INTERNATIONAL CAPITAL FLOWS, INTEREST RATES, AND THE MONEY SUPPLY

by

Charles Freedman

Discussion Paper No. 73-32, May 1973

Center for Economic Research
Department of Economics
University of Minnesota
Minneapolis, Minnesota 55455

INTERNATIONAL CAPITAL FLOWS, INTEREST RATES, AND THE MONEY SUPPLY*

by

Charles Freedman

1. Introduction

The system of fixed exchange rates requires a commitment by governments that exchange rates be prevented from moving beyond their intervention points. In order to meet this obligation, the government (or its agency) or the central bank must intervene in the foreign exchange market whenever the exchange rate moves to a limiting value. Thus, the responsible agency in each country (except the United States) will sell foreign currency (usually United States dollars[1]) and buy local currency when the exchange rate (defined as the number of units of domestic currency to purchase one unit of foreign currency) is at the ceiling and do the reverse when the exchange rate is at the floor. The United States generally plays a passive role in this process although most of the world's reserves are in the form of U. S. dollars.

In this paper we look at a number of implications of the system of fixed exchange rates in the context of a two-country model. For expositional purposes we will call the two countries the United States (the passive country) and Canada (the intervening country). From the point of view of the Canadian government, capital movements into Canada lead to an increase in international reserves which must be financed by

---

* The first draft of this paper was written during a visiting year at the Department of Banking and Finance of the Bank of Canada. I should like to acknowledge the helpful comments on the first draft by James Dingle and George Post. The views expressed are those of the author and no responsibility for them should be attributed to the Bank of Canada.

increases in the outstanding debt of the government or decreases in assets held by the government or the central bank. Similarly, decreases in international reserves lead to decreases in government debt outstanding or increases in assets held by the government or central bank.[2] Since there are a number of different ways of financing increases in international reserves and using the funds generated by decreases in international reserves, the question immediately arises as to how different methods of dealing with reserve changes affect different variables of the economic system. In particular we wish to investigate the effect of different government policies on domestic interest rates and on various definitions of the money supply.

The approach we take to the problem of changes in international reserves leads naturally to the exploration of a number of interesting issues. First, why do countries like Germany and Canada find it difficult to sterilize capital flows when sterilization appears to be a relatively simple technical operation? Secondly, is it possible that an explosive spiral can occur in which a capital inflow leads to an increase in interest rates (as the government finances the increase in international reserves by issuing new bonds), which leads to a further inflow, which leads to a further increase in interest rates, etc? Thirdly, since the system is asymmetric in the sense that the United States plays a passive role and other countries play an active role, do capital movements between the United States and other countries have effects on United States interest rates and the United States money supply which are different from their effects on other countries' interest rates and money supplies? A practical example of this problem

arose after the Smithsonian agreement of December, 1971 when a "reflow" of funds from Europe to the United States was expected. The question then arose as to whether this inflow would lead to an increase or decrease in United States interest rates. Finally, what will be the effect of international capital movements on the implementation of a Friedman-type rule of constant rates of growth of the money supply?

In Section 2 of this paper, we develop a simple model of the financial sectors of Canada and the United States. We then analyze the effects of a change in parameter (in all cases a decline in the United States interest rate) on Canadian interest rates and the Canadian money supply under various government and central bank policies for dealing with the increase in international reserves held by Canada. The results are used to interpret the difficulties perceived by countries such as Canada and Germany in sterilizing capital flows. The possibility of an explosive spiral in interest rates and capital flows is also discussed in Section 2. We use the model to comment on the problems of implementing a Friedman-type rule in an open economy.

In Section 3, we use a slightly different model with a more detailed model of the United States financial sector and a less detailed model of the Canadian financial sector to examine the effects of capital flows on United States interest rates and the United States money supply under different Canadian policies. The analysis will be used to deal with the effects of the expected reflow of funds in 1972.

2. The Model

The world is assumed to be composed of two countries, Canada and the United States. There exist four Canadian dollar financial assets - bonds issued by the Canadian government, bonds issued by private borrowers,[3] time deposits at Canadian banks, and demand deposits at Canadian banks. For purposes of this section, the United States financial sector is assumed to consist of only two assets - United States dollar bonds and United States money. Wealth owners in both Canada and the United States are assumed to hold all six available assets as part of their portfolios. We make the further assumption of weak gross substitutability; that is, the effect of an increase in an interest rate is to increase the quantity demanded of the asset with the higher interest rate and to reduce or leave unchanged the quantity demanded of the other assets.

Canadian private borrowers issue bonds in both United States and Canadian markets. As the interest rate on one form of debt increases, less debt is issued in that form and more debt is issued in the relatively cheaper form. The Canadian federal government issues only Canadian dollar bonds and United States borrowers issue only United States dollar bonds.[4]

Canadian banks are assumed to operate in the following manner. There is a fixed interest rate on time deposits[5] and the banks supply all time deposits demanded at that rate. The supply of demand deposits is determined by total reserves of the banking system (which is under control of the central bank), the required reserves on the existing

volume of time deposits, and the required reserve ratio on demand deposits. For simplicity we shall assume that the required reserve ratios on time deposits and demand deposits are equal.[6] The earning assets of the banks are composed of Canadian dollar government bonds and Canadian dollar private bonds.[7] An increase in the rate of interest on one type of bond causes the banks to increase their holdings of that type of bond and reduce their holdings of the other type of bond.

United States banks supply money in an amount determined by the magnitude of available reserves (which is under the control of the Federal Reserve) and the required reserve ratio. Their entire portfolio of earning assets is composed of United States dollar bonds.

The Bank of Canada holds Government of Canada bonds, United States dollar bonds, and deposits at the Federal Reserve. Its liabilities are bank reserves and the deposits of the Government of Canada. The Government of Canada holds deposits at the Bank of Canada, deposits at the chartered banks, and United States dollar bonds. Its liabilities are the outstanding stock of government bonds.[8]

The Federal Reserve holds United States dollar bonds as its assets. Its liabilities are the reserves of United States banks and the United States dollar deposits of the Bank of Canada. The United States government is consolidated with United States wealth owners and United States corporations for purposes of this part of the analysis.

The formal model is spelled out in detail in the Appendix. The system has five market-clearing equations and twelve identities which can be combined into four independent equations in four variables - the rates of interest on Government of Canada bonds, private Canadian

bonds, United States dollar bonds and the sum of the international reserves held by the Government of Canada and Bank of Canada. If the rate of interest in the United States is set by the Federal Reserve, then the holdings of United States bonds by the Federal Reserve replaces the United States interest rate as a variable of the system. The latter system can be dichotomized into two subsystems - three equations in the two Canadian interest rates and Canadian holdings of international reserves and a fourth equation which can be solved for Federal Reserve holdings of United States bonds. Since we are not really interested in the latter variable, we can treat the system as having three equations (market clearing equations for Government of Canada debt, private Canadian debt, and Canadian money) in three variables (the two Canadian interest rates and Canadian holdings of international reserves).

We now turn to an examination of some of the policies available to the government and central bank to finance international reserve increases and to use the funds that become available when reserves decrease.[9]

(1) The government can issue new bonds to finance an increase in reserves and retire outstanding bonds when reserves decrease. This policy is equivalent to a complete sterilization policy by the central bank in which the latter engages in open-market sales (purchases) to prevent any change in bank reserves and the money supply when international reserves increase (decrease). The equivalence of these policies can be seen through the economics of the situation. The government policy of debt issue and retirement involves a change in government bonds outstanding and (since the central bank's holdings are unchanged) a change in the public's holding of government bonds. The central bank's sterilization

policy involves changes in the amount of government bonds in the hands of the public even though total bonds are unchanged. The net economic effect is the same since it is only the magnitude of the excess demand for government debt that is significant, not the way in which that excess demand came about. As we shall see, this policy prevents any change in the total money supply (including government deposits) or private money holdings (excluding government deposits) but may sometimes result in a change in domestic money holdings (holdings of money by residents of Canada).

(2) The government changes its holdings of demand deposits at the chartered banks when international reserves change. This policy results in no change in the total money supply, but the change in private money holdings is precisely the opposite of the change in the government deposits. The domestic money holdings may or may not change depending on the circumstances.

(3) The central bank allows the chartered banks to increase their deposits by the amount of the capital inflow to deposits and uses open market operations (Policy 1) to sterilize other forms of capital inflow. The central bank thus engages in "trimming" operations in which bank reserves increase by the increase in deposits times the required reserve ratio.[10]

(4) The central bank allows the chartered banks to increase their deposits by the amount of the capital inflow to deposits (whether by domestic residents or by foreigners) but the marginal reserve ratio on deposits by foreigners is 100 percent. Other types of capital inflows are sterilized by open market operations (Policy 1). This is the type of policy used by countries concerned with the size of the banking

system and the ability of chartered banks to make domestic loans with the funds they receive when deposits by foreigners increase.[11]

We now turn to the comparative statics of the system. In all cases the parameter change under discussion is a reduction in the United States interest rate brought about by Federal Reserve open-market operations.[12] Because of this reduction in United States rates, Canadian financial instruments become more attractive to both American and Canadian investors. Furthermore, Canadian debtors shift some of their debt to the United States. Thus there is capital inflow to Canada. Now it turns out that the results of these capital inflows depend crucially on the destination of the inflows. We distinguish between (a) inflows into government debt; (b) inflows into private debt (including the shift by private borrowers of the source of their financing); and (c) inflows into deposits.[13] In Table 1 we present the effects of a decline in the United States interest rate for different government policies and for different types of capital flows. In this table, a plus means an increase, a minus a decrease, and a zero means no change. The entry +1 denotes that the increase is exactly equal to the capital inflow.

The economics underlying the results presented in Table 1 is relatively straightforward. Under Policy 1 capital flows are not allowed to affect the reserves of the banking system. Hence the money supply is held constant. If foreigners[14] desire to hold government bonds (case a), the government (central bank) can satisfy these desires by issuing bonds (conducting open market sales of government bonds) with the result that there is no excess demand or excess supply in any market.

Table 1

EFFECTS OF A DECLINE IN THE UNITED STATES INTEREST RATE

	Interest Rate on Government of Canada Bonds	Interest Rate on Private Canadian Bonds	Total Money Supply (Including Government Deposits)	Private Money Holdings	Private Domestic Money Holdings	Bank Earning Assets
		(a) Inflow to Government Debt				
Policy 1	0	0	0	0	0	0
Policy 2	-	-	0	+	+	0
		(b) Inflow to Private Debt				
Policy 1	+	-	0	0	0	0
Policy 2	-	-	0	+	+	0
		(c) Inflow to Deposits				
Policy 1	+	+	0	0	-	0
Policy 2	0	0	0	+1	+	0
Policy 3	+	-	+1	+1	+	1-ρ
Policy 4 (Only Foreigners Shift)	0	0	+1	+1	0	0
Policy 4 (Foreigners and Domestic Residents Shift)	+	-	+1	+1	+	+

Therefore interest rates do not change. From the Canadian authorities' point of view, they are exchanging their own debt in return for foreign currency assets (generally held in the form of United States government treasury bills) and hence they are acting as a form of financial intermediary. They issue a financial claim on themselves in return for a financial claim on the United States government. If, as is usually the case, Canadian interest rates are higher than American, the government's intermediation results in a net cost to the Canadian authorities of the difference between the rates of interest on government bonds in the two countries. The perceived benefit to the Canadian authorities is that they are not required to revalue the Canadian exchange rate or reduce Canadian interest rates in response to the capital inflow; that is, a certain degree of domestic autonomy is permitted.

There are two cases in which even this simple model breaks down. First, if the central bank is short of domestic bonds, it will at some point be unable to sterilize capital inflows by conducting open-market sales. However, if the foreigners wish to hold government bonds it is reasonable for the central bank to borrow from the government, i.e., have the government issue more bonds in return for the foreign exchange or for an increase in government deposits at the central bank.[15] Secondly, if holdings of Canadian assets by Americans have an infinite interest rate elasticity then any change in United States interest rates will be followed by an equivalent change in Canadian interest rates. Any attempt to sterilize capital flows in such circumstances would be futile since only one world interest rate is viable.[16] For the rest of our discussion we will continue to assume that the elasticities of demand

for financial assets with respect to interest rates are finite.

In case b , foreigners want to purchase private debt whereas the authorities can issue only government debt. There is therefore an excess supply of government debt and an excess demand for private Canadian debt. This leads to a decline in the interest rate on private debt and an increase in the interest rate on government debt. In effect, Canadian wealth owners must intermediate between the foreign lenders and the Canadian authorities by giving up private debt in return for government debt. This shift in Canadian portfolios is brought about by the changes in the interest rates on the two assets. The reduction in the interest rate on private debt reduces the magnitude of the increase in Canadian international reserves in the new equilibrium.

It is worth examining this case in somewhat more detail since this is the situation in which it is alleged that an explosive spiral can occur. The argument for the spiral is as follows. The inflow of capital caused by the reduction in the American interest rate is financed by a government debt issue to the public. This leads to an increase in Canadian interest rates, which leads to a further inflow. "This will require further operations by the Exchange Fund Account, further recourse to the bond market, further upward pressure on interest rates, and so on in a vicious circle."[17] The fallacy in the argument derives from the fact that the distinction between the rate of interest on private debt and that on government debt is ignored. As was pointed out, the issue of government debt does lead to an increase in interest rate on government debt but at the same time there is a <u>decrease</u> in the interest rate on private debt. Thus the induced capital inflow does not occur and no

spiral is set off. Furthermore, even if we combine the cases of inflows into government debt, into private debt, and into deposits, there will still be no explosive spiral set off.[18]

If the foreigners shift from United States debt to Canadian bank deposits when United States interest rates decline (case c), then the policy of complete sterilization leads to an excess demand for money and an excess supply of government debt. This will lead to increases in the interest rates on both types of Canadian bonds. In effect, Canadian residents must be induced to give up deposits to the foreigners in return for government debt. That is, the Canadian nonbank public is acting as an intermediary between foreign investors and the Canadian government. The required portfolio shift is brought about by an increase in the interest rate on government debt and a smaller increase in the rate on private debt. Thus private domestic money holdings decline even though the total money supply is unchanged. In this case we have the odd result that a decline in United States interest rates leads to an increase in Canadian interest rates.

Policy 2, the use of demand deposits held by the government to finance the increase of reserves, is a viable policy only in the short run since over the longer run the Canadian government tries to hold its demand deposits at a relatively fixed level.[19] Nonetheless, it is worth exploring the implications of Policy 2 because it is the method of financing generally used in the short run by the Canadian authorities when international capital flow takes place.

If the reduction in the United States interest rate leads to an inflow into government or private marketable debt (cases a and b), then the use of Policy 2 leads to a decline in both Canadian interest rates and an increase in total private money holdings and in private domestic money holdings (although the total money supply and total bank assets are constant). The foreigners wish to purchase marketable debt and the authorities wish to run down their deposits. There is therefore an excess demand for bonds and an excess supply of money and both interest rates fall. Canadian residents have to intermediate between the foreigners' demand for bonds and the government's supply of deposits by reducing the marketable debt and increasing the deposits in their portfolio. The interest rate changes are the means whereby this shift in Canadian portfolios is induced. The reduction in Canadian interest rates reduces the size of the increase in international reserves in the new equilibrium.

If the foreigners wish to hold deposits (case c) then Policy 2 results in no change in interest rates since the government is supplying the same instrument as the foreigners are demanding. The total money supply and bank earning assets are unchanged but total private money holdings and private domestic money holdings rise.

As mentioned in the Introduction, it is somewhat puzzling why governments and central banks treat sterilization as such a significant problem when it appears to be a technical problem which is easily handled except in the case of infinite elasticity of capital movements with respect to interest rates or highly elastic speculative movements. Our analysis indicates, however, that even if the latter conditions do not exist,

capital flows may result in a policy dilemma for the authorities. Suppose that the central bank is concerned with stabilizing two targets - domestic interest rates and some variant of the money supply. Suppose first that the authorities wish to hold constant the total money supply. (including government deposits) or total bank assets. The choice of the latter aggregate may be based on the crucial role of bank loans in driving the real sector, a point which will recur later in the discussion. Policy 1 is successful in achieving both targets if the inflow is to government debt (in which case both Canadian interest rates are unchanged) or if the inflow is to private debt (in which case the average of the Canadian rates does not change very much). On the other hand, if the inflow is to deposits then Policy 1 results in increases in the two Canadian interest rates although the total money supply remains unchanged. If Policy 2 is used, interest rates will fall if capital inflows are to marketable debt. If capital flows are to deposits then interest rates are unchanged under Policy 2. The total money supply is unchanged under Policy 2 regardless of the destination of the capital flow.

The optimal policy thus appears to be the following. Use Policy 1 if capital flows are to marketable debt and Policy 2 if capital flows are to deposits. Such a policy leaves the average of domestic interest rates unchanged or almost unchanged and leaves the total money supply constant. We thus have the interesting result that a single instrument (method of financing international reserves) can be used to achieve two targets (constant money supply and constant interest rates) but that the choice of instrument must be suited to the destination of the capital

flows. It should also be noted that in the case of an inflow to deposits, the use of Policy 2 leads to an increase in private money holdings and possibly also to an increase in private domestic money holdings.

Unfortunately, many countries are not in a position to use Policy 2 because their holdings of deposits at the chartered banks are either small or zero. In such a case the inflow to deposits leads to a serious dilemma. If Policy 1 is used domestic interest rates will rise and may rise substantially if domestic holdings of government debt are not very interest-elastic (as is claimed in some European countries). If Policy 3 is used, the central bank allows the chartered banks to expand in order to supply the new deposits being demanded.[20] As can be seen in Table 1, the use of Policy 3 leads to an increase in the total money supply and private money holdings equal to the capital inflow into deposits. Domestic money holdings may also go up if some of the shift from United States instruments to Canadian deposits is by Canadian residents. What is most important in this case is that bank earning assets increase by $(1 - \rho)$ times the capital inflow, where ρ is the required reserve ratio on deposits. That is, the increase in earning assets is equal to the increase in deposits less the increase in required reserves. Generally, such an increase in bank assets will lead to an increase in bank loans in the real world (equivalent to a purchase of private bonds in our model). Since central banks treat the amount of business loans as a key variable in the linkage between monetary actions and the real sector,[21] this expansion of business loans may be viewed as a disturbing factor. Thus in the case of a capital flow into deposits, the option between Policy 1 and Policy 3 turns out to be an option between higher interest rates and increased bank loans, neither

of which may be desirable. Insulation of the domestic economy from external influences may therefore not be possible in all cases and central banks may be forced to choose between losing control over interest rates and losing control over the size of the banking system and the magnitude of bank loans. It is this dilemma which may be at the heart of the complaints by central banks about the difficulties of dealing with capital inflows.

As a partial solution to this dilemma, the monetary authorities can turn to Policy 4, which imposes a marginal reserve ratio of 100 percent on foreign deposits.[22] The central bank allows the banks to expand their deposits by the amount of the capital inflow into deposits. The funds from the new deposits by foreigners are then impounded by the central bank via the marginal 100 percent reserve ratio. In effect this policy forces the banks to purchase government or central bank debt with the funds made available by the increase in deposits.

As can be seen in Table 1 Policy 4 works perfectly if the entire inflow to deposits is by foreigners. In that case interest rates are unchanged and bank loans and private domestic money holdings are unchanged. However, if some of the capital inflow to deposits involves shifts by residents of Canada from United States assets to Canadian bank deposits, then even Policy 4 fails to insulate the domestic economy completely since only the conventional reserve ratio, ρ, is imposed on deposits by residents. Hence the banks are able to expand their loans to the extent that the increase in deposits is by residents. We conclude therefore that the case of inflow to deposits provides a dilemma to authorities who are concerned both with interest rates and bank lending capacity

except in the case in which all the inflow is by foreigners. In that case Policy 4 is optimal. However, if differential reserve ratios on foreign-owned and domestically-owned bank deposits are not possible and if Policy 2 is not available, the inflow into deposits results in either increased interest rates (Policy 1) or increased money supply and bank assets (Policy 3). There is then no way of achieving both constant interest rates and constant bank assets.

Now suppose, instead, that the authorities are trying to follow a Friedman-type policy of constant growth in a monetary aggregate. The question immediately arises as to which monetary aggregate is appropriate and which type of government policy should be followed when foreigners hold deposits at domestic banks.[23] Since the rule clearly aims at some variant of private money holdings, Policy 2 is ruled out since it always results in changes in private money holdings, although the total money supply is unchanged. If the appropriate target of policy is total private money holdings, then Policy 1, complete sterilization, should always be used since it prevents the capital flow from affecting total private money holdings. If the appropriate target is domestic money holdings, then Policy 1 should be used in the case of inflows to marketable debt and Policy 3 or Policy 4 should be used to deal with shifts by foreigners to deposits. Desired shifts by residents from foreign assets to deposits must be offset by Policy 1 if domestic money holdings are to remain unchanged. Thus the policy to insulate private domestic money holdings from the effects of international capital flows is as follows - (i) sterilize all inflows into marketable debt and all desired inflows into deposits by residents by Policy 1; (ii) allow desired inflows into

deposits by foreigners to take place. Under this policy the total money supply and private money holdings will increase but private domestic money holdings will be unchanged. Bank loans will increase if Policy 3 is used but not if Policy 4 is used (100 percent reserves on the margin). Finally, domestic interest rates will increase because the central bank does not allow the increased demand for money by residents to be validated.

Friedman's own policy prescription which focuses on private money holdings excluding certificates of deposit will lessen the kinds of problems discussed since most shifts of funds by residents and foreigners will be into certificates of deposit and therefore will leave Friedman's preferred aggregate unaffected. However, since Friedman's preferred aggregate makes no distinction between foreign and domestic deposits, changes in holdings at commercial banks (except for certificates of deposit) by foreign monetary authorities and private foreigners may change the rate of growth of the monetary aggregate or require some offset.

The distinction between private money holdings (M_2) and private domestic money holdings (M_2 minus foreign holdings) can be a significant one in the case of the United States. For example, the rates of growth in seasonally unadjusted M_2 in 1970 and 1971 were 8.3 percent and 11.3 percent respectively. The corresponding figures for domestic private money holdings were 10.5 percent and 13.4 percent. Thus the rates of growth of domestic private money holdings were over two percentage points above the rates of growth of M_2 for these two years.

Admittedly, the declines in foreign deposits in 1970 and 1971 were unusually large. Nonetheless, any government trying to achieve a constant rate of growth of the money aggregate will have to consider which monetary aggregate is the most appropriate target.

3. Effects of Capital Flows on the United States Economy

We now turn to an examination of the effects on the United States money supply and United States interest rates of international capital flows. Recall that the United States generally plays a passive role in the system since it is the central bank or government of the other country that builds up and runs down holdings of United States assets as capital flows move to and from that country. Thus it becomes important in this context to look at the form in which the foreign monetary authorities hold their United States assets. There are four principal United States assets held by foreign authorities:

(i) Marketable United States government debt.

(ii) Deposits at the Federal Reserve Bank.

(iii) Deposits at United States commercial banks.[24]

(iv) Nonmarketable United States government debt.[25]

In addition we will examine the case in which it is the United States government that intervenes in exchange markets by using its stock of foreign exchange to keep the United States dollar from moving through the intervention points.

In order to analyze the United States position, we expand the United States financial sector in our model. We now assume the existence of four United States assets - government debt, private debt, demand deposits, and time deposits. We further assume that the interest rate on time

deposits is fixed in the short run and that the reserve ratio on time deposits is equal to that on demand deposits. The Canadian financial sector in our model is contracted by consolidating private debt and government debt into one instrument. We further assume that the Canadian central bank sets an interest rate target and then uses open-market operations to attain that target.[26] The model is discussed in some detail in the Appendix.

In Table 2 we examine the effect of a decline in Canadian interest rates on a number of United States economic variables under various assumptions regarding the form in which Canadian authorities hold United States assets. It should be borne in mind that any autonomous shift into United States assets from Canadian assets yields the results set out in Table 2 as long as the Bank of Canada fixes the Canadian interest rate. Thus the results will also cover the case of the expected reflow of funds into the United States following the Smithsonian agreement. Note that for ease of exposition we again deal separately with inflows into different instruments.

It turns out that each case in this section of the paper gives identical results to a policy in Section 2. Thus, for example, if the Canadian authorities use marketable United States government debt as the form of reserves which they accumulate or decumulate, the effect on the United States is the same as the effect in Canada of Policy 1 (complete sterilization). This can easily be seen by examining the economics of the situation. No matter what the destination of the capital inflow to the United States, the Canadian authorities sell United States government debt to obtain the United States dollars needed to intervene in the ex-

Table 2

EFFECT OF A DECLINE IN CANADIAN INTEREST RATES

Foreign Authorities Hold	Interest Rate on United States Government Bonds	Interest Rate on Private United States Bonds	Total Money Supply (Including Government Deposits)	Private Money Holdings	Private Domestic Money Holdings	Bank Earning Assets
		(a) Inflow to Government Debt				
Marketable Debt	0	0	0	0	0	0
Deposits at Federal Reserve	-	-	+	+	+	+
Deposits at Banks	-	-	0	+	+	0
		(b) Inflow to Private Debt				
Marketable Debt	+	-	0	0	0	0
Deposits at Federal Reserve	-	-	+	+	+	+
Deposits at Banks	-	-	0	+	+	0
		(c) Inflow to Deposits				
Marketable Debt	+	+	0	0	-	0
Deposits at Federal Reserve	-	-	+	+	+	+
Deposits at Banks	0	0	0	+1	+	0

change markets. Thus the action of the Canadian authorities leads to an excess supply of United States government debt. The actions of private investors and borrowers lead to a corresponding demand for United States government debt (case a), an excess demand for private debt (case b), or an excess demand for money (case c). But this situation is precisely the same as that under Policy 1 in Canada in which government or central bank actions led to an excess supply of government debt and the actions of private investors and borrowers led to an excess demand for some Canadian asset. The results in the case of the authorities using marketable debt are therefore exactly the same as the results in Table 1 for Policy 1. In cases b and c we can think of the American public acting as an intermediary between the Canadian authorities (selling United States government debt) and the Canadian investors (desiring some other kind of United States asset).

The case in which the Bank of Canada uses its deposits at the Federal Reserve is equivalent to the case of no sterilization in Canada, a situation which we did not analyze earlier but which was mentioned in footnote 11. As can be seen, the decrease in the Bank of Canada's holdings at the Federal Reserve is very expansionary and leads to declines in United States interest rates and increases in the money supply, no matter what the destination of capital flows.

The use of deposits at commercial banks by the Canadian authorities is equivalent to Policy 2 in the Canadian case. In both cases, the actions of the authorities lead to an excess supply of deposits. If investors are shifting to marketable United States debt, there is an excess demand for marketable debt and an excess supply of deposits leading to declines

in interest rates. If investors are shifting to deposits there will be no change in interest rates since the supply of deposits by the Canadian authorities is exactly equal to the demand for deposits by investors.

In the three cases discussed thus far, we have seen that the United States situation corresponds exactly to a corresponding Canadian situation. However, there is a major difference between the Canadian and United States situations. In the Canadian situation, the Canadian authorities have the option of choosing a policy appropriate to the economic circumstances and thereby insulating the Canadian economy. In the American situation, it is the choice of the foreign authorities as to which reserve asset they are going to accumulate or decumulate. Thus the "policy" is being made by the foreign authorities and not by United States authorities. If the circumstances lead to undesirable results (e.g., a change in interest rates not appropriate to the economic situation), the Federal Reserve will have to carry out defensive operations. Clearly, in the case in which the foreign central bank reduces its deposit at the Federal Reserve Bank, the United States authorities will use open-market operations to offset the expansionary effects of the action. But if the foreign authorities run down their bank deposits when investors want to hold marketable debt, then the Federal Reserve cannot offset the effects completely although the United States Government could offset them by increasing its own deposits at commercial banks and issuing new debt. Similarly, if investors want deposits and the foreign authorities are running down their holdings of United States debt, the United States

authorities will be unable to offset the effects on the domestic economy unless the United States Government is willing to reduce its bank deposits and retire its debt. If the latter policy is not used, the Federal Reserve is faced with the option of higher interest rates or an increased money supply and increased bank loans. Thus the Federal Reserve will face the same dilemma in the case of an inflow into United States deposits as was faced by the Canadian authorities in the case of an inflow into Canadian deposits.

If the Canadian authorities reduce their nonmarketable United States government debt (by turning them into the Treasury) or if the United States itself intervenes in the foreign exchange market, then the United States situation becomes formally equivalent to the Canadian situation discussed above. For in the case of an increase in foreign exchange held by the United States, the authorities have to deal with the question of how to finance the net increase in reserves brought about by the capital inflow. And in the case of the redemption of the nonmarketable United States government debt by the Canadian authorities, the United States Government must either issue new debt or reduce its balances at commercial banks. In both cases, the question of government financing comes to the fore just as in the Canadian situation.

Based on the above analysis and certain institutional considerations, we can indicate the likely results for the reflow of funds to the United States. First, given their holdings of United States Government debt, it is likely that the central banks would sell or redeem United States debt as their international reserves declined. And if they redeemed non-

marketable debt it is likely that the United States Government would issue new debt to finance the redemption. It is less clear what the destination of funds would be. It is likely that most of the returning funds would be assets held by American residents in the Eurodollar market. Some of the funds, however, would be shifts by Europeans to United States instruments. It is very likely that some substantial portion of the inflow would be into certificates of deposit. Hence the rate on government debt would increase and the rate of private debt would probably increase. If the Federal Reserve acted to offset these increases, the money supply and private domestic money holdings would have to increase.[27]

APPENDIX

In this appendix we set out the model underlying the discussion in the text. In Table A1 we summarize the holdings of financial claims by different transactors in the system of Section 2. The notation used is as follows:

G - Government of Canada Canadian dollar bonds

P - Canadian dollar bonds other than those issued by the Government of Canada

Q - United States dollar bonds

M - Canadian dollar demand deposits

T - Canadian dollar time deposits

N - United States dollar deposits

A - Bank of Canada

B - Canadian chartered banks

C - Canadian wealth owners

E - Canadian private borrowers

H - Government of Canada

J - Federal Reserve

K - United States banks

F - United States wealth owners, government, and private borrowers

R - Deposits at Bank of Canada

U - Deposits at Federal Reserve

D - Demand

S - Supply

W - Wealth

V - Debt

ρ - Reserve ratio on demand deposits and time deposits in Canada

η - Reserve ratio on deposits in United States

Thus, for example, T_C^D is the demand for time deposits at Canadian banks by Canadian wealth owners. In Table A1 a positive item denotes an asset of the transactor and a negative item denotes a liability. The columns of Table A1 give us the balance sheets of the transactors in the system, and the sum of financial assets or liabilities for each class of transactors is shown in the bottom row of the table. The rows in the table are either market clearing equations or identities and the sum of the variables in each row is shown in the column on the right.

We can now write out the equations for market clearing for each of the financial instruments in which market clearing occurs - G, P, Q, M, N.

$$G_C^D + G_B^D + G_A^D + G_F^D = G_H^S \tag{1}$$

$$P_C^D + P_B^D + P_F^D = P_E^S \tag{2}$$

$$Q_C^D + Q_H^D + Q_A^D + Q_F^D + Q_K^D + Q_J^D = Q_E^S + Q_F^S \tag{3}$$

$$M_C^D + M_H^D + M_F^D = M_B^S \tag{4}$$

$$N_C^D + N_F^D = N_K^S \tag{5}$$

Table A1

HOLDINGS OF FINANCIAL CLAIMS

Transactor / Financial Claim	Canadian Nonbank Lender	Government of Canada	Canadian Private Borrowers	Canadian Banks	Bank of Canada	United States Nonbanks	United States Banks	Federal Reserve	Sum
Government of Canada Bonds	G_C^D	$-G_H^S$	---	G_B^D	G_A^D	G_F^D	---	---	0
Other Canadian Dollar Bonds	P_C^D	---	$-P_E^S$	P_B^D	---	P_F^D	---	---	0
United States Dollar Bonds	Q_C^D	Q_H^D	$-Q_E^S$	---	Q_A^D	$Q_F^D - Q_F^S$	Q_K^D	Q_J^D	0
Canadian Dollar Demand Deposits	M_C^D	M_H^D	---	$-M_B^S$	---	M_F^D	---	---	0
Canadian Dollar Time Deposits	T_C^D	---	---	$-T_B^S$	---	T_F^D	---	---	0
United States Dollar Deposits	N_C^D	---	---	---	---	N_F^D	$-N_K^S$	---	0
Deposits at Bank of Canada	---	R_H	---	R_B	$-R_B - R_H$	---	---	---	0
Deposits at Federal Reserve	---	---	---	---	U_A	---	U_K	$-U_A - U_K$	0
Sum	W_C	$-V_H$	$-V_E$	0	0	$W_F - V_F$	0	0	0

We also have the following identities and technical relationships.

$$G_C^D + P_C^D + Q_C^D + M_C^D + T_C^D + N_C^D \equiv W_C \quad \text{(wealth owners in Canada)} \quad (6)$$

$$G_F^D + P_F^D + Q_F^D + M_F^D + T_F^D + N_F^D \equiv W_F \quad \text{(wealth owners in U. S.)} \quad (7)$$

$$P_E^S + Q_E^S \equiv V_E \quad \text{(private borrowers in Canada)} \quad (8)$$

$$G_H^S - Q_H^D - M_H^D - R_H \equiv V_H \quad \text{(Government of Canada)} \quad (9)$$

$$Q_F^S \equiv V_F \quad \text{(private borrowers and government in U. S.)} \quad (10)$$

$$G_B^D + P_B^D + R_B \equiv M_B^S + T_B^S \quad \text{(Canadian banks)} \quad (11)$$

$$Q_K^D + U_K \equiv N_K^S \quad \text{(U. S. banks)} \quad (12)$$

$$G_A^D + Q_A^D + U_A \equiv R_B + R_H \quad \text{(Bank of Canada)} \quad (13)$$

$$Q_J^D \equiv U_A + U_K \quad \text{(Federal Reserve)} \quad (14)$$

$$T_C^D + T_F^D \equiv T_B^S \quad \text{(time deposits identity)} \quad (15)$$

$$R_B \equiv \rho\, M_B^S + \rho\, T_B^S \quad \text{(Canadian bank reserves)} \quad (16)$$

$$U_K \equiv \eta\, N_K^S \quad \text{(U. S. bank reserves)} \quad (17)$$

Equations (6) to (14) are the balance sheet identities for the various transactors in the system. Equation (15) states that the Canadian banks stand ready to supply all time deposits demanded by wealth owners at the current rate on time deposits. Equations (16) and (17) relate the reserves held by the banks to their deposit liabilities and the reserve ratios.[38]

Substituting from equations (6) to (17) into equations (1) to (5) we get the following market clearing equations.

$$G_C^D + b\left(\frac{1}{\rho} - 1\right)(G_A^D + Q_A^D + U_A - R_H) + G_A^D + G_F^D - G_H^S = 0 \tag{18}$$

$$P_C^D + (1 - b)\left(\frac{1}{\rho} - 1\right)(G_A^D + Q_A^D + U_A - R_H) + P_F^D - P_E^S = 0 \tag{19}$$

$$Q_C^D + Q_H^D + Q_A^D + Q_F^D + \left(\frac{1}{\eta} - 1\right)(Q_J^D - U_A) + Q_J^D - Q_E^S - Q_F^S = 0 \tag{20}$$

$$M_C^D + M_H^D + M_F^D + T_C^D + T_F^D - \frac{1}{\rho}(G_A^D + Q_A^D + U_A - R_H) = 0 \tag{21}$$

$$N_C^D + N_F^D - \frac{1}{\eta}(Q_J^D - U_A) = 0 \tag{22}$$

In (18) and (19), b is the fraction of earning assets of the banks which is invested in Government of Canada bonds and $(1 - b)$ is the fraction invested in private Canadian dollar debt. As we shall see, b is a function of the interest rates in the system.

We now have five equations of which only four are independent because of the balance sheet constraints. There are four variables in the system - r_G, r_P, r_Q, and $(Q_A^D + Q_H^D + U_A)$. The first three are the interest rates on Government of Canada bonds, private Canadian dollar bonds and United States dollar bonds. The fourth variable is the amount of international reserves held by the Canadian authorities (central bank and government). We can therefore solve any four of the five equations, say (18) to (21), for the four variables of the system. If we argue that the United States interest rate is set by the Federal Reserve we can treat r_Q as a parameter of the system and Q_J^D, the holdings of United States bonds by the Federal Reserve, as a variable. This change dichotomizes the system into two subsystems. We can use equations (18), (19), and (21) to solve for r_G, r_P and $(Q_A^D + Q_H^D + U_A)$ since Q_J^D does not enter these equations. Then (20) can be used to solve for Q_J.

Since we are not interested in Q_J^D at this stage of our analysis we will therefore treat our system as one of three equations in three unknowns.

As indicated in the text, the signs of the partial derivatives of the asset demand and liability supply functions are determined by the assumption of weak gross substitutability. Hence an increase in its own rate of interest increases the quantity demanded of a given asset and an increase in another rate of interest reduces or leaves unchanged the quantity demanded of the given asset. Similarly an increase in the rate of interest on a given liability reduces the amount supplied of that liability and an increase in another rate of interest increases or leaves unchanged the amount supplied of that liability. Furthermore, the balance sheet constraint requires that the changes in the assets or liabilities of a transactor consequent upon a change in any interest rate sum to zero. Finally, the banks increase the fraction of their holdings of earning assets in government (private) bonds when the rate on government (private) bonds increases. That is,

$$\frac{\partial b}{\partial r_G} > 0 \ , \quad \frac{\partial b}{\partial r_P} < 0 \ .$$

We now treat formally the various policies of the government and central bank.

(1) The Government of Canada issues new debt to finance international reserve increases and retires outstanding debt with the proceeds of reserve decreases.

$$\frac{dQ_H^D}{d\lambda} = \frac{dG_H^S}{d\lambda} \tag{23}$$

where λ is an arbitrary shift variable. Alternatively, the Bank of

Canada conducts open-market sales to offset the effect of the change in international reserves on bank reserves

$$\frac{dQ_A^D}{d\lambda} + \frac{dG_A^D}{d\lambda} = 0 \quad . \tag{24}$$

To see the equivalence of these two policies, we note that if we differentiate the system of equations with respect to λ, we get the same result if we treat Q_H^D as a variable and impose the restriction in equation (23) or if we treat Q_A^D as a variable and impose the restriction in equation (24).

(2) The government uses its deposits at the chartered banks. This policy can be expressed as

$$\frac{dQ_H^D}{d\lambda} + \frac{dM_H^D}{d\lambda} = 0 \quad . \tag{25}$$

(3) The central bank allows the banks to increase their deposits by the amount of the inflow into deposits. Bank reserves must therefore increase by ρ times the amount of the inflow into deposits. Therefore central bank holdings of government debt must fall by $(1 - \rho)$ times the amount of the inflow into deposits. Thus we have

$$\frac{dG_A^D}{d\lambda} = - (1 - \rho) \frac{dQ_A^D}{d\lambda} \tag{26}$$

for case c in which capital flows only into deposits.

(4) The central bank allows the banks to increase their deposits by the amount of the inflow into deposits. A marginal reserve ratio of 100 percent is imposed on deposits by foreigners. This policy can be handled formally in a number of ways. We can either create a new central bank liability which must be held against foreign deposits. Or the banks can be forced to purchase government debt on the margin to back these

foreign deposits. Or we can rewrite our reserve requirements equation to take into account the differential reserve. If we use the latter approach, equation (16) becomes

$$R_B = \rho\ M_B^S + \rho\ T_B^S + (1 - \rho)[M_F^D + T_F^D] \qquad (16')$$

and in the case of an inflow into deposits the Bank of Canada open-market sales become

$$\frac{dG_A^D}{d\lambda} = -\ (1 - \rho)\ \frac{dQ_A^D}{d\lambda} + (1 - \rho)\left(\frac{dM_F^D}{d\lambda} + \frac{dT_F^D}{d\lambda}\right). \qquad (27)$$

If all the inflow into deposits is by foreigners then the Bank of Canada does not have to carry out any open-market operations since the increase in bank reserves is exactly equal to the increase in required reserves because of the 100 percent reserve ratio. If the entire inflow into deposits is by domestic residents then this policy is exactly the same as policy (3) discussed above. If some of the inflow is by foreigners and some by domestic residents, then there is an open-market sale corresponding to $(1 - \rho)$ times the inflow involving domestic residents.

As discussed at length in the text the destination of the inflow proved to be of crucial importance. We examine three cases. When we say that the inflow is entirely to government debt we mean that the following conditions hold - G_C^D, G_F^D, Q_C^D, and Q_F^D are all responsive to a change in λ (a reduction in the United States interest rate, r_Q) and P_C^D, P_F^D, P_E^S, M_C^D, T_C^D, M_F^D, T_F^D, Q_E^S are not responsive to change in λ (i.e., their partial derivatives with respect to λ are zero). Similarly when we say that the inflow is entirely to private debt, we mean that P_C^D, P_F^D, P_E^S, Q_C^D, Q_F^D, Q_E^S are influenced by the

change in λ and the rest of the variables are not. Finally when we say that the inflow is entirely to deposits, we mean that M_C^D, M_F^D, T_C^D, T_F^D, Q_C^D and Q_F^D are affected by the change in λ and the rest of the variables are not.[29]

Now we can differentiate the system of equations with respect to a change in λ. The policy under consideration enters the solution since one of constraints (24) to (27) is imposed on the model. The discussion in the text derives from the solution of the system for each policy used. For expository purposes, we treated separately the different destinations of the capital inflow but, of course, a general statement can be made regarding the effect of contemporaneous shifts into government debt, private debt, and deposits.

The model in Section 3 expands the role of the United States financial sector and contracts that of the Canadian financial sector. The two types of Canadian bonds are consolidated into one and United States dollar bonds are divided into two kinds, government and private. The Canadian central bank is now assumed to set the Canadian interest rate and to hold it at the target level. The "policies" under consideration now hinge on which United States dollar instrument the Canadian authorites run down when there is a capital flow from Canada to the United States. We examine the following possibilities - United States treasury bills, deposits at the Federal Reserve, and deposits at commercial banks. There are two further possibilities to be considered, the case in which the Canadian government redeems a nonmarketable bond at the Treasury, and the case in which the United States uses its stock

of foreign exchange to intervene in the market. For each case, the model can be solved to determine the effects of capital flows on interest rates and the money supply. Once again, the destination of the capital flow plays a crucial role in the discussion.

FOOTNOTES

1. Note that although the United States dollar is generally used as the currency of intervention, this does not imply that reserves be held in this form except for working balances. Provided that gold and the dollar are interchangeable, reserves may be held in gold or dollars. Indeed any asset may be held as a reserve as long as it is easy to shift back and forth between it and the intervention currency.

2. This statement holds true whether the international reserves are held by the government directly or by an exchange fund created for the purpose of holding the reserves, or by the central bank. The equivalence will be shown in the model developed in Section 2, and in the Appendix .

3. In the real world this category would include provincial and municipal bonds in addition to corporate bonds.

4. The latter assumption can be relaxed if desired to allow issue of debt in Canada by United States borrowers.

5. Since the analysis is set in the short run, this assumption is reasonable.

6. The relaxation of this assumption complicates the analysis substantially but changes very few of the substantive conclusions.

7. The latter can be treated as equivalent to bank loans to private borrowers at a rate determined by the market rate for private bonds.

8. Note that we have consolidated the balance sheet of the Exchange Fund with that of the government. There is no economic significance to the existence of a separate Exchange Fund which holds United States dollar assets and has a corresponding liability to the government.

9. The mathematics of the different government policies are spelled out in the Appendix. For textbook treatments of sterilization see Kindleberger [4, Chapter 19] or Caves and Jones [3, page 331].

10. See Kindleberger [4, page 355].

11. Two other policies which we do not discuss are the do-nothing policy and the constant interest rate policy. In the former, bank reserves increase (decrease) by the full amount of any capital inflow (outflow); hence a multiple expansion of deposits results from a capital inflow and a multiple contraction of deposits results from a capital outflow. Under the constant interest rate policy the central bank sets the interest rate on government debt and the central bank holdings of government debt become a variable of the system.

12. The initial change is brought about by Federal Reserve open-market purchases of bonds. As a result of the initial change, there is a shift of assets to Canada which would tend to increase the United States interest rate. This tendency is offset by further Federal Reserve open-market purchases which hold the United States interest rate at its desired level.

13. Because of the assumption that reserve ratios are the same on demand deposits and time deposits, we do not need to distinguish between the two types of deposit.

14. Although our discussion is couched in terms of the purchase of financial instruments by foreigners we get precisely the same results if it is residents who are shifting from foreign to domestic assets. An exception to this statement occurs in the case of Policy 4 in which different marginal reserve ratios are applied to deposits depending on the nationality of the holder.

15. In the reverse situation when the authorities are short of foreign exchange, they will not be able to hold the exchange rate constant when a capital outflow occurs unless they are willing to borrow on their own account in the United States.

16. Mundell [8] has analyzed this case in the context of a flow model. The impossibility of sterilization carries over to a stock model.

17. Marsh [5, page 263].

18. There are two cases in which an explosive spiral can occur. First, if the demand for Canadian bonds is a function of interest rates and the magnitude of Canadian reserves, the latter being a form of speculative demand, it will be the case that interest-induced capital inflows lead to increased reserves which lead to speculative inflows. If the latter are sufficiently large, the result can be explosive. A second situation in which instability can occur is that in which the rate on time deposits is tied to

the rate on government bonds and certain crucial elasticities are sufficiently large.

19. In the longer run excess deposits are used to retire debt and a shortage of deposits leads to debt issue. Thus even if the government uses Policy 2 in the short run, it switches to Policy 1 in the longer run.

20. This policy is discussed in Kindleberger [4, page 355]. The central bank must supply new bank reserves equal to the reserve ratio on deposits times the increase in deposits. This is called "trimming" in the Kindleberger text.

21. For discussions of the importance of bank loans see [10, 7, 11, page 467, and 2].

22. For a discussion of the actual policies adopted in Germany, Japan, and Switzerland see Mills [6, pages 8-16]. Note that the central bank may pay no interest, below-market rates of interest, or market rates of interest on these reserves. The latter policy would be equivalent to requiring the banks to purchase nonmarketable government debt bearing the same rate of interest as market issues with the proceeds of the increase in deposits. That is, the foreign deposits would bear a secondary reserve ratio of $(1 - \rho)$, and the only eligible assets would be special nonmarketable government debt. For analyses of the success or lack of success of the German authorities in sterilizing capital inflows see Willms [12] and Porter [9].

23. Although our model is a static model, we can treat the question of growth by pretending that the capital inflow occurs in a situation of constant predetermined growth of some aggregate and that the authorities act to prevent the inflow from disturbing the growth path.

24. In fact, foreign monetary authorities hold both demand deposits and time deposits at United States commercial banks. For simplicity of exposition we aggregate all deposits into one class but the results are similar (although not precisely the same) when we disaggregate deposits into two classes.

25. As of December 31, 1972 the allocation of holdings in the United States by foreign monetary authorities was as follows (in millions of United States dollars):

United States Government debt	52,696	(86.0%)
Deposits at Federal Reserve	325	(0.5%)
Deposits at commercial banks	7,997	(13.0%)
Others	265	(0.4%)
Total	61,284	(100.0%)

At least $15.7 billion (26%) and perhaps substantially more of the government debt is nonmarketable. The deposits at commercial banks are overstated by holdings of bankers' acceptances and commercial paper. (Source: Federal Reserve Bulletin, February 1973.)

As of December 31, 1971, 0.8% of Canadian Exchange Fund holdings in the United States were in the form of bank deposits, 20.5% were in treasury bills, 75.0% were in nonmarketable United States treasury notes, and 3.6% were in the form of other investments. (Source: Bank of Canada Review, June 1972.)

26. The consolidation of private and government debt and the assumption of an interest rate target in Canada allows us to dichotomize the system once again, thereby simplifying the mathematics without changing the results substantively.

27. For a different view, see Balbach [1].

28. It would be simple to introduce excess reserves and borrowed reserves to the system but the qualitative results would be uneffected by this change.

29. It does not affect the final result if we allow N_C^D and N_F^D to be affected by a change in λ .

LITERATURE CITED

[1] Balbach, Anatol. "Will Capital Reflows Induce Domestic Interest Rate Changes?" Federal Reserve Bank of St. Louis, Review (July, 1972), 2-5.

[2] Board of Governors of the Federal Reserve System. Federal Reserve Bulletin (September, 1966), 1338-1339.

[3] Caves, Richard E. and Ronald W. Jones. World Trade and Payments, An Introduction. Boston: Little, Brown and Company, 1973.

[4] Kindleberger, Charles P. International Economics, Fourth Edition. Homewood, Illinois: Richard D. Irwin, Inc., 1968.

[5] Marsh, Donald B. "Johnson's Tour of the Northern Dominion." Canadian Journal of Economics and Political Science, 30 (May, 1964), 258-265.

[6] Mills, Rodney H., Jr. "The Regulation of Short-Term Capital Movements in Industrial Countries." Board of Governors of the Federal Reserve System, Staff Economic Studies, No. 74 (October, 1972).

[7] Minsky, Hyman P. "Comment." The Review of Economics and Statistics, 45 (Supplement: February, 1963), 64-72.

[8] Mundell, R. A. "Capital Mobility and Stabilization Policy Under Fixed and Flexible Exchange Rates." Canadian Journal of Economics and Political Science, 29 (November, 1963), 475-485.

[9] Porter, Michael G. "Capital Flows as an Offset to Monetary Policy: The German Experience." International Monetary Fund, Staff Papers, XIX (July, 1972), 395-424.

[10] Smith, Warren L. "On the Effectiveness of Monetary Policy." American Economic Review, 46 (September, 1956), 588-606.

[11] Tobin, James. "The Monetary Interpretation of History." American Economic Review, 55 (June, 1965), 464-485.

[12] Willms, Manfred. "Controlling Money in an Open Economy: The German Case." Federal Reserve Bank of St. Louis, Review (April, 1971), 10-27.

DISCUSSION PAPER SERIES

71-1	A Subordinated Stochastic Process Model with Finite Variance for Speculative Prices	Peter King Clark
71-2	A Note on Approximate Regression Disturbances	Clifford Hildreth
71-3	Induced Innovation in Agricultural Development	Yujiro Hayami and Vernon W. Ruttan
71-4	Wage Structures in Latin America	Peter Gregory
71-5	Optimization and Scale Economies in Urban Bus Transportation	Herbert Mohring
71-6	An Approach to the Study of Money and Nonmoney Exchange Structures	Neil Wallace
71-7	Coalitions, Core, and Competition	Marcel K. Richter
71-8	Instantaneous and Non-Instantaneous Adjustment to Equilibrium in Two-Sector Growth Models	Antonio Bosch Andreu Mas-Colell Assaf Razin
71-9	A Static Nonstationary Analysis of the Interaction between Monetary and Fiscal Policy	Neil Wallace
71-10	Are There Exogenous Variables in Short-Run Production Relations?	Christopher A. Sims
71-11	An Adjusted Maximum Likelihood Estimator of Autocorrelation in Disturbances	Clifford Hildreth Warren T. Dent
71-12	Wage Fund, Technical Progress and Economic Growth	Hukukane Nikaido
71-13	The Economics of Malnourished Children: A Study of Disinvestment in Human Capital	Marcelo Selowsky Lance Taylor
72-14	Industrial Capacity Utilization in Colombia: Some Empirical Findings	Francisco E. Thoumi
72-15	Monopolistic Competition, Objective Demand Functions and the Marxian Labor Value in the Leontief System	Hukukane Nikaido
72-16	The Stability of Models of Money and Growth with Perfect Foresight	Thomas J. Sargent Neil Wallace
72-17	Consumerism: Origin and Research Implications	E. Scott Maynes

72-18	Income and Substitution Effects in Labor Force Participation and Hours of Work	H. Gregg Lewis
72-19	On Investment in Human Capital Under Uncertainty	Assaf Razin
72-20	Ventures, Bets and Initial Prospects (Revised)*	Clifford Hildreth
72-21	A Competitive Market Model for "Futures" Price Determination	Peter King Clark
72-22	Rational Expectations and the Dynamics of Hyperinflation	Thomas J. Sargent Neil Wallace
72-23	Seasonality in Regression	Christopher A. Sims
72-24	The Impact of the Wage-Price Freeze on Relative Shares: A Test of Short-Run Market Expectations	Sol S. Shalit Uri Ben-Zion
73-25	A Model of the Eurodollar Market	Charles Freedman
73-26	A Note on Exact Tests for Serial Correlation	Christopher A. Sims
73-27	The Cost of Capital and the Demand for Money by Firms	Uri Ben-Zion
73-28	Distributed Lags	Christopher A. Sims
73-29	Economic Factors Affecting Population Growth: A Preliminary Survey of Economic Analyses of Fertility	T. Paul Schultz
73-30	A Note on the Elasticity of Derived Demand under Decreasing Returns	Assaf Razin
73-31	The Use of Operational Time to Correct for Sampling Interval Misspecification	Peter K. Clark
73-32	International Capital Flows, Interest Rates, and the Money Supply	Charles Freedman

* Revised March 1973

Center for Economic Research
University of Minnesota