Table II-4, column 3) indicate an increase in domestic income and interest rates. Because of the higher income, the trade balance deteriorates. The change in capital account is uncertain due to the counter forces created by the increase in income and interest rates. This ambiguity also appears in the expression for the change in the level of foreign exchange reserves.

$$\frac{dR}{dG} = \frac{f_G}{\Delta_2} \left[B_Y L_i - D_i L_Y \right] \lessgtr 0 \quad (17)$$

Few distinguishing features are presented by the above relationships. The increase in income is apparently smaller than the constant interest differential setting (see relevant expressions in Tables II-3 and II-4) but further comparisons with respect to income or other domestic activity measures provide no additional information.

The salient characteristics of this policy situation are therefore the positive relationship between foreign income and domestic interest rates, the absence of a foreign interest rate effect on domestic income, interest rates and the trade balance, as well as the absence of a relationship between the disturbances and the money supply.

Summary

This section attempts to draw together the various pressures which exogenous disturbances place on the economy under the set of policy objectives considered. A summary of relationships given in

Tables II-1 through II-4 is set out in Table II-5. Each of the major indicators of economic activity (Y , i , R , Ms) are listed vertically and matched with the three disturbance terms (Y_F , i_F , G). The signs of the relationships provided by this matching are then displayed across the table for each of the policy situations examined above. Thus reading across the first row gives the sign for dY/dY_F under the conditions of an inactive monetary policy 1, a constant level of foreign exchange reserves 2, a constant Canada-United States interest differential 3 and a constant money supply 4. Column 3A gives the results for the constant interest rate differential on the condition that $C_i = -C_{i_F}$. Where it was possible to ascertain a quantitative difference between expressions exhibiting the same sign, a ranking by policy objective is given in the last column. Based on the case just reviewed, national income is affected more by a change in foreign income under the constant reserves policy than if monetary policy were inactive.

The last three rows indicate the necessary response of monetary policy to each disturbance by type of policy goal. The relative size of these responses are ranked in the last column as above.

The observation that the policy goal determines the relative size of adjustment within the economy is much more pronounced in this table than in the preceding discussion. The ranking of adjustments which this permits, although incomplete, offers two significant contributions. First it enables a distinction to be made

TABLE II-5
Exogenous Disturbances and Their Relative Impact on the Economy

	Distur- bance	1	Policy Objective			4	Relative Impact
			2	3	3A		
Y	Y_F	+	+	+	+	+	$1 < 2; 3 = 3A > 4$
	i_F	-	-	-	-	0	$4 < 1 < 2 < 3A$
	G	+	+	+	+	+	$1 < 2 < 3 = 3A; 3 > 4$
i	Y_F	-	-	0	0	+	$3 = 3A < 1 < 2; 3 = 3A < 4$
	i_F	+	+	1	1	0	$4 < 1 < 2; 3 = 3A > 4$
	G	+	+	0	0	+	$3 = 3A < 1 < 2; 3 = 3A < 4$
R	Y_F	+	0	+	+	+	$1 > 2; 2 < 3 = 3A; 2 < 4$
	i_F	-	0	-	+	-	$1 > 2; 2 < 3A; 2 < 4$
	G	+	0	-	-	+	$2 < 3 = 3A$
Ms	Y_F	+	+	+	+	0	$4 < 1 < 2; 3 = 3A > 4$
	i_F	-	-	-	-	0	$4 < 1 < 2 < 3 = 3A$
	G	+	+	+	+	0	$3 = 3A > 4$
γ	Y_F	0	+	-	-	-	$1 < 2; 1 < 3 = 3A; 1 < 4$
	i_F	0	-	-	-	+	$1 < 2 < 3A; 1 < 4$
	G	0	+	+	+	+	$1 < 2; 1 < 3 = 3A; 1 < 4$

between different policy goals when the signs of the expressions are the same. Since the Bank is not overly generous with information on the specific goals it pursues, this will prove valuable in the empirical work. The second contribution is more general in that it indicates the cost or trade off associated with a particular policy goal. What is more, this information is available by type of disturbance. A more complete discussion of these contributions will be presented in the following chapter.

This concludes the theoretical discussion. The model offers a rich array of testable hypotheses and insights on existing work. The remainder of the study concentrates on empirical tests of these propositions.

APPENDIX II-1

Throughout the analysis the sign ϕ is taken as negative. Since this is not immediately obvious from the expression, it is examined in more detail here.

In the presentation of the model it was argued that the budget constraint (equation 6) and the balance of payments (equation 4) were always satisfied. This being the case the partials with respect to Y for both equations will be interrelated.

Differentiating the budget constraint with respect to Y gives

$$f_Y - 1 - T_Y + C_Y^* - C_Y + L_Y - M_S \frac{dR}{dY} = 0 \quad A1.1$$

since $Z_Y = -C_Y$ (equation 5). Now from equation 4 it can be shown that $dR/dY = T_Y + C_Y$. Substituting into A1.1 and collecting terms gives

$$1 - f_Y + (1 + M_S)B_Y - C_Y^* - L_Y = 0 \quad A1.2$$

and

$$1 - f_Y + B_Y - \frac{L_Y}{M_S} = -M_S B_Y + C_Y + \frac{L_Y(M_S - 1)}{M_S} \quad A1.3$$

Since $B_Y = T_Y + C_Y$. Now the sign of C_Y^* is ambiguous because an increase in Y will result in greater supply of and demand for bonds.

However as long as C_Y^* does not take a large negative value

$$1 - f_Y + B_Y - \frac{L_Y}{M_S} > 0$$

because $B_Y < 0$ and, under a fractional-reserve banking system,

$Ms_R > 1$.

Furthermore,

$$\phi = -Ms_R \left[C_{Y_F} (1 - f_Y) + f_{Y_F} (1 - f_Y + B_Y - \frac{L_Y}{Ms_R}) \right] < 0 \quad A1.4$$

An analagous argument shows that

$$\theta = C_{Y_F} (1 - f_Y) + f_{Y_F} (1 - f_Y + B_Y) > 0 \quad A1.5$$

APPENDIX II-2

While the present study only considers open market operations as an instrument of monetary policy, one might well argue that the Bank Rate and transfers of government deposits should also be considered. This appendix forwards a justification for restricting the scope of the analysis to the one policy tool.

The reason for rejecting the Bank Rate is straightforward. In Canada the method of calculating required reserves is based on the semi-monthly average of the deposits from the previous period. This technique places the chartered banks in a position where they are seldom forced to approach the central bank for funds. Moreover the Bank Rate is usually kept above the treasury bill rate so that chartered banks are discouraged from borrowing except in extreme circumstances.¹ As a consequence, borrowed reserves are relatively insignificant and relegated to a minor role in Canadian monetary policy.

The other alternative, management of government deposits, is frequently used by the Bank of Canada. By transferring government deposits between the Bank of Canada and

¹For a brief discussion of the role of the Bank Rate in Canada see D. Bond and R. Shearer [2], especially pp. 402-409.

the chartered banks it is possible to alter the reserve position of the chartered banks in the same way as through open market operations. The purported advantage of deposit transfer is that it is not necessary for the Bank of Canada to enter the securities market and thus avoid the resultant changes in interest rates. This of course is only a very short run phenomenon for the chartered banks would be encouraged to enter the securities market themselves, creating the same end result which would have occurred if open market transactions had been used.

This can be shown explicitly as follows. If deposit transfers are used, a term for the public demand for money, D_g , must be included in the money market equation above (equation 2). If this modified version of the model is now differentiated as before the equilibrium condition for the money market becomes

$$L_Y dY + A_1 di + dD_g - M_s d - M_{s_R} = 0$$

Since $dD_g = d\gamma$

$$L_Y dY + A_1 di + (1 - M_{s_R}) d - M_{s_R} dR = 0$$

Solving the model for the various disturbances and policy environments, the resultant impact on the economy is identical to that shown above.²

²A minor change is necessary for Case IV. In this instance the policy object must be defined as a constant privately held money supply.

CHAPTER III

A. The Setting

'The Bank of England works with so much secrecy and so much concealment of important statistics that it is never easy to state with precision what it is doing.'¹

One of the most significant arguments of the previous chapter was that the particular objective pursued by the central bank conditions the manner in which various disturbances influence the behavior of economic activity. The design of this chapter is to determine just what the aims of the Bank of Canada were during the period of the fixed exchange rate. This is no mean task as one of the Bank's aims appears to be the concealment of its objectives. What is more, this latter objective seems to be the only one for which evidence is readily available so that the source of Keynes' exasperation with the Bank of England arises all too frequently to plague the efforts of contemporary research on the operations of the Bank of Canada.

1. But What is the Bank of Canada Really Trying to Do?

Since any evaluation of monetary policy requires a knowledge of the objectives pursued by the monetary authority, there have been several attempts by researchers to articulate them: Courchene [10],

¹J. M. Keynes, "The Economic Consequences of Mr. Churchill," Essays in Persuasion, (Royal Economic Society Edition; Cambridge: Macmillan Co., 1972), p. 219.

Hay [17], Johnson and Winder [25] and Reuber [32]. For the most part the primary sources of the objectives forwarded are the official statements by the governor. The governor's annual reports and speeches are carefully sifted for indications of what the Bank was attempting to accomplish over some period of time. This technique is rather frustrating for so often the pronouncements are couched in the following terms:

. . . the broad objectives of monetary policy are those of public economic policy generally, that in Canada these are rightly set high, and that they may be said to include: sustained economic growth at high levels of employment and efficiency, internal price stability and the maintenance of a sound external financial position, an equitable sharing of economic benefits and burdens and the maintenance of a high degree of economic freedom.²

Such 'motherhood' statements offer little illumination of the principles governing the day-to-day operations of the Bank. They give little appreciation of potential conflicts in the realization of these goals much less any indication of the weights attached to the individual objectives.³ It is argued that the vague or misleading statements contained in the official statements of the governor are deliberate since it is in the interests of the Bank to divert attention away from its actual objectives and operations by creating a 'mythology' about itself. This 'mythology' is intended to establish

²Bank of Canada, Annual Report of the Governor, 1962 (Ottawa: Bank of Canada, 1963), p. 62.

³Johnson and Winder [25], especially pp. 79-82, were able to introduce the principle of revealed preference as to the relative priority of various policy objectives but this does not eliminate the problem of assigning weights.

a public image which will give it 'social importance' but at the same time stave off criticism and outside interference by concealing the true nature of its activity.⁴ Given these conditions it appears that official statements alone will offer only limited assistance in discovering the policy objectives of the Bank. However, used in conjunction with other information these statements may prove quite valuable.

Fortunately official statements are not the exclusive source of information on policy objectives. The institutional framework within which the Bank operated can also be shown as an important influence on policy goals. For instance it was argued above that one of the characteristics of a small economy operating under a fixed exchange rate was that the monetary sector is highly susceptible to foreign economic disturbances. In the short run it may be possible to neutralize many of the effects of these disturbances by permitting substantial fluctuations in the level of official holdings of gold and foreign exchange.⁵ When this safety valve is removed, the sensitivity of the monetary sector to external developments would be intensified. A direct result is a reduction in the flexibility of monetary policy or more specifically, the subjection of monetary policy to balance of

⁴J.F. Chant and K. Acheson, 'Mythology and Central Banking,' *Kyklos*, 26 (1973), p. 363.

⁵This of course is only a stop-gap measure to enable a country to ride out a temporary balance of payments disequilibrium. A fundamental disequilibrium causing a continuous accumulation or depletion of reserves would necessitate either a change in monetary policy or the exchange rate.

payments considerations. The next section argues how the imposition of a ceiling on official holdings of gold and foreign reserves created such a situation in Canada.

2. The Reserve Ceiling

During the early 1960's the United States was experiencing a serious and chronic overall deficit on her balance of payments. This prompted several policies (such as the interest equalization tax and guidelines for American based multinational corporations) which were designed specifically to rectify the situation. Since Canada depended heavily on capital inflows from the United States as both a source of investment funds and a means of financing her own trade account deficit, the measure would have produced serious problems. Through a series of negotiations Canada was able to obtain preferential treatment on several items but this was not done without cost. In order to gain exemptions from the interest equalization tax in June of 1963, Canadian authorities agreed not to take advantage of the situation to build up foreign exchange reserves. In fact Canada accepted a ceiling of US \$2,700 million on her official gold and foreign exchange holdings. Later, in February 1965, the Americans issued a set of guidelines for American based multinational corporations. The guidelines would have reduced the flow of American capital but once again Canada was able to obtain a partial exemption. Acquisition of the preferential status called for a new ceiling of US \$2,550 million on official reserves. The new ceiling, implemented early in 1966, was

reached by the end of the year and was retained until December 1968.⁶

What is necessary now is to determine whether or not the ceiling had a significant impact on the activities of the central bank. Fundamental to this is why the Bank should be concerned about the level of official reserves. The reason being that official reserves permit a country to ride out a short term balance of payments deficit without devaluing its currency. It is therefore important that the level of reserves be at such a level that speculators feel the country is able to follow this course. If not, there will be speculation against the currency when a deficit emerges. While the ability to finance a deficit provided by substantial foreign exchange reserves is of some value it is not acquired gratis. Tying up resources in the form of an international medium of exchange incurs the opportunity cost of the income stream which the equivalent real resources would have yielded in terms of consumption or investment.

All of this leads to the question of what was the desired level of reserves for the period in question.⁷ But what is more pertinent to the problem at hand is the question of what was the desired level of reserves in relation to the ceiling? Only if the imposed ceiling lay below the desired level of reserves could it have

⁶For a brief discussion of these developments see Bank of Canada Annual Report of the Governor, 1963 (Ottawa: Bank of Canada, 1963), pp. 4-6 and 1965, p. 9.

⁷A general discussion of the demand for foreign exchange reserves is contained in H. G. Grubel [16], especially Chapters 2 and 3. A more complete discussion as well as a review and evaluation of the literature on the topic is given in Jürg Niehans [31].

influenced the conduct of monetary policy. Were this the case the Bank would have been compelled to minimize the fluctuations in foreign exchange reserves. Any reduction in the stock would prompt speculation which could force devaluation while any increase would contravene the terms of the accord reached with the United States. As will be shown below, there is a substantial body of evidence available to argue that this was the dominant policy objective of the Bank.

One of the more direct indications that the ceiling was below the desired level of reserves is seen in official statements by the Governor regarding the economy's capacity to withstand a balance of payments deficit.

It is of course true, as we have seen, that in periods of crisis Canada can have ready access to massive international assistance but I would take it that we would want to be in a position to accommodate substantial fluctuations in the flow of our international receipts and payments without such assistance.⁸

Given that Canada required US \$750 million of international assistance during the exchange crisis between November 1967 and June 1968, it would appear that the level of reserves set by the ceiling was inadequate by this criterion.⁹

Another way to get an idea of the relationship between desired reserves and the ceiling is to examine some measure of reserve

⁸Bank of Canada, Annual Report of the Governor, 1963 (Ottawa: Bank of Canada, 1964), p. 9.

⁹For details of the international transfers see Bank of Canada, Annual Report of the Governor, 1967 (Ottawa: Bank of Canada, 1968), p. 11.

adequacy against the ceiling level of reserves. Unfortunately the status of theory on measuring the adequacy of reserves at the time of the ceiling was still rather primitive. In fact the most widely used indicator of reserve adequacy was the ratio of reserves to imports.¹⁰ In spite of the numerous difficulties which encumber the reliability of this ratio it gained a great deal of currency through the International Monetary Fund.¹¹ Given the popularity of the ratio until the late sixties it is probably reasonable to assume that the Bank would be concerned with the ratio as it would reveal to speculators the ability of Canada to withstand a short run balance of payments deficit and therefore the strength of the Canadian dollar.

Even though the desired ratio is not known it is possible to infer the relationship it bore to the actual ratio. Some idea of this can be gained by a comparison of the actual ratio during the ceiling period with those of other open economies and the Canadian ratio which prevailed during the period of flexible exchange rates. Ceteris paribus if the Canadian ratio was below those of similar economies it would intimate that the Canadian reserves were inadequate or below the desired level. Because reserves play a much

¹⁰ There are numerous problems involved with using this ratio as an indicator, not the least of which is that it omits the capital account which is potentially more erratic than current account in behavior. For a more complete discussion of this see Jürg Niehans [31].

¹¹ This ratio was made popular through two IMF publications [21] [22].

lesser role in the adjustment process under flexible rates, the observation of a decline in the ratio from the flexible to fixed exchange rate environment would substantiate this inference.¹²

Table III-1 shows the reserve to import ratio in percentage terms for Canada and a composite of eight industrial countries for the 1951-68 period.

From the table it appears that on the basis of the reserves to imports ratio, the level of reserves was below the desired level during the ceiling period. The steady decline of the Canadian ratio during the fixed exchange rate period moves contrary to expectations since the more important role of reserves during these years would call for a higher ratio. Even more telling is the observation that while the ceiling was in effect, the ratio was only above the average ratio for the flexible exchange rate period for one year, 1963, which was only affected by the ceiling during the second half. From 1965 to 1968 the ratio lies below the average.

Comparing the Canadian ratio to the composite finds the Canadian average falling from the first to the second period while the average of the eight remains constant. This not only argues that Canadian reserves were kept below that desired level by the ceiling but also argues against the possibility of structural change between the two periods.

¹²The Governor reflected similar sentiments in Bank of Canada, Annual Report of the Governor, 1962 (Ottawa: Bank of Canada, 1963), p. 9.

TABLE III-1

Reserves as a Percentage of Imports for Canada and
Eight Industrial Countries by Year 1951-68

End of	'51	'52	'53	'54	'55	'56	'57	'58	'59	'60	'61	'62	'63	'64	'65	'66	'67	'68
Canada	46	44	40	46	40	33	31	36	33	32	37	40	39	38	35	27	25	24
The 8*	30	34	39	42	43	38	33	46	45	47	49	47	44	43	42	39	38	34
Average Ratio for Canada during flexible exchange rate 1951-61																		
38																		
Average Ratio for Canada during fixed exchange rate 1962-68																		
33																		
Average Ratio for the eight																		
1951-61																		
41																		
Average Ratio for the eight																		
1962-68																		
41																		

*The 8: Belgium, France, Germany, Italy, Netherlands, Sweden,
Canada and JapanSource: 1951-64 International Reserves Needs and Availability,
IMF, Washington, D.C., 1970.
1965-68 International Financial Statistics.

Evidence of inadequate reserves does not necessarily reflect the presence of the ceiling. The same result would occur if the country were experiencing balance of payments difficulties. The necessary condition for the ceiling to be the causal factor is the existence of upward pressure on the level of reserves. Indications of this appear in the actions of the government which was obliged to purchase US \$168 million in its own securities and IBRD bonds during 1966 in order to reduce the level of reserves to the new US \$2,550 million ceiling. Similarly in 1967 a purchase of US \$69 million was necessary to maintain the reserves at the new level.¹³

Drawing these various arguments together presents a strong case for the proposition that the Bank was directing its policy to keep the level of gold and foreign exchange holdings at the ceiling from June 1963 to December 1968. At the same time it gives reason to reject the goal of a constant money supply or sterilization. As pointed out by Mundell [29] the latter objective would not be feasible in a world of interest elastic capital flows unless the

¹³When the ceiling was introduced, the Canadian Government made a commitment to repatriate her own securities held in the United States and purchase bonds from the International Bank for Reconstruction and Development to supplement the efforts of monetary policy in preventing a build-up of foreign exchange reserves. For further discussion of this refer to Bank of Canada, Annual Report of the Governor, 1965 (Ottawa: Bank of Canada, 1966), p. 9 and 1967, p. 66.

Notice that although this policy guaranteed that reserves would not exceed the ceiling it did not release monetary policy from the constraints of the ceiling. In other words it was an emergency measure not a means of providing monetary policy freedom of action. This will be brought out more forcefully in the next section.

country was able to accommodate a continuous increase or decrease in reserves. A similar result was obtained in the previous chapter where it was shown that under this goal a change in foreign interest rates would precipitate a change in reserves which was greater than a neutral policy (see Table II-6). The material above has demonstrated that when the ceiling was operative there were significant constraints on both positive and negative changes in reserves. It follows that the objective of a constant money supply which requires substantial movements in reserves could not have been successfully pursued by the Bank.

However plausible the arguments for a constant reserves policy during this period, they do not constitute proof that this was indeed the case. What is necessary for this is knowledge of the actual behaviour of monetary policy. The following section employs the theoretical framework developed in Chapter II to acquire this information.

B. An Empirical Test of the Constant Reserves Hypothesis

The model presented in Chapter II provides a means of discovering what the objective of monetary policy is over a particular period of time. This information emanates from the way in which the exogenous disturbances--foreign income, interest rates and government spending--affect domestic economic activity. Therefore the means of finding out if the constant reserves policy is in force consists of regressing indicators of the latter on the former and comparing the

results with the predictions generated by the model under this constraint¹⁴ (see Table II-2).

The monitors of domestic economic activity used are Canadian GNE (Y_c), Canadian short term interest rates (i_c), Canadian merchandise trade balance (MTB), net short term capital flows between Canada and the United States (STC_{us}), the Canadian money supply (M_2) and the Bank of Canada's holdings of government bonds (HGB). The exogenous disturbances included are American GNE (Y_{us}), American short term interest rates (i_{us}) and the Canadian government budgetary surplus (GS).¹⁵

The graphs of the endogenous variables indicated a strong seasonal variation. To accommodate this, dummy variables were included in the regressions. An additional dummy was entered to pick up the effect of revisions in the Bank Act which started to take effect in the second quarter of 1967 (a complete list of variables is given in Appendix III-1).

¹⁴The regressions should include both the lagged stock of foreign exchange reserves and the lagged stock of short term capital (see equations 1, 2 and 4 above). Unfortunately data on the stock of short term securities is not available so that the regressions only include R_{t-1} .

¹⁵This last series GS requires some additional comments. The model developed in Chapter II employed governmental spending as a measure of autonomous domestic expenditure. The variable which best approximates this for purposes of the statistical analysis is the full employment budgetary surplus. Unfortunately there is no consistent series available for the period covered by the analysis so the budgetary surplus was used as a proxy. A consequence of this is that the results produced by the series must be viewed sceptically.

The graphs also revealed that the endogenous variables exhibited a lagged response to the exogenous variables. The latter were therefore lagged up to four quarters. In each instance the specific lag presented was chosen on the basis of its t value.

1. The Evidence

All statistical results presented are based on quarterly data. Some work using monthly data was also attempted but the difficulties encountered with respect to serial correlation and the introduction of lags were so pervasive that it was dropped.

The time period under analysis extends from the third quarter of 1963 to the fourth quarter of 1968--the duration of the ceiling on reserves. This period embraces two major exchange crises (III'62 to IV'62 and IV'67 to II'68). Since the model is not really designed to accommodate such phenomena, results were also tabulated without these observations. These are denoted by NS. Those results which include the observations from this period are designated by an S.

Looking back at Table II-6 shows that the dominant characteristic of the constant reserves case is the absence of any relationship between any of the disturbances and the level of official holdings of gold and foreign exchange. One of the predications then is that the reserves should maintain a fairly constant level over the period. Figure II demonstrates that the reserves exhibit very little variation during the period of the ceiling. The only exception is recorded between November 1967 and June 1968 when there was a run on

FIGURE 1

CANADA'S OFFICIAL HOLDINGS OF FOREIGN EXCHANGE

the dollar arising from the devaluation of the pound and new American guidelines to correct balance of payments problems.

When reserves follow such a pattern one would expect that there would be little or no relationship between reserves and the various exogenous disturbances. This is borne out in Table III-2 which gives the simple correlations between reserves and the three disturbances. The table readily demonstrates that while a significant relationship exists between official holdings and the disturbances when there were no restrictions on reserves, this relationship virtually disappears with the imposition of the ceiling.

The absence of such a relationship in a fixed exchange rate milieu is unusual. As pointed out earlier, reserves provide the short run adjustment mechanism for balance of payments disequilibrium and therefore should exhibit considerable variation. At the time of the return to fixed exchange rates in 1962 the Governor of the Bank seemed resigned to this as noted by the following remark. "... we have changed our exchange rate system to one in which larger fluctuations in reserves must be regarded as normal."¹⁶ The fact that reserves did not behave in this fashion suggests that there was some counter action present. The observation of a strong relationship outside the ceiling period adds further weight to this contention.

If the Bank was acting through its open market operations to keep reserves constant, then the effects of the disturbances on the other indicators (income, interest rates, the current account, the

¹⁶Bank of Canada, Annual Report of the Governor, 1962 (Ottawa: Bank of Canada, 1963), p. 9.

TABLE III-2
Simple Correlations Between Canada's Official
Holdings of Foreign Exchange and
Exogenous Disturbances

	Y_{us}	i_{us}	GS
Ceiling ₁			
S	-.1560 ₋₄	.0974 ₋₃	.4412 ₋₃ *
R			
NS	.2615	.2874	.5923 ₋₁ **
No Ceiling ₂			
S	.8569 ₋₄ **	.8785 ₋₄ **	.8490 ₋₄ **
R			
NS	.8896 ₋₄ **	.9428 ₋₄ **	.9829 ₋₄ **

1. Ceiling period: S III'63-IV'68
NS observations from speculative
periods IV'67-II'68 excluded
2. No Ceiling: S III'62-I'70; III'63-IV'68 excluded
NS I'63-I'70; III'63-IV'68 excluded

* significant at 5% level
** significant at 1% level

capital account, the money supply and the bond holdings of the central bank) should all be consistent with the predictions of Table II-2. The discussion below considers the influence of the disturbances on each of the indicators in turn.

Table III-3 summarized the behavior of monetary policy in light of the three disturbances. For convenience the expected sign of the coefficient as per Table II-2 is shown in parentheses with the exogenous disturbances across the top of the table.

An increase in American income would produce an improvement in the current account and generate an increase in foreign exchange reserves. In order to prevent the build-up in reserves the central bank would have to undertake an expansionary monetary policy to produce a deterioration in both capital and current accounts which would just counteract the reserve inflow leaving the level constant. This is backed by equations III-3-2 which show the relationship for both S and NS periods to be positive and significant.

The relationship between American interest rates and central bank bond holdings should be negative because the outflow of capital in response to higher foreign interest rates would have to be countered by a contractionary monetary policy. This would restore reserves to their former level by lowering imports and improving the capital account through lower income and higher interest rates. The regression coefficients of equations III-3-3 show the opposite--that monetary policy reacted positively to American interest rates.

The contradiction can be explained quite easily. The pre-

TABLE III-3
The Response of Canadian Monetary Policy to Exogenous
Disturbances During the Ceiling Period

	C	(+) $\dot{Y}_{us}$	(-) $\dot{Y}_{us}$	($\dot{Z}$) $\dot{G}_S$	R	B	Q_1	Q_3	Q_4	R ²	DW
S	1142.403 (2.43)*	1.242 (3.05)**	155.759 ₋₄ (3.21)**	-0.074 ₋₃ (0.37)	0.193 ₋₁ (1.98)	144.285 (1.95)	-42.204 (0.94)	34.116 (0.65)	58.042 (1.33)	.952	1.84
HGB NS III-3-1	964.893 (1.81)	0.955 (1.92)	151.549 ₋₃ (1.92)	-0.045 ₋₄ (0.16)	0.313 (2.54)*	168.171 (1.86)	-8.420 (0.14)	43.134 (0.62)	70.328 (1.51)	.934	1.37
S	793.772 (2.54)*	1.790 (5.67)**			0.361 ₋₁ (3.66)**	255.930 (3.76)**	-13.050 (0.26)	50.106 (1.07)	99.665 (2.06)	.920	1.26
HGB NS III-3-2	815.276 (2.34)*	1.869 (5.58)**			0.338 (2.75)*	235.548 (3.03)**	0.577 (0.01)	46.604 (0.91)	70.415 (1.31)	.913	0.86
S	1901.631 (6.31)**		243.592 ₋₄ (5.37)**		0.126 ₋₁ (1.03)	223.713 (2.93)*	-72.873 (1.37)	0.575 (0.01)	28.084 (0.55)	.914	1.14
HGB NS III-3-3	1240.282 (3.92)**		233.160 (6.17)**		0.334 (2.93)*	202.095 (2.69)*	1.224 (0.02)	62.045 (1.32)	82.786 (1.68)	.925	1.50
S	2602.561 (6.34)**			0.711 (4.39)**	0.197 ₋₁ (1.48)	443.630 (8.11)**	-103.162 (1.65)	-98.645 (1.53)	3.803 (0.06)	.889	0.92
HGB NS III-3-4	2399.486 (4.76)**			0.792 ₋₄ (4.18)**	0.221 ₋₁ (1.33)	442.716 (6.71)**	108.842 (1.58)	218.143 (3.16)**	89.678 (1.40)	.872	1.98

* Significant at the 5% level
** Significant at the 1% level

dictions as set forth in Chapter II consider the exogenous disturbances to be independent. However examination of Table A-III-2-1 of Appendix III-2 points out that there is a strong correlation between Y_{us} and i_{us-4} . Thus one of the fundamental assumptions of the model is violated.

What this implies for the empirical results is that the respective influences of these two external shocks occur almost simultaneously. In other words the effect of an increase in American income eliciting an expansionary monetary policy exceeds the effect of an increase in American interest rates calling for a contractionary policy. As a result the observed action by the central bank is expansionary. In terms of the multipliers given in Table II-2 this means that $(dY/dY_F) dY_F > (dY/di_F) di_F$ so that the combined effect is positive. Consequently the negative influence of i_F is not picked up by the regression analysis.

Equations III-3-4 suggest that monetary and fiscal policy are negatively related. This might be explained by the argument that a contractionary fiscal policy will increase reserves through lower income by more than the loss generated by the reduction in interest rates and so necessitate an expansionary monetary policy in order to maintain the level of foreign exchange reserves.

A more acceptable explanation emerges from the positive relationship which holds between domestic income and the budgetary surplus (see Table III-4 below). This means that the increase in income associated with an expansionary monetary policy would bring

about an increase in the budgetary surplus; so registering the observed negative relationship between monetary and fiscal policy.

Regressing HGB on all disturbances simultaneously (equations III-3-1) finds the t values on all variables declining and GS becoming insignificant. The lower values obtained for Y_{us} and i_{us} reflect the high multicollinearity noted above while the poor showing of GS can be attributed either to the series used (see footnote 15) or to the stronger influence of the balance of payments considerations on monetary policy.

A summary of the impact of the exogenous disturbances on domestic income is provided by Table III-4. American income should exert a positive influence on Canadian income via the current account. Reinforcing this is an expansionary monetary policy attempting to counter the effect of the improvement in the balance of payments. This is verified by equations III-4-2.

American interest rates are predicted to display a negative relationship with Canadian income because any change will precipitate a capital flow which will move Canadian interest rates in the same direction. The positive and highly significant coefficients observed in equations III-4-3 can again be attributed to a strong positive correlation between American income and interest rates (see Table A-III-2-1, Appendix III-2) coupled with the dominant influence of American income. As a result there is an apparent positive relationship.

Recall that the behaviour of monetary policy as noted above is also consistent with this observation. If i_{us} were the stronger in-

TABLE III-4

The Response of Canadian Income to Exogenous Disturbances During the Ceiling Period

	C	(+) $\bar{Y}_{us}$	(-) i_{us}	(-) GS	R	B	q_1	q_3	q_4	$\bar{R}^2$	DW
Y_c	-1778.682 (0.75)	13.786 (3.46)**	903.565 ₋₁ (2.80)*	-0.083 ₋₃ (0.09)	0.513 ₋₁ (0.98)	1164.644 (2.61)*	-757.252 (3.33)**	1550.404 (5.56)**	341.614 (1.48)	.985	1.12
III-4-1	-172.566 (0.06)	10.000 (2.54)*	995.170 ₋₁ (3.19)**	0.920 ₋₃ (0.88)	0.726 ₋₁ (1.12)	1698.346 (3.82)**	-831.719 (3.23)**	1461.614 (4.55)**	462.614 (1.89)	.989	1.06
Y_c	-2770.856 (1.92)	23.499 (16.18)**			-0.134 ₋₁ (0.30)	217.119 (0.69)	-711.331 (3.07)**	1294.256 (6.02)**	158.681 (0.73)	.979	1.20
III-4-2	-2775.854 (1.73)	23.110 (14.93)**			-0.057 ₋₁ (0.10)	447.442 (1.25)	-674.870 (2.64)*	1280.525 (5.43)**	276.070 (1.12)	.980	1.11
Y_c	485.227 (0.32)		2015.807 ₋₁ (14.25)**		1.386 ₋₁ (2.81)*	2617.857 (10.96)**	-836.367 (3.21)**	1826.222 (7.44)**	557.313 (2.30)*	.973	2.23
III-4-3	-1663.804 (1.10)		1924.954 ₋₁ (15.83)**		2.161 ₋₁ (4.37)**	2809.822 (11.76)**	-658.594 (2.73)*	2035.741 (9.17)**	884.426 (3.88)**	.982	2.22
Y_c	19341.821 (4.46)**			8.237 ₋₃ (4.82)**	-1.800 ₋₁ (1.28)	2872.755 (4.97)**	-1753.660 (2.66)*	-430.797 (0.63)	-887.586 (1.39)	.847	1.53
III-4-4	20525.202 (4.49)**			9.567 ₋₃ (6.16)**	-2.150 ₋₁ (1.49)	2778.347 (4.89)**	-2196.240 (3.46)**	-666.925 (1.04)	-634.525 (1.06)	.904	1.14

*Significant at the 5% level

**Significant at the 1% level

fluence on Y_c then a negative relationship between i_{us} and HGB would have been observed.

The budgetary surplus, while significant, takes the wrong sign (equations III-4-4). This cannot be ascribed to the simultaneous occurrence of other disturbances but rather is a reflection of the influence of income on the surplus. The underlying reason for this can be traced back to the fact that GS is an inadequate measure of autonomous fiscal expenditures.

The impact of the disturbances on Canadian interest rates is summarized in Table III-5. Again there seems to be a problem in that American GNE registers a positive influence on Canadian interest rates instead of the predicted negative effect (equations III-5-2). The explanation lies in the simultaneous change in i_{us} which exerts a greater positive force on Canadian interest rates. Evidence of this dominant role is seen in equations III-5-1 where Y_{us} becomes insignificant when regressed with i_{us} . The problems noted above regarding the reliability of the GS series are again present.

As well as offering additional verification of the constant reserves hypothesis, Table III-5 marshalls evidence against the constant money supply hypothesis. Were such a policy objective in effect there would be little or no relationship between the two interest rates (see Table II-5).

The overall behavior of the balance of payments has proved to be consistent with the constant reserves hypothesis as reserves

TABLE III-5
The Response of Canadian Interest Rates to Exogenous
Disturbances During the Ceiling Period

	C	(-) Y _{us}	(+) i _{us}	(-) QS	R	B	Q ₁	Q ₃	Q ₄	R ²	DW
i _c	S	3.361 (2.30)*	-0.004 (1.20)	1.220 (4.51)**	0.001 (1.70)	-0.001 ₋₁ (-1.22)	0.753 (2.03)	0.014 (0.06)	-0.349 (1.78)	.899	1.62
III-5-1	NS	-3.581 (2.42)*	0.005 (2.67)*	0.938 (6.23)**	-0.002 ₋₂ (3.52)**	0.0 ₋₁ (0.71)	-0.252 (1.26)	0.184 (1.29)	0.338 (2.18)*	.961	1.97
i _c	S	0.083 (0.04)	0.011 (5.36)**			-0.001 ₋₁ (1.70)	-0.487 (1.13)	0.248 (0.78)	-0.178 (0.60)	.749	0.91
III-5-2	NS	-1.600 (1.15)	0.001 (7.37)**			0.0 ₋₁ (0.68)	-0.754 (2.43)**	0.070 (0.32)	0.104 (0.51)	.823	1.00
i _c	S	1.935 (1.58)		1.084 (9.22)**		-0.001 ₋₁ (1.67)	0.362 (1.80)	0.004 (0.02)	-0.240 (1.22)	.890	1.39
III-5-3	NS	1.379 (1.52)		0.997 (11.80)**		0.0 ₋₁ (1.16)	0.139 (0.94)	-0.169 (1.13)	-0.106 (0.77)	.923	1.69
i _c	S	5.040 (2.31)*			0.004 (3.82)**	0.0 ₋₁ (0.60)	0.919 (2.78)*	0.373 (0.96)	0.797 (1.80)	.629	0.87
III-5-4	NS	6.318 (2.53)*			0.004 ₋₂ (4.16)**	-0.001 ₋₁ (1.03)	-0.157 (0.39)	0.988 (2.63)*	0.491 (1.60)	.600	0.53

*Significant at the 5% level

**Significant at the 1% level

did not respond to the disturbances. More specific consideration is given to this sector in Tables III-6 and III-7 where the developments of the merchandise trade balance and short term capital movements are recorded.

Table III-6 shows that neither American income nor interest rates affect the merchandise trade balance. The reason for this can be seen by analysing the relationship between Y_{us} and MTB. Recall from Table II-2 that the influence of American income is ambiguous. This was shown by the expression $dT/dY_F = T_Y/\Delta_1 + T_{Y_F} \neq 0$. It is therefore possible to observe no relation between MTB and Y_{us} if the change in exports is just offset by a change in imports arising from the change in domestic income. The strong correlation between Y_{us} and i_{us} (Appendix III-2, Table II) plus the strong impact of Y_{us} on Y_c (see above) explains why the coefficient for i_{us} is insignificant. (Notice that monetary policy moves to reinforce this change in Y_c and therefore offsets the influence of Y_{us} .)

The impact of the budgetary surplus on the trade balance conforms with expectations and therefore, to the extent that the data reflects fiscal policy, adds support to the constant reserves hypothesis.

One would intuitively expect that if the disturbances produce little change in the current account that the capital account would show a similar result. The reason being that if reserves are to remain constant and there is no change in the balance of trade there will be no change in the capital account balance. This is borne out

TABLE III-6
The Response of the Merchandise Trade Balance to Exogenous
Disturbances During the Ceiling Period

	C	($\pm$) Y_{us}	(+) i_{us}	(+) GS	R	B	Q_1	Q_3	Q_4	$\bar{R}^2$	DW
S	481.612 (3.98)*	-0.034 (0.11)	1.304 ₋₁ (0.05)	0.122 ₋₁ (2.07)	-0.158 ₋₁ (-4.11)**	5.174 (0.14)	36.166 (2.14)	64.621 (3.73)**	66.624 (3.30)**	.709	2.16
MTB NS III-6-1	614.456 (5.34)**	0.198 (0.65)	-20.367 ₋₁ (0.75)	0.189 ₋₁ (3.46)**	-0.223 ₋₁ (4.73)**	-46.862 (1.28)	17.115 (1.10)	48.741 (2.74)*	56.134 (3.22)**	.811	2.16
S	359.560 (3.17)	0.163 (1.43)			-0.158 ₋₁ (4.42)	-11.292 (0.46)	38.238 (2.10)	63.583 (3.75)	39.739 (2.34)	.658	2.13
MTB NS III-6-2	382.921 (2.94)**	0.204 (1.63)			-0.173 ₋₁ (3.77)**	-32.410 (1.12)	30.240 (1.46)	61.838 (3.24)**	29.519 (1.47)	.645	1.66
S	378.787 (3.55)**		15.0 ₋₁ (1.53)		-0.148 ₋₁ (4.32)**	4.494 (0.27)	37.301 (2.07)	67.549 (3.98)**	42.578 (2.53)*	.664	2.00
MTB NS III-6-3	391.066 (3.07)**		17.953 ₋₁ (1.75)		-0.154 ₋₁ (3.70)**	-12.413 (0.62)	30.194 (1.48)	68.652 (3.66)**	34.770 (1.81)	.654	1.66
S	469.658 (5.25)**			0.117 ₋₁ (2.83)*	-0.160 ₋₁ (5.32)**	0.950 (0.07)	36.321 (2.32)*	64.256 (4.41)**	65.157 (3.88)**	.747	2.17
MTB NS III-6-4	595.729 (6.22)**			0.169 ₋₁ (4.40)**	-0.200 ₋₁ (6.36)**	26.593 (1.88)	18.355 (1.26)	56.888 (4.34)**	58.218 (4.12)**	.834	2.20

*Significant at the 5% level

**Significant at the 1% level

in Table III-7 which suggests that the disturbances have little effect on the short term capital flows.

It is of some interest to note that while the coefficients are not significant they do bear the correct sign so that the two accounts offset each other to eliminate any change in foreign exchange reserves.

The results for the capital account display some parallel with the study by Caves and Reuber [14]. While they were able to find highly significant coefficients on interest rates for both long and short term capital movements during the period of flexible exchange rates (1952-61) this relationship changed drastically over the years of the fixed exchange rate 1962-69. Specifically their examination of short term capital movements revealed that while the Canada-United States short term interest differential was still a significant determinant of capital flows, its significance in terms of its *t* value more than halved.¹⁷ This was contrary to their expectations of finding capital flows to be much more sensitive to interest rates during a period when the exchange rate was fixed. As an explanation of the results, they argued that the various moves by the Canadian and American governments (such as the interest equalization tax and guidelines) employed to keep the exchange rate constant were much more unsettling for investors than flexible exchange

¹⁷ Richard E. Caves and Grant L. Reuber, "International Capital Markets and Canadian Economic Policy Under Flexible and Fixed Exchange Rates, 1952-69," Department of Economics Research Paper 7125, University of Western Ontario (London, Ontario: 1971), Table 2, p. 14. (Mimeographed.)

TABLE III-7
The Response of Net Short Term Capital Movements Between
Canada and the United States to Exogenous
Disturbances During the Celling Period

	C	(±) y_{us}	(-) i_{us}	(-) gs	R	B	Q_1	Q_3	Q_4	R ²	DW
S	-1853.474 (1.06)	3.474 ₋₄ (1.39)	-175.886 (1.34)	-1.140 ₋₄ (1.87)	0.137 ₋₁ (0.45)	-491.350 (1.98)	-120.298 (0.93)	-529.071 (3.31)**	168.492 (1.46)	.946	1.56
SC	-279.666 (0.17)	1.589 ₋₄ (0.51)	-81.186 ₋₁ (0.39)	-0.731 ₋₂ (1.20)	0.104 ₋₁ (0.26)	-172.269 (0.50)	-151.824 (0.78)	-442.012 (2.92)*	91.506 (0.63)	.493	1.62
III-7-1	S	1248.087 (1.47)	-0.924 ₋₄ (0.91)		-0.210 ₋₁ (0.84)	-175.227 (0.92)	-57.347 (0.45)	-319.218 (2.68)*	120.766 (1.01)	.485	1.55
SC	NS	1461.401 (1.59)	-0.944 ₋₄ (0.92)		-0.279 (0.93)	-54.049 (0.26)	11.096 (0.08)	-360.131 (2.81)*	113.983 (0.85)	.503	1.90
III-7-2	S	1035.145 (1.42)	-81.103 (1.15)		-0.226 ₋₁ (0.94)	-246.693 (2.06)	-42.898 (0.34)	-316.453 (2.70)*	135.199 (1.13)	.501	1.59
SC	NS	1303.223 (1.52)	-74.123 ₋₁ (1.07)		-0.324 ₋₁ (1.15)	-138.923 (1.02)	10.716 (0.08)	-384.294 (3.04)**	97.708 (0.75)	.515	1.84
III-7-3	S	-11.087 (0.01)		-0.614 ₋₄ (1.69)	0.018 ₋₁ (0.06)	-203.459 (1.71)	-106.446 (0.86)	-434.975 (3.32)**	134.054 (1.19)	.544	1.43
SC	NS	246.291 (0.25)		-0.612 ₋₂ (1.65)	-0.061 ₋₁ (0.19)	-23.481 (0.15)	-119.728 (0.81)	-402.077 (3.34)**	118.883 (0.96)	.566	1.76
III-7-4	III-7-4										

*Significant at the 5% level

**Significant at the 1% level

rates.¹⁸ While these developments were of a descriptive nature, the model developed here offers a more satisfactory explanation. As shown above, disturbances such as an increase in American income produce an increase in Canadian income and a decrease in Canadian interest rates. The developments in Canada call for a capital outflow while the rise in American income lends to a capital inflow. As a result the net flow could well be negligible even though the interest differential is increased. This underscores a point made earlier that a complete model of the economy even though highly aggregative, offers a much more rigorous explanation of events than the partial models.

The final pieces of evidence on the constant reserves hypothesis come from the movements of the money supply. Examination of the results on Table III-8 reveals that in terms of the foreign disturbances Y_{us} is the more significant. Since an increase in American income would ordinarily produce an increase in foreign exchange reserves, there must be an offsetting expansionary monetary policy (Table II-2). This is evidenced by equations III-8-2 and is consistent with the findings on central bank bond holdings discussed above. Whereas an increase in American interest rates should bring about a loss in reserves and an offsetting contraction in the money supply, this is not registered by equations III-8-3 as it is overshadowed by the influence of Y_{us} which occurs almost simultaneously (see Appendix III-2, Table I). Notice that this too is consistent

¹⁸Ibid., p. 20.

TABLE III-8
The Response of the Canadian Money Supply to Exogenous
Disturbances During the Ceiling Period

	C	(+) Y_{us}	(-) i_{us}	($\pm$) GS	R	B	Q_1	Q_3	Q_4	R^2	DW
M_2	4304.574 (1.17)	19.015 (3.08)**	549.263 ₋₁ (1.10)	2.578 ₋₃ (1.85)	-0.454 ₋₁ (0.56)	2343.370 (3.39)**	-203.639 (0.58)	-8.936 (0.02)	230.699 (0.64)	.981	0.87
III-8-1	4673.429 (0.90)	18.960 (3.05)**	590.822 (1.10)	2.518 ₋₃ (1.22)	-0.635 ₋₁ (0.62)	2458.583 (3.45)**	-210.166 (0.41)	-225.915 (0.41)	50.147 (0.11)	.974	1.02
M_2	-2222.152 (1.07)	29.720 (14.23)**			-0.084 ₋₁ (0.13)	1390.252 (3.09)**	158.415 (0.48)	384.006 (1.24)	482.176 (1.55)	.977	1.21
III-8-2	-2815.754 (1.15)	29.290 (12.38)**			0.183 ₋₁ (0.21)	1607.991 (2.93)*	360.316 (0.92)	443.860 (1.23)	542.225 (1.43)	.973	0.95
M_2	2086.783 (0.79)		2491.305 ₋₁ (10.26)**		1.852 ₋₁ (2.19)*	4475.577 (10.92)**	4.276 (0.01)	1041.006 (2.47)*	982.093 (2.35)*	.959	2.42
III-8-3	5747.943 (1.64)		2673.411 (8.19)**		0.519 ₋₁ (0.42)	4529.365 (7.95)**	-229.141 (0.40)	-59.432 (0.11)	-216.165 (0.37)	.941	1.74
M_2	27132.224 (5.72)**			11.350 ₋₃ (6.06)**	-2.608 ₋₁ (1.70)	4585.789 (7.24)**	-1279.450 (1.77)	-1991.367 (2.68)*	-988.034 (1.41)	.904	1.37
III-8-4	27277.897 (4.84)**			12.413 ₋₃ (6.84)**	-2.640 ₋₁ (1.48)	4504.887 (6.44)**	-1626.053 (2.08)	-2097.275 (2.65)**	-665.714 (0.90)	.913	1.10

*Significant at the 5% level

**Significant at the 1% level

with the results obtained for HGB which also concluded that the overall monetary policy would be expansionary.

The positive sign taken by GS in equations III-8-4 again registers the influence of domestic income on the surplus giving the appearance of opposing monetary and fiscal policies (see above).

An interesting feature about the change in the money supply is the means by which it changes. The money supply in this model is determined by open market operations and official holdings of foreign exchange. Now under this policy goal the monetary authority is using open market operations to minimize the fluctuations in foreign exchange reserves. One therefore expects that foreign exchange reserves will not be an important determinant of the money supply. This is brought out by the following regressions.

$$\begin{aligned}
 S \quad M2 = & -12484.973 + 1.882R_{-4} + 8.303HGB_{-4} + 2251.715B \\
 & (2.11) \quad (6.47)** \quad (3.31)** \\
 & + 344.623Q_1 + 116.888Q_3 - 216.603Q_4 \quad \bar{R}^2 = .943 \\
 & (0.67) \quad (0.22) \quad (0.43) \quad DW = 1.35 \quad (1)
 \end{aligned}$$

$$\begin{aligned}
 NS \quad M2 = & -13101.500 + 1.267R_{-4} + 8.847HGB_{-3} + 2398.291B \\
 & (1.28) \quad (6.23)** \quad (3.28)** \\
 & + 690.249Q_1 + 156.265Q_3 + 1385.373Q_4 \quad \bar{R}^2 = .935 \\
 & (1.17) \quad (0.27) \quad (2.52)* \quad DW = 1.23 \quad (2)
 \end{aligned}$$

* significant at the 5% level

** significant at the 1% level

A cursory glance at these results might offer the conclusion that the foreign sector played little or no part in the determination of the domestic money supply. However, as seen above, the money

supply is not insulated from exogenous foreign disturbances. The important thing to note is that official holdings do not provide the channel for transmitting these disturbances. Rather it is the efforts of the central bank attempting to keep the level of reserves constant which transmits the foreign disturbances to the domestic money supply. Monetary policy is the transfer mechanism.

What is more interesting is that because this policy was followed changes in the money supply in response to foreign disturbances were even greater than if a neutral monetary policy were followed (see Table II-5).

The overall conclusion that a constant reserves policy was in effect offers insight into the conduct of monetary policy during this period. An investigation of Canadian monetary policy by Courchene has shown that it produced abnormal increases in the money supply during the late 1960's.¹⁹ Employing the model of this paper shows that such changes in the money supply are a direct result of the constant reserves policy because the money supply is more closely tied to foreign disturbances than if a neutral monetary policy had been followed (see Table II-5). Furthermore to the extent that money affects the level of economic activity, the Canadian economy was much more exposed to external disturbances.

Summary

From 1963 to 1968 Canada accepted a ceiling on her official

¹⁹Thomas J. Courchene, "Recent Canadian Monetary Policy," Journal of Money Credit and Banking, III (February, 1971), p. 39.

holdings of foreign exchange in return for exemptions from policies introduced by the American government to correct a chronic balance of payments problem. There is a reasonable body of evidence to argue that this ceiling was established below the level of reserves which was held desirable. As a result the Bank of Canada was constrained to follow a policy which minimized the fluctuations in these reserves. Statistical evidence provides a general verification of this hypothesis. Several discrepancies which do occur can be explained by the strong positive correlation between American income and interest rates. Problems with respect to the performance of the budgetary surplus can be ascribed to the errors introduced by using this variable as a proxy for fiscal policy.

During the period of the ceiling the Canadian money supply was highly susceptible to changes outside the economy--particularly American income. Because monetary policy was forced to keep official holdings of foreign exchange reserves constant, it produced a situation in which there was little autonomous control over the money supply.

C. Fixed Exchange Rates with no Restrictions on Official Holdings of Foreign Exchange

After the results of the last section it is tempting to push the model a little further and examine the period of the fixed exchange rate which was not subject to a reserve ceiling. This covers two short subperiods before and after the ceiling (III'62 to II'63 and I'69 to I'70). There is already some information on these sub-

periods which distinguishes them from the ceiling years. Graph I and Table III-2 showed that reserves were more volatile and significantly related to the exogenous disturbances. This suggests that the policy objective of constant reserves was not in effect outside the ceiling period. Naturally this begs the question of which objective did prevail for these other subperiods of the fixed exchange rate.

The clues provided by the Governor's statements forward two conflicting goals: a constant money supply and a constant interest differential. Consider first the possibility that the Bank attempted to neutralize any influence of foreign exchange holdings on the domestic money supply.

There would appear to be some reason for thinking along these lines as the Governor places heavy emphasis on the problems of inflation in the Annual Report of 1969.

Throughout the past year, the policy of the Bank has been directed towards achieving and maintaining tight credit conditions in order to help bring inflationary pressures in the economy under control.²⁰

The proof of this contention would be a discovery of no relationship between foreign exchange reserves and the money supply along with the other predictions summarized in Table II-4.

There is one major problem which could emerge from this which revolves about the Bank's ability to sterilize the influence of foreign exchange reserves. Mundell [29] argued that such a

²⁰Bank of Canada, Annual Report of the Governor, 1969 (Ottawa: Bank of Canada, 1970), p. 7.

policy was impossible in a world of highly interest elastic capital flows. If this is true then it would be possible to observe fluctuations in the money supply in response to foreign disturbances. This is borne out in the following table of simple correlations.²¹

TABLE III-9

Simple Correlations between Exogenous
Disturbances and the Money Supply
(No Constraints on Official
Holdings of Reserves)

	Y_{us}	i_{us}	GS
M2	.9980**	.9846**	.8482**
** significant at 1% level			

The table readily demonstrates that strong positive relationships existed between the money supply and the disturbances. But does this constitute proof that the Bank was not adhering to the policy objective of a constant money supply? Probably not. What it may indicate is that the Bank was unsuccessful in its attempts to insulate the money supply from foreign disturbances. If this were the case, then the money supply would be positively related to official holdings but negatively related to the bond holdings of the central bank with

²¹Because of the lack of observations, both subperiods were combined. For the same reason it was not possible to present results which excluded observations from periods of speculation. This would call for the introduction of a dummy variable to pick up any structural change between the periods. This was tried but in most cases it was statistically insignificant.

official holdings playing the dominant role.

Regressing the money supply on these two variables

$$M_2 = 11568.152 + 0.662R_{-1} + 0.692HGB_{-3} + 11438.825B$$

$$(4.77) \quad (2.83) \quad (69.43)$$

$$-392.413Q_1 - 31.034Q_3 + 119.139Q_4 \quad \bar{R}^2 = .999$$

$$(-5.76) \quad (-0.27) \quad (1.23) \quad DW = 2.92 \quad (3)$$

finds reserves to be the most important determinant but the coefficient on bond holdings is positive, suggesting that the Bank was not trying to sterilize disturbances emanating from the balance of payments. It would therefore appear that the constant money supply objective was not in force.

What the above does show is that the money supply was influenced by the balance of payments and furthermore that the transmission mechanism was official holdings of foreign exchange. This is a striking contrast with the findings for the ceiling period (see equations 1 and 2 above).

Fortunately the Governor's reports submit an alternate hypothesis, namely that policy was geared to producing a Canada-United States interest differential which would maintain an inflow of capital to offset the balance of trade deficit.

Looking at the first subperiod finds the Governor's report referring to monetary policy which was "directed toward promoting and maintaining a level of interest rates in Canadian financial markets which would help in establishing a net inflow of capital large enough to cover the current account deficit in the balance

of international payments. . . ."22 In a similar vein, commenting on the period of fixed exchange rates after the ceiling, he observed that "the trend of interest rates in Canada in 1969 was greatly influenced by the movement of rates abroad. . . ."23

Later, in 1970 he noted:

The rapid shift of current account to a position of substantial surplus removed the need which existed for many years to maintain interest rate levels high enough to attract a net inflow of capital to cover the current account deficit.²⁴

1. The Evidence

In order to test this latter proposition, the relationships between the exogenous disturbances and the indicators of economic activity were examined for the two subperiods which were not subject to a ceiling on foreign exchange reserves. The results are considered in light of the predictions presented in Table II-3.

Take first the type of action that the monetary authority would have to undertake when faced, for instance, by an increase in American income. This would act to increase foreign exchange reserves and the money supply so that there would be a tendency for Canadian interest rates to fall. One would therefore expect a contractionary monetary policy if the international interest differential were to be maintained. Table III-10 shows that the actual res-

²²Bank of Canada, Annual Report of the Governor 1962 (Ottawa: Bank of Canada, 1963), p. 4.

²³Ibid., 1969, p. 11.

²⁴Ibid., 1970, p. 2.

TABLE III-10

The Response of Canadian Monetary Policy to Exogenous Disturbances
(No Ceiling on Official Holdings of Reserves)

	C	(+) Y_{us}	(-) i_{us}	(+) GS	R	$\bar{R}^2$	DW
HGB	1742.062	2.378	65.754 ₋₃	0.110	-0.166 ₋₁	.986	3.74
III-10-1	(4.71)**	(2.35)	(0.62)	(0.84)	(2.22)		
HGB	1436.945	3.134			-0.157 ₋₁	.989	3.72
III-10-2	(13.73)**	(16.47)**			(2.37)		
HGB	2220.754		356.918 ₋₃		-0.128 ₋₁	.962	1.84
III-10-3	(10.04)**		(8.68)**		(-1.05)		
HGB	2707.896			0.928	0.194 ₋₁	.787	1.91
III-10-4	(4.02)**			(2.91)*	(0.78)		

*Significant at the 5% level

**Significant at the 1% level

ponse was quite the opposite. Moreover the predictions regarding i_{us} and GS also fail which leads to a rejection of this hypothesis.

If the Bank was not attempting to sterilize the flow of foreign exchange reserves nor keep the interest rate differential constant, what was the objective of the observed open market operations? The only objective consistent with the action taken is the constant reserves policy. The fact that reserves did respond to the disturbances suggests that the authorities did not attempt to eliminate all fluctuations in official holdings but rather acted to reduce their size. Regrettably there are no official statements to lend support to this conclusion but as shown above these statements are at best unreliable. However other evidence in the form of observed relationships between the indicators of economic activity and the disturbances do support the argument.

The influence of the disturbances on domestic income (Table III-11) follows the pattern predicted for the constant reserves situation. The problem of a strong positive correlation between Y_{us} and i_{us} create the same difficulties as noted above in the discussion of the ceiling period. The reaction of Canadian interest rates to American rates is consistent with the theoretical predictions (Table III-12). While the observed influences of Y_{us} and GS can be explained by the strong positive correlation between both of these variables and i_{us} .

The evidence on the foreign sector of the economy (Tables III-13 and III-14) follows closely that presented for the ceiling

TABLE III-11

The Response of Canadian Income to Exogenous Disturbances
(No Ceiling on Official Holdings of Reserves)

	C	(+) Y_{us}	(-) i_{us}	(-) GS	R	R^2	DW
Y_c	4926.082	8.943	1409.584	2.049 ₋₁	-1.352 ₋₁	.968	1.98
III-11-1	(0.94)	(0.61)	(1.15)	(1.09)	(1.28)		
Y_c	-2671.616	28.790			-1.490 ₋₁	.966	1.73
III-11-2	(1.57)	(9.34)**			(1.38)		
Y_c	5518.669		2516.309		-0.960 ₋₁	.967	1.47
III-11-3	(2.84)*		(9.59)**		(0.96)		
Y_c	10847.394			9.618 ₋₁	1.045 ₋₁	.829	2.73
III-11-4	(1.91)			(3.55)**	(0.49)		

*Significant at the 5% level

**Significant at the 1% level

TABLE III-12

The Response of Canadian Interest Rates to Exogenous Disturbances
(No Ceiling on Official Holdings of Reserves)

	C	(-) Y_{us}	(+) i_{us}	(-) GS	R	$\bar{R}^2$	DW
i_c	5.315 (3.45)*	-0.0 ₋₄ (0.08)	1.013 (2.56)	0.001 ₋₁ (1.89)	-0.001 ₋₁ (5.09)**	.983	3.24
III-12-1							
i_c	0.691 (1.07)	0.014 ₋₄ (11.00)**			-0.002 ₋₁ (4.48)*	.962	2.15
III-12-2							
i_c	4.385 (7.84)**		1.131 (14.96)**		-0.001 ₋₁ (-5.19)**	.979	2.93
III-12-3							
i_c	6.662 (2.66)*			0.004 ₋₁ (3.56)*	-0.001 ₋₁ (0.59)	.745	2.25
III-12-4							

*Significant at the 5% level

**Significant at the 1% level

TABLE III-13

The Response of the Canadian Merchandise Trade Balance to Exogenous Disturbances (No Ceiling on Official Holdings of Reserves)

	C	(+) Y_{us}	(+) i_{us}	(+) GS	R	$\bar{R}^2$	DW
MTB	230.293 (2.25)	-0.726 ₋₄ (1.78)	58.855 ₋₂ (1.22)	0.142 ₋₃ (1.84)	0.026 ₋₁ (0.66)	.764	3.03
III-13-1							
MTB	-78.655 (0.78)	0.279 ₋₄ (1.34)			-0.021 ₋₁ (0.31)	.222	1.36
III-13-2							
MTB	12.731 (0.13)		35.080 ₋₂ (2.20)		-0.038 ₋₁ (0.74)	.439	1.49
III-13-3							
MTB	88.857 (1.11)			0.142 ₋₃ (3.72)**	-0.014 ₋₁ (0.50)	.694	1.87
III-13-4							

**Significant at the 1% level

TABLE III-14
The Response of Net Short Term Capital Flows Between Canada and
the United States to Exogenous Disturbances (No Ceiling
on Official Holdings of Reserves)

	C	(*) Y_{us}	(-) i_{us}	(-) GS	R	$\bar{R}^2$	DW
SC	3798.084	-7.405 ₋₃	741.418 ₋₄	0.709	-0.537 ₋₁	.439	2.45
III-14-1	(2.86)*	(1.94)	(1.64)	(1.62)	(1.81)		
SC	926.687	0.074 ₋₃			-0.336 ₋₁	.096	3.23
III-14-2	(1.71)	(0.07)			(-0.96)		
SC	1061.466		48.547 ₋₄		-0.436 ₋₁	.117	3.21
III-14-3	(1.64)		(0.38)		(1.19)		
SC	1497.540			0.370	-0.541 ₋₁	.240	2.93
III-14-4	(2.05)			(1.07)	(1.99)		

* Significant at the 5% level

period. The previous discussion regarding the absence of significant relationships applied to the findings for this period.

The impact of the disturbances on the money supply correspond to both the predictions and the results obtained for the ceiling period (Table III-15) so no further comment is required.

Summary

Since the policy objective in force throughout the period of fixed exchange rates appears to change only in degree rather than content, is there anything which separates out the years subject to the ceiling? The significant difference centers on the relative strength of the foreign sector on the economy. As shown above a policy which minimizes the fluctuations in foreign exchange reserves has the consequence of making income, interest rates and the money supply more sensitive to changes in American income and interest rates than if monetary policy were inactive. Therefore the two subperiods which allowed for greater fluctuations in reserves dampened the effects of external disturbances on the economy.

TABLE III-15
The Response of the Canadian Money Supply to Exogenous Disturbances
(No Ceiling on Official Holdings of Reserves)

	C	(+) Y_{us}	(-) i_{us}	(+) GS	R	R^2	DW
M_2	-6673.178 (1.91)	43.360 (4.63)**	-911.120 (1.30)	0.708 (0.72)	-0.186 (0.43)	.997	1.93
III-15-1							
M_2	-4720.889 (5.20)**	34.491 (20.88)**			-0.029 (0.05)	.995	0.79
III-15-2							
M_2	4551.116 (1.63)		2873.399 (7.60)**		1.011 (0.70)	.962	0.70
III-15-3							
M_2	9759.725 (1.39)			10.531 (3.17)*	3.643 (1.40)	.851	2.13
III-15-4							

*Significant at the 5% level

**Significant at the 1% level

APPENDIX III-1

LIST OF VARIABLES

GS	Government of Canada budgetary surplus in millions of Canadian dollars: DBS National Accounts.
HGB	Bank of Canada holdings of government bonds in millions of Canadian dollars. Average of Wednesdays adjusted for international central bank transfers: Bank of Canada Statistical Supplement.
i_c	Canadian three month treasury bill rate Average of Wednesdays: Bank of Canada SS.
i_{us}	American three month treasury bill rate Average of Wednesdays: Bank of Canada SS.
M_2	Canadian money supply; currency plus demand deposits plus time deposits in millions of Canadian dollars Average of Wednesdays: Bank of Canada SS.
MTB	Merchandise trade balance for Canada in millions of Canadian dollars: Bank of Canada SS.
R	Official holdings of foreign exchange reserves in millions of Canadian dollars. Adjusted for international transfers between central banks: Bank of Canada SS.
STC_{us}	Short term capital movements (net) between Canada and the U.S. in millions of Canadian dollars: DBS Balance of Payments.
Y_c	Canadian GNE in millions of Canadian dollars Seasonally Adjusted: DBS National Accounts.
Y_{us}	American GNE in billions of U.S. dollars Seasonally Adjusted: US Department of Commerce Current Business Indicators.

- B Dummy variable denoting the change in the Bank Act. B takes a value of 0 up to the second quarter of 1967 and a value of 1 thereafter.
- C Constant.
- Q_1, Q_3, Q_4 Seasonal dummy variables.

APPENDIX III-2
TABLE A III-2-1

Simple Correlations Between Exogenous Variables for the
Ceiling Period III'63-IV'68

	Y _{us}	Y _{us-1}	Y _{us-2}	Y _{us-3}	Y _{us-4}	i _{us}	i _{us-1}	i _{us-2}	i _{us-3}	i _{us-4}	GS	GS-1	GS-2	GS-3	GS-4	R-1	NS
Y _{us}						.852	.871	.947	.928	.901	.426	.527	.798	.699	.575	-.038	
Y _{us-1}						.849	.874	.954	.935	.911	.412	.544	.770	.711	.556	-.060	
Y _{us-2}						.838	.868	.956	.944	.923	.417	.523	.783	.683	.572	-.061	
Y _{us-3}						.817	.857	.956	.947	.930	.350	.529	.766	.698	.541	-.086	
Y _{us-4}						.788	.844	.959	.950	.924	.359	.480	.778	.677	.553	-.116	
i _{us}	.881	.877	.867	.851	.828						.485	.439	.745	.808	.535	.142	
i _{us-1}	.873	.876	.870	.859	.843						.510	.570	.671	.664	.675	.006	
i _{us-2}	.867	.875	.878	.871	.860						.408	.546	.714	.686	.642	-.004	
i _{us-3}	.849	.860	.868	.869	.864						.351	.462	.746	.646	.613	-.047	
i _{us-4}	.832	.846	.856	.863	.865						.383	.479	.700	.696	.595	.056	
GS	.541	.525	.528	.478	.486	.597	.583	.440	.324	.357						.309	
GS-1	.509	.520	.501	.502	.452	.463	.586	.584	.412	.305						.248	
GS-2	.652	.632	.643	.624	.620	.618	.603	.688	.722	.528						.142	
GS-3	.584	.601	.578	.590	.572	.652	.560	.566	.631	.688						.332	
GS-4	.594	.580	.595	.569	.582	.542	.661	.580	.566	.634						.408	
R-1	-.224	-.232	-.230	-.252	-.274	-.120	-.153	-.143	-.117	.040	-.008	.019	.075	.327	.300		

APPENDIX III-2
TABLE A III-2-2

Simple Correlations Between Exogenous Disturbances

	Y_{us}	Y_{us-1}	Y_{us-2}	Y_{us-3}	Y_{us-4}	i_{us}	i_{us-1}	i_{us-2}	i_{us-3}	i_{us-4}	GS	GS-1	GS-2	GS-3	GS-4	R-1
Y_{us}																
Y_{us-1}																
Y_{us-2}																
Y_{us-3}																
Y_{us-4}																
i_{us}	.992	.993	.993	.993	.994											
i_{us-1}	.983	.986	.987	.987	.988											
i_{us-2}	.978	.981	.983	.982	.984											
i_{us-3}	.990	.992	.992	.992	.993											
i_{us-4}	.989	.991	.992	.992	.993											
GS	.906	.904	.901	.902	.899	.863	.914	.883	.896	.868						
GS-1	.923	.919	.919	.920	.920	.870	.885	.875	.902	.912						
GS-2	.853	.855	.852	.854	.859	.830	.917	.847	.917	.886						
GS-3	.862	.868	.871	.870	.869	.876	.883	.856	.905	.906						
GS-4	.887	.892	.895	.894	.894	.899	.903	.830	.875	.925						
R-1	.839	.840	.843	.845	.850	.821	.821	.820	.837	.863	.775	.782	.728	.649	.739	

CHAPTER IV

Summary and Conclusions

This study has examined the reaction of the Canadian monetary sector to changes in American income, interest rates and autonomous domestic expenditures. Because of important interdependencies between the monetary sector and the rest of the economy, the investigation was developed within the framework of an aggregate model of the economy. Of the three disturbances enumerated, the main concern of the study has been those disturbances originating in the United States. Two features of the disturbances were studied: the mechanism by which they are transmitted to the Canadian economy and, secondly, the ultimate impact they have on the level of economic activity. Both of these aspects must be dealt with if the Canadian economy is ever to become more independent of economic developments beyond her borders.

While there are numerous ways by which external disturbances are transferred to the Canadian economy, this study has concentrated on the balance of payments. Within the confines of this transfer mechanism, the investigation has devoted particular attention to the transmission of disturbances to the monetary sector.

The investigation of the impacts of and the transfer mechanisms for disturbances was given a new dimension by introducing

the goals of the monetary authority into the model. This feature produced the interesting result that both the impact of a disturbance and the means by which it is effected change with the environment which is created by a particular policy objective. This provided a great deal of assistance in the empirical work, because it made possible the identification of the relevant policy objective by the nature of the impact that the disturbances had on the economy. Once this was established the appropriate transfer mechanism was revealed.

This feature also has considerable merit for other empirical studies on the evaluation of policy. Since the identification of the policy goal is essential for this type of work, and since this information is seldom revealed by the policy maker himself, it is a valuable tool for analysis.

The empirical testing of the model examined Canada's most recent experience with fixed exchange rates. During a portion of this period, Canada was subject to a ceiling on the official holdings of foreign exchange. Under this constraint it was found that the relevant objective of monetary policy was a constant level of foreign exchange reserves. It was also found that the disturbances were transmitted to the monetary sector via the Bank of Canada's open market operations. This is rather interesting for it shows that finding the money supply is strongly influenced by variables under the control of the central bank does not necessarily mean that the money supply is under the control of that institution.

Another important conclusion relates to the cost of following the constant reserves policy. Under this particular policy, constraint, the model shows that the impacts of foreign disturbances on the Canadian money supply, income, and interest rates are in each case greater than would have taken place in the absence of monetary policy. The policy of constant reserves therefore carried with it a significant cost, namely that of tying the Canadian economy even more closely to external economic developments.

The section of the study dealing with the portions of the fixed exchange rate period which were not influenced by the reserve ceiling was severely hampered by a lack of observations. In spite of this difficulty, the evidence argued that a less severe form of the constant reserves policy was followed. While the transfer mechanism remained the same, its strength was reduced because some movement in reserves was permitted.

The study therefore provides a means of identifying the policy of the central bank, the associated mechanism by which foreign disturbances are transmitted to the domestic monetary sector, and a way of assessing the costs of a particular policy in terms of how it affects the susceptibility of the economy to foreign disturbances.

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