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The Foreign Currency Business of the Canadian Banks: An Econometric Study

Charles Freedman

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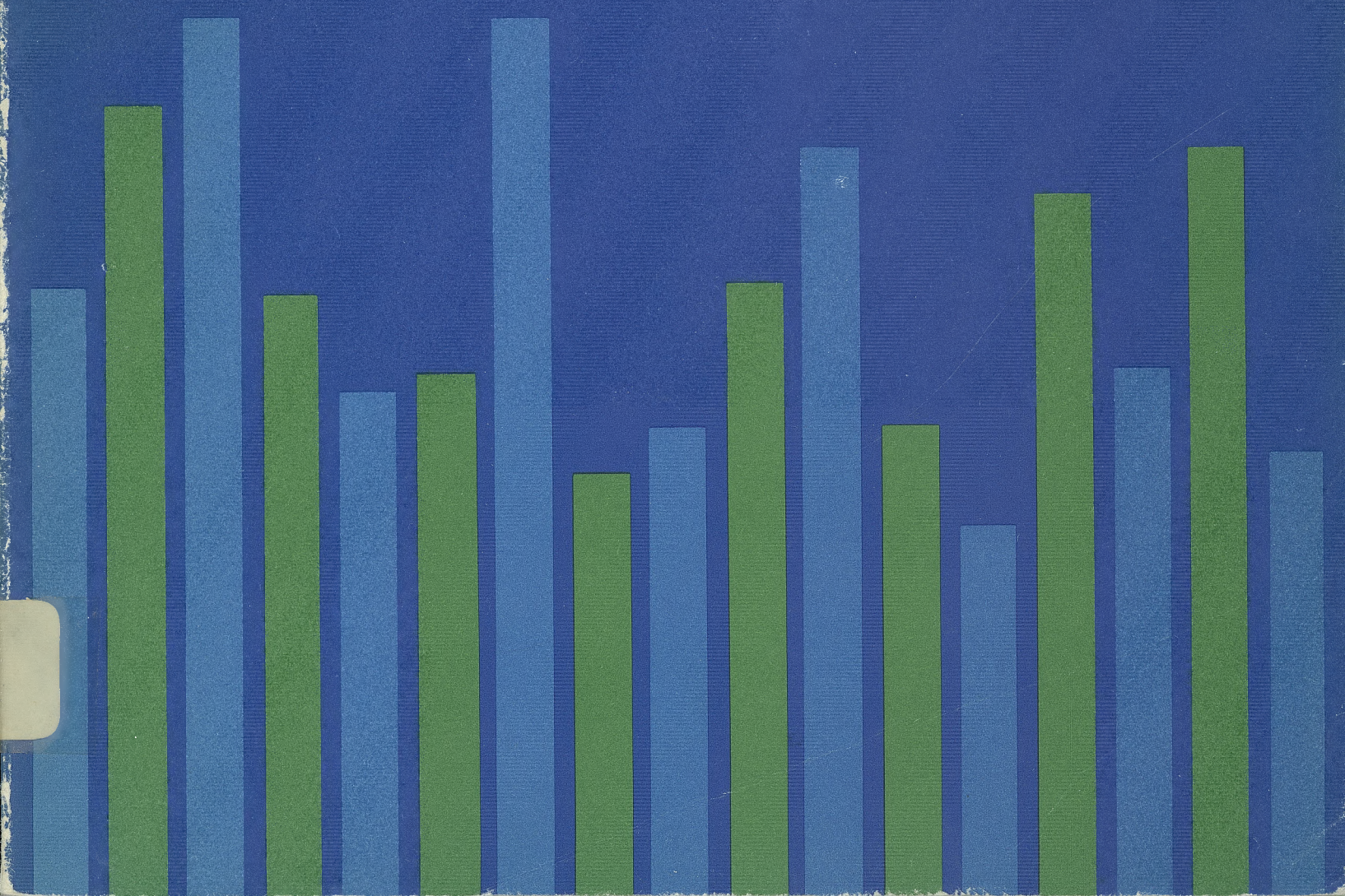

THE FOREIGN CURRENCY BUSINESS OF THE CANADIAN BANKS: AN ECONOMETRIC STUDY

by

Charles Freedman

ISSUED BY THE PUBLICATIONS COMMITTEE OF THE BANK OF CANADA

This study was prepared as part of the econometric research programme of the Bank of Canada. The views expressed are those of the author and no responsibility for them should be attributed to the Bank.

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Charles Freedman
Bank of Canada

AVANT-PROPOS

Les avoirs et engagements en devises étrangères des banques à charte canadiennes ont enregistré une croissance rapide au cours des années soixante et représentent actuellement une proportion considérable de l'ensemble de leurs bilans. Dans cette étude, j'analyse les facteurs fondamentaux de cette croissance ainsi que certaines incidences des opérations en devises étrangères de ces institutions sur la politique monétaire au Canada et la balance canadienne des paiements. J'étudie également le rôle que jouent les banques à charte en leur qualité de participants au marché de l'eurodollar ou de circuit que peuvent éventuellement emprunter les fonds qui se déplacent entre les États-Unis et le marché de l'eurodollar.

Le montant des avoirs et engagements en devises des banques à charte est déterminé au moyen d'un processus complexe, qui traduit l'interdépendance existant entre les déposants, les emprunteurs et les banques elles-mêmes. J'examine en détail le comportement de chacune de ces catégories d'agents économiques. Les taux d'intérêt offerts par les banques pour les dépôts en monnaies étrangères sont établis à partir des taux d'intérêt versés aux investisseurs sur d'autres instruments financiers comparables et des taux de rendement que les banques peuvent obtenir de leurs placements. C'est à la lumière des taux d'intérêt des dépôts en monnaies étrangères et de ceux des autres instruments financiers disponibles sur le marché que les déposants fixent le volume de dépôts en devises qu'ils désirent détenir. Les banques semblent déterminer le montant de leurs avoirs nets en devises en tenant compte du loyer de l'argent en vigueur aux États-Unis et au Canada, de l'orientation de la politique monétaire canadienne et de l'encours des dépôts-swaps.

Quant au montant des prêts bancaires en devises, il est fondamentalement fonction de la demande, elle-même influencée par les taux d'intérêt relatifs et par le degré de difficulté qu'éprouvent les emprunteurs à recourir à d'autres sources de financement. Les avoirs liquides en devises des banques à charte sont répartis en dépôts, en prêts à vue et en titres. Une attention particulière est accordée, à toutes les étapes de l'étude, à l'incidence de certaines directives officielles sur les différentes équations de comportement.

Dans le dernier chapitre, j'essaie de rechercher les conséquences des opérations en devises étrangères des banques à charte. Les variations des taux d'intérêt au Canada par rapport aux taux à l'étranger donnent lieu, par le biais de ces opérations, à des entrées et à des sorties considérables de capitaux. La possibilité qu'ont les banques de varier leur position nette en devises leur permet de réagir avec encore plus de souplesse à la politique de gestion des réserves-encaisse de l'institut d'émission. Avant l'adoption des directives, les banques canadiennes constituaient entre les États-Unis et le marché de l'eurodollar un circuit qu'empruntait un volume substantiel de capitaux, en réponse à des variations relatives des taux d'intérêt. Disons en résumé que les opérations affectant les avoirs et engagements en devises des banques à charte jouent un rôle non négligeable dans le fonctionnement du système financier canadien et illustrent en partie les liens existant à l'échelle internationale entre le Canada, les États-Unis et le reste du monde.

ABSTRACT

The foreign currency assets and liabilities of the Canadian chartered banks grew rapidly over the 1960s and now account for a substantial share of their total assets and liabilities. In this study I analyze the forces underlying this growth as well as some of the implications for Canadian monetary policy and for the Canadian balance of payments of transactions in these assets and liabilities. I also examine the role of the chartered banks as participants in the Euro-dollar market and as a possible conduit for funds between the United States and the Euro-dollar market.

A complex process determines the quantities of chartered bank foreign currency assets and liabilities outstanding. The process reflects interaction among depositors, borrowers, and the banks themselves. I examine in detail the behaviour of each of these groups. Interest rates offered by the banks on foreign currency deposits are set on the basis of the rates obtainable by investors on competing financial instruments and the rates the banks can earn on assets in which they invest. Given the interest rates on foreign currency deposits and those on competing financial instruments, depositors decide what quantity of such deposits they wish to hold. The banks appear to determine the size of their net foreign asset positions on the basis of interest rates in the United States and Canada, the stance of Canadian monetary policy, and the amount of swapped deposits outstanding. Chartered bank foreign currency loans are primarily a function of the borrowers' demand for funds. This demand is influenced by relative interest rates and by the degree of difficulty encountered in obtaining loans elsewhere.

Chartered bank foreign currency liquid assets are allocated among deposits, call loans, and securities. Throughout this study careful attention is paid to the effect of certain official guidelines on the various behavioural relationships.

In the concluding chapter I attempt to evaluate the significance of chartered bank transactions in foreign currency assets and liabilities. Changes in Canadian interest rates relative to rates abroad give rise to substantial capital outflows and inflows via these transactions. The scope for varying their net foreign asset positions gives the banks an additional degree of flexibility in responding to the central bank's cash reserve management. Before the guidelines were imposed, Canadian banks channelled substantial amounts of funds between the United States and the Euro-dollar market in response to relative interest rate changes. In short, transactions in chartered bank foreign currency assets and liabilities play a significant role both in the working of the Canadian financial system and as part of the international linkages between Canada, the United States, and the rest of the world.

Chapter 1

INTRODUCTION

A. Overview

The Canadian chartered banks[1] have very substantial assets and liabilities denominated in foreign currencies, principally in U.S. dollars. The analysis in this study is intended to explain the evolution of these foreign assets and liabilities over the decade 1962 to 1971 (inclusive) by centering on the forces that motivate the behaviour of the participants in the markets for foreign currency assets and liabilities - depositors, borrowers, and the chartered banks themselves. In the course of the discussion, I explain how the transactions of the Canadian banks in foreign currency instruments relate to the domestic setting, in particular to Canadian monetary policy and the Canadian balance of payments. The relationship of chartered bank transactions to the Euro-dollar market and the role of the banks in the transfer of funds between the United States and Europe are also investigated in some detail.

The significance of foreign currency assets as a part of chartered bank portfolios is shown in Figure 1 where the total foreign currency assets and total Canadian dollar assets of the banks are charted. As can be seen the rate of growth of foreign currency assets has substantially exceeded that of domestic assets during the period under study with the result that foreign currency assets have increased from 19.9% of total assets at the end of March 1962 to 26.6% at the end of December 1971. The same

Figure 1

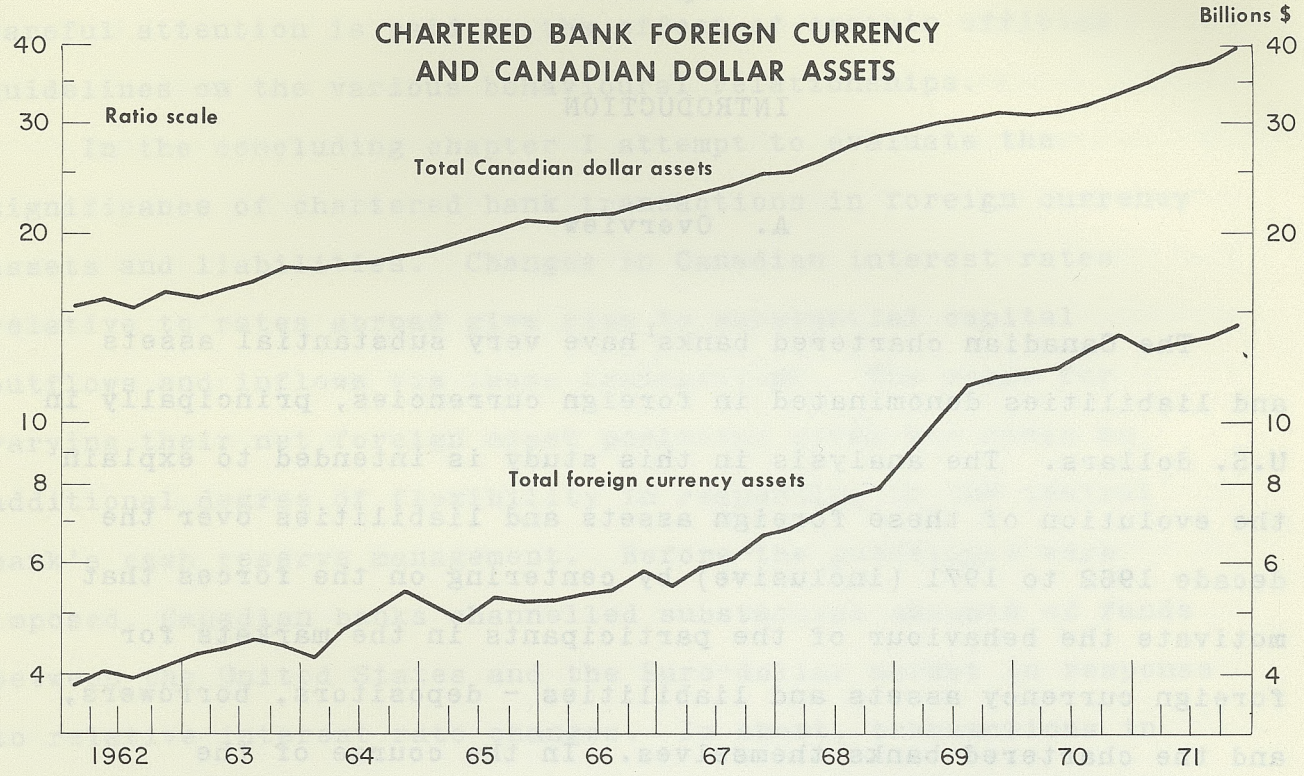
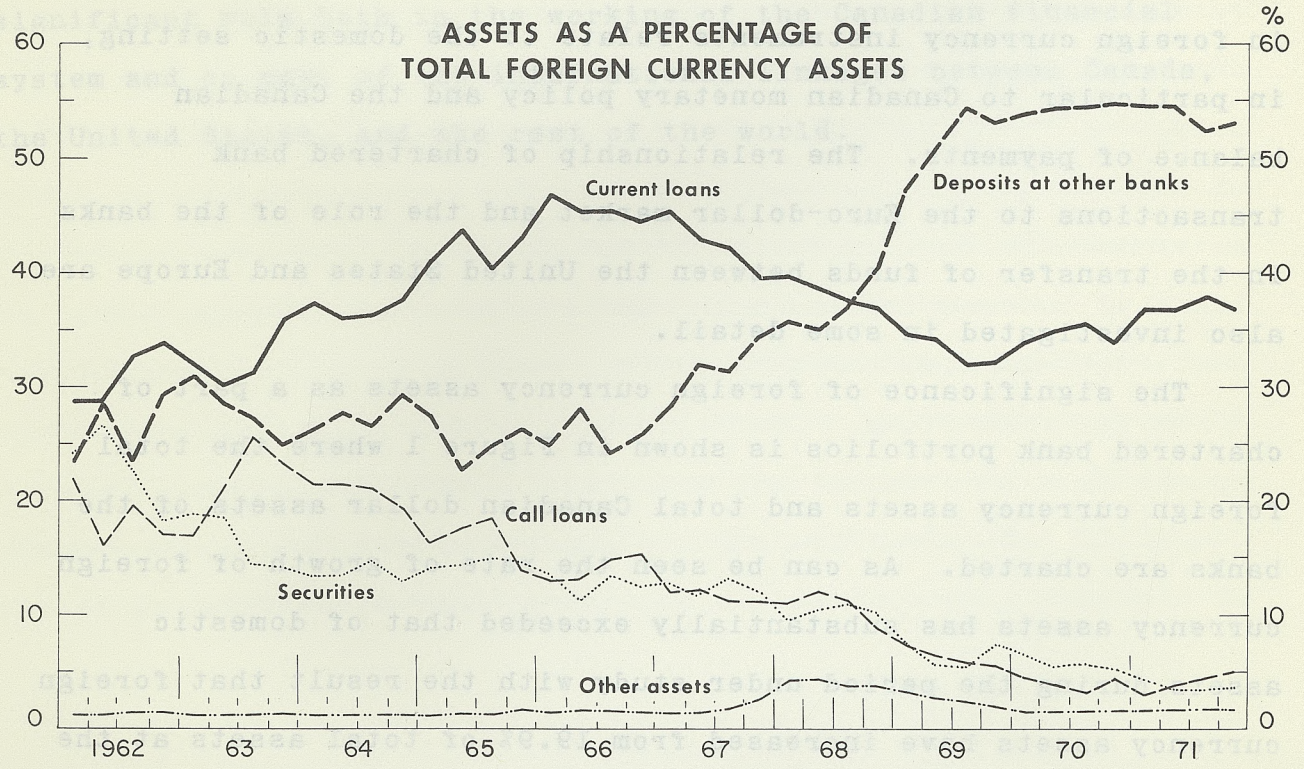


Figure 2



point is brought out by comparing the increase of 159% in domestic assets with the increase of 276% in foreign currency assets during the period 1Q62 to 4Q71.

In Figure 2 I show the division of foreign currency assets held by the banks into five types - call loans, current loans (defined as all loans other than call loans), securities, deposits at other banks, and other assets. The most striking features of this division were the steady decline of call loans and securities over the period, the steady growth of deposits, and the cyclical movement of current loans. The early importance of call loans [2], [36] was substantially reduced by the rapid growth of Euro-dollar deposits, which became the predominant liquid asset in the foreign currency portfolio. Three phenomena accounted for the movement of current loans: the growth of foreign currency loans to Canadian residents, especially in the period up to 1966; the rapid growth of the Euro-dollar loan market; and the entry of the New York agencies of Canadian banks into the cyclical business of making commercial loans to U.S. corporations [29] during the latter half of the period.

The relative importance of deposits by residents of Canada,[2] the United States[3], and the rest of the world and of other liabilities in the foreign currency liabilities at Canadian banks is illustrated in Figure 3. As a result of the balance of payments programme introduced by the U.S. authorities in February 1965 there was a sharp decline in the U.S. share of these deposits during 1965. The Canadian share fluctuated over the period and fell substantially in 1970 and 1971. The increase in rest-of-world deposits was a reflection of the rapid rate of

Figure 3

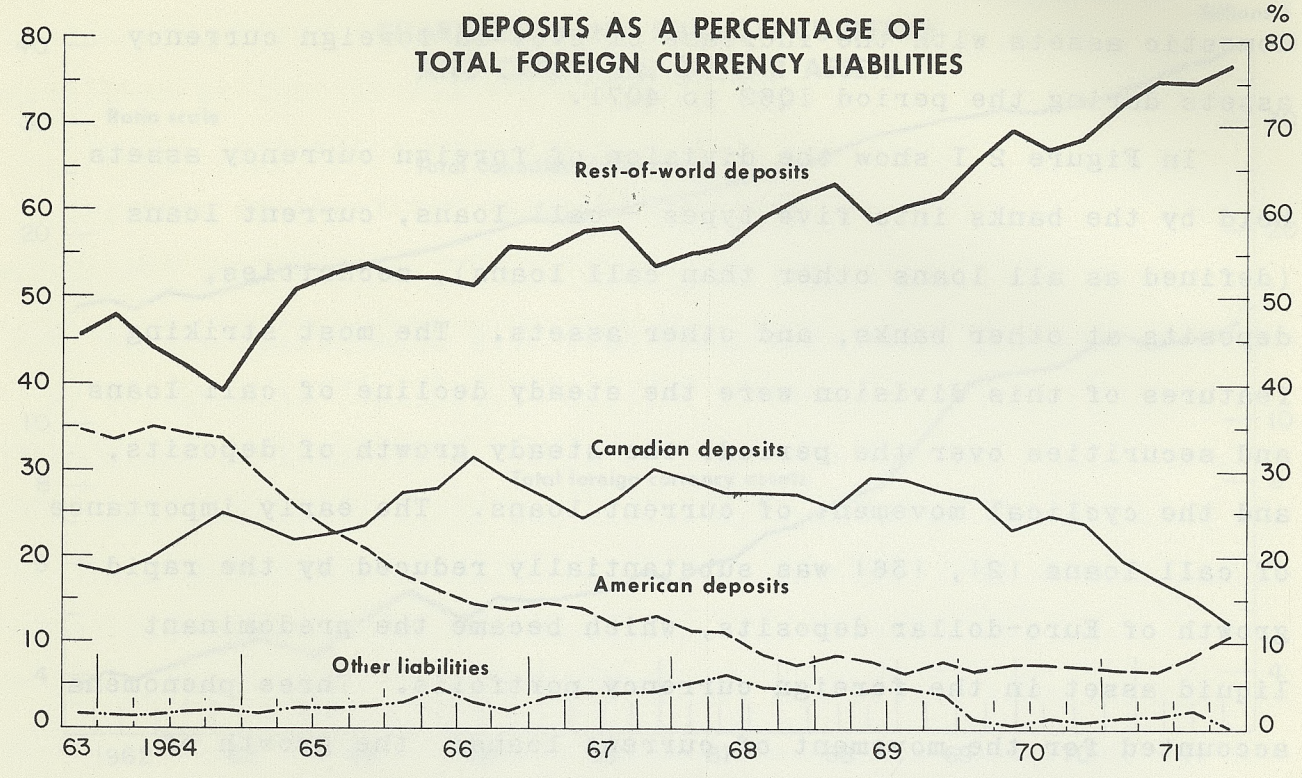
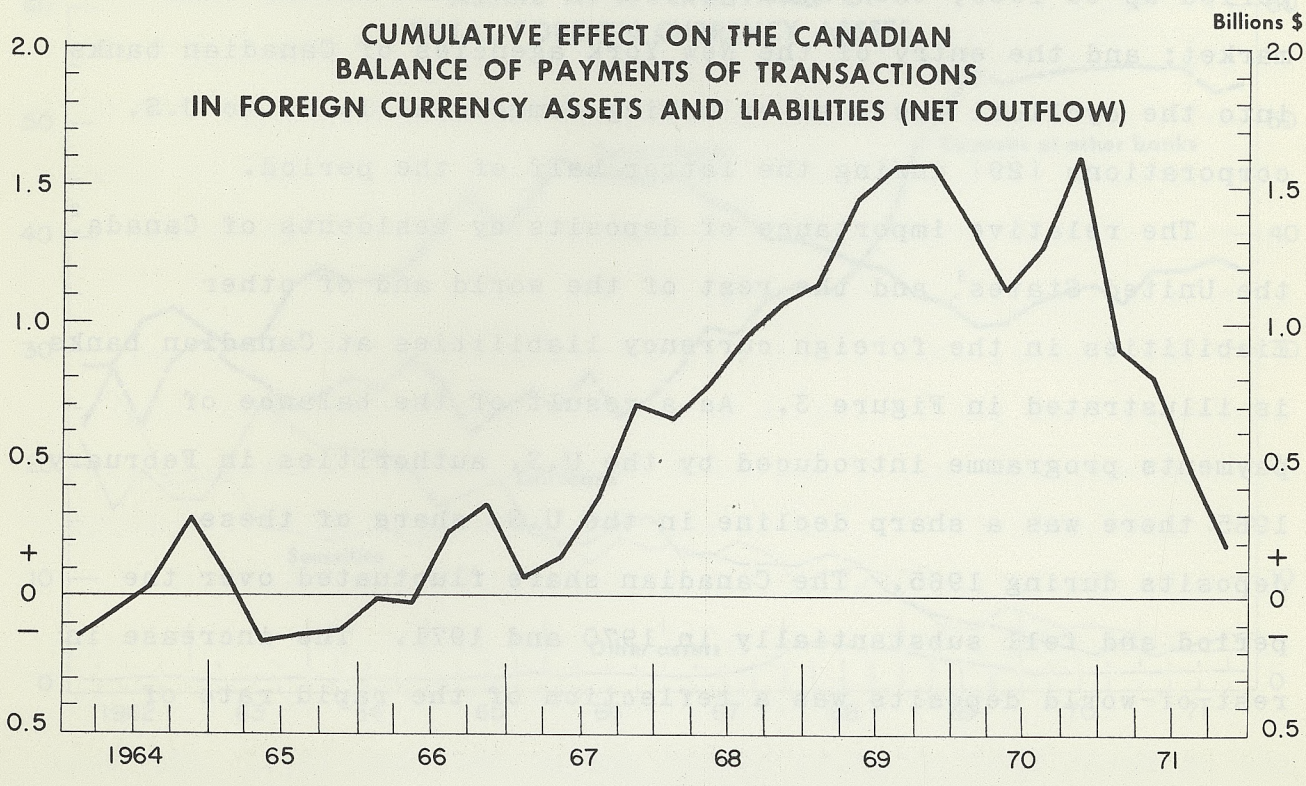


Figure 4



growth of the Euro-dollar market to which Canadian banks have made a not insignificant contribution.

In Figure 4, I set out the cumulative effect on the Canadian balance of payments (calculated from the end of 1963) of the transactions in foreign currency assets and liabilities (excluding gold) of chartered bank head offices and branches in Canada.[4] These transactions resulted in a cumulative outflow of $1,603 million by 4Q70 followed by a substantial decline in 1971. During the eight-year period the cumulative effect of the transactions was a relatively small net outflow of $193 million.

B. Institutional Detail

The transactions of the Canadian banks in foreign currency assets and liabilities can be divided into three segments: those related to head offices and branches in Canada, those related to New York agencies, and those related to other foreign branches. The manner of operation of each of these segments is sufficiently different to warrant separate discussion.

Head offices and branches in Canada (henceforward to be called head office) periodically post announcements of interest rates on foreign currency deposits in Canada. Prior to the imposition of the 1968 guidelines (to be discussed in detail below) the same interest rate was paid to all depositors regardless of nationality. During the guidelines period (May 1968 to January 1974) separate rates were posted for deposits by residents of Canada, the United States, and other countries, and the banks stood ready to accept deposits offered at the posted rates. (When the guidelines were withdrawn in January 1974 the

banks resumed the former practice of paying the same interest rate to all depositors.)

In the early 1960s the banks had created an instrument called a swapped deposit, which is of interest mainly to Canadian residents. Swapped deposits are funds converted into a foreign currency, usually U.S. dollars, that have been placed on term deposit with a bank and that the bank has undertaken to convert back into Canadian dollars at maturity. Thus the depositor is covered against changes in the value of his investment resulting from changes in the value of the Canadian dollar. The rate paid by the banks on swapped deposits (RSD) is an all-inclusive one. It is a function both of the rate on uncovered U.S. dollar deposits (RL) and of the forward spread expressed as an annual interest rate (RFS). The forward spread is equal to the difference between the forward exchange rate and the spot exchange rate for U.S. dollars in Canada. Therefore it represents the gain from or cost of covering a swapped deposit in the forward exchange market.

Foreign currency assets at head offices and branches in Canada are equal to the sum of foreign currency deposits and the net foreign asset position. The latter is defined as the difference between foreign currency assets and foreign currency liabilities and it therefore represents the shift by the banks from Canadian dollar assets to foreign currency assets, if positive, and vice versa, if negative. Foreign currency assets at chartered bank head offices and branches in Canada are allocated among deposits held at chartered bank agencies in New York, deposits held at U.S. banks, Euro-dollar deposits, loans to

residents of Canada, loans to non-residents of Canada, securities, and a number of minor items.

The New York agencies obtain most of their funds from head offices in the form of deposits. During the early 1960s these agencies had been a major force in the market for call loans in New York, ie, day, call, and short-term loans to investment dealers and stock brokers. More recently they have shifted a significant part of their assets into current loans to corporations and federal funds loans to U.S. banks. New York agencies also hold sizeable amounts of securities and deposits in U.S. banks.

Other foreign branches and agencies of Canadian banks fall into two groups - those engaged mainly in retail banking in Central America, South America, and the United States; those engaged in Euro-dollar banking (mainly in Europe). In the aggregate data the operations of the latter group are far more important than those of the former and therefore I ignore the retail branches. European branches are effectively part of the Euro-dollar market, setting rates on deposits related to the Euro-dollar rate and investing mainly in Euro-dollar deposits and in Euro-dollar loans.

Canadian banks have acted as a major conduit of funds between the United States and Europe. Before the 1968 guidelines were imposed, funds had been shifted between Europe and North America[5] in response to relative interest rates. Imposition of the guidelines prevented shifts from North America to Europe when the Euro-dollar rate was relatively high but allowed movements from Europe to the United States when the Euro-dollar rate was low relative to U.S. rates.

C. Official Guidelines

An important part of my empirical analysis of the foreign currency assets and liabilities of the Canadian banks relates to the effect of various official guidelines on the banks and on their depositors. The government-imposed restrictions most relevant to this analysis are: the U.S. balance of payments programme of February 1965, the prohibition of swapped deposits at Canadian chartered banks between March 4, 1968 and June 13, 1968, the guidelines on chartered bank foreign currency operations established in May 1968 and ended in January 1974, and the ceiling on swapped deposits in force from July 1969 to March 1970. It is worth outlining each of the restrictions in somewhat more detail at this stage.

The U.S. balance of payments programme of February 1965[6]

Under this programme the U.S. authorities ordered banks, other financial institutions, and industrial and commercial enterprises to reduce their holdings of U.S. dollar deposits at banks outside the United States. Thus banks were informed by the Federal Reserve Board that they should "refrain from increasing such deposits ... and should, in a reasonable and orderly manner, seek to reduce them" [16] March 1965, p 375. Financial institutions other than banks were requested by the Federal Reserve Board to limit holdings of liquid funds abroad (including U.S. dollar deposits held outside the United States) to the 1964 year-end total. "The longer-term objective is to reduce such investments in a gradual and orderly manner to the December 31, 1963 level" [16] March 1965, p 375. Among the guidelines

suggested by the U.S. Secretary of Commerce to non-financial corporations was one recommending the "repatriation of short-term financial assets in excess of those needed for working capital in developed countries" [7] p 267. In March 1968, as part of the agreement that resulted in the Canadian guidelines, the U.S. authorities exempted Canada from "all U.S. balance of payments measures affecting capital flows that were being administered by the Department of Commerce and the Federal Reserve System" [3] 1968, p 36. Thus the U.S. guidelines were no longer operative vis-à-vis Canada and it was the Canadian guidelines that indirectly constrained deposits of U.S. residents in Canadian banks after 1968.

Prohibition of swapped deposits (1968)

From March 4,1968 to June 13,1968 chartered banks and other financial intermediaries were requested by the Bank of Canada not to facilitate swapped deposit transactions [3] 1968, p 36. Thus no rates on swapped deposits were quoted during this period and swapped deposits were run down by a substantial amount.

Guidelines for chartered banks from May 1968 to January 1974

The exemption of Canada from the U.S. balance of payments programme of January 1968 was accompanied by measures on the Canadian side to prevent Canada from being used as a channel for U.S. funds en route to other countries. Accordingly, guidelines on the foreign currency operations of Canadian banks, other Canadian financial institutions, and Canadian non-financial corporations were introduced in May 1968. (See [3] 1968, pp 13-14 and Appendix.)

An agreement on guidelines for the chartered banks, comprising three requirements, was announced on May 3, 1968. The first two guidelines related to dealings with residents of all countries other than Canada and the United States (designated throughout this study as residents of the rest of the world). These two guidelines were designed to prevent funds from flowing to the rest of the world from North America via Canadian banks. The third quideline was designed to prevent an increase in transactions between U.S. depositors and U.S. borrowers via the intermediation of Canadian banks because such transactions are part of the U.S. balance of payments deficit according to the liquidity definition. A more detailed discussion of the Canadian guidelines appears in the Appendix to this chapter. The guidelines were removed in January 1974 [3] 1973, p 42.

Ceiling on swapped deposits (1969-1970)

On July 15, 1969 the Bank of Canada requested the chartered banks to accept a temporary ceiling on swapped deposits. In January 1970 the Bank requested other financial institutions not to facilitate 'split swaps'.[7] (See [3] 1969, pp 13, 50.) The request to observe a temporary ceiling was withdrawn at the end of March 1970 [3] 1970, p 49.

D. Structure of the Study

The remainder of Chapter 1 is an overview of the structure of this study. I begin by discussing the nature of my approach using both flow diagrams and examples of balance sheets. A summary of the analysis to be presented in Chapters 2 to 6 is

then laid out. Special attention is paid to the effect of the guidelines of May 1968 on the behaviour of the banks and the structure of their operations.

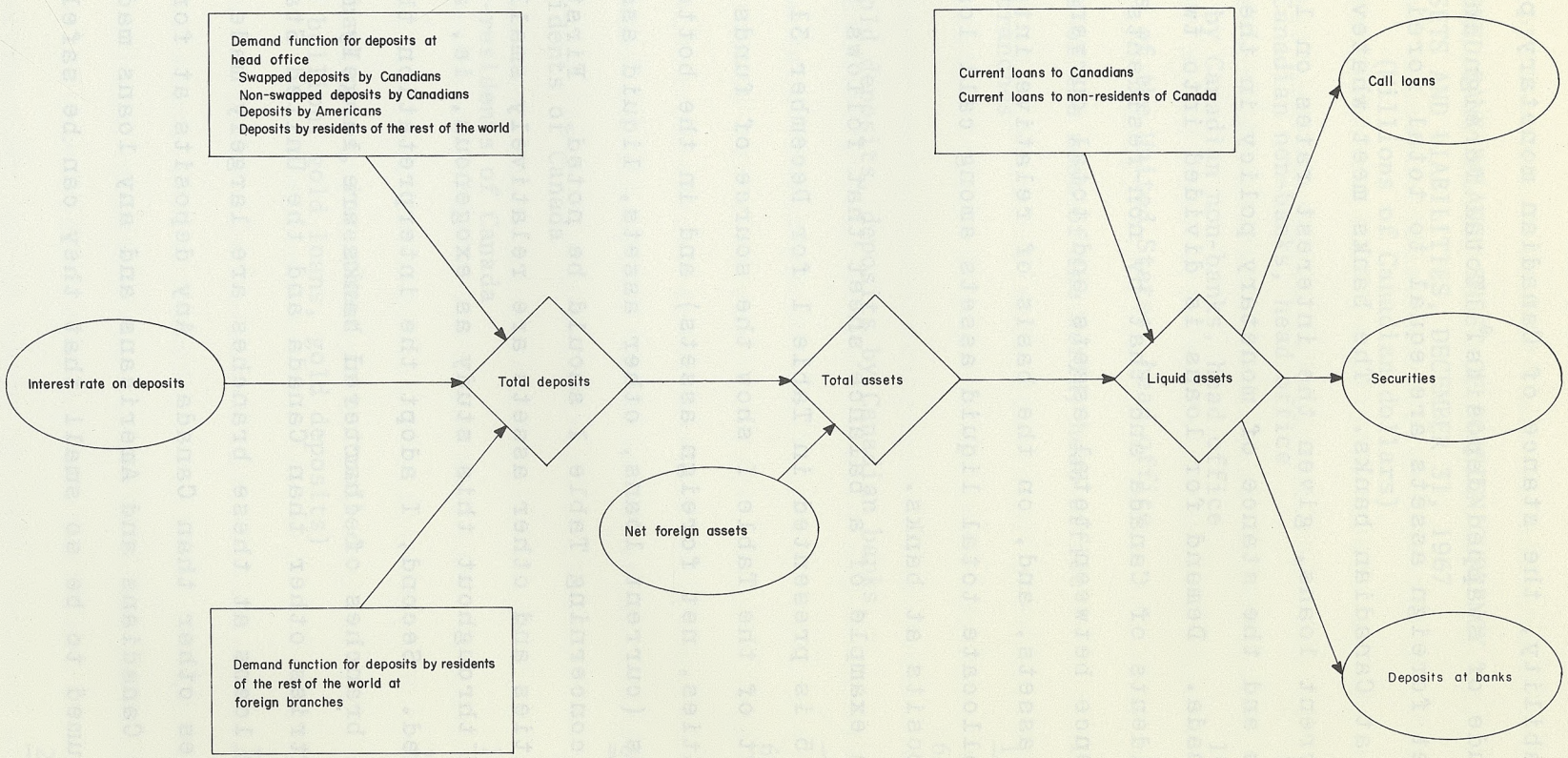
The guidelines strongly influenced the conduct of chartered bank transactions in foreign currency assets and liabilities. Guidelines 1 and 2 prevented the banks from expanding their Euro-dollar deposits and loans with funds raised in North America, and Guideline 3 prevented the banks from intermediating between U.S. lenders and U.S. borrowers. Thus the guidelines significantly affected the asset allocation of the banks. Furthermore, because under the guidelines deposits by residents of the rest of the world were at least as good as deposits by Canadians (in terms of the uses to which such funds could be put), and because the latter, in turn, were at least as good as deposits by Americans, a three-tier system of interest rates developed after the middle of 1968. Separate interest rates were posted for U.S. dollar deposits made by residents of Canada, the United States, and the rest of the world. The interest rate on deposits by residents of the rest of the world was the same as or greater than that on deposits by Canadians, which, in turn, was the same as or greater than that on deposits by Americans. When the guidelines were binding, these rates differed markedly. Because of the pervasive effect of the guidelines on both the asset side and the liability side of transactions in foreign currency instruments, I discuss separately the operations of the banks in the period before and the period when the guidelines were in force.

The period prior to the guidelines - January 1962 to April 1968

In Figure 5 I present a schematic outline of the determination of interest rates, foreign currency deposits, net foreign assets, and foreign currency assets of different kinds. Ovals represent chartered bank behavioural functions, rectangles represent the behavioural functions of transactors other than the chartered banks, and diamonds represent identities or the results of the interaction of behavioural relationships. Because of the recursive nature of the system Figure 5 is designed to be read from left to right; each item plays a part in the determination of items to the right of it but does not affect items to the left of it, ie, there is no feedback in this system. The chartered banks set an interest rate on foreign currency deposit liabilities (RL) based on interest rates in Canada, the United States, and Europe. Foreign currency deposits are divided into four categories: swapped deposits by Canadians (SD), non-swapped deposits by Canadians (NSD), deposits by Americans (DEPUS), and deposits by residents of the rest of the world (DEPRW). The latter category, in turn, is divided into deposits at head offices and branches in Canada (DEPRWHO) and deposits at foreign branches (DEPRWFB).[8] The interaction of interest rates posted for foreign currency deposits with deposit demand functions gives total deposits. Note that I do not use the breakdown of depositors by banks and others. That breakdown was rejected partly because it is less tractable for empirical analysis than the breakdown I use and partly because decisions by the Canadian banks on asset allocation do not appear to be influenced by the split of deposits between banks and others. Canadian banks determine their net foreign asset position on the basis of

Figure 5

FLOW CHART FOR THE PERIOD PRIOR TO THE GUIDELINES



profitability, the stance of Canadian monetary policy, and the magnitude of swapped deposits.[9] Total foreign currency deposits plus net foreign assets are equal to total foreign currency assets at Canadian banks. The banks meet whatever demand exists for current loans, given the interest rates on loans in various markets and the stance of monetary policy in the United States and Canada. Demand for loans is divided into two segments - that by residents of Canada and that by non-residents of Canada. The difference between total assets and total current loans is total liquid assets, and, on the basis of relative interest rates, the banks allocate total liquid assets among call loans, securities, and deposits at banks.

An example of a balance sheet that follows the ordering of Figure 5 is presented in Table 1 for December 31, 1967. In the top part of the Table I show the source of funds (deposits, other liabilities, net foreign assets) and in the bottom part the use of funds (current loans, other assets, liquid assets). Two points concerning Table 1 should be noted. First, since other liabilities and other assets are relatively small items they are treated throughout this study as exogenous, ie, as not to be explained. Second, I adopt the interpretation that deposits at foreign branches of chartered banks are largely made by residents of countries other than Canada and the United States and that current loans at these branches are largely made to residents of countries other than Canada. Any deposits at foreign branches made by Canadians and Americans and any loans made to Canadians are assumed to be so small that they can be safely ignored.[10]

Table 1

CHARTERED BANK BALANCE SHEET OF FOREIGN CURRENCY
ASSETS AND LIABILITIES, DECEMBER 31, 1967
(Millions of Canadian dollars)

Swapped deposits by Canadian non-banks, head office	906
Non-swapped deposits by Canadian non-banks, head office	1044
Deposits by residents of the United States, head office	842
Deposits by residents of the rest of the world, head office	1719
Deposits at foreign branches	1719
Total deposits	6230
Other liabilities (gold deposits, deposits by Canadian banks, minus float)	250
Total liabilities	6480
Net foreign assets	162
Total assets	6641
Current loans to residents of Canada	817
Current loans to non-residents of Canada	1817
Total current loans	2634
Other assets (coin, bank notes, investment in controlled corporations, gold bullion, gold loans, gold deposits)	172
Total liquid assets	3835
Call loans	744
Foreign securities	788
Deposits at banks	2303
	0

The guidelines period - May 1968 to January 1974

The imposition of guidelines in May 1968 made a substantial difference to the operations of Canadian banks in foreign currency assets and liabilities. Guidelines 1 and 2 effectively limited the increase in rest-of-world assets to the increase in rest-of-world liabilities, and Guideline 3 required either that liabilities to the United States be kept below the February 1968 level or that additional funds raised in the United States be used in Canada. The effect of Guidelines 1 and 2 was substantially more important than the effect of Guideline 3, and I therefore emphasize the former in this discussion.

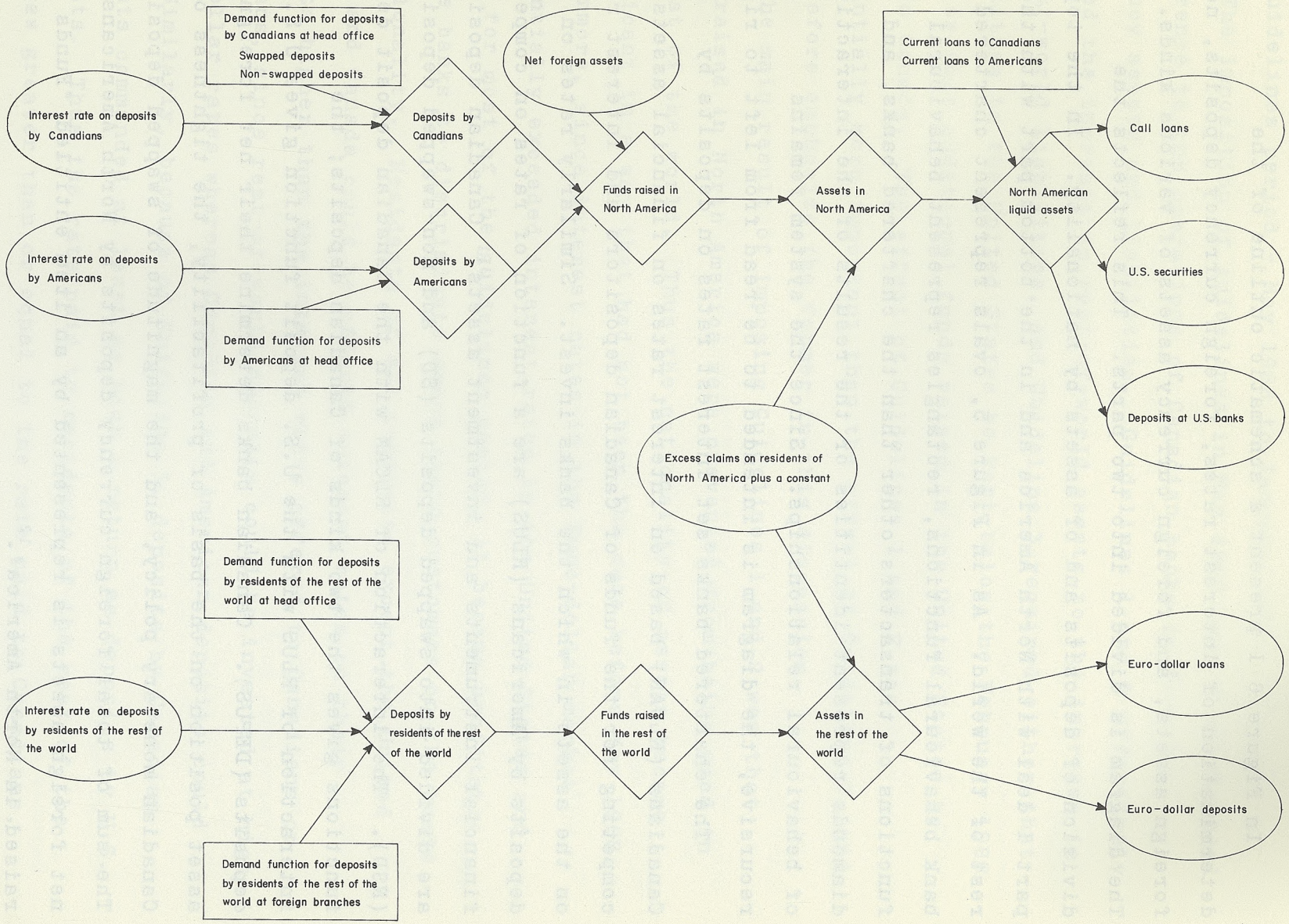
The main result of imposing Guidelines 1 and 2 was that funds raised in North America were prevented from being used in the rest of the world. Thus the nationality of assets became significant in a way that had not been the case before May 1968. Furthermore, since interest rates in the Euro-dollar market substantially exceeded interest rates in the United States and Canada for most of the guidelines period, it became profitable for the banks to discriminate among their customers on the basis of nationality. Residents of all countries except the United States and Canada could be offered interest rates on their deposits higher than the interest rates offered to Canadians or Americans, since rest-of-world deposits could be invested at high Euro-dollar rates whereas Canadian and American deposits could not. Similarly, because of Guideline 3, deposits by Canadian residents commanded at least as high a return as deposits by U.S. residents. Thus the rate paid to residents of the rest of the world was greater than or equal to the rate paid to Canadians, which was greater than or equal to the rate paid to Americans.

In Figure 6 I present a schematic outline of the determination of interest rates, foreign currency deposits, net foreign assets, and foreign currency assets of various kinds. The diagram is divided into two parts. This reflects the division of deposits and of assets by nationality. In the top part I deal with North America and in the bottom part with the rest of the world. As in Figure 5, ovals represent chartered bank behavioural functions, rectangles represent behavioural functions of transactors other than the chartered banks, and diamonds represent identities or the results of the interaction of behavioural relationships. Since the system remains recursive, the diagram is intended to be read from left to right.

The chartered banks set interest rates on deposits by Canadians (RLCAN) based on interest rates on financial assets competing for the funds of Canadian depositors and interest rates on the assets in which the banks invest. Similarly rates on deposits by Americans (RLUS) are a function of rates on competing financial instruments and investment assets.[11] Canadian deposits are divided into swapped deposits (SD) and non-swapped deposits (NSD). The interaction of RLCAN with the Canadian deposit demand functions gives the two kinds of Canadian deposits; the interaction of RLUS with the U.S. deposit function gives U.S. deposits (DEPUS). Canadian banks determine their net foreign asset position on the basis of profitability, the tightness of Canadian monetary policy, and the magnitude of swapped deposits. The sum of total foreign currency deposits by North Americans and net foreign assets is represented by an item entitled "Funds raised in North America".[12]

Figure 6

FLOW CHART FOR THE GUIDELINES PERIOD



Turning to the bottom of the diagram one sees that the chartered banks set a rate on head office deposits by all depositors other than Canadians and Americans (RLRW). Rest-of-world deposit functions are divided into two parts - those for rest-of-world deposits at head office (at the rate RLRW) and those for rest-of-world deposits at foreign branches (at a rate related to the Euro-dollar rate (RED)). The interaction of rates with deposit functions gives rest-of-world deposits (DEPRW), which, in turn, is equal to "Funds raised in the rest of the world".[13]

I now turn to the link between liabilities classified according to geography and assets classified according to geography. Guidelines 1 and 2 in effect called for a ceiling on rest-of-world assets equal to the funds raised in the rest of the world minus a constant amount equal to the February 1968 net liabilities to residents of the rest of the world. This implies, of course, that there is a floor on North American assets equal to funds raised in North America plus the constant amount mentioned above. There is nothing to prevent North American assets from being above the floor, ie, to prevent rest-of-world assets from being below the ceiling. The magnitude of North American assets above the floor, excess claims on residents of North America (ASSETEXNA), is a function of U.S. interest rates, the Euro-dollar rate, and a dummy representing balance sheet window dressing at the chartered bank financial year-end. Thus to get North American assets I add the constant amount and excess claims on residents of North America to funds raised in North America. And to get rest-of-world assets I subtract the constant

amount and excess claims on residents of North America from the funds raised in the rest of the world.

At the top of Figure 6 North American assets are allocated into various categories of assets. The banks first meet the demand for current loans by Canadians (LOANCAN) and Americans. These loans are a function of interest rates and the stance of monetary policy in the United States and Canada. The difference between North American assets (ASSETNA) and North American current loans is North American liquid assets. These are divided, on the basis of relative interest rates,[14] among call loans (CL), U.S. securities (SECUS), and deposits at U.S. banks.

Rest-of-world assets are divided between Euro-dollar loans (EDLOAN) and Euro-dollar deposits (EDDEP), a division based on an equilibrium allocation between these two assets and a movement over time towards this desired allocation. The magnitude of Euro-dollar loans is determined by the chartered banks, in contrast with the magnitude of current loans to North American borrowers that is determined primarily by the borrowers' demand for funds. This distinction is based on the fact that the Euro-dollar loan market is really a market in which banks can, within limits, change the magnitude of their loans as they desire, whereas loan markets in the United States and Canada are not markets in this sense.[15]

An example of a balance sheet following the ordering of Figure 6 is presented in Table 2 for December 31, 1971. In the top part of the table I show the source of funds and in the bottom part the use of funds. Note the following points about Table 2. First, a number of small items are treated as exogenous for purposes of this study. These include deposits of one

Table 2

CHARTERED BANK BALANCE SHEET OF FOREIGN CURRENCY ASSETS AND LIABILITIES
DECEMBER 31, 1971

(Millions of Canadian dollars)

North America		The Rest of the World		Total Including Unallocated Items	
Swapped deposits by Canadian non-banks, head office	732	Deposits by residents of the rest of the world, head office	4,806		
Non-swapped deposits by Canadian non-banks, head office	965	Deposits at foreign branches	6,126		
Deposits by residents of the United States, head office	1,491				
Deposits by Canadian banks, head office	11				
Total North American deposits	3,199	Total rest-of-world deposits	10,932	Total foreign currency deposits	14,130
				Gold liabilities	32
Net foreign currency assets, head office (excluding investment in controlled corporations)	158	Net foreign currency assets, foreign branches	4	Net foreign assets (including investment in controlled corporations	307
		Minus float	-23	Minus float	-23
Funds raised in North America	3,357	Funds raised in the rest of the world	10,913		
Excess claims on residents of North America plus a constant	-17	Minus excess claims on residents of North America minus a constant	17		
Total North American foreign currency assets	3,340	Total rest-of-world foreign currency assets	10,930	Total foreign currency and gold assets	14,446
Current loans to residents of Canada	1,088				
Current loans to residents of the United States at head office and New York agencies	n.a.				
Total current loans, North America	n.a.	Euro-dollar loans	n.a.	Current loans, total	5,314
				Gold assets	39
				Investment in controlled corporations	138
Other assets (coin, bank notes, Canadian foreign-pay securities)	123	Other assets (rest-of-world securities)	80	Other assets	203
North American liquid assets	n.a.				
Call loans	715			Call loans	715
U. S. securities	382			U. S. securities	382
Deposits at North American banks	n.a.	Euro-dollar deposits	n.a.	Deposits at banks	7,656
	0		0		0

Canadian bank in another, other assets (coin, bank notes, Canadian securities payable in foreign currencies, rest-of-world securities), gold deposits, gold assets, and investment in controlled corporations. Second, transactions at foreign branches (except at New York agencies) are assumed to be only with non-residents of the United States and Canada. Third, I ignore liabilities of New York agencies other than those to head office, which account for over 90% of liabilities, and I ignore assets of New York agencies arising from the liabilities that are not to head office. Fourth, some items on the balance sheet are not available and proxy variables must therefore be used in further analysis. Fifth, I arbitrarily allocate 'float' to the rest of the world.

In the following chapters of this study I deal fully with the various behavioural relationships outlined above. Chapter 2 is a discussion of the determination of interest rates on foreign currency deposits by the chartered banks. In Chapter 3, I analyze the demand functions of the various depositors at Canadian banks. The net foreign asset position of Canadian banks is discussed at length in Chapter 4. Current loans to residents of Canada, the United States, and the rest of the world are analyzed in Chapter 5 where I also explain the allocation of chartered bank foreign currency liquid assets among the various component assets. Finally, in Chapter 6, I discuss some of the implications of chartered bank transactions in foreign currency assets and liabilities for the Canadian balance of payments and for Canadian monetary policy, basing this discussion on the equations developed in previous chapters. I also examine the role of the chartered banks as a conduit of funds between the

United States and Europe, and the process determining the growth of foreign currency assets and liabilities at Canadian banks.

Appendix to Chapter 1

THE GUIDELINES OF MAY 1968

The guidelines[16] read as follows:

1. The total of a bank's foreign currency claims on residents of countries other than Canada and the United States should not rise above the level of the end of February 1968 unless the increase is accompanied by an equal increase in its total foreign currency liabilities to residents of countries other than Canada and the United States.

2. If there should be a decline in the total of a bank's foreign currency liabilities to residents of countries other than Canada and the United States from the level at the end of February 1968 the bank should achieve an equal reduction in its total foreign currency claims on residents of countries other than Canada and the United States as quickly as the liquidity of such assets will permit.

3. Each bank should allow an increase in its U.S. dollar liabilities to residents of the United States from the level at the end of February 1968 only to the extent that the increase is fully matched by the sum of (1) the increase from that date in the bank's U.S. dollar claims on residents of Canada, (2) the decrease from that date in the bank's U.S. dollar liabilities to residents of Canada, and (3) the decrease from that date in the bank's own spot position in U.S. dollars.

These restrictions can be translated into symbolic form. Guidelines 1 and 2 may be written

$$ASSETRWHO(t) - ASSETRWHO(68) \leq DEPRWHO(t) - DEPRWHO(68)$$

where

ASSETRWHO is the foreign currency claims (or assets) of head office and branches in Canada on residents of the rest of the world (ie, excluding the United States and Canada),

DEPRWHO is the foreign currency deposits by residents of the rest of the world at head office and branches in Canada,

t is the end of the current period, and

68 is the figure for the end of February 1968.

Alternatively, one may write

$$ASSETRWHO(t) - DEPRWHO(t) \leq ASSETRWHO(68) - DEPRWHO(68)$$

That is, the net foreign currency claims of the banks on the rest of the world must not increase above the level of net claims at the end of February 1968.[17] For the system as a whole, the net claims on the rest of the world at the end of February 1968 were -$119.1 million.

Guideline 3 may be written symbolically

(i) $DEPUS(t) - DEPUS(68) \leq 0$ or

(ii) $DEPUS(t) - DEPUS(68) \leq [ASSETCAN(t) - ASSETCAN(68)] - [DEPCAN(t) - DEPCAN(68)] - [NFAHO(t) - NFAHO(68)]$

where

ASSETCAN is foreign currency claims on residents of Canada at head office and branches in Canada,

DEPCAN is foreign currency deposits by residents of Canada at head office and branches in Canada,

DEPUS is foreign currency deposits by residents of the United States at head office and branches in Canada,

NFAHO is net foreign assets of head office and branches in Canada.

A bank satisfies this restriction if its liabilities to Americans have declined since February 1968 or if the increase in its liabilities is less than the increase in its net foreign currency claims on Canadians minus the increase in its net foreign assets. That is, an increase in liabilities to Americans can be used to purchase net foreign currency claims on Canadians or net claims in Canadian dollars, since a reduction in NFAHO is equivalent to an increase in net Canadian dollar assets.

When the requirements of the three quidelines are combined it is evident that an increase in foreign currency claims on Americans is possible only in two ways. First, if liabilities to Americans rise above the base level of February 1968, then an increase in claims on Americans over the February 1968 base can be carried out without violating the guidelines only via an increase in net liabilities to the rest of the world. Second, if American liabilities fall below the February 1968 base, then increased claims on Americans can be financed via an increase in net foreign currency liabilities to Canadians or to the rest of the world, or an increase in net foreign assets, or an increase in liabilities to Americans to the level of February 1968.

Chapter 1 Footnotes

1 The chartered banks are the ten privately owned banks that are chartered (ie, licensed) by Parliament under the Bank Act [8]. In this study the terms chartered banks and Canadian banks are used interchangeably.

2 The terms resident of Canada and Canadian are used interchangeably.

3 The terms resident of the United States and American are used interchangeably.

4 In calculating the balance of payments effect I ignored changes in the Canadian dollar exchange rate. See [9] p 43 and [10] p 20 for calculations that take into account changes in the exchange rate. There is a relatively small difference between my results and the Statistics Canada figures.

5 The term North America is used in this study to denote just Canada and the United States.

6 The sources consulted in the discussion of the U.S. balance of payments programme are: Hood [28], Brimmer [7] Federal Reserve Bulletin [16] various issues, and the Bank of

Canada Annual Report [3] 1965.

7 A 'split swap' occurs when a foreign currency deposit and its forward cover are acquired in separate transactions involving different financial intermediaries. It is thus equivalent to a swapped deposit.

8 The interest rate paid on deposits at branches of Canadian banks in Europe is related to the rate paid on Euro-dollar deposits in Europe (RED) not to the rate paid at head office (RL).

9 See Shearer [36] for an early discussion of the relationship between net foreign assets and swapped deposits.

10 In the period prior to the guidelines I include the New York agencies under the term foreign branches. Nonetheless the assumptions are probably reasonable.

11 When U.S. deposits were held at or below their February 1968 levels, only the rates on competing instruments were used in determining RLUS.

12 The statements in this paragraph should be qualified to take into account net gold assets, net foreign assets at foreign branches, and investment in controlled

corporations. For the precise relationships see the balance sheet in Table 2.

13 The statements in this paragraph should be qualified to take into account net foreign assets of foreign branches. Again see Table 2.

14 The effect of Guideline 3 has not been integrated into the analysis at this point.

15 In this overview I have omitted discussion of some minor items that I treat as exogenous such as gold assets and Canadian and rest-of-world securities payable in foreign currencies.

16 Source: Bank of Canada. Annual Report [3] 1968 pp 69-70.

17 Small adjustments are permitted under the Canadian guidelines for net earnings offshore over time and for Export Development Corporation guarantees. Note also that as of September 30, 1970 the United States has been redefined to include Puerto Rico and the U.S. Virgin Islands and consequently these are not part of "the rest of the world". This change means that net claims on residents of the rest of the world as of February 1968 were changed from -$170.0 million to -$119.1 million.

The banks were required to adjust their portfolios to meet the new definition by March 31, 1971.

Chapter 2

THE SETTING OF INTEREST RATES ON FOREIGN CURRENCY DEPOSITS

As was pointed out in Chapter 1, the chartered banks set the interest rates on foreign currency deposits (including swapped deposits) and accept the deposits forthcoming at the posted rates. In this chapter, I examine in detail the determinants of interest rates on foreign currency deposits.

A. A Theoretical Model of Chartered Bank Behaviour

To explain the determination of interest rates on foreign currency deposits, I resort to a very simple model of chartered bank behaviour. The banks (treated for simplicity as a single bank) are assumed to maximize the net profit from their transactions in foreign currency assets and liabilities, ie, they maximize the difference between the interest received from investments in foreign currency assets and the interest paid on foreign currency liabilities. Furthermore, it is assumed that the banks face rising deposit demand curves such that a change in the interest rate on foreign currency deposits will lead to a finite change in the amount of foreign currency deposits demanded at Canadian banks. This means that a decrease in the rate paid on foreign currency deposits by Canadian banks relative to the rates on other financial instruments will lead to a loss of some, but not all, of their deposits. Similarly, an increase in the rate paid on foreign currency deposits will lead to a shift of some, but not all, funds from other financial assets into these

deposits. The assumption of finite elasticities is equivalent to the assumption that, from the point of view of the depositors, foreign currency deposits and other assets are imperfect substitutes. I also assume that the banks are interest-rate-takers in the markets for the assets in which they invest. This means that their actions have at most an infinitesimal effect on the interest rates of their investment assets - a plausible assumption given that the banks typically invest the bulk of their funds in assets of which they hold only a small proportion of the total amounts outstanding.[1]

The formal model based on the above assumptions is set out in detail in Appendix 1 to this chapter. In the text I shall use a geometric presentation to show the implications of a slightly simpler model than that used in Appendix 1. Throughout this chapter I assume that Canadian banks have no net foreign asset position.[2]

I now turn to a consideration of the model. The bank is assumed to maximize net profits from transactions in foreign currency assets and liabilities, ie, the difference between the interest earned and the interest paid on these foreign currency transactions.[3] In the most general case,

$$PROF = [(ASSETTOT)(RA)] - [(DEPUS)(RLUS)+(DEPRW)(RLRW) + (NSD)(RLCAN)+(SD)(RSD-RFS)] \quad (1)$$

where:

ASSETTOT is total foreign currency assets held by Canadian banks,

DEPRW is foreign currency deposits by residents of the rest of the world at Canadian banks,

DEPUS is foreign currency deposits by residents of the

United States at Canadian banks,

NSD is non-swapped deposits (ie, those not covered forward at the bank) by residents of Canada at Canadian banks,

PROF is net profit from transactions in foreign currency assets and liabilities,

RA is the interest rate on total foreign currency assets,

RFS is the interest rate equivalent of the forward spread between the U.S. dollar and the Canadian dollar;[4]

RLCAN is the interest rate on foreign currency deposits at Canadian banks by residents of Canada,

RLRW is the interest rate on foreign currency deposits at Canadian banks by residents of the rest of the world,

RLUS is the interest rate on foreign currency deposits at Canadian banks by residents of the United States,

RSD is the interest rate on swapped deposits at Canadian banks, and

SD is swapped deposits by residents of Canada at Canadian banks.

The assumption that all foreign currency assets bear the rate RA is made solely for expositional convenience and is relaxed in Appendix 1.

The profit on transactions in foreign currency assets and liabilities is arrived at by subtracting the interest payments on foreign currency liabilities from the interest earnings on foreign currency assets. In order to calculate the net return to the bank on a transaction in which swapped deposits are used to

purchase U.S. dollar assets one can either add RFS to the interest rate on the asset or subtract RFS from the rate paid on the liability as is done in equation (1). The assumption that net foreign assets are equal to zero is equivalent to the assumption that foreign currency assets are equal to foreign currency liabilities, that is

ASSETTOT = DEPUS + DEPRW + NSD + SD (2)

A further simplification is allowed by the relationship between the rate on swapped deposits (RSD) and the rate on non-swapped deposits (RLCAN) namely

RSD = RLCAN + RFS (3)

This relationship, which will be justified in more detail in Section B of this chapter, asserts that the rate on swapped deposits is equal to the rate on non-swapped deposits plus the interest rate equivalent (positive or negative) of covering the transaction in the forward exchange market.

One must at this stage distinguish sharply between the period prior to the guidelines and the guidelines period. In the former the same rate was paid on all foreign currency deposits regardless of the nationality of the depositor. Hence,

RLRW = RLCAN = RLUS (4)

During the guidelines period restrictions on the use of funds from different geographical areas lead to the relationship

RLRW $\geq$ RLCAN $\geq$ RLUS (4')

as described in Chapter 1.

Since I assume that the bank treats RA and RFS as being beyond its control[5], its objective is to maximize net profit by setting the single interest rate on deposits (which I shall call RL henceforward) in the period prior to the guidelines and by

setting the three interest rates on deposits (RLCAN, RLRW, and RLUS) in the guidelines period.

1. The period prior to the guidelines

For the period prior to the guidelines equations (1), (2), (3), and (4) are combined to give the profit function

PROF = (DEPUS+DEPRW+NSD+SD)(RA-RL) (5)

The net profit on each category of deposit is equal to the amount of deposit times the profit margin, which is the difference between the interest rate on assets in which the bank invests (RA) and the interest rate it pays on deposits (RL). The bank perceives the deposit demand functions (DEPUS, DEPRW, NSD, and SD) to be increasing functions of the differentials between the rate paid on foreign currency deposits by Canadian banks and the rates paid on other instruments competing for funds. Thus, DEPUS would be a function of the differential between RL and the rate on the instrument competing with foreign currency deposits at Canadian banks for the funds of Americans. Although in the simple model there is only one competing rate in each deposit demand function, it is trivial to extend that model to include more than one competing rate in each function. In practice the competing rate for U.S. funds might be the rate on U.S. treasury bills (RUSTB) or the rate on U.S. certificates of deposit (RUSCD). Similarly the competing rate for rest-of-world funds might be the Euro-dollar rate (RED) and the competing rate for non-swapped deposits and for swapped deposits might be the rate on Canadian instruments or the (covered or uncovered) rate on U.S. instruments.

In Figure 7 the aggregate deposit function (DEPUS+DEPRW+NSD+SD), which is labelled DEP, is graphed against RL for given rates on competing instruments and for given RFS. Thus at a rate RL_1 the amount of foreign currency deposits demanded in the aggregate is DEP_1 for given competing rates and for given RFS. The rate on the asset in which the bank invests its funds (RA_1) is shown as a horizontal line reflecting the fact that the banks are assumed to be price-takers in the markets for their investment assets. As is always the case when the decision-maker perceives that he is facing rising curves for his inputs, the bank maximizes profits by equating the marginal revenue from an extra dollar of deposits (in this case equal to the average revenue (RA)) to the marginal cost of an extra dollar of deposits (here depicted as the marginal cost (MC) curve). To obtain an extra dollar of deposits the bank must raise RL. Hence the marginal cost of an extra dollar of deposits is equal to the interest paid on that dollar of deposits plus the increase in interest payments on all existing deposits brought about by the increase in RL. Thus the marginal cost curve (MC) lies above the average cost curve (DEP). Profit-maximizing equilibrium occurs at the point where marginal revenue equals marginal cost, ie, at the level of deposits DEP_1, which corresponds to the interest rate RL_1.

I now turn to the effect on RL of changes in the given conditions of the system, namely the interest rate on investments (RA), the interest rates on competing instruments, and RFS. The results, which are formally proved in Appendix 1 of this chapter and which are discussed below, are as follows: First, an increase in RA or in one of the competing interest rates causes a

Figure 7

THE SETTING OF RL IN THE PERIOD PRIOR TO THE GUIDELINES

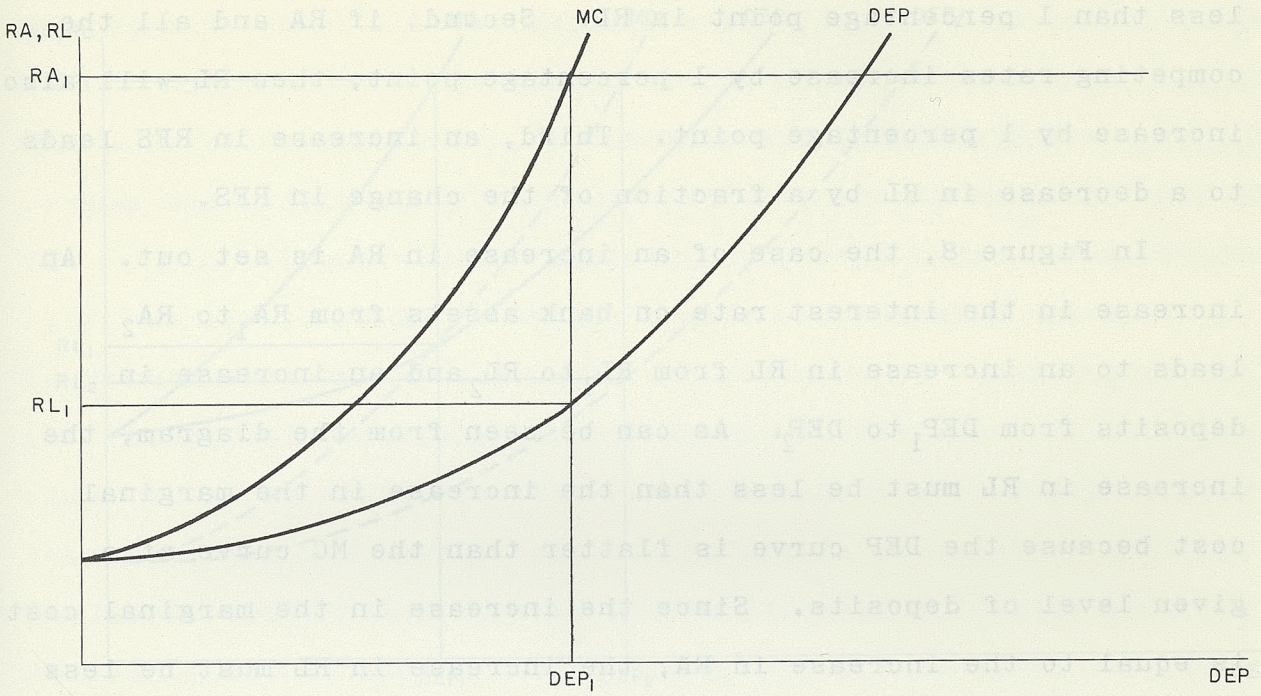
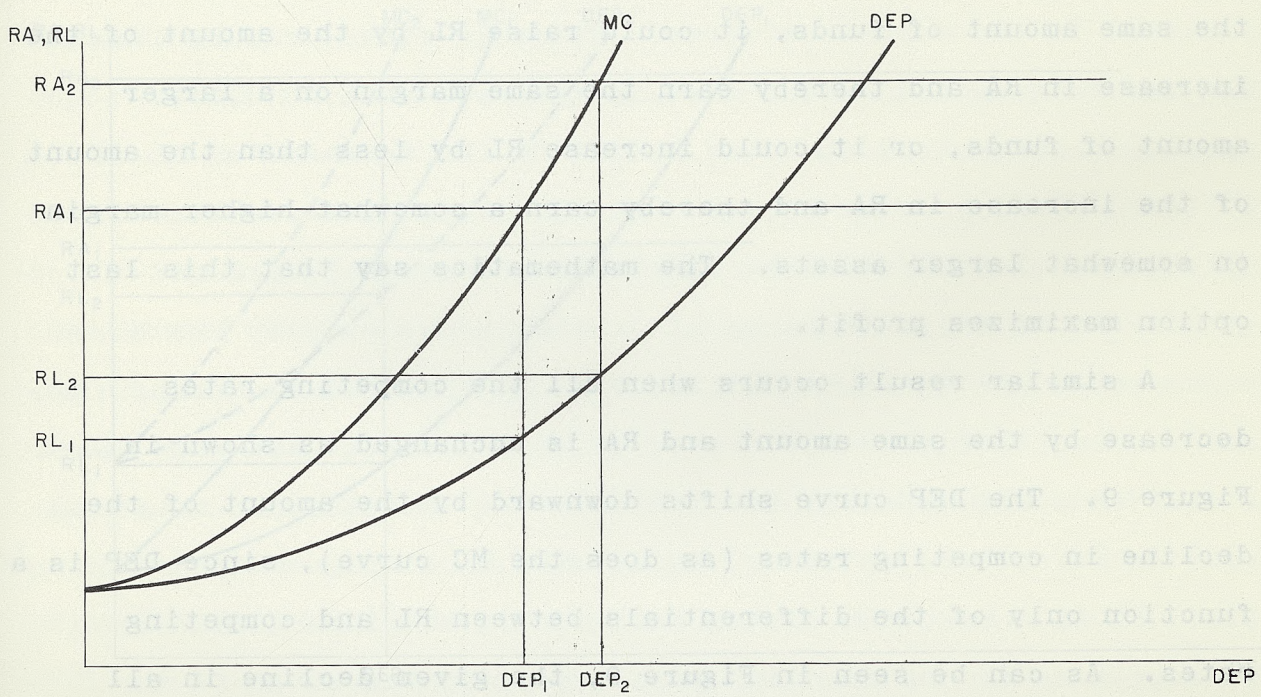


Figure 8

THE EFFECT ON RL OF AN INCREASE IN RA



fractional increase in RL. That is, a 1 percentage point increase in RA or in a competing rate results in an increase of less than 1 percentage point in RL. Second, if RA and all the competing rates increase by 1 percentage point, then RL will also increase by 1 percentage point. Third, an increase in RFS leads to a decrease in RL by a fraction of the change in RFS.

In Figure 8, the case of an increase in RA is set out. An increase in the interest rate on bank assets from RA_1 to RA_2 leads to an increase in RL from RL_1 to RL_2 and an increase in deposits from DEP_1 to DEP_2. As can be seen from the diagram, the increase in RL must be less than the increase in the marginal cost because the DEP curve is flatter than the MC curve at a given level of deposits. Since the increase in the marginal cost is equal to the increase in RA, the increase in RL must be less than the increase in RA. This result can be interpreted as follows: The increase in RA gives the bank three options. It could leave RL unchanged and hence earn a higher profit margin on the same amount of funds, it could raise RL by the amount of the increase in RA and thereby earn the same margin on a larger amount of funds, or it could increase RL by less than the amount of the increase in RA and thereby earn a somewhat higher margin on somewhat larger assets. The mathematics say that this last option maximizes profit.

A similar result occurs when all the competing rates decrease by the same amount and RA is unchanged as shown in Figure 9. The DEP curve shifts downward by the amount of the decline in competing rates (as does the MC curve), since DEP is a function only of the differentials between RL and competing rates. As can be seen in Figure 9, the given decline in all

Figure 9

THE EFFECT ON RL OF A DECREASE IN ALL THE COMPETING RATES

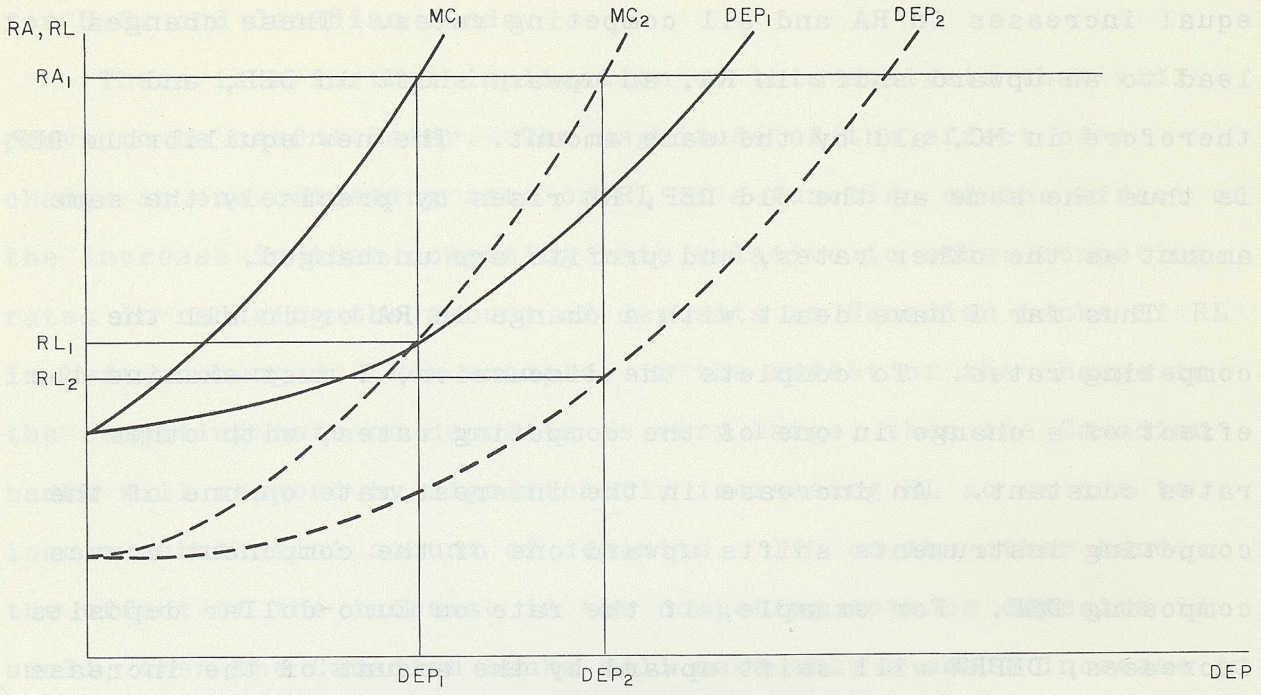
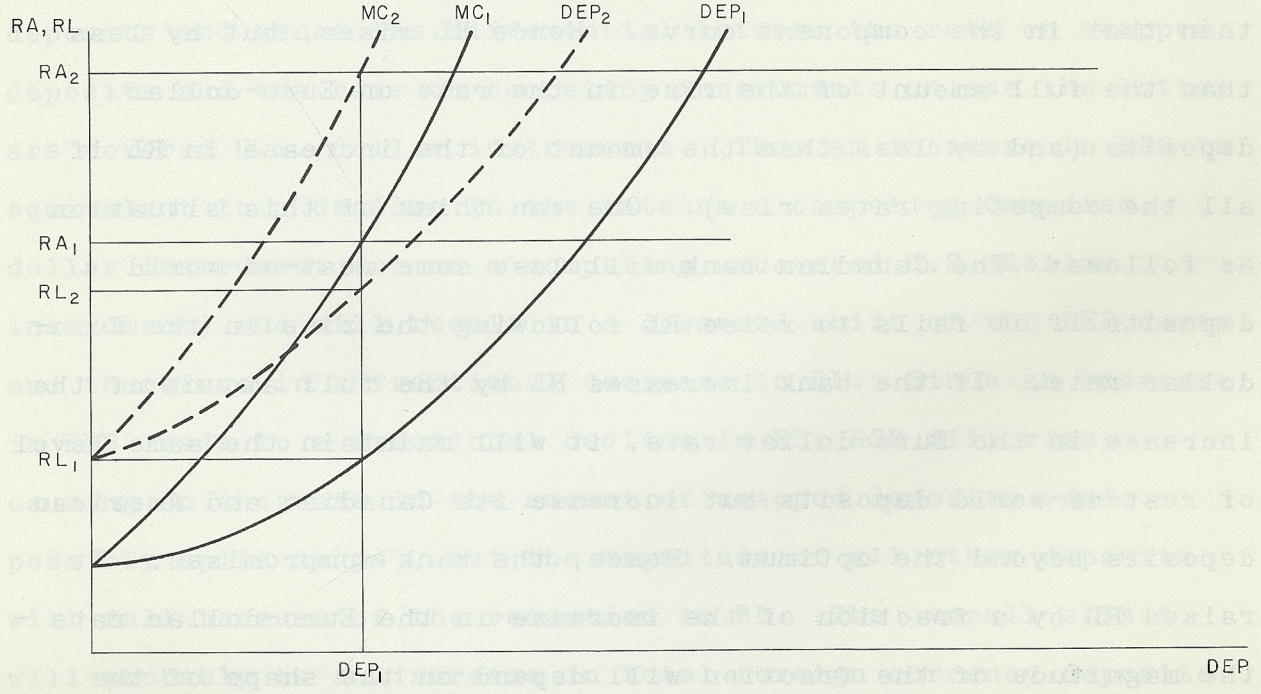


Figure 10

THE EFFECT ON RL OF AN INCREASE IN RA AND IN ALL THE COMPETING RATES



competing rates leads to a smaller decline in RL and to an increase in deposits. In Figure 10 I illustrate the case of equal increases in RA and all competing rates. These changes lead to an upward shift in RA, an upward shift in DEP, and therefore in MC, all by the same amount. The new equilibrium DEP is thus the same as the old DEP, RL rises by precisely the same amount as the other rates, and profits are unchanged.

Thus far I have dealt with a change in RA or in all the competing rates. To complete the discussion, I must examine the effect of a change in one of the competing rates, with other rates constant. An increase in the interest rate on one of the competing instruments shifts upward one of the component curves composing DEP. For example, if the rate on Euro-dollar deposits increases, DEPRW will shift upward by the amount of the increase since an equivalent increase in RL would leave the differential and therefore DEPRW unchanged. If other interest rates remain unchanged, the upward shift in the overall DEP curve will be less than that in the component curve. Hence RL rises, but by less than the full amount of the rise in the rate on Euro-dollar deposits (and by less than the amount of the increase in RL if all the competing rates rise). One can think of this situation as follows: The Canadian bank will lose some rest-of-world deposits if it fails to raise RL following the rise in the Euro-dollar rate. If the bank increases RL by the full amount of the increase in the Euro-dollar rate, it will maintain the same level of rest-of-world deposits but increase its Canadian and American deposits beyond the optimum. Hence, the bank compromises. It raises RL by a fraction of the increase in the Euro-dollar rate - the magnitude of the fraction will depend on the shape of the

various deposit functions. A similar story can be told for increases in interest rates on financial instruments competing for U.S. and Canadian funds.

There is a further implication of this analysis that will prove to be useful later. The magnitude of the effect of a change in one competing rate on RL is a function of the effect of the increase in that competing rate relative to other competing rates in reducing the amount of deposits at Canadian banks if RL is left unchanged. For example, if the effect of the change in the competing rate on deposits is very large, then the Canadian banks will respond by significantly increasing RL so as not to lose a substantial amount of deposits. If, on the other hand, the effect of the increase in the competing rate on deposits is small, then the Canadian banks will make only a small increase in RL.[6]

Because the rate on swapped deposits is equal to the sum of RL and RFS, an increase in RFS will increase the rate on swapped deposits and hence the differential between the rate on swapped deposits and the rate on competing instruments unless the latter are covered U.S. dollar instruments. Thus an increase in RFS is equivalent to a decline in the rate on a competing Canadian dollar instrument (or on a competing uncovered U.S. dollar instrument) and will result in a downward shift of the DEP curve and therefore in a fractional decrease in RL. Since an increase in RFS leads to a fractional decline in RL, RSD will rise, causing an increase in the amount of swapped deposits (and possibly split swaps), but the magnitude of all other deposits will fall because of the reduction in RL. The overall effect will probably be an increase in total foreign currency deposits

(including swapped deposits) at Canadian banks. It can also be shown (see Appendix 1 to this chapter) that the effect on RL of a decrease in RFS is equal to or less than the effect of an equal increase in the interest rates on competing instruments that are arguments in the SD and the NSD function.

Generalizing from the above model, one can argue that the regression equation for the period prior to the guidelines should have the following functional form:

RL = f_1(interest rates on assets in which the banks invest, interest rates on financial instruments competing with chartered bank foreign currency deposits, the interest rate implied by the forward spread).

The coefficients on the interest rates are expected to be positive fractions summing to 1 and the coefficient on RFS is expected to be a negative fraction. The results of such a regression will be presented later in this chapter.

I have argued above that the importance of a given competing rate in the determination of RL is a function of the effect, ceteris paribus, of a change in that rate on the quantity of deposits demanded. Application of the U.S. balance of payments programme of February 1965 reduced substantially the effect of a change in interest rates on DEPUS. That is, the guidelines reduced the effect on DEPUS of a change in competing U.S. rates (and also of a change in RL). Hence, for the period after the imposition of the programme, one would expect the effect of the competing U.S. rate on RL to decline substantially compared to its effect prior to the application of the programme. Thus the regression equation for the period February 1965 to March 1968 will be the same as the regression equation for the period

January 1962 to February 1965 except that the coefficients on the rates of interest of instruments competing for U.S. funds should be lower for the later period; and, since the sum of all the interest rate coefficients equals 1, the coefficients on competing Canadian rates and competing rest-of-world rates should be higher for the later period.

2. The guidelines period

In the guidelines period separate interest rates were posted on deposits by residents of Canada, the United States, and the rest of the world. I begin by treating in detail the case in which Guidelines 1 and 2 are imposed on the banks but Guideline 3 is assumed not to exist. I then introduce the effect of Guideline 3 into the analysis.

By ignoring Guideline 3 I reduce the relevant geographic areas to two - North America (Canada and the United States) and the rest of the world. The rates paid on deposits by residents of the two areas are RLNA (which is simply the common rate for RLCAN and RLUS) and RLRW, respectively. One can then distinguish two cases. When the constraints of Guidelines 1 and 2 were not binding[7] (a situation that occured when interest rates in North America were the same as or higher than interest rates in the Euro-dollar market) rest-of-world deposits were not superior to North American deposits, with the result that RLRW and RLNA were equal. The model of the period prior to the guidelines is then appropriate. For most of the 1968-1971 period, however, interest rates in the Euro-dollar market exceeded those in North America and therefore RLRW exceeded RLNA. I analyze this case by assuming that, when Guidelines 1 and 2 were binding, rest-of-

world deposits were entirely placed in rest-of-world assets (ASSETRW), which bear the rate RARW, and that North American deposits were placed in North American assets (ASSETNA), which bear the rate RANA.[8] This assumption gives

ASSETRW = DEPRW (2')

ASSETNA = DEPUS + NSD + SD

The profit function incorporating Guidelines 1 and 2 is thus as follows:

PROF = [(ASSETNA)(RANA) + (ASSETRW)(RARW)] (1')

- [(DEPUS)(RLNA) + (DEPRW)(RLRW)

+ (NSD)(RLNA) + (SD)(RSD-RFS)]

One can then combine (1'), (2') and (3) to get

PROF = (DEPRW)(RARW-RLRW) (5')

+ (DEPUS+NSD+SD)(RANA-RLNA)

The net profit on each category of foreign currency deposit is thus equal to the magnitude of the deposit times the profit margin on that category. The banks now control the two interest rates, RLNA and RLRW, and set these so as to obtain the maximum profit, given the interest rates on the assets in which the banks invest (RANA and RARW), the interest rates on competing instruments, and RFS. Figure 11 is a portrayal of the maximum profit position. In this position the marginal revenue from each source of funds is equated to its marginal cost.

The above analysis implies the following regression equations for RLNA and RLRW when Guidelines 1 and 2 were binding constraints:

RLRW = f_2(RARW, interest rates on instruments competing for rest-of-world funds).

RLNA = f_3(RANA, interest rates on instruments competing for

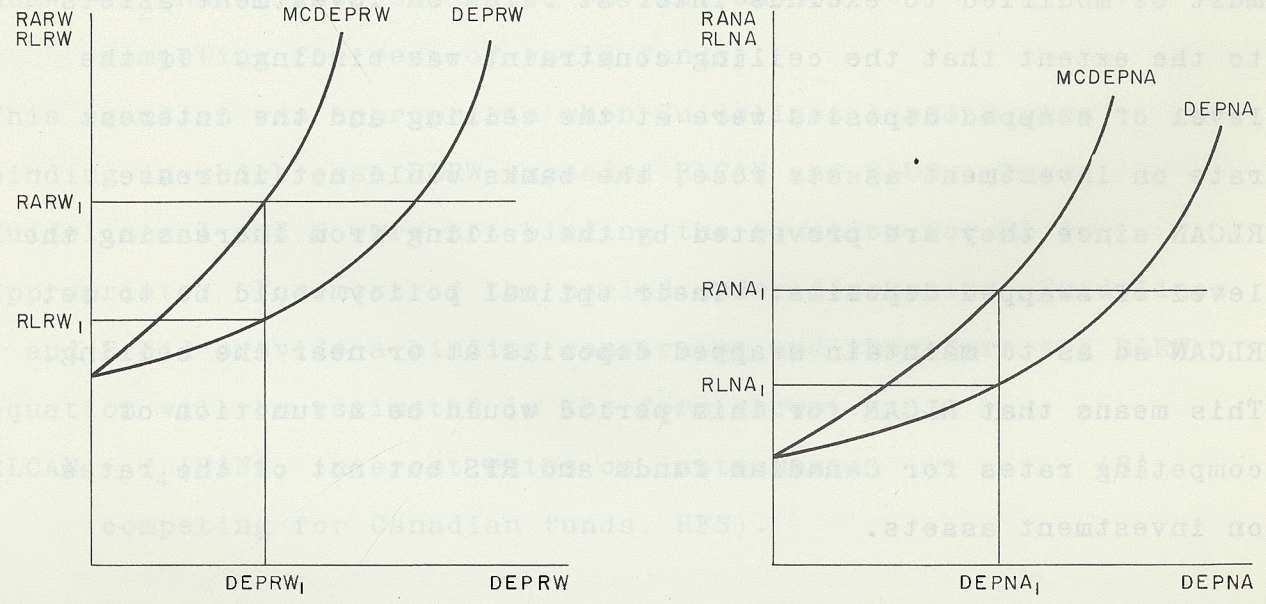
North American funds, RFS).

The coefficient on each interest rate is expected to be a positive fraction, the sum of the interest rate coefficients is expected to be 1, and the coefficient on RFS is expected to be a negative fraction.

The effect of Guideline 3 must now be integrated into the analysis. I continue to assume that Guidelines 1 and 2 are binding. Recall that there are two ways in which the banks could satisfy Guideline 3. If they wish to increase their investments in the United States above the February 1968 level, they will hold their liabilities to U.S. residents below the February 1968 level. In this case, the rate on U.S. deposits (RLUS) will generally be set so as to maintain U.S. deposits near the February 1968 level[9]. An increase in rates on instruments competing for U.S. funds will lead the banks to increase RLUS in

Figure 11

THE SETTING OF RLNA AND RLRW IN THE GUIDELINES PERIOD



order to hold U.S. deposits at about the same level. An increase in RANA, however, will have no effect on RLUS since the banks are prevented from increasing the level of U.S. deposits above the February 1968 level in any case. If the banks satisfy Guideline 3 by borrowing in the United States in order to invest in Canada, then RLUS will equal RLCAN and RLUS will therefore be a function of RANA (in this case the rate on foreign currency assets in Canada) and rates on instruments competing for Canadian and U.S. deposits. During much of the guidelines period under study (1968-1971) most of the banks kept their deposits below the February 1968 level and one would therefore expect RLUS to have been a function of competing U.S. rates only.

The implication of the above discussion is that RLCAN is a function of investment rates on North American assets, competing rates for Canadian funds (and competing rates for U.S. funds in periods when Guideline 3 was satisfied in the second way), and RFS. However, for the period July 1969 to March 1970 when a ceiling was imposed on swapped deposits, the regression for RLCAN must be modified to exclude interest rates on investment assets to the extent that the ceiling constraint was binding. If the level of swapped deposits were at the ceiling and the interest rate on investment assets rose, the banks would not increase RLCAN since they are prevented by the ceiling from increasing the level of swapped deposits. Their optimal policy would be to set RLCAN so as to maintain swapped deposits at or near the ceiling. This means that RLCAN for this period would be a function of competing rates for Canadian funds and RFS but not of the rates on investment assets.

B. Empirical Results

For convenience I repeat and discuss briefly the theoretical regression equations.

Period prior to guidelines

$RL = f_1$(interest rates on all investment assets, (6)
interest rates on all competing instruments, RFS).

I have argued that the size of the coefficients on interest rates on U.S. instruments competing for the funds of American depositors should fall in the period following the introduction of the U.S. balance of payments programme compared to their size in the period before the programme was introduced and that the coefficients on other competing rates should rise. One would therefore expect a break in the structure dated February 1965 with the indicated effect on the magnitude of the coefficients.

Guidelines period

$RLRW = f_2$(RARW, interest rates on instruments (7)
competing for rest-of-world funds).

This equation was appropriate when Guidelines 1 and 2 were binding in which case RLRW exceeded RLCAN and RLUS. When Guidelines 1 and 2 were not binding the equation for RL is appropriate. For most of the period under discussion, Guidelines 1 and 2 did provide a binding constraint and therefore the RLRW equation will be estimated in the form shown.

$RLCAN = f_4$(RANA, interest rates on instruments (8)
competing for Canadian funds, RFS).

This is the preferred equation when Guidelines 1 and 2 were binding and when Guideline 3 was satisfied by American deposits being held below their February 1968 level. When a ceiling on swapped deposits was in effect (July 1969 to March 1970), the rates on North American assets (RANA) would be dropped from the equation.

RLUS = f_5(interest rates on instruments competing for U.S. funds). (9)

This is the preferred equation for the period in which Guideline 3 was satisfied by the holding of American deposits below their February 1968 level.

For equations (6), (7), (8) and (9) I expect that each interest rate coefficient is a positive fraction, the sum of the interest rate coefficients is unity, and the coefficient on RFS is a negative fraction in absolute value equal to or less than the sum of the coefficients on competing interest rates in the SD and NSD functions.

Unfortunately the theory described above gives no indication of which real world interest rates belong in the class of competing rates in the various deposit demand functions. The situation regarding interest rates on assets in which the banks invest is somewhat better because the classes of assets in which the banks invest are known and interest rate data for these assets are available. The strategy used in this chapter is to run initial regressions of RL containing, as explanatory variables, RFS and all interest rates that might reasonably fall into the category of competing interest rates or investment interest rates. Those rates that are insignificant or that have the wrong sign are then dropped and the regression is allowed to

choose which interest rates belong. That is, the decision as to which financial instruments are substitutes for foreign currency deposits at Canadian banks and which investment assets are most important to Canadian banks is based on the empirical results. This approach is not as arbitrary as might appear at first glance, since the theory developed above and summarized in the theoretical regression equations (6), (7), (8), and (9) implies rather strongly which variables should and should not enter significantly. For example, competing rates for rest-of-world funds should include the Euro-dollar rate but they are unlikely to include the rate on Canadian finance paper. Similarly the effect on the coefficients of the break in structure in February 1965 and of the imposition of the ceiling on swapped deposits in 1969-1970 can be examined for conformity with theoretical expectations. Thus the fairly strong theoretical assumptions used have led to fairly explicit implications regarding the inclusion of variables, the signs of coefficients, and, in some cases, the magnitude of the coefficients.

The interest rate series used throughout the study are collected from a variety of sources by the Bank of Canada. In most cases the rates are those prevailing on Wednesday of each week. Where a different basis is used, I attempt to adjust the rates in order to make them comparable. A detailed discussion of interest rates and other data appears in Notes on Empirical Variables at the end of this study. The following mnemonics denoting interest rates are used throughout:

RCCD Interest rate on ninety-day deposit receipts at Canadian banks. (Interest rate on Canadian dollar certificates of deposit.)

then uncover. In each case a small difference between RSD and RL + RFS would not make such a transaction profitable (because of transaction costs) but a major difference might well cause a large shift by depositors - yet such shifts do not appear to occur. Fifth, for some of the later years, independent information is available on RL and RLCAN; when these data are used one gets similar regression results to those obtained by using RSD - RFS.

The data for RLRW and RLUS come from the weekly (Thursday) report of the Foreign Exchange Adviser, International Department, Bank of Canada based on his conversations with one or two of the banks. The quality of these data is probably not as good as the quality of the RL and RLCAN data and therefore the regression results based on the RLRW and RLUS data must be viewed with some caution.

A final consideration in shaping the form of the empirical work is the peculiar form of the data. For 1962 through 1967 the rate on swapped deposits is as of Wednesday; for 1968 through 1971 it is an average for the week ending on Wednesday. To make the other variables consistent with this formulation, I took simple averages of consecutive Wednesday data for RFS and for all the interest rate series for the years 1968 to 1971. The figures used are available weekly from January 3, 1962 to December 29, 1971 with the following exceptions: Data for RUSCD are available only from July 17, 1963. Observations on RUSCD are missing for December 24 and December 31, 1969. Observations on RUSCL are missing for these two dates and also for October 15, 1969, November 12, 1969, February 11, 1970, and December 29, 1971. There are no observations on RSD for January 3, 1968 and for the

period March 13, 1968 to June 5, 1968, during which time the banks were requested by the Bank of Canada not to facilitate transactions in swapped deposits. In the regressions containing variables that lack observations I simply omit these observations from the regression period.

The regressions explaining RL, RLCAN, RLRW, and RLUS are presented in Tables 3, 4, and 5. The figures in parentheses are t-statistics. The summary measures reported are: SEE, the standard error of estimate; R^2, the coefficient of multiple determination; COV, the coefficient of variation; and DW, the Durbin-Watson statistic. For the equations using the Hildreth-Lu autoregressive transformation [27] I use R^2 defined as $1-(\Sigma u_i^2/\Sigma y_i^2)$ where u_i is the residual from the autoregressive equation and y_i is the deviation from the mean of the untransformed dependent variable. The coefficient of variation is defined as the SEE taken as a percentage of the mean value of the dependent variable. For the equations with the autoregressive transformation I use the mean of the untransformed dependent variable in the denominator.

In the regressions explaining RL for the period prior to the guidelines each of the variables RUSCD, RUSCL, RUSFP, and RCPRI has the wrong sign or is of low significance. The regression of RL on the remaining variables is shown in the first line of Table 3. The most important interest rate variable both in terms of magnitude of coefficient and in terms of t-statistic is RCFP followed closely by RUSPRI, RED, and RUSTB. Because the Durbin-Watson statistic showed strong positive autocorrelation of the disturbances, the regression of RL was run a second time using the Hildreth-Lu autoregressive technique. The results are shown

Table 3

WEEKLY REGRESSIONS OF RL FOR THE PERIOD PRIOR TO THE GUIDELINES

Period	C	RCFP	RCCD	RUSPRI	RUSTB	RED	RFS	U_{-1}	SEE	R^2	COV	DW
Jan.3/62 to Mar.6/68	-.52 (5.0)	.34 (7.7)	.07 (1.7)	.30 (7.7)	.19 (4.4)	.20 (4.1)	-.44 (11.9)		.177	.963	3.94	0.77
	-.44 (2.2)	.35 (6.1)	.04 (0.7)	.31 (4.4)	.23 (3.6)	.15 (2.7)	-.48 (12.1)	.64	.139	.979	3.10	2.15
Jan.3/62 to Feb.3/65	-.50 (2.1)	.36 (5.1)	.18 (2.9)	.28 (6.6)	.30 (4.4)		-.55 (9.1)		.165	.968	3.68	0.96
	-.30 (0.7)	.28 (3.3)	.13 (1.4)	.29 (3.8)	.39 (4.5)		-.47 (7.5)	.58	.138	.979	3.09	2.10
Feb.10/65 to Mar.6/68	-.30 (2.3)	.35 (6.1)		.28 (6.6)		.37 (6.8)	-.27 (5.8)		.165	.968	3.68	0.96
	-.32 (1.3)	.48 (6.6)		.29 (3.8)		.24 (3.6)	-.43 (8.2)	.58	.138	.979	3.09	2.10

in the second line of Table 3. As can be seen the coefficient estimates were not greatly changed by the use of the autoregressive transformation.

I now turn to a more detailed analysis of the period prior to the guidelines. Institutional considerations suggest a structural break in February 1965 with the imposition of the U.S. restrictions on capital flows. Unfortunately, the usual Chow test [13] and [18] on the existence of a structural break cannot be carried out for the period prior to the guidelines, because the U.S. prime rate (RUSPRI) is a constant over the period January 1962 to February 1965. Therefore no regression that includes RUSPRI can be run for this period. To get around this problem, I use a variant of the Chow test designed for periods with insufficient observations but usable in this case as well.[11] The F-statistic on the test of the null hypothesis, that the coefficients were unchanged by the imposition of the U.S. balance of payments programme, is equal to 1.40 compared to a critical F of 1.31 (5%). Thus the statistical results indicate rejection of the hypothesis of no structural change.

A further insight into the period prior to the guidelines can be gained by allowing the constant and the coefficients of all the variables except RUSPRI to vary between the 1962-1965 period and the 1965-1968 period. Theory suggests that the coefficient on the interest rates of financial instruments competing for U.S. funds with foreign currency deposits in Canadian banks should decline in the 1965-1968 period while the coefficients on other competing rates should rise and the coefficients on the interest rates for bank investments should remain roughly constant. The regression that allows the constant

and all interest rates except RUSPRI to vary is shown in equation (10) (where 1 represents the period January 1962 to February 1965 and 2 represents the period from February 1965 to March 1968). The results are similar for the regression with autoregressive transformation, which is not presented.

$$
\begin{aligned}
RL = &- .45\,C1 + .36\,RCFP1 + .19\,RCCD1 + .32\,RUSTB1 - .03\,RED1 \\
&\quad (1.5) \quad (5.1) \quad (2.9) \quad (3.8) \quad (0.4) \\
&- .56\,RFS1 - .26\,C2 + .37\,RCFP2 - .00\,RCCD2 - .07\,RUSTB2 \\
&\quad (9.1) \quad (1.7) \quad (5.9) \quad (0.0) \quad (1.0) \\
&+ .40\,RED2 - .27\,RFS2 + .28\,RUSPRI \\
&\quad (6.3) \quad (5.5) \quad (4.9)
\end{aligned}
\tag{10}
$$

$$SEE = .165 \quad R^2 = .968 \quad COV = 3.69\% \quad DW = 0.97$$

Thus the coefficient on RED is approximately zero in the 1962-1965 period and the coefficients on RCCD and RUSTB are approximately zero in the 1965-1968 period. The disappearance of RUSTB, the competing interest rate for U.S. funds, is consistent with theoretical expectations. Using constrained estimation techniques I regressed RL on RCFP, RCCD, RUSPRI, RUSTB, and RFS for the period January 1962 to February 1965 and on RCFP, RUSPRI, RED, and RFS for the period February 1965 to March 1968 with the added requirement that the coefficient on RUSPRI be the same for both regressions.[12] The result of this regression is presented in the bottom four lines of Table 3. As before the autoregressive transformation makes relatively little difference to the results.

As mentioned above, in all the equations for the period prior to the guidelines the rates RUSCD, RUSCL, and RUSFP entered with the wrong sign or with very low significance. The results are surprising on the surface in that Altman [2] pp 306-307

argues that RL was related to the interest rates paid by U.S. banks. However, Munro [31] p 6 suggests that in the early period the U.S. treasury bill was the financial instrument with which U.S. dollar deposits at Canadian banks competed. Munro's assertion is borne out by the size and significance of the RUSTB variable in the 1962-1965 period. The insignificance of the New York call loan rate may be due to the fact that call loans, although large on average in this period, were not marginally very important. That is, new funds were invested mainly in current loans rather than in call loans.

An interesting aspect of these regressions is the importance of RUSPRI in all the equations. A significant proportion of the increase in assets during the period was placed in current loans. It appears from the regression results that the rate charged on current loans was related to RUSPRI[13] even for loans to residents of Canada. These loans to Canadians accounted for about 15% of head office foreign currency assets over the period prior to the guidelines. Substantial loans to non-residents were also made at head office, amounting to approximately 10% of head office foreign currency assets over the same period. In the early part of the period a significant portion of these loans went to residents of the United States, but toward the end of the period most of them went to residents of other countries.

The main competing interest rates in the period prior to the guidelines were the rates on Canadian finance paper (RCFP) and certificates of deposit (RCCD), the rate on U.S. treasury bills in 1962-1965 (RUSTB), and the rate on Euro-dollar deposits in 1965-1968 (RED). These results are consistent with the relative importance of Canadian deposits as a proportion of total head

office deposits (32% on average over the period prior to the guidelines), the relative decline of U.S. deposits, and the rise of rest-of-world deposits following the introduction of the U.S. balance of payments programme in February 1965.

In Tables 4 and 5 I present the regressions explaining RLCAN, RLRW, and RLUS for the guidelines period. The RLCAN regressions for the entire guidelines period (with and without autoregressive transformation) are presented in the top two lines of Table 4. Theory indicates that the period with the ceiling on swapped deposits (July 1969 to March 1970) should have a different equation from the rest of the period. The test of the null hypothesis, that the ceiling made no difference for the regressions with the five interest rates (RCFP, RCCD, RUSPRI, RUSTB, RED) and RFS, yields an F of 7.04 compared to a critical F of 2.06 (5% level). Hence the two sub-periods within the guidelines period must be treated separately.

In the regression of RLCAN on the five interest rates and on RFS for the guidelines period excluding the ceiling, the coefficients of RUSTB and RED are equal to -.01 and .00, respectively (regression not presented). When the same regression is done for the ceiling period, RCCD and RUSPRI have the wrong sign and RUSTB is insignificant (regression not presented). When I drop the insignificant and wrong-signed variables, I get the results presented in the last four lines of Table 4. In the theoretical section of this chapter I have argued that, when there is a ceiling on swapped deposits, RLCAN should be a function of competing rates for Canadian funds and RFS but not a function of rates on bank investments. The equation for the ceiling period does show this pattern, since

Table 4

WEEKLY REGRESSIONS OF RLCAN FOR THE GUIDELINES PERIOD

Period	C	RCFP	RCCD	RUSPRI	RUSTB	RED	RFS	U_{-1}	SEE	R^2	COV	DW
June 12/68 to Dec.29/71	-.12 (0.6)	.51 (6.7)	.10 (1.7)	.32 (5.8)	.07 (1.8)	.04 (1.8)	-.85 (20.2)		.180	.986	2.49	1.01
	.05 (0.2)	.59 (6.3)	.05 (0.7)	.30 (3.5)	.05 (0.8)	.04 (1.2)	-.88 (15.3)	.51	.157	.989	2.17	2.04
June 12/68 to July 9/69 and	-.19 (1.2)	.44 (7.0)	.29 (4.0)	.34 (6.3)			-.94 (33.8)		.161	.987	2.36	1.35
Apr.1/70 to Dec.29/71	-.07 (0.3)	.53 (7.1)	.16 (2.1)	.35 (4.7)			-.93 (24.6)	.37	.152	.990	2.23	1.98
July 16/69 to Mar.25/70	.10 (0.1)	.82 (4.7)				.16 (2.4)	-.75 (5.5)		.190	.818	2.12	0.94
	.66 (0.4)	.73 (3.0)				.18 (1.9)	-.79 (4.3)	.58	.162	.866	1.81	2.16

RUSPRI drops out of the regression. Rather surprisingly, RED re-enters the regression for this sub-period. There is a plausible explanation for such a result. While the ceiling was in force the rate on Euro-dollar deposits reached extremely high levels[14] and consequently some Canadian residents may have treated the Euro-dollar deposit as a possible investment in a way they had not done previously. The Euro-dollar rate would then have become a competing rate for Canadian funds and have influenced the setting of RL. Some indirect evidence supporting this explanation can be derived by combining Bank of England data and Bank of Canada data to get a series representing the U.S. dollar claims of Canadian non-banks (ie, total Canadian claims minus claims of Canadian banks) on U.K. banks. These claims tripled between June 1969 and March 1970, a period that coincided with the ceiling on swapped deposits, but during the twenty-one months between March 1970 and December 1971 the increase was only 46%.

In the equation for the guidelines period excluding the ceiling, RUSPRI plays an important role, which indicates that a large part of the deposits by Canadians was placed in current loans. I shall argue in Chapter 5 that loans to U.S. residents by the New York agencies were the most important use of chartered bank North American funds in this period.

A Chow test was run to determine whether the pre-ceiling period and post-ceiling period have the same structure. The test of the null hypothesis of no structural change yielded an F-statistic of 1.84 compared to a critical value of 2.28(5%). The pre-ceiling period and the post-ceiling period will therefore continue to be considered as a single period.

I now turn to a brief discussion of RLRW and RLUS, the interest rates on deposits by residents of the rest of the world and by residents of the United States in the guidelines period. The method of approach in the regressions for these variables was precisely the same as that used in the analysis of RL. I began by regressing RLRW and RLUS on all the interest rates and RFS. The variables that were insignificant or had the wrong sign were then dropped and I proceeded in stages to the regressions presented in Table 5. RLRW is mainly a function of RED, as was to be expected, and to a much smaller extent of RUSFP. These results suggest that residents of the rest of the world are comparing the rates offered by Canadian banks with Euro-dollar rates and rates on American market instruments. The data on RLUS are available only for the year 1971; therefore the results must be treated with extreme caution. According to the regression this rate is highly sensitive to RUSCD and to a much smaller extent to RUSPRI.[15] The equation for RLUS, using the Hildreth-Lu technique, was unchanged from the ordinary least squares equation.

The preferred regressions are therefore shown in the last four lines of Table 3 for RL, in the last four lines of Table 4 for RLCAN, and in Table 5 for RLRW and RLUS. Using these regressions I can now test the hypothesis suggested by the theory that the sum of the coefficients on the interest rate variables should equal 1. For the six preferred regressions with autoregressive transformation this sum is equal to 1.09, 1.01, 1.04, 0.91, 1.01, and 1.14, respectively. The t-statistic on the test of the null hypothesis, that the sum equals 1, is equal to 0.8, 0.2, 1.3, 0.4, 0.2, and 2.6, respectively. The critical

Table 5

WEEKLY REGRESSIONS OF RLRW AND RLUS FOR THE GUIDELINES PERIOD

Dependent Variable	Period	C	RUSFP	RUSCD	RUSPRI	RED	U_{-1}	SEE	R^2	COV	DW
RLRW	Aug./68 to Dec./71	.18 (1.1)	.24 (4.9)			.76 (21.4)		.413	.938	5.22	1.08
		.28 (1.0)	.35 (4.5)			.66 (12.0)	.52	.362	.966	4.57	2.17
RLUS	Jan./71 to Dec./71	-.35 (1.2)		1.01 (33.6)	.13 (2.2)			.120	.969	2.37	1.79

t-value is approximately 1.96 (5%) and 2.576 (1%) for a two-tailed test. Thus there is only one equation in which the sum of the coefficients significantly exceeds 1 - that for RLUS in the guidelines period.

The second hypothesis examined is that the coefficient on RFS is not greater in absolute value than the sum of the coefficients on the interest rates of instruments competing for Canadian funds. This hypothesis can be restated as follows: The coefficient on RFS plus the sum of the coefficients on the competing interest rates is greater than or equal to zero. This second sum is either positive or insignificantly less than zero except in the guidelines period without the ceiling during which time it is significantly less than zero. There is no apparent explanation for the latter result.

A number of assertions about the setting of interest rates can be examined with the aid of variants of the equations presented thus far. The first of these assertions is the notion that a stock adjustment model is a satisfactory representation of the setting of RL or Euro-dollar rates in general. (See Munro [31] and Hendershott [26], respectively.) The coefficient of a lagged dependent variable (added to the basic equation) is significant in equations without autoregressive transformation but loses all significance when the Hildreth-Lu technique is used. For example, for the period February 1965 to March 1968 I obtained the following pair of equations:

$$\begin{array}{l} RL = -.21 + .27\,RCFP + .17\,RUSPRI + .25\,RED - .22\,RFS \\ \qquad\quad (1.7)\ (5.1)\qquad (3.9)\qquad\quad (4.6)\qquad (5.1) \\ \qquad + .30\,RL_{-1} \\ \qquad\quad (4.8) \end{array} \tag{11}$$

$$SEE = .150 \quad R^2 = .948 \quad COV = 2.87\% \quad DW = 1.65$$

$$RL = -.27 + .45\,RCFP + .29\,RUSPRI + .26\,RED - .41\,RFS + .00\,RL_{-1} + .52\,u_{-1} \quad (12)$$
$$(1.2)\ (6.4)\qquad (3.9)\qquad (3.8)\qquad (7.7)\qquad (0.1)$$

$$SEE = .142 \quad R^2 = .967 \quad COV = 2.72\% \quad DW = 2.02$$

These results are consistent with Griliches's observation [22] pp 33-34 that the lagged dependent variable can enter an equation very significantly even if it does not belong to the underlying structure by 'picking up' the effect of first-order serial correlation of the errors. This mis-specification cannot be identified through the Durbin-Watson statistic because the latter is biased toward 2 in the presence of a lagged dependent variable. (See Nerlove and Wallis [32].)

Although it is inappropriate to use a stock adjustment model in the determination of interest rates a simple one-period lag may exist. That is, this week's interest rate setting on RL may be responding to last week's interest rate in other markets. To test this possibility, I entered all the independent variables both currently and with a one-period lag. In no case did the lagged variable have the correct sign and a significant t-statistic.

Another assertion often made is that the banks raise rates in order to show larger than usual assets and liabilities at their year-end in October. To test this assertion, I ran a regression with monthly averages of interest rate data and a dummy for October. Although it had the correct sign, the dummy was not significant.

Yet another possibility is that monetary tightness in Canada may cause the banks to increase RL to attract foreign currency

funds that then can be transformed into Canadian dollars and used in turn to make loans. To test this possibility I added to the basic equations the RDX2 variable RABEL [25] defined as the earning liquid asset ratio of the chartered banks, ie, the ratio of liquid assets (excluding those needed for meeting primary and secondary reserve requirements) to the total Canadian dollar assets of the banking system plus net foreign assets. Three variants of RABEL were used: RABEL, the first difference of RABEL, and RABEL de-trended. Each was added to the basic equations employing the monthly averages of interest rates. With one exception, the coefficient of RABEL had either the wrong sign or was insignificant. The exception was in the ceiling period July 1969 to March 1970 and even here RABEL was on the margin of insignificance with a one-tailed test at the 5% level.

Most of the regressions presented above have serious autocorrelation of disturbances as shown by the low Durbin-Watson statistics. The theoretical model described implies that the coefficient of each interest rate variable is approximately equal to the ratio of various partial derivatives. If the partial derivatives increase as the magnitude of deposits related to them increases (as would occur, for example, if elasticities are constant), then the coefficient of the interest rate variable will be directly related to the magnitude of the appropriate type of deposit. For example, the coefficient of RED should increase over time as deposits by Europeans rise relative to deposits by Canadians. Attempts to incorporate this notion, in the expectation that its omission is responsible for the autocorrelation of disturbances, yielded results that were not superior to those obtained from the simple model.

Appendix 1 to Chapter 2

A MATHEMATICAL FORMULATION OF THE MODEL

In this appendix, I derive mathematically the results appearing in the text of Chapter 2 within the context of a somewhat more complicated model than is there developed. The banks are assumed to maximize their net profits from transactions in foreign currency assets and liabilities.

$$PROF = [(AFC1)(RA1) + (AFC2)(RA2)] - [(DEPUS)(RLUS) + (DEPRW)(RLRW) + (NSD)(RLCAN) + (SD)(RSD-RFS)] \quad (A1)$$

This approach is the same as that used in the text of Chapter 2 except for the existence of two foreign currency assets, AFC1 and AFC2, with interest rates RA1 and RA2. The assumption of zero net foreign assets (to be relaxed in Chapter 4) implies that

$$AFC1 + AFC2 = DEPUS + DEPRW + NSD + SD \quad (A2)$$

I repeat here the relationship between RSD and RLCAN, namely

$$RSD = RLCAN + RFS \quad (A3)$$

The demand functions for foreign currency deposits at Canadian banks are assumed to have as arguments the differential between the interest rate on foreign currency deposits at Canadian banks and the interest rates on competing assets. Hence

$$DEPUS = DEPUS\ (RLUS-RCUS) \quad (A4)$$

$$DEPRW = DEPRW\ (RLRW-RCRW)$$

$$NSD = NSD\ (RLCAN-RCNSD) \text{ or } NSD = NSD(RLCAN+RFS-RCNSD)$$

$$SD = SD\ (RSD-RCSD)$$

where RCUS, RCRW, RCNSD, and RCSD are the interest rates on instruments that compete for the funds of U.S. depositors, rest-of-world depositors, and Canadian holders of non-swapped

deposits and swapped deposits, respectively.[16] These competing rates may be the same or different. For example, the Euro-dollar rate might enter both the DEPRW and NSD functions. It is likely that RCRW and RCUS are rates on competing U.S. dollar instruments (eg, U.S. finance paper, U.S. treasury bills, U.S. certificates of deposit, and Euro-dollar deposits) and that RCSD is a rate on a Canadian dollar instrument (eg, Canadian finance paper, and Canadian certificates of deposit). The rate RCNSD may be the rate on a U.S. dollar instrument if holders of non-swapped deposits generally compare a non-swapped deposit with a U.S. dollar instrument. On the other hand, if non-swapped deposits represent mainly split swaps, then the appropriate differential to enter into the NSD function is (RLCAN+RFS-RCNSD), since holders of split swaps will behave like holders of ordinary swapped deposits. In this case RCNSD is likely to be the rate on a Canadian dollar instrument or the rate on a covered U.S. dollar instrument.

For all of the functions in equation (A4), the first derivative of the function with respect to its argument is positive (an increase in the differential leads to an increase in deposits demanded) and the second derivative is zero or negative. This implies demand curves of the sort shown in Figure 7, with a straight line demand curve replacing the curved demand curve if the second derivative is zero.

The final assumption needed to carry out the analysis concerns the portfolio allocation behaviour of the banks as the interest rates on the investment assets change. I assume that

$$AFC1/(AFC1+AFC2) = f(RA1-RA2) \text{ and } f' > 0 \qquad (A5)$$

The proportion of total funds placed in the first asset is an increasing function of the differential between RA1 and RA2.

In this appendix I focus on the period prior to the guidelines and then comment briefly on the changes needed to deal with the guidelines period. Since there was no distinction between depositors on the basis of nationality before May 1968, the interest rates on all classes of foreign currency deposits were the same. Therefore

$$RLUS = RLRW = RLCAN \qquad (A6)$$

I shall use the term RL to denote the common interest rate in the period prior to the guidelines.

Equations (A1), (A2), (A3), (A5), and (A6) can be combined to give the profit function in the period prior to the guidelines

$$PROF = [DEPUS+DEPRW+NSD+SD][(f)(RA1)+(1-f)(RA2)-RL] \qquad (A7)$$

(Remember that f is a function of the difference between RA1 and RA2.) The net profit from transactions in foreign currency assets and liabilities is equal to the amount of deposits times the profit margin, which is the difference between the weighted average of the interest rates on assets in which the banks invest and the rate paid on deposits. The profit-maximizing position can be found by the differentiation of this expression with respect to RL and by setting the result equal to zero. This gives

$$[(f)(RA1)+(1-f)(RA2)][\frac{\partial}{\partial RL}(DEPUS+DEPRW+NSD+SD)] \qquad (A8)$$

$$= RL[\frac{\partial}{\partial RL}(DEPUS+DEPRW+NSD+SD)] + [DEPUS+DEPRW+NSD+SD]$$

The left-hand side of equation (A8) is the marginal revenue obtained from increasing RL, namely the earnings from investing in AFC1 and AFC2 the extra funds attracted by the increase in RL.

The right-hand side is the marginal cost of increasing RL and consists of two terms. The first term is the interest payments on the extra funds attracted by the increase in RL. The second term is the increase in the interest payments on existing liabilities caused by the increase in RL.[17]

It is easy to show that the second-order condition for a maximum is satisfied at the extremum. The usual methods of comparative statics analysis are then employed to yield the following results:

$0 < (dRL/dRCUS) < 1$ (A9)

$0 < (dRL/dRCRW) < 1$ (A10)

$0 < (dRL/dRCNSD) < 1$ (A11)

$0 < (dRL/dRCSD) < 1$ (A12)

$0 < (dRL/dRA1) < 1$ if a certain condition discussed below is met (A13)

$0 < (dRL/dRA2) < 1$ if a certain condition discussed below is met (A14)

$-1 < (dRL/dRFS) < 0$ (A15)

Also the following relationships can be derived:

$dRL/dRCUS + dRL/dRCRW + dRL/dRCNSD + dRL/dRCSD + dRL/dRA1 + dRL/dRA2 = 1$ (A16)

$- dRL/dRFS \leq dRL/dRCNSD + dRL/dRCSD$ (A17)

The effect of a change in one of the competing rates on RL is a positive fraction. The precise expression for dRL/dRCUS, for example, is

$$\frac{\frac{\partial DEPUS}{\partial RL} - \frac{\partial^2 DEPUS}{\partial RL^2}\left[f(RA1)+(1-f)(RA2)-RL\right]}{2\frac{\partial DEP}{\partial RL} - \frac{\partial^2 DEP}{\partial RL^2}\left[f(RA1)+(1-f)(RA2)-RL\right]}$$

where DEP = DEPUS + DEPRW + NSD + SD

Because the second partial derivatives are multiplied by the net profit margin, a number on the order of .01 or .02, the dominant factors in this expression are generally the first partial derivatives. Clearly the size of dRL/dRCUS is a function of the relative sizes of ∂DEPUS/∂RL and of the partial derivatives of the other deposit functions with respect to RL. It follows that a decline in ∂DEPUS/∂RL, such as occurred following the introduction of the U.S. balance of payments programme in February 1965, will reduce dRL/dRCUS. Corresponding statements can be made about the effect of changes in the other competing rates on RL.

Expression (A16) is the assertion that an equal increase in all rates leads to an increase in RL of the same amount. Expression (A17) is derived from the notion that an increase in RFS has exactly the same effect as a decrease in competing rates in all cases where RFS appears in the argument of the function. RFS appears in the demand for swapped deposits when the comparison is with a Canadian instrument or an uncovered U.S. instrument (but not if the comparison is with a covered U.S. instrument) and RFS also appears in the demand for non-swapped deposits when the non-swapped deposit is a split swap and the comparison is with a Canadian instrument or an uncovered U.S. instrument (but not if the comparison is with a covered U.S. instrument). It is clear that the absolute value of the effect of RFS will be as great as the sum of the effect of RCSD and RCNSD, if all non-swapped deposits are split swaps and if there are no comparisons with covered U.S. instruments. It is also clear that RFS will have a smaller effect (in absolute value) if

the above conditions are not satisfied. I assume throughout that RFS does not appear in DEPUS or DEPRW.

The condition needed for both expression (A13) and expression (A14) to hold is that an increase in the smaller of RA1 and RA2 would lead to an increase in profit if total assets were held constant. This would rule out the unlikely possibility of such a large shift to the asset with the lower yield when its interest rate increased that total profits would actually fall.

The discussion of the guidelines period in the text begins with a discussion of the case in which Guidelines 1 and 2 were binding and Guideline 3 did not exist. The profit function is altered by the imposition of equality between rest-of-world assets and rest-of-world liabilities. In this case the banks have control over two separate rates, RLNA and RLRW, and the usual methods of partial differentiation to find the maximum of the profit function are used. The two first-order conditions are rather special in that each condition is a function of only one of the variables, RLNA and RLRW, and therefore the comparative statics are obtainable by analyzing each equation separately. I then go on in the text to incorporate the effects of Guideline 3. These effects differ depending on which of the two methods of satisfying Guideline 3 is being used by the banks.

Appendix 2 to Chapter 2

INTEREST RATES ON STERLING DEPOSITS AT CANADIAN BANKS

The Canadian banks accept deposits denominated in sterling and other foreign currencies in addition to U.S. dollar deposits. The latter are by far the largest component of chartered bank foreign currency liabilities. For example, at the end of December 1970 U.S. dollar liabilities accounted for 98.4% of total foreign currency deposits at head office and branches in Canada compared to 0.4% in sterling and 1.2% in other foreign currencies. It is nonetheless interesting to examine how the banks determine the rate on deposits denominated in sterling.[18]

There are two competing hypotheses to be considered in this connection. First, the rate on sterling deposits (RL£) may be a function of various competing rates as was the case for the U.S. dollar deposit rate. Second, RL£ may be calculated by subtracting the rate implied by the forward spread between sterling and U.S. dollars (RFS£$) from the U.S. dollar deposit rate. That is, the rate on sterling deposits is set so that sterling deposits yield precisely the same return as U.S. dollar deposits when the cost of cover is taken into account.

The data I use to examine the determination of the interest rate on sterling deposits are taken from the interest rate sheet issued on Thursdays by one of the large Canadian banks. On this sheet the rates on U.S. dollar deposits for various terms are also set out. The bank in question accounts for a sizeable portion of total sterling deposits at Canadian banks and virtually all its sterling deposits are held by non-residents.

I use the following series in addition to all the ones defined earlier:

RL£CB Interest rate on sterling deposits (90-179 days) at a large Canadian bank. These rates are posted every Thursday. They are available with gaps from June 1968 to the present.

RL$CB Interest rate on U.S. dollar deposits (90-179 days) at a large Canadian bank.

RUK Interest rate on three-month deposits with local authorities in the United Kingdom. The rates are for Wednesdays.

RFS£$ Interest rate equivalent of the forward spread between the pound sterling and the U.S. dollar. This is the 360-day interest rate equivalent of the spread between the spot and forward rates for the pound in New York computed on the basis of Wednesday noon quotations (supplied by the Securities Department of the Bank of Canada).

In the initial regression, RL£CB was regressed on RUK, all the competing interest rates available, RFS£$, RFS, and also on RL$CB and RLRW. The latter two rates were included in order to explore the possibility discussed above that the rate on sterling deposits is simply equal to some rate on U.S. dollar deposits minus RFS£$. By dropping wrong-signed variables and then insignificant variables I arrived at the following equations:

$$\begin{array}{l} \text{RL£CB} = .17 + .82\ \text{RUK} + .10\ \text{RUSTB} \\ \qquad\quad (1.5)\ \ (41.4)\qquad (4.6) \end{array} \tag{A18}$$

$$\text{SEE} = .244 \quad R^2 = .962 \quad \text{COV} = 3.41\% \quad \text{DW} = 1.07$$

$$RL£CB = \underset{(5.6)}{2.90} + \underset{(6.6)}{.34}\ RUK + \underset{(3.9)}{.26}\ RUSTB + .90\ u_{-1} \qquad \text{(A19)}$$

SEE = .193 R^2 = .989 COV = 2.69% DW = 2.31

Neither RFS nor RFS£$ nor the rate implied by the forward spread between the pound and Canadian dollar[19] enters significantly and with the correct sign. In the equation with autoregressive transformation the coefficient on RUK declines markedly and that on RUSTB increases substantially. The null hypothesis, that the sum of the coefficients is equal to 1, is rejected at the 1% level (the t-statistic is 5.1 for the regression with autoregressive transformation).

Clearly the major influence on the sterling deposit rate is the rate on deposits with local authorities in the United Kingdom, which is meant to represent the interest rate level on sterling instruments. A secondary influence is the U.S. treasury bill rate. A possible interpretation of this result is as follows: Investors considering a sterling investment compare the interest rate on U.K. investments and the rate on sterling deposits offered by Canadian banks. Thus the sterling rate offered by Canadian banks must respond to the competing U.K. rate. The rate on U.S. treasury bills probably represents the possibility that some of these depositors will shift from sterling deposits to U.S. dollar instruments as the U.S. rate rises. Canadian banks are apt to meet some of this competition in order to retain the business. It is somewhat surprising that the comparison between the U.S. dollar rate and the sterling rate appears to be made on an uncovered basis.

Chapter 2 Footnotes

1 The banks do, however, invest in call loans of which they hold, at times, a large proportion of the total.

2 This assumption is relaxed in Chapter 4.

3 Note that I ignore deposits at foreign branches for the purposes of this discussion and treat only deposits at head office.

4 The forward spread between the U.S. and the Canadian dollar expressed as an annual interest rate (RFS) is equal to the difference between the forward and spot rate divided by the spot rate and then multiplied by 365/90 to put it on an annual basis. It is the same as the "implicit interest rate" in Grubel [24] p 4.

5 In fact the rate on swapped deposits (RSD) feeds back into RFS through transactions in the forward exchange market. But the bank probably does not take this into account in its calculations.

6 For a more precise statement of the assertions in this paragraph, see Appendix 1 of this chapter.

7 By a binding constraint I mean one that alters the behaviour of the banks in some manner. If a constraint does not bind, the banks reach the position they would have reached in the absence of the constraint.

8 In fact, as will be shown in Chapter 5, even when Guidelines 1 and 2 were binding not all rest-of-world deposits were placed in rest-of-world assets. However, the assumption is a reasonable first approximation.

9 If U.S. competitive rates were so high that holding U.S. deposits at the ceiling implied a RLUS higher than RLCAN, the banks would leave RLUS at the same level as RLCAN and allow U.S. deposits to decline below the ceiling. This situation does not appear to have occurred with any frequency in the period under study.

10 The term Canadian certificates of deposit (CCD) is used to refer to non-personal term and notice deposits at Canadian banks.

11 There is a serious technical difficulty in all the F tests in this chapter. The Chow test presupposes serial independence of the errors. Under conditions of serial correlation the robustness of the F test is not known. The properties of the Chow test applied to regressions with autoregressive transformation are also not known.

Throughout the chapter I report results from comparisons of the equations without autoregressive transformation. In most cases application of the Chow test to regressions with autoregressive transformation (and common autoregressive parameter) gives the same result.

12 This regression, of course, yields the same coefficients for the 1965-1968 period as the regression of RL on RCFP, RUSPRI, RED, and RFS for that period. Similarly the regression of RL on RCFP, RCCD, RUSTB, and RFS for the 1962-1965 period yields the same coefficients for these variables as does the constrained equation. Only the constant differs between the constrained and unconstrained equations for the 1962-1965 period.

13 There is no way of telling from the regressions whether the rate on current loans was equal to RUSPRI, RUSPRI times a constant, or RUSPRI plus a constant.

14 The mean Euro-dollar rate in the ceiling period was 10.31% compared to 4.78% in the period prior to the guidelines and 7.50% in the non-ceiling part of the guidelines period.

15 The coefficient on RUSCL was on the margin of significance as well.

16 It is a simple matter to allow more than one competing rate in each function.

17 I have ignored the time pattern of maturation of existing liabilities in this analysis.

18 It is worth noting that most of the sterling deposits are held by foreign banks.

19 This rate is virtually equal to the sum of RSF£$ and RFS.

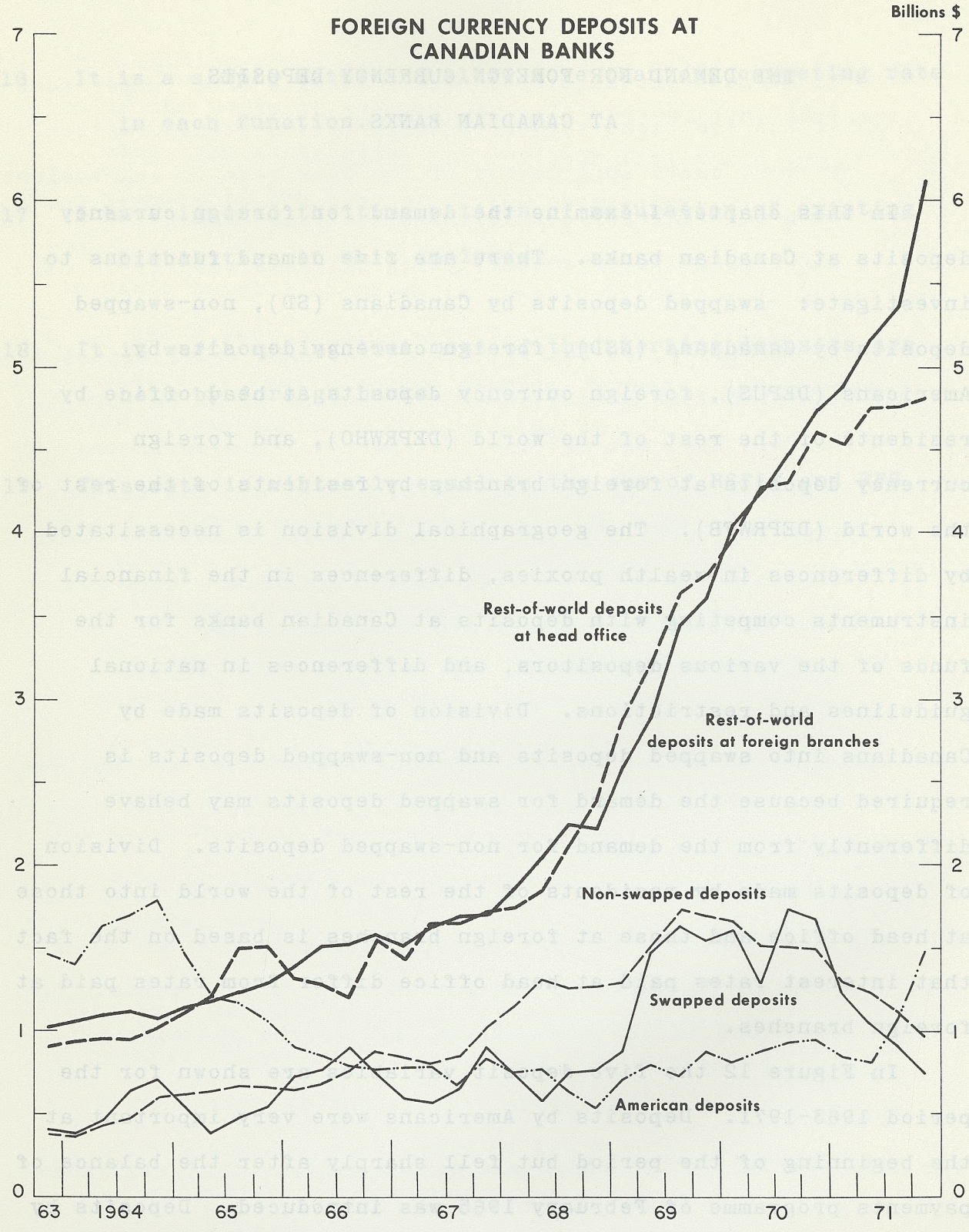
Chapter 3

THE DEMAND FOR FOREIGN CURRENCY DEPOSITS AT CANADIAN BANKS

In this chapter I examine the demand for foreign currency deposits at Canadian banks. There are five demand functions to investigate: swapped deposits by Canadians (SD), non-swapped deposits by Canadians (NSD), foreign currency deposits by Americans (DEPUS), foreign currency deposits at head office by residents of the rest of the world (DEPRWHO), and foreign currency deposits at foreign branches by residents of the rest of the world (DEPRWFB). The geographical division is necessitated by differences in wealth proxies, differences in the financial instruments competing with deposits at Canadian banks for the funds of the various depositors, and differences in national guidelines and restrictions. Division of deposits made by Canadians into swapped deposits and non-swapped deposits is required because the demand for swapped deposits may behave differently from the demand for non-swapped deposits. Division of deposits made by residents of the rest of the world into those at head office and those at foreign branches is based on the fact that interest rates paid at head office differ from rates paid at foreign branches.

In Figure 12 the five deposit variables are shown for the period 1963-1971. Deposits by Americans were very important at the beginning of the period but fell sharply after the balance of payments programme of February 1965 was introduced. Deposits by Canadians, swapped and non-swapped, grew rapidly in 1969 and

Figure 12


FOREIGN CURRENCY DEPOSITS AT CANADIAN BANKS
Billions $
7
6
5
4
3
2
1
0
Rest-of-world deposits at head office
Rest-of-world deposits at foreign branches
Non-swapped deposits
Swapped deposits
American deposits
63
1964
65
66
67
68
69
70
71

declined even more rapidly in 1971. Rest-of-world deposits grew rapidly both at head office and at foreign branches. In the last two years of the period DEPRWFB increased more quickly than DEPRWHO.

A. Theory

Simple equations are used to explain the demand for these various deposits at Canadian banks. Desired deposits can be written as:

$$D_t^* = \phi_0 + \phi_1 S_t + \theta_0 r_{0t} + \theta_1 r_{1t} + \theta_2 r_{2t} + \ldots + \theta_k r_{kt} \qquad (13)$$

where

D_t^* is the desired deposits of some class of lender,

S_t is the scale variable appropriate to that lender (eg, wealth, financial assets, etc.),

r_{0t} is the rate of interest on the foreign currency deposit,

r_{it} $(i=1,\ldots,k)$ are the interest rates on competing financial instruments.

I use two alternative specifications for the adjustment of actual deposits (D_t) to desired deposits (D_t^*). The first is the standard stock adjustment model $[\Delta D_t = \delta(D_t^* - D_{t-1})]$ with speed of adjustment δ. This model gives the equation:

$$D_t = \delta\phi_0 + \delta\phi_1 S_t + \delta \sum_{i=0}^{k} \theta_i r_{it} + (1-\delta) D_{t-1} \qquad (14)$$

In this case the response of D_t to a change in all the variables on the right-hand side of the equation is assumed to occur with

the same time path, ie, a geometric distributed lag with rate of decay $(1-\delta)$.

An alternative model allows for a much more rapid adjustment in response to a change in the scale variable than in response to a change in interest rates. The different treatment of the two variables arises because along a growth path the growth of deposits may occur with only a short lag even though the response of deposits to interest rate changes still involves long lags of adjustment. The equation arising from the immediate adjustment in response to the scale variable and to geometric decay on the other variables is:

$$D_t = \phi_0 + \phi_1 S_t + \delta \sum_{i=0}^{k} \theta_i [r_{it} + (1-\delta) r_{i,t-1} + (1-\delta)^2 r_{i,t-2} + \ldots] \qquad (15)$$

Using the usual Koyck technique of lagging equation (15) once, multiplying by $(1-\delta)$, and subtracting the result from equation (15) one obtains:

$$D_t = \delta\phi_0 + \phi_1 S_t - \phi_1 (1-\delta) S_{t-1} + \delta \sum_{i=0}^{k} \theta_i r_{it} + (1-\delta) D_{t-1} \qquad (16)$$

Note that the coefficient of S_{t-1} is equal to the negative of the product of the coefficients of S_t and D_{t-1}. One can run the regression freely and then examine how close the coefficient on S_{t-1} comes to the product of these other coefficients.[1] Alternatively one can use a nonlinear regression programme to constrain the coefficients appropriately. The generalization of this model to a model in which D_t responds, say, to S_t and S_{t-1} is straightforward.

B. Empirical Results

The new variables used in this chapter are:

M Canadian imports.

NNI Net new Canadian issues of securities payable in foreign currencies excluding Government of Canada issues.

T Trend (= 1 in January 1962).

WEALTHCAN A proxy for the liquid assets of Canadians. This is defined as the sum of currency outside banks, Canadian dollar deposits at chartered banks (adjusted to exclude Government of Canada deposits and Canadian dollar float), foreign currency deposits by Canadians at chartered banks, deposits at trust companies and mortgage loan companies, and Canada Savings Bonds outstanding.

WEALTHRW A proxy for the liquid assets of residents of the rest of the world. This is defined as the sum of their Euro-dollar deposits and Euro-currency deposits at banks in Belgium-Luxemburg, France, Germany, Italy, Netherlands, Sweden, Switzerland, United Kingdom, Canada, and Japan.

X Canadian exports

XR Exchange rate of the U.S. dollar in Canadian cents, average noon rate.

Interest rates used in the monthly equations are the monthly averages-of-Wednesday data. The prefix 'log' refers to a natural logarithm. The suffix US$ means that the variable has been converted into a U.S. dollar equivalent.[2]

1. Swapped deposits

The above discussion of the demand for foreign currency deposits indicates that the demand for deposits is a function of a scale variable, the interest rate on these deposits, and the interest rates on competing instruments. The appropriate scale variable for swapped deposits is some form of wealth variable for Canadian residents. I use WEALTHCAN to represent the sum of various liquid assets held by Canadian residents. The linear form of the equation therefore becomes

$$SD = \alpha + \beta WEALTHCAN + \gamma_1 RSD - \gamma_2 RCCD - \gamma_3 RUSTB - \gamma_4 RFS + (1-\delta)SD_{-1} \quad (17)$$

where I expect $\gamma_i > 0$, $i = 1,\ldots,4$ $\quad 0 < \delta < 1$

The particular rates shown in equation (17) are used simply for expositional purposes. I tried all the interest rates available and discarded sequentially those with wrong signs or of low significance. Since the rate on swapped deposits (RSD) includes the cost of forward cover, it can be compared by the depositor directly with the rates on other Canadian instruments. If the comparison of the rate on swapped deposits with the rates on U.S. investments is made on a covered basis (eg, with RUSTB+RFS), then γ_4 will equal γ_3 in the above equation.[3,4] On the other hand, if some investors compare the rate on swapped deposits to U.S. rates on an uncovered basis, then $\gamma_4 < \gamma_3$.

A second testable hypothesis is that holders of swapped deposits examine only interest rate differentials and not the levels of interest rates: that is, equal increases in RSD and competing rates leave unchanged the magnitude of swapped deposits demanded. In such a case equation (17) may be written as

$$SD = \alpha + \beta WEALTHCAN + \gamma_2(RSD-RCCD) + \gamma_3(RSD-RUSTB-RFS) + (1-\delta)SD_{-1} \quad (18)$$

Comparing equation (17) and (18) one sees that the null hypothesis, that only differentials matter, implies[5] that γ_1, the coefficient on RSD, is equal to the sum of the coefficients γ_2 and γ_3.

I ran the monthly regression for RSD for the period June 1962 to December 1971 (excluding March to May 1968, the period in which no new swapped deposits were accepted and consequently for which no data on RSD are available). In the final form (regression not presented) I included the interest rates RSD, RCCD, RUSTB, and RFS because each had the right sign and was significant in the main regression or in one of the sub-period regressions to be discussed below. For the 1962-1971 period all the interest rate coefficients had correct signs and were either significant or almost significant. The coefficient on WEALTHCAN was insignificant, largely as a result of the sharp decline in swapped deposits in 1971.

If the period is broken at May 1968 when the guidelines were introduced, one finds that the behaviour of swapped depositors differed in the two halves of the period.[6,7] During the first half of the period, when the instruments competing with swapped deposits were mainly Canadian dollar certificates of deposit (CCD), the coefficients on U.S. rates and RFS had the wrong sign or were insignificant. During the second half of the period the instruments competing with swapped deposits were CCD and U.S. financial instruments.[8]

When separate regressions were run for the two sub-periods June 1962 to February 1968 and June 1968 to December 1971, the coefficient on the scale variable WEALTHCAN was negative in the 1968-1971 period. As mentioned above, this is the result of the

decline in swapped deposits during 1971. Because a negative coefficient on a scale variable is meaningless and because there is no reason to believe that the effect of the scale variable changed over the period, I constrained the coefficient of WEALTHCAN (and that of SD_{-1}) to be the same over the two sub-periods. All the interest rate coefficients and the constant were allowed to differ over the sub-periods. Using this constrained regression, I found that the test on the null hypothesis, that only differentials matter, yielded an F of 0.60 compared to a critical F of 3.09 (5%). The test on the joint null hypothesis, that all comparisons are on a covered basis and that only differentials are relevant, gave an F of 1.74 compared to a critical F of 2.70 (5%). Apparently depositors are interested only in interest rate differentials and apparently the relevant differentials with U.S. rates are the covered differentials. The results of the regression with interest rate differentials are presented in the first two lines of Table 6. Although the coefficient on WEALTHCAN for the period as a whole is positive it is not significant. The equilibrium multipliers derived from the coefficient on the rate differential (RSD-RCCD) are $394 million in the first sub-period and $733 million in the second sub-period. For the covered U.S. rate differential (RSD-RFS-RUSTB), the equilibrium multiplier in the second sub-period is $312 million. Thus an increase of 100 basis points in the rate on swapped deposits relative to competing rates led to an increase in swapped deposits of $394 million in the first sub-period and $1,045 million in the second sub-period. The speed of adjustment in the swapped deposit equation is 26.4% in the month

Table 6

DEPOSIT REGRESSIONS

Dependent Variable	Regression	Period	C	WEALTH-CAN	T	RSD - RCCD	RSD - RFS - RUSTB	NNI	ΔXR	Lagged Dependent Variable	SEE	R^2	COV	DW
SD	Monthly	June/62 to Feb./68	97.58 (2.1)	.00075 (0.4)		104.05 (3.9)				.736 (18.8)	73.6	.970	8.85	1.74
SD	Monthly	June/68 to Dec./71	70.27 (0.8)	.00075 (0.4)		193.63 (5.0)	82.31 (4.0)			.736 (18.8)				
SD	Weekly	June/62 to Mar./68	23.94 (5.0)		.0176 (0.7)	22.87 (4.4)				.941 (114.2)	33.7	.994	4.03	2.03
SD	Weekly	June/68 to Dec./71	14.70 (1.3)		.0176 (0.7)	39.04 (5.4)	21.98 (5.4)			.941 (114.2)				
NSD(US$)	Monthly	June/62 to Feb./68	17.61 (0.6)	.00058 (0.5)		35.64 (2.2)		.25 (4.2)	72.68 (3.1)	.903 (25.6)	43.8	.990	5.05	2.23
NSD(US$)	Monthly	June/68 to Dec./71	10.45 (0.2)	.00058 (0.5)		64.30 (2.7)	21.23 (1.8)	.25 (4.2)		.903 (25.6)				

of the change in explanatory variables and 60% in the first three months following that change.

The equilibrium multipliers on interest rate differentials explain a substantial part of the massive buildup of swapped deposits in 1969 and the equally massive rundown of swapped deposits in 1971. The average differential between RSD and RCCD for the years 1968 to 1971 was .38, .86, .81, and .27, respectively.[9] Similarly, the average differential between the swapped deposit rate and the covered U.S. treasury bill rate for the same years was .33, 1.69, 1.70, and 1.20. The increase in 1969 of 48 basis points in the CD rate differential and 136 basis points in the covered U.S. treasury bill rate differential would lead to an increase of $776 million in swapped deposits and thus account for most of the 1969 increase. The decline in 1971 of 54 basis points in the CD rate differential and 50 basis points in the U.S. treasury bill rate differential would lead to a decline of $552 million in swapped deposits. Thus much, but not all, of the 1971 experience can be accounted for by the movement of the interest rate differentials.[10]

Another way of looking at the 1971 experience is to use the 1962-1970 regression to predict for 1971. The difference between the 1962-1970 and the 1962-1971 regression is that the former has somewhat smaller equilibrium interest rate multipliers (the difference being about 25%) and a substantially larger multiplier on the scale variable (.0187 compared to .0028). If the 1962-1970 equation is used to predict 1971,[11] one obtains consistent overestimates of the swapped deposit levels, particularly during the last eight months of 1971.[12] I conclude that the changes in interest rate differentials may account for a substantial part of

the decline in swapped deposits but not for all of it. The suggestion that the decline in swapped deposits was the result of a shift by Canadians to the Euro-dollar market found no support in the data. The differential between the swapped deposit rate and the interest rate on three-month Euro-dollar deposits in London (RED) entered with the wrong sign for 1971. Thus the behaviour of swapped deposits in 1971 remains something of a puzzle.[13]

Similar regressions were run with weekly swapped deposits data based on Wednesday balance sheets. The regression for the period June 13,1962 to December 29,1971 (excluding January 3,1968 and March 13,1968 to June 5,1968) has the same variables as the monthly equation with one exception. Because WEALTHCAN is not available on a weekly basis a simple trend was used in its place.[14] When the period was split in 1968, the null hypothesis, that there is no structural break, was decisively rejected. The test for the joint null hypothesis, that only differentials matter and that comparisons with U.S. instruments are covered comparisons, yielded an F well below the critical value.

I again imposed the constraint that the coefficients on the scale variable (T) and on the lagged dependent variable be the same in the two sub-periods. Weekly regressions for the two sub-periods are presented in lines 3 and 4 of Table 6. The equilibrium multipliers for the RCCD differential are $388 million in the first sub-period and $662 million in the second sub-period. These are not very different from the $394 million and the $733 million of the monthly equation. The equilibrium multiplier for the covered U.S. differential for the second sub-period is $373 million compared to $312 million for the

monthly equation. The speed of adjustment of .059 implies a monthly adjustment of .24 - slightly less than the .26 of the monthly regression. The weekly equation has a substantially lower standard error of estimate than does the monthly equation and the Durbin-Watson statistic is also much better than that in the monthly equation.[15]

2. Non-swapped deposits

Non-swapped deposits of Canadian residents are comprised of at least three fairly distinct segments. The first segment is the 'split swap' component. Split swaps occur when the holder of a U.S. dollar deposit in a Canadian bank covers the deposit by a separate purchase of forward Canadian dollars. The only difference between a swapped deposit and a split swap is that in the former case the forward cover is supplied by a bank as part of the transaction (and the bank quotes an all-inclusive rate for the swapped deposit including the forward cover) whereas in the latter case the deposit and the purchase of forward cover are separate transactions. Of course, in the data, the split swaps come under the NSD category. The second segment of non-swapped deposits involves the holding of an uncovered U.S. dollar deposit. This segment may include investment by Canadians who do not cover either because of exchange rate speculation or because they ordinarily hold U.S. dollar investments. It also may include part of the working balances of exporters and importers who do substantial business in U.S. dollars. The third segment of the NSD variable is the temporary holding of U.S. dollar deposits at Canadian banks by the issuers of debt denominated in foreign currencies. In the literature it is often suggested, for

example by Caves and Reuber [12] pp 84-85, that Canadian issuers of securities in the United States hold the funds they receive in the form of U.S. dollars until these funds are needed in Canada. This approach has two advantages for the issuer. First, no exchange risk is incurred while the funds are held in a foreign currency. Second, if the foreign currency is exchanged for Canadian dollars gradually rather than in one operation, the risk of turning the exchange rate against the issuer at the time of the exchange is reduced. The U.S. dollar assets of these issuers may be held in uncovered foreign currency deposits at Canadian banks.[16]

The equation for split swaps should look exactly like the equation for swapped deposits.

$$NSD_1 = \alpha_1 + \beta_1 WEALTHCAN + \gamma_1(RL+RFS) - \gamma_2 RCCD - \gamma_3 RUSTB - \gamma_4 RFS + (1-\delta)NSD_{1,-1} \tag{19}$$

Once again one can argue that, if all comparisons are covered, $\gamma_4 = \gamma_3$ and that, if only differentials are relevant, $\gamma_1 = \gamma_2 + \gamma_3$. The equation for investment in U.S. dollars is:

$$NSD_2 = \alpha_2 + \beta_2 WEALTHCAN + \Psi_1 RL - \Psi_2 RUSTB + \Psi_3 \Delta XR + \Psi_4 f_1(M) + \Psi_5 f_2(X) + (1-\delta)NSD_{2,-1} \tag{20}$$

The scale variable ought perhaps to be holdings by Canadian residents of foreign currency assets but since this scale variable is not available on a monthly basis I use WEALTHCAN once again as a proxy. In equation (20) I presuppose that no comparisons are made with Canadian interest rates although there

would be no difficulty in allowing for such a comparison. It is assumed that transaction balances of exporters and importers are some function of Canadian exports (X) and Canadian imports (M). The possibility of speculation on a change in the exchange rate is treated by simply entering the first difference in the exchange rate.[17] The equation for holdings of NSD by issuers of securities payable in foreign currencies is:

$$NSD_3 = \alpha_3 + \lambda_1 NNI + \lambda_2 NNI_{-1} + \lambda_3 RL - \lambda_4 RUSTB + \lambda_5 \Delta XR + (1-\delta)NSD_{3,-1} \qquad (21)$$

The variable NNI represents net new Canadian issues of securities payable in foreign currencies excluding Government of Canada issues.[18] Introduction of lagged NNI into the equation allows for the possibility that adjustment may be much more rapid to a change in NNI than to a change in interest rates. Interest rate variables allow for the possibility that issuers may switch between U.S. financial instruments and foreign currency deposits at Canadian banks on the basis of the relative interest rates. The exchange rate variable is placed in the equation in an attempt to capture speculation by issuers on exchange rate movements. That is, the timing of the shift from U.S. dollars into Canadian dollars may be affected by the expectations of issuers regarding future movements in the exchange rate.

Equations (19), (20) and (21) are summed to get an equation for total NSD.

$$NSD \equiv NSD_1 + NSD_2 + NSD_3$$

$$= \mu_1 + \mu_2 WEALTHCAN + \mu_3 RL - \mu_4 RCCD - \mu_5 RUSTB + \mu_6 RFS + \mu_7 \Delta XR \qquad (22)$$

$$+ \mu_8 f_1(M) + \mu_9 f_2(X) + \mu_{10} NNI + \mu_{11} NNI_{-1} + (1-\delta)NSD_{-1}$$

Note that one must assume the same speed of adjustment, δ, in equations (19), (20), and (21) to permit the aggregation into a single equation. Using equation (22) one can test the hypothesis that interest rate comparisons with Canadian rates involve RL + RFS, ie, are split swaps, and that only differentials matter.

When equation (22) is estimated for the entire period (regression not presented), the coefficients on the interest rate variables are not significant with the exception of RL and RFS. Although the F test does not imply a structural break in 1968 (an F of 1.76 compared with a critical F of 1.97 (5%)), my experiments indicate that the competing interest rates do indeed change between the two sub-periods just as they do in the swapped deposit equations. When the period is split, the results improve greatly. In the first sub-period the CD rate is the only competing rate, whereas in the second sub-period the U.S. treasury bill rate also enters. In the NSD equations (as in the SD equations) I impose the constraint that the scale variable and the lagged dependent variable have the same coefficient in both sub-periods.[19]

The results of the regressions are presented in line 5 and 6 of Table 6. On the covered CD differential the equilibrium multipliers are $367 million in the first sub-period and $663 million in the second sub-period. The equilibrium multiplier on the comparison with RUSTB (either RSD with RUSTB + RFS or RL with RUSTB) is $219 million in the second sub-period. Thus an increase of 100 basis points in the rate on non-swapped deposits relative to other rates leads to an increase of $367 million in NSD in the first sub-period and $882 million in the second

sub-period.[20,21] The speed of adjustment is a rather slow 9.7% per month, which is equivalent to a 26.3% adjustment in the first quarter following the change.

The same NSD equation estimated for the period 1962 to 1970 gives a substantially faster and probably more reasonable speed of adjustment (27% monthly) and substantially smaller equilibrium multipliers on the interest rate differentials. As expected, the coefficient on the scale variable also increases markedly - the equilibrium multiplier is .0317 compared to .0060. When this equation is used to predict 1971, one gets consistent overestimates of the level of NSDs. The mean residual for 1971 was -$125.2 million, which is three times the standard error of estimate. The largest residual was -$226.1 in November 1971.

I now comment briefly on some other aspects of the NSD regressions. First, although various functions of imports and exports were tried,[22] none entered significantly with the right sign. This suggests that deposits of exporters and importers are not an important part of non-swapped deposits. Second, the net new issues variable enters significantly in both sub-periods. Statistical tests indicated that the coefficient was the same in both sub-periods and therefore I constrained the coefficient to be the same in both sub-periods. Lagged NNI did not perform in the expected fashion, which leads to the conclusion that adjustment to a change in NNI is not immediate. An increase of $1 in net new issues of foreign-pay securities produces an increase in NSD of $.25 in the period of the change. The holdings of NSD fall to $.226 in the next period, $.204 in the following period, and so on. Third, the ΔXR variable entered significantly in the first sub-period but not in the second. An

increase of 1¢ in the exchange rate for the U.S. dollar in the first sub-period led to an increase in NSD of $73 million in the first month. These holdings fell to $66 million in the second month, $60 million in the third month, etc. There are two possible interpretations of this result. One is that exchange rate expectations are extrapolative. An increase in the exchange rate for the U.S. dollar leads to expected further increases and causes wealth-owners temporarily to shift to U.S. dollar deposits. The other interpretation involves the behaviour of issuers of foreign-pay bonds. It may be that an increase in the U.S. exchange rate leads them to shift from investments in the United States (deposits at U.S. banks or U.S. market investments) into instruments denominated in Canadian dollars, namely split swaps, in order to take advantage of the temporarily high rate on the U.S. dollar.[23] There is no obvious reason why ΔXR is not significant in the second period.[24]

3. Deposits by residents of the United States

Deposits by U.S. residents over the period of analysis (1963-1971) have been determined primarily by guidelines, both American and Canadian. Thus the U.S. balance of payments programme of February 1965 and Canadian Guideline 3 of May 1968 are used to explain most of the movement of deposits by U.S. residents in Canadian banks.

At the end of 1963 foreign currency liabilities to American residents were $1,476 million, or 46% of total foreign currency deposits at head office and Canadian branches. They reached a peak of $1,948 million in January 1965 (46% of total deposits) and fell to $1,070 million in December 1965 (28% of total

deposits). They reached a trough of $540 million in December 1968 (11% of total deposits) and grew sporadically until mid-1971 when they started to increase fairly rapidly, reaching $1,491 million (19% of total deposits) in December 1971.

The prolonged slump in American deposits was caused mainly by the introduction of U.S. guidelines in February 1965. Under these guidelines, banks, non-banking financial institutions, and industrial and commercial enterprises were requested to reduce their holdings of U.S. dollar deposits at banks outside the United States. As indicated above, the 1965 guidelines and those that followed had a large impact and a lasting effect on deposits by U.S. residents at Canadian banks. This is not surprising considering that a substantial proportion of the deposits by U.S. residents at foreign banks was then in Canadian banks. For example, Brimmer [7] p 271 reports that at end of 1964 the 425 companies for which information was available "held about $1.2 billion of short-term foreign financial assets, of which about three-quarters were held through Canadian institutions". During the eleven months following the introduction of the guidelines in February 1965, foreign currency liabilities of Canadian banks to U.S. residents fell from $1,948 million to $1,070 million, a drop of 45%.

The other main influence on deposits by U.S. residents over the period was Guideline 3, introduced in May 1968 by the Canadian authorities.[25] Under Guideline 3 funds raised by the chartered banks in the form of increased liabilities to U.S. residents had to be used by the banks to increase claims or reduce liabilities in Canada.[26] This requirement prevented Canadian banks from acting as a 'pass-back', ie, borrowing funds

in the United States and placing them in U.S. assets.[27] Such behaviour would increase the U.S. balance of payments deficit in terms of the liquidity definition and this is presumably the reason for preventing it. For much of the time from May 1968 to December 1971, most Canadian banks met the requirement of Guideline 3 by holding their liabilities to U.S. residents below the level of February 1968. In the last half of 1971, the reduction in claims on U.S. residents to the level of early 1968 enabled some of the banks to use funds raised from U.S. residents to reduce liabilities to Canadian residents. The constellation of interest rates in the two countries made this kind of operation profitable for the banks.

Given the importance of various guidelines over the period, it is not surprising that my attempts to estimate an equation for deposits by U.S. residents were generally unsuccessful. For the period January 1966 to February 1968 the following equation was the best that I could produce:[28]

$$\begin{aligned} DEPUS(US\$) &= \underset{(1.6)}{165.26} + \underset{(0.4)}{11.39}\,(RL-RUSTB) \\ &\quad + \underset{(6.7)}{.758}\,DEPUS(US\$)_{-1} \end{aligned} \tag{23}$$

$SEE = 47.9 \quad R^2 = .691 \quad COV = 6.31\% \quad DW = 2.35$

In equilibrium an increase of 100 basis points in the interest rate differential would lead to an increase in U.S. deposits of $47.1 million.

For the guidelines period the banks quoted a separate rate on deposits by Americans (RLUS). Unfortunately, data on the rate paid to Americans are available only for 1971. My best equation for this period is:

$$\begin{aligned} \text{DEPUS(US\$)} = &- 2658.13 + 24.11\ T + 444.27\ \text{RLUS} \\ &\quad (2.7) \qquad (2.1) \qquad (1.3) \\ &- 474.91\ \text{RUSCD} + .895\ \text{DEPUS(US\$)}_{-1} \qquad (24) \\ &\quad (1.2) \qquad\quad (3.7) \end{aligned}$$

$$\text{SEE} = 73.6 \quad R^2 = .936 \quad \text{COV} = 7.59\% \quad \text{DW} = 2.19$$

The equilibrium multipliers are $4,231 million for an increase of 100 basis points in RLUS and $4,523 million for an equivalent decrease in RUSCD. These multipliers are probably far too high; the peculiar results can perhaps be attributed to the shortness of the period (12 months).[29]

4. Deposits by residents of the rest of the world

The first problem in specifying the demand for deposits by residents of the rest of the world (ie, residents of all countries except the United States and Canada) was the choice of an appropriate scale variable. Over the period of study a massive increase occurred in Euro-dollar and Euro-currency deposits by residents of the rest of the world. Put another way, there was a very large shift out of domestic currencies into foreign currencies, especially into the U.S. dollar. It is beyond the scope of this study to examine the reason for the growth of the Euro-dollar market and the Euro-currencies market. (See, for example, [40] or [30].) I take that growth as given and treat rest-of-world deposits at Canadian banks as one part of it. That is, I take the deposits of Europeans in external currencies as the scale variable and try to explain their deposits at Canadian banks as a function of that scale variable and of the relevant interest rates.

The second problem in specifying the equations involved the split between head office and foreign branches. Over the period, a growing proportion of rest-of-world deposits has been booked at foreign branches. One must examine the differences, if any, between the behaviour of depositors who book at head office and those who book abroad.

In the equation for deposits at head office by residents of the rest of the world I treat such deposits as a function of the scale variable WEALTHRW (defined as the total Euro-dollar and Euro-currency deposits by residents of the rest of the world), the lagged scale variable (to allow for rapid adjustment), the interest rate on deposits at head office (RLRW),[30] the interest rate on deposits in the Euro-dollar market (RED), and the lagged dependent variable. The regression for the period January 1965 to December 1971[31] (excluding March to July 1968 and December 1968 to January 1969 because the data are not available) is:

$$\begin{aligned} \text{DEPRWHO(US\$)} = {} & 12.14 + .0356\ \text{WEALTHRW} \\ & (0.2) \quad (1.9) \\ & - .0297\ \text{WEALTHRW}_{-1} + 138.59\ \text{RLRW} \\ & (1.6) \qquad\qquad\quad (2.7) \\ & - 111.41\ \text{RED} + .856\ \text{DEPRWHO(US\$)}_{-1} \\ & (2.2) \qquad\quad (10.8) \end{aligned} \tag{25}$$

$$\text{SEE} = 121.1 \quad R^2 = .993 \quad \text{COV} = 4.66\% \quad \text{DW} = 2.15$$

The equilibrium multipliers on the interest rates RLRW and RED are \$962 million and \$774 million, respectively.[32] An increase of \$1 billion in total holdings of Euro-dollars and Euro-currencies by residents of the rest of the world would lead to an immediate increase of \$36 million in deposits at head office. As the relationship between the current variable and the lagged scale variable indicates, adjustment is virtually instantaneous

(.0356 x .856 = .0305 ≈ .0297). There are only small lagged effects of the increase in the scale variable on deposits at head office. The speed of adjustment in the equation is 14.4% per month, which implies a quarterly adjustment of 37.3%.

The proportion of WEALTHRW accounted for by deposits at head office declined from 8.1% in December 1964 to 5.1% in December 1971.[33] To see the extent to which the Canadian banks failed to maintain their position in the Euro-dollar market I ran the same equation in logarithmic form.

$$\begin{aligned} \text{LOGDEPRWHO(US\$)} = {} & .117 + .953\ \text{LOGWEALTHRW} \\ & (1.1)\quad (2.9) \\ & - .864\ \text{LOGWEALTHRW}_{-1} + .288\ \text{LOGRLRW} \\ & \quad (2.7) \qquad\qquad\quad (1.7) \\ & - .276\ \text{LOGRED} + .864\ \text{LOGDEPRWHO(US\$)}_{-1} \\ & \quad (1.7) \qquad\quad (13.4) \end{aligned} \tag{26}$$

$$\text{SEE} = .048 \quad R^2 = .993 \quad \text{COV} = 0.62\% \quad \text{DW} = 1.80$$

This equation implies that a 100% increase in WEALTHRW leads to a 57.4% increase in deposits at head office.[34] The result is consistent with the fact that branches of U.S. banks in Europe have grown more important over the period and that the relative share of other banks in the Euro-dollar market has, as a consequence, declined.

The specification of equations for deposits by residents of the rest of the world at foreign branches (DEPRWFB) runs into difficulty because this variable is composed of two fairly distinct segments. The first and more important segment in the earlier period is deposits at the Caribbean and Latin American branches of Canadian banks. Such deposits are simply part of the retail business of these banks. The second and more important segment in the later period is deposits at branches of Canadian

banks in London, Frankfurt, other Euro-dollar centres, and The Bahamas. This business, which is a significant part of the Euro-dollar market, is a wholesale business.

The interest rate paid on Euro-dollar deposits at foreign branches of Canadian banks is related to the Euro-dollar rate. Over the period the Euro-dollar rate was, on average, 28.5 basis points above the rate paid to residents of the rest of the world on head office deposits (RLRW).[35] This fact suggests that residents of the rest of the world are prepared to pay a small premium for the extra safety of a deposit in Canada compared to a deposit in London.[36] A similar conclusion emerges by comparing rates paid on deposits by Canadian banks in Montreal or Toronto and those paid by branches of Canadian banks in London, England. Thus, according to Wood Gundy [42], on July 31, 1969 the difference between the rate on U.S. dollar deposits at Canadian banks in Canada and at Canadian banks in London ranged between 6 basis points and 31 basis points depending on the maturity of the deposit.

Deposits at foreign brances are explained by WEALTHRW and a lagged dependent variable. There is little indication that adjustment to changes in wealth is rapid. None of the interest rates that were tried in the equation comes close to being significant. The final equation is:

$$\begin{aligned} \text{DEPRWFB(US\$)} &= \underset{(2.7)}{75.14} + \underset{(4.2)}{.0163}\ \text{WEALTHRW} \\ &\quad + \underset{(11.5)}{.753}\ \text{DEPRWFB(US\$)}_{-1} \end{aligned} \tag{27}$$

$$\text{SEE} = 85.8 \quad R^2 = .997 \quad \text{COV} = 3.34\% \quad \text{DW} = 2.43$$

The test on the null hypothesis of no structural break at the guidelines yields an F-statistic of 0.53 compared to a critical F

of 2.72 (5%). Thus the same equation can be used to explain deposits at foreign branches throughout the period. The equilibrium multiplier of WEALTHRW is .066, which is consistent with the mean ratio of DEPRWFB to WEALTHRW over the period of 6.94%.[37]

The logarithmic equation for deposits at foreign branches suggests that these deposits did not grow as quickly as WEALTHRW.

$$\begin{aligned} \text{LOGDEPRWFB(US\$)} = &- .187 + .140\ \text{LOGWEALTHRW} \\ &(2.8)\quad (3.4) \\ &+ .839\ \text{LOGDEPRWFB(US\$)}_{-1} \\ &(16.6) \end{aligned} \tag{28}$$

SEE = .032 R^2 = .997 COV = 0.41% DW = 2.45

The equilibrium multiplier on LOGWEALTHRW is .870, which indicates that a 100% increase in WEALTHRW leads to an 83% increase in DEPRWFB,[38] and implies an increase in DEPRWFB over the period of about 6.1 times - equal in fact to the actual increase.

This concludes discussion of the deposit demand functions. In general the magnitude of the interest rate coefficients indicates substantial substitutability between foreign currency deposits at Canadian banks and other instruments. Swapped deposits and non-swapped deposits by Canadian residents are a function of interest rate differentials (rather than interest rate levels), and all interest rate comparisons are either between covered rates or between the rates on instruments denominated in the same currency. Rest-of-world deposits at Canadian banks are strongly related to a proxy scale variable representing total Euro-dollar and Euro-currency deposits by residents of the rest of the world. The demand functions

explored in this chapter are reasonably consistent with the equations on interest rate determination in Chapter 2, which are based on the demand functions as perceived by the banks. Specifically, the competing interest rates found in the interest rate equations are in the main those found in the demand functions themselves. One exception is the RLCAN regression in Table 4 that does not contain a competing U.S. interest rate, whereas the SD and NSD regressions in Table 6 contain RUSTB as a competing rate for the guidelines period. Similarly, the RLRW regressions in Table 5 do contain a U.S. interest rate whereas the DEPRWHO regressions (25) and (26) do not. In general, however, the results of the Chapter 2 regressions and the results of the Chapter 3 regressions are broadly consistent.

Appendix to Chapter 3

THE CURRENCY DENOMINATION OF DEPOSIT VARIABLES

In this appendix I deal with the problem of whether the deposit variables (and the loan variables of Chapter 5) should be denominated in U.S. dollars or Canadian dollars. This problem does not occur for the other variables, either because they are dimension-free (interest rates), relatively close to zero (NFA), or related to a scale variable affected in the appropriate way by exchange rate changes (as in the asset allocation equations of Chapter 5).

There is no difficulty in dealing with deposits or loans by non-residents of Canada. These are almost all treated by the depositor or borrower as foreign currency items and therefore should be handled in U.S. dollar terms. Similarly, to the extent that non-swapped deposits by Canadian residents are not covered and are treated by holders as U.S. dollar investments, this treatment should be applied to NSD.

The problem arises in the case of swapped deposits, the part of non-swapped deposits that is covered, and the part of loans to Canadian residents that is covered. I can illustrate the difficulty best with a simple example. Suppose a Canadian resident obtains a $100 swapped deposit with a Canadian bank at the beginning of period 1 when a U.S. dollar is exactly equal to a Canadian dollar. Suppose that this swapped deposit has a maturity of three months. Now assume that the U.S. dollar increases to $1.10 Canadian at the end of the second month. At the beginning of the fourth month the depositor receives his

funds ($100 Canadian plus interest) and puts the $100 into a swapped deposit again. I show in the following table the value of the swapped deposit according to different methods of accounting (ignoring interest throughout).

End of Period	Swapped Deposits in Canadian Dollars	Swapped Deposits in U.S. Dollars
0	0	0
1	100	100
2	110	100
3	110	100
4	100	90.9

If the series for the Canadian dollar value of the deposit is used, an increase in value is shown at the end of period 2. This increase is spurious because the contract for the forward sale of the U.S. dollars ensures that the depositor will make no gain on the appreciation of the U.S. dollar. Use of the U.S. dollar series does not produce a spurious increase when appreciation occurs but does produce a spurious decline when the contract is renewed. The problem arises from the fact that the depositor has both a deposit and a forward contract and that the data take account only of the deposit. Unfortunately without a complete time-profile of deposit maturation and information on forward transactions one cannot correct for these spurious movements in the data.[39] Since neither approach is perfect, I decided to transform non-swapped deposits into U.S. dollar terms because some non-swapped deposits are probably not covered. Swapped deposits and loans to Canadian residents are treated in Canadian dollar terms. All transactions with non-residents are treated in U.S. dollar terms.

Chapter 3 Footnotes

1 In general, putting S_t and S_{t-1} in the equation is equivalent to allowing the geometric distributed lag on S to begin in the period following the change in S and allowing the coefficient of S in the period of the change to be freely estimated.

2 A theoretical discussion on whether deposit variables should be computed in Canadian dollars or U.S. dollars appears in the appendix to this chapter.

3 This can easily be seen if one rewrites equation (17) with RUSTB + RFS replacing RUSTB and RFS.

4 In the more general case the null hypothesis, that the comparison is made only with covered rates, implies that the coefficient on RFS is equal to the sum of the coefficients on the rates of U.S. dollar financial instruments. Note that there is no interpretation in my theory for $\gamma_4 > \gamma_3$ except that a rate on a U.S. dollar instrument has been omitted.

5 In the more general case, the null hypothesis implies that the coefficient on RSD is equal to the sum of the

coefficients on all the competing interest rates in the equation.

6 The F-statistic for the test of the null hypothesis, that the structure remains unchanged over the period, was 3.83 compared to a critical F of 2.10 (5%). In order to be certain that it was not the 1971 period that caused the break, I ran the same test on the 1962-1970 regression. The F-statistic was 3.47 compared to a critical F of 2.11 (5%).

7 I do not suggest that application of the guidelines caused the change in structure, but simply that Canadian investors extended their horizon to foreign instruments at some point around 1968. This result is consistent with the growth in claims abroad by Canadian non-banks after 1968 shown in the Canadian balance of payments statistics.

8 The interest rate that gave the best result was RUSTB. However, it undoubtedly is serving as a proxy for U.S. interest rates in general. For example, RUSFP performed almost as well as RUSTB in the regressions.

9 The 1968 average simply excludes those weeks for which no swapped deposit rate exists.

10 The underlying cause of the 1971 reduction in swapped deposits (as opposed to the means) was the decline in the demand by non-banking corporations for funds at New York agencies as shown by the decline in loans made by New York agencies in 1971. This decline can be attributed to the easing of monetary policy in the United States. I shall discuss the 1969-1971 experience further at the end of Chapter 5.

11 Recall that, because there is a lagged dependent variable in the equation, this method is biased towards small residuals.

12 The residuals for January to April 1971 averaged less than one standard error. The mean residual for May to December 1971 was -$158.3 million or more than twice the standard error. The largest residual occurred in December 1971 and was -$221 million.

13 One can compare this period with the July 1969 to March 1970 period when a ceiling was imposed on swapped deposits at the request of the Bank of Canada. During the 1969-1970 period the banks kept swapped deposits below the ceiling by adjusting the interest rate on swapped deposits. This can be shown by the magnitudes and signs on the residuals for the period or by the insignificance of a dummy variable for the period.

14 The correlation between WEALTHCAN and the trend (T) on a monthly basis for 1962 to 1971 is .9899.

15 The null hypothesis of no serial correlation is not rejected by the Durbin h-statistic [15] in either case.

16 There may also be an element of speculation in the timing of the exchange of U.S. dollars for Canadian dollars by the issuer.

17 Several more sophisticated proxies of expected changes in the exchange rate were tried without success.

18 The Government of Canada typically does not hold foreign currency deposits at banks in Canada.

19 The joint null hypothesis, that only differentials matter and that all comparisons are made on a same currency basis, is on the margin of rejection with an F of 2.81 compared to critical Fs of 2.70 (5%) and 3.98 (1%). Nevertheless the results are substantially better when differentials are used. I therefore present the results of the regressions with differentials in Table 6.

20 These multipliers are in U.S. dollar terms since NSD has been transformed into U.S. dollar terms for the regression.

21 As in the case of swapped deposits, changes in interest differentials account for most of the changes in non-swapped deposits in the years 1969 and 1971.

22 Among the functions tried were the raw variable, the seasonally adjusted variable, a three-month moving sum, and a twelve-month moving sum.

23 Note that this implies regressive expectations on the part of the issuers.

24 The simultaneous estimation of the SD and NSD equations using Zellner's seemingly unrelated regression approach [43] yielded very similar results to those presented in Table 6 because the correlation between the residuals in the SD regression and the residuals in the NSD regression is only 0.18.

25 After the U.S. authorities exempted Canada from "all United States balance of payments measures affecting capital flows that were being administered by the Department of Commerce and the Federal Reserve System" [3] 1968, p 36, the U.S. guidelines were no longer operative vis-à-vis Canada and it was the Canadian guidelines that indirectly constrained U.S. deposits until their removal in January 1974.

26 Increased claims or reduced liabilities can be either in U.S. dollars or in Canadian dollars. The latter situation occurs when the net foreign asset position of the banks is reduced.

27 Recall that Guidelines 1 and 2 prevented funds raised in Canada or the United States from being 'passed through' to the Euro-dollar market.

28 The choice of dates for the two DEPUS equations (23) and (24) is based on the fact that the rapid rundown of deposits was completed by the end of 1965, and that for the guidelines period there is no information until 1971 on rates paid to U.S. residents.

29 The trend is needed because without it the coefficient on the lagged dependent variable exceeds 1. When the interest differential is used instead of the two interest rates, the impact multiplier is $351 million but the equilibrium multiplier is a completely unbelievable $16,706 million for an increase in the differential of 100 basis points.

30 Recall that in the period prior to the guidelines RLRW was equal to the rate paid on all U.S. dollar deposits (RL), whereas in the guidelines period RLRW was paid only to

residents of countries outside the United States and Canada.

31 The null hypothesis of no structural break in 1968 yielded an F-statistic of 1.28 compared to a critical F of 2.24 (5%). Therefore deposits at head office are treated in a single equation for the entire period.

32 The null hypothesis, that only differentials matter, was rejected with an F-statistic of 5.96 compared to a critical F of 3.98 (5%). The equation using an interest rate differential had a monthly speed of adjustment of only 3.35% and an equilibrium multiplier of $2,956 million for a change of 100 basis points in the differential.

33 Equation (25) indicates that a change in WEALTHRW leads to an equilibrium increase in deposits at Canadian banks of 4.1% of that change. This marginal increase of 4.1% was well below the beginning average proportion of 8.1% and therefore is consistent with the substantial decline of the average over the period.

34 The equilibrium multiplier of LOGWEALTHRW is .6544. A doubling of WEALTHRW leads to an increase of DEPRWHO of 2 raised to the power 0.6544, which equals 1.574. Over the period WEALTHRW has increased to about eight times its

initial value, which implied a quadrupling of DEPRWHO. In fact deposits at head office increased to about 5.1 times their initial value during the period. (All calculations are in U.S. dollar values.)

35 In the period prior to the guidelines (1965-1968) the average difference was 34.5 basis points and in the guidelines period (1968-1971) it was 22.8 basis points.

36 Presumably this safety factor relates to the possibility that the authorities will impose exchange controls or other controls. See Aliber [1] for a discussion of "political risk" in connection with short-term foreign investments. See Freedman [20] pp 205-206 for a discussion of "foreign risk" and other risks in the holding of a long-term foreign bond.

37 Over the period DEPRWFB fell from 8.7% to 6.5% of WEALTHRW.

38 The doubling of WEALTHRW results in a change in DEPRWFB of 2 raised to the power 0.87, which equals 1.83.

39 It is worth noting that the balance of payments treatment of these data also suffers from the same difficulty. The balance of payments calculations would show an increase of $100 in period 1, no change in period 2 and 3, and a decline of $10 in period 4 (the difference between US$100

and US$90.9 tranformed into Canadian dollars at the average exchange rate for the U.S. dollar).

Chapter 4

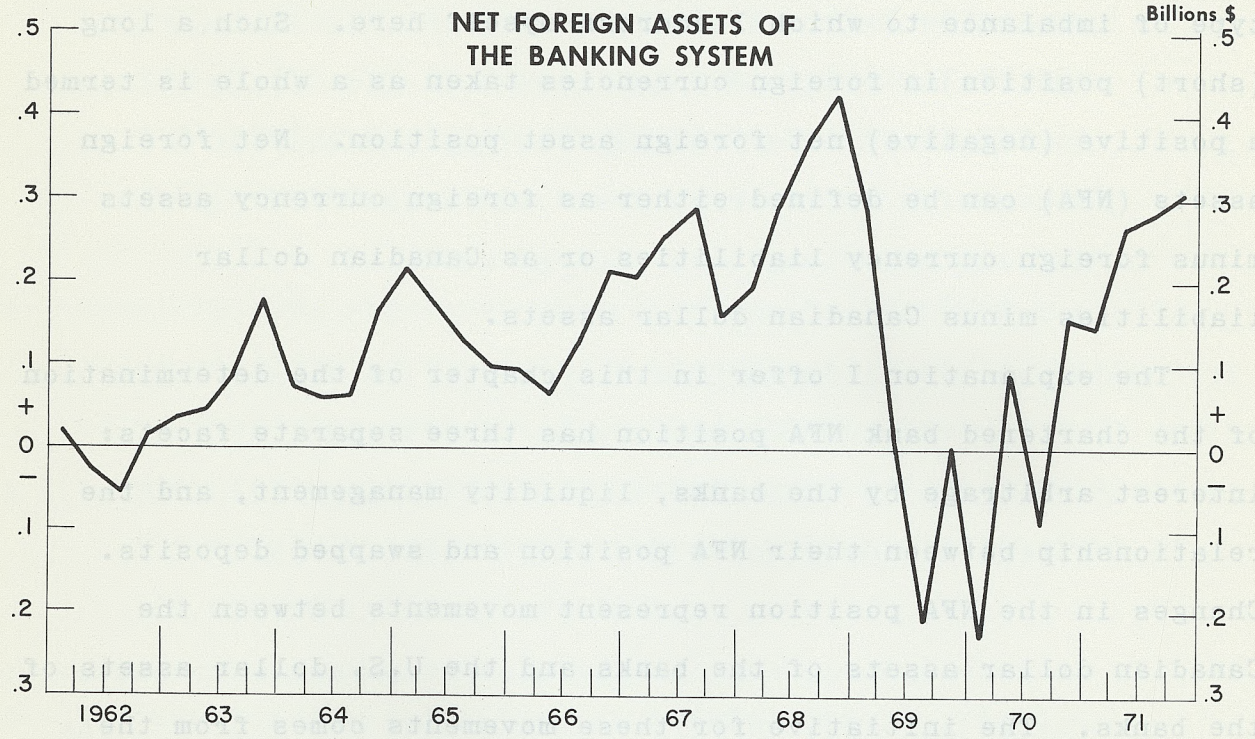
THE NET FOREIGN ASSET POSITION

Most of the chartered bank transactions in foreign currency assets and liabilities involve the booking of liabilities in a foreign currency and the purchase of assets denominated in the same currency. There are two ways in which this pattern can be broken. The banks can have a long position in one foreign currency and a short position in another leaving them with a flat Canadian dollar position.[1] They can also have a long or a short position in all foreign currencies taken together, and therefore a short or a long position in the Canadian dollar. This is the type of imbalance to which I address myself here. Such a long (short) position in foreign currencies taken as a whole is termed a positive (negative) net foreign asset position. Net foreign assets (NFA) can be defined either as foreign currency assets minus foreign currency liabilities or as Canadian dollar liabilities minus Canadian dollar assets.

The explanation I offer in this chapter of the determination of the chartered bank NFA position has three separate facets: interest arbitrage by the banks, liquidity management, and the relationship between their NFA position and swapped deposits. Changes in the NFA position represent movements between the Canadian dollar assets of the banks and the U.S. dollar assets of the banks. The initiative for these movements comes from the banks themselves. Shifts of assets may be in response to interest rate differentials between Canada and other countries (arbitrage), to changes in the stance of Canadian monetary

policy, or to changes in the magnitude of swapped deposits on the books of the banks. In this chapter I examine each of these facets of the NFA position and then put them together in a regression equation that explains the movement of that position. In the course of examining the NFA position of the banks, I shall deal with the existence of two measures of NFA - banking system NFA (NFASYS) and head office NFA (NFAHO)[2]. The difference between them is the NFA of the foreign branches and agencies of the Canadian chartered banks (NFAFB). One may ask whether NFASYS or NFAHO is the variable one should try to explain. Another way of putting this question is to ask whether the banks attempt to adjust NFASYS or NFAHO.

Figure 13



The volatility of the net foreign asset position of the system is shown in Figure 13. There is no apparent trend to the variable and the fluctuations appear to increase over time.

A. Theory

The model I now derive is a static profit-maximizing model in which I attempt to explain the investment or arbitrage side of the NFA position. To this I graft on in rather ad hoc fashion variables that pick up some of the characteristics of NFA as part of dynamic liquidity management and variables relating to the magnitude of swapped deposits. In the empirical section of this chapter I show that these three elements together explain a substantial proportion of the movement of NFA.

1. Arbitrage by the banks

In the profit-maximizing model in Chapter 2 of this study I treat foreign currency transactions as giving rise to profits that the banks (treated for simplicity as a single bank) maximize. Zero net foreign assets are also assumed in that model. At times it will obviously be profitable, however, for the bank to carry out arbitrage transactions between the Canadian and foreign currency assets at its disposal. To get at this aspect of the bank's activities I broaden the profit function to include both Canadian dollar and foreign currency transactions. Once again, I avoid the asset allocation problem by assuming that only one foreign currency asset and one Canadian dollar asset exist.[3] The profit function then appears as:

$$P = [(AFC)(RAFC) - (DEPUS+DEPRW+NSD+SD)(RL)] + [(ACAN)(RACAN) - (CCD)(RCCD) - (OCD)(ROCD)] \quad (29)$$

where

ACAN is Canadian dollar assets,

AFC is foreign currency assets,

CCD is Canadian dollar certificates of deposit,

DEPRW is foreign currency deposits by residents of the rest of the world,

DEPUS is foreign currency deposits by residents of the United States,

NSD is non-swapped deposits by residents of Canada,

OCD is Canadian dollar deposits other than certificates of deposit,

P is net profit from transactions in Canadian dollar and foreign currency assets and liabilities,

RACAN is the interest rate on Canadian dollar assets,

RAFC is the interest rate on foreign currency assets,

RCCD is the interest rate on Canadian dollar certificates of deposit,

RL is the interest rate on foreign currency deposits at Canadian banks,

ROCD is the interest rate on Canadian dollar deposits other than certificates of deposit, and

SD is swapped deposits by residents of Canada.

Equation (29) is the profit function for the period prior to the guidelines in which the same rate of interest is paid on foreign currency deposits regardless of the nationality of the holder. The extension to the guidelines period is straightforward. I still assume that the rate on swapped deposits is equal to RL plus RFS. As well, I continue to assume that the demand functions for foreign currency deposits are functions of the differential between the interest rate on foreign currency deposits and the appropriate competing interest rates.

As a first approximation I also assume that RAFC and RACAN are outside the control of the bank.[4] Furthermore, at most times, the rate on chequing accounts and non-CD savings accounts (ROCD) is fixed. Hence the bank adjusts the two interest rates under its control, RL and RCCD, to maximize profits. There is one more degree of freedom available to the bank. It can shift between Canadian dollar assets and foreign currency assets, ie, it can open up a positive or negative NFA position.

The definition of NFA gives

$$NFA = AFC - (DEPUS+DEPRW+NSD+SD) \text{ or} \quad (30)$$

$$NFA = CCD + OCD - ACAN \quad (31)$$

Substituting for AFC and ACAN from equation (30) and (31) into equation (29), I obtain

$$P = (DEPUS+DEPRW+NSD+SD)(RAFC-RL) \quad (32)$$
$$+ (CCD)(RACAN-RCCD) + (OCD)(RACAN-ROCD)$$
$$+ (NFA)(RAFC-RACAN)$$

Thus the bank has a profit margin of (RAFC-RL) on its foreign currency deposits, (RACAN-RCCD) on its Canadian dollar CDs, (RACAN-ROCD) on its other Canadian dollar deposits, and (RAFC-RACAN) on its net foreign assets. The above discussion has proceeded as if the banks leave their NFA position uncovered whereas in fact some or all of it is probably covered in the forward exchange market. To take this element into account one should multiply NFA by (RAFC+dRFS-RACAN). In this expression d is the fraction of changes in NFA, in response to interest rate changes, that is covered in the forward exchange market and RFS is the interest rate implied by the forward spread.

If RACAN, RAFC, and ROCD are treated as given, the banks find the maximum profit position by differentiating the profit

function with respect to RL, RCCD, and NFA. This exercise would lead to a corner solution in which all funds are put into foreign currency assets if (RAFC+dRFS-RACAN) > 0 or all funds are put into Canadian dollar assets if (RAFC+dRFS-RACAN) < 0. If (RAFC+dRFS-RACAN) = 0, the level of NFA is indeterminate. The reason for these somewhat peculiar results is precisely the same as the reason for similar results in simple theories of arbitrage. If there were no risks involved in arbitrage and the costs of acquiring funds by selling assets were constant, then a small arbitrage margin would lead to indefinitely large movements. (See [34] for a general discussion of this problem.) Now there clearly are risks in running too large a net foreign asset position. For example, a sudden reduction in Canadian dollar liabilities might force a repatriation to Canada of U.S. funds before maturity at a cost related to the movement of interest rates and exchange rates between the time of the purchase of an asset and of its repatriation. A second reason why banks do not run an indefinitely large NFA position in either direction is that, according to the Bank Act [8] Section 72, subsection 7, they must "maintain adequate and appropriate assets against liabilities payable in foreign currencies". This requirement is intended to prevent disruptions in foreign markets from affecting the Canadian dollar position of Canadian banks. The Inspector General of Banks would probably disapprove of excessively large movements of NFA in either direction. In this connection the Royal Commission on Banking and Finance refers to "the careful review of the banks' foreign liquidity which the Inspector General now undertakes" in [35] p 140. It is also probable that the banks have an idea of a preferred range of NFA

and that they try to remain within this range. Over the period December 1963 to December 1971 the NFA position of head office has varied from -$290 million to $494 million and the NFA position of the banking system has moved between -$302 million and $435 million. These numbers are not large compared to total foreign currency assets, which amounted up to $8,974 million at head office and up to $14,446 million for the entire banking system.

To express the undesirability of having an excessively large NFA position in either direction one can treat the bank as maximizing an objective function of the form

$$aP - b(NFA-NFA^*)^2 \qquad a > 0,\ b \geq 0 \qquad (33)$$

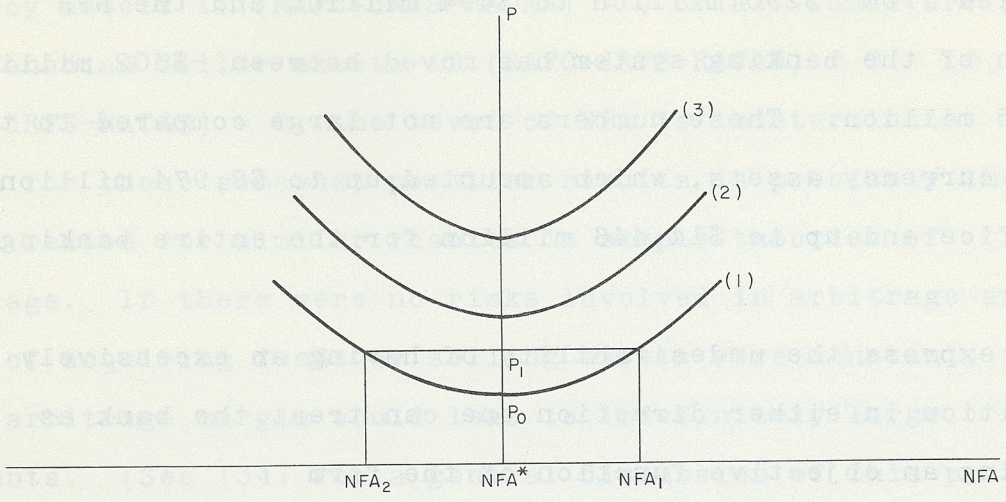
where

NFA* is a desired NFA position presumably related to the bank's permanent investment in subsidiaries, controlled corporations, etc.[5]

This function implies a set of indifference curves in the P, NFA plane of the sort shown in Figure 14. The bank is as happy with profit P_0 and NFA* as with profit P_1 and NFA_1, or with profit P_1 and NFA_2. That is, the bank is willing to take on a NFA position larger or smaller than NFA* only if it receives a higher profit. Of course, curve (2) is preferred to curve (1), since for any level of NFA curve (2) indicates a higher profit. The slope of the indifference curves is equal to $(2b/a)(NFA-NFA^*)$, ie, it is zero when NFA=NFA*, positive when NFA > NFA*, and negative when NFA < NFA*. Furthermore the slope increases in absolute value the further the NFA position is from NFA*.

Figure 14

INDIFFERENCE CURVES FOR PROFITS AND NET FOREIGN ASSETS



The more unbalanced the bank's NFA position compared to its desired position, the greater the increase in profitability required to unbalance it further. The symmetry of the NFA position around NFA* is a desirable feature of the function, since the bank is probably no more willing or only a little more willing to increase its NFA position too much than to reduce it too much. To the extent that there is asymmetry in the reaction of the bank, the function will be wrong. But such asymmetry is not likely to be too important a factor in the decisions made by the bank.

I maximize the objective function in equation (33) with respect to RL, RCCD, and NFA to get the following first-order conditions:[6]

$$RAFC\left[\frac{\partial}{\partial RL}\,(DEPUS+DEPRW+NSD+SD)\right] = RL\left[\frac{\partial}{\partial RL}\,(DEPUS+DEPRW+NSD+SD)\right] + [DEPUS+DEPRW+NSD+SD] \tag{34}$$

$$RACAN\left[\frac{\partial CCD}{\partial RCCD}\right] = RCCD\left[\frac{\partial CCD}{\partial RCCD}\right] + CCD \qquad (35)$$

$$a[RAFC+dRFS-RACAN] - 2b[NFA-NFA^{*}] = 0 \qquad (36)$$

Equation (34) states that RL will be moved to the point where the marginal cost of a change in RL will be equal to the marginal revenue from such a change. Equivalently, RL will be moved to the point where the cost of an extra dollar of deposits will be equal to the return from it. Similarly, equation (35) states that RCCD will be moved to the point where the marginal cost of a change in RCCD will be equal to the marginal revenue from such a change. Equation (36) may be rewritten as

$$NFA = NFA^{*} + (a/2b)(RAFC+dRFS-RACAN) \qquad (37)$$

When the interest rate differential is in favour of foreign currency assets, NFA > NFA*. When it is in favour of Canadian dollar assets, NFA < NFA*. And when the differential is zero, NFA = NFA*.

I show the profit-maximizing procedure in Figures 15 and 16. The left panel of Figure 15 represents equation (34). Here the marginal cost of foreign currency deposits (MCDEPFC) is equated to the average rate of return on foreign currency assets (RAFC). The right panel of Figure 15 represents equation (35). Here the marginal cost of Canadian dollar certificates of deposit (MCCCD) is equated to the average rate of return on Canadian dollar assets (RACAN). If NFA were zero, then the total profit of the banks would be:

$$(RAFC_0-RL_0)DEPFC_0 + (RACAN_0-RCCD_0)CCD_0 + (RACAN_0-ROCD_0)OCD_0$$

Figure 15

THE SETTING OF RL AND RCCD

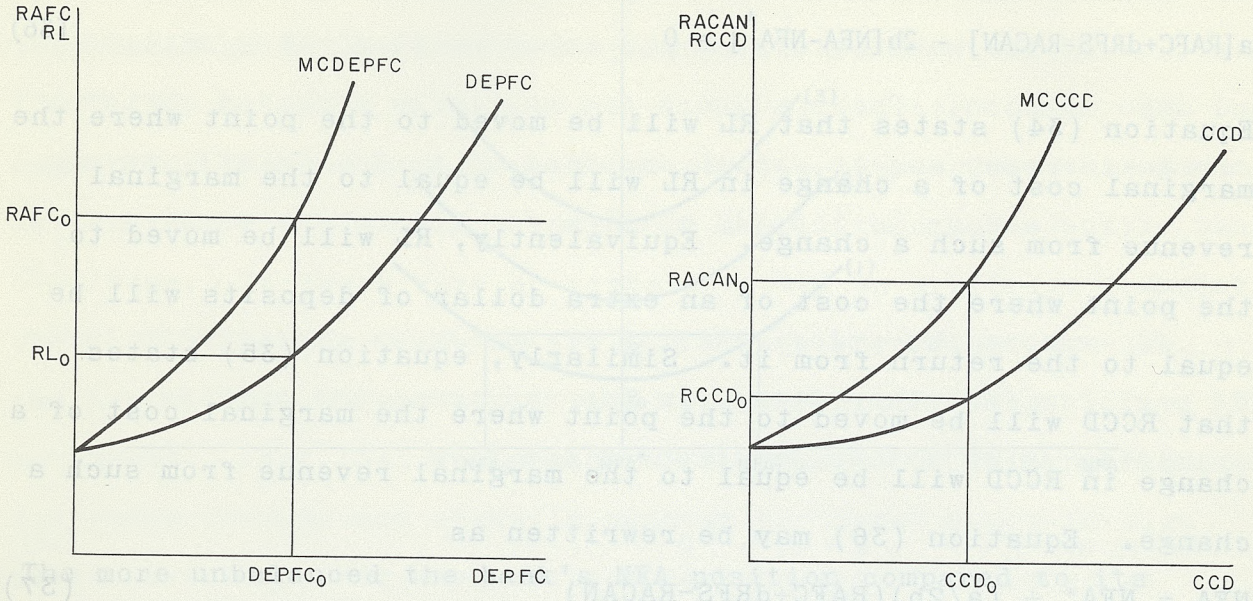
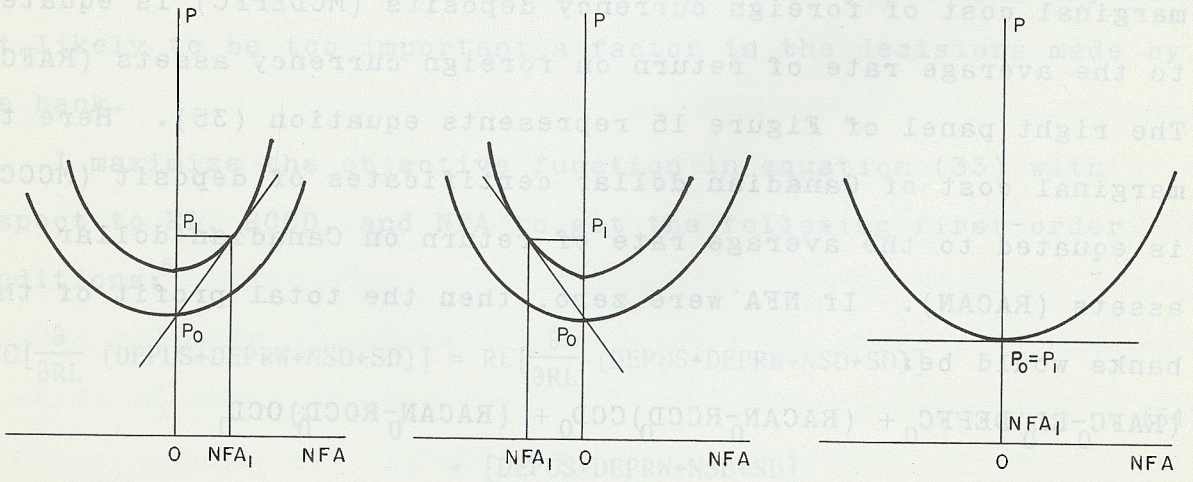


Figure 16

THE DETERMINATION OF NFA



This profit is shown as P_0 in Figure 16 where it is assumed for simplicity that NFA* is equal to zero. The slope of the indifference curves is equal to (2b/a)NFA. From equation (36) it is evident that (2b/a)NFA = RAFC + dRFS - RACAN at the maximum profit position, ie, the slope of the indifference curve is equal to the interest rate differential (represented in Figure 16 by the slope of the straight line going through $(0,P_0)$). In the left panel of Figure 16 this interest rate differential is positive implying a positive NFA position, in the center panel of Figure 16 it is negative implying a negative NFA position, and in the right panel of Figure 16 it is zero implying a zero NFA position. The extension to non-zero NFA* poses no difficulty.

The only interest rates entering into the determination of the optimum NFA position are the rates on assets in which the bank invests. It might be argued that the NFA position involves a shift from liabilities in one currency to assets in another currency and that therefore the rates RL and RCCD should somehow enter into the equation. Actually this is not the case if the above theory is correct. Turn again to Figure 15. For a zero NFA position, a maximum profit position is reached where the interest rate on foreign currency assets is equated to the marginal interest cost of foreign currency liabilities. A similar situation applies in the case of Canadian dollar assets and CCD. If the rate of interest on foreign currency assets is substantially higher than that on Canadian dollar assets, profits can be increased by moving to a positive NFA position. The question that remains is: which is the less expensive way of doing this - by increasing Canadian dollar deposits or by reducing Canadian dollar assets? If Canadian dollar deposits are

increased via an increase in RCCD, obviously the marginal cost will be greater than RACAN, which is the cost of reducing Canadian dollar assets. Hence the latter method will be used to raise the funds for investing in foreign currency assets. Conversely, if interest rates lead to a negative NFA position, it is cheaper to achieve this position by reducing foreign currency assets than by increasing foreign currency liabilities. Such a model implies that changes in the NFA position involve a switch between assets denominated in different currencies rather than a movement from liabilities of one currency into assets of another.[7]

The question of what determines NFA* remains to be considered. There appears to be a notion that it is appropriate to hold spot foreign currency assets in relation to the amount of investment in controlled corporations. The bank may also decide to back other long-term investments by a positive NFA position. These may include some of the securities held by the bank. This is an empirical question that will be discussed in Section B of this chapter.

The regression equation implied by the above theory is almost precisely equivalent to equation (37),

$$NFA = f_1(NFA^*, RAFC, RFS, RACAN) \qquad (38)$$

The derivative of NFA is positive with respect to the first three arguments and negative with respect to RACAN.

2. The theory of liquidity management[8]

Ideally, one would like to treat the effect on the NFA position of chartered bank daily liquidity management as a dynamic problem involving elements of inventory management

related to the uncertainty of cheque-clearing flows. Such a treatment, however, is well beyond the scope of this study. Instead, I shall simply refer to some of the prevalent ideas regarding bank liquidity management and try to examine the implications of these ideas for movements in NFA.

The effect on the chartered banks of changes in Bank of Canada monetary policy is described as radiating out from primary reserves to secondary reserves, then to tertiary assets, and finally to less-liquid assets such as loans and mortgages. At each of the first three stages, the chartered bank response to tightness or ease is reflected in part in chartered bank adjustment of the NFA position. I address myself here to the allocation of chartered bank domestic assets and net foreign assets in response to a change in monetary policy.

Bank of Canada monetary policy primarily impinges on chartered bank asset management via adjustment of the excess primary reserves of the banks. Since the banks must hold primary reserves at a certain level over the averaging period and since there is on each day a danger of a loss of cash through the cheque-clearing mechanism, the banks try to hold positive amounts of excess reserves, particularly towards the end of the averaging period. When the Bank of Canada reduces the excess primary reserves available to the banks as a group, each bank will try harder than before to maintain its own cash position. This involves selling secondary and tertiary assets to the general public.

One way in which the banks can compete for cash at a time of restrictive monetary policy is by selling foreign currency assets and converting the proceeds into Canadian dollars. The sale of

U.S. dollars may be either to the Exchange Fund Account (administered by the Bank of Canada on behalf of the Minister of Finance) or to some other participant in the market. If the sale is to the Exchange Fund, payment will be made by a cheque on the Bank of Canada. In order to maintain the supply of excess primary reserves at the level reflecting current policy, the Bank of Canada typically acts to offset this increase in chartered bank reserves by drawing down Government of Canada deposits at the banks. Since a bank selling a foreign currency liquid asset gets the full amount of the transaction in Canadian dollars from the sale of U.S. dollars to the Exchange Fund and since it loses only an administered proportion[9] of the drawdown of Government of Canada deposits, the bank involved gains 1 minus this proportion times the size of the liquidation.[10] If the sale of funds is to a participant in the foreign exchange market other than the Exchange Fund, then the bank selling the U.S. dollars will gain at the expense of the bank in which the purchaser of the U.S. dollars has an account.

The second stage and the third stage of the effect of the tightening process can best be examined together. In response to the reduction in excess cash by the central bank, the chartered banks sell off liquid assets, both domestic and foreign. The first line of defence - secondary reserves held largely in the form of treasury bills and day-to-day loans - is constrained by the requirement that secondary reserves must be kept above the level set by the Bank of Canada. As the excess secondary reserves are reduced, tertiary assets (including the foreign currency liquid assets held by the banks) are used more and more in liquidity management. Thus one expects NFA to be reduced as

excess secondary reserves fall because low excess secondary reserves spell more reliance on tertiary assets in cash management operations.

The decision as to which tertiary asset or assets to use for cash management is presumably based on considerations of cost, liquidity, and diversification. Other things being equal, one would expect the asset with the lowest yield to be sold at a time of tightness since this is the transaction that would produce the desired change in liquidity with the smallest reduction in profit. Diversification of assets, on the other hand, suggests a fairly proportionate reduction in liquid assets of all sorts. This is particularly the case in the situation being considered. The banks would be very loath to reduce their foreign currency liquid assets too drastically while counteracting monetary tightness in Canada because these assets are needed to meet any sudden reduction in foreign currency liabilities. Since the banks desire both profitability and diversification, NFA and Canadian tertiary assets would probably both be reduced as monetary tightness is increased in Canada. Furthermore, the relative magnitudes of these reductions will be a function of relative interest rates so that the reduction in NFA will be greater when the rate on U.S. liquid assets is low relative to Canadian rates than when that rate is high relative to Canadian rates.

The regression equation derived from this part of the analysis is of the form:

$$NFA = f_2(\text{Excess primary reserve ratio, excess secondary reserve ratio, the ratio of tertiary assets to total Canadian dollar assets}) \quad (39)$$

The derivative of NFA with respect to each argument is positive, and the derivative itself is a function of relative interest rates.

3. Swapped deposits and net foreign assets

The relationship between swapped deposits and net foreign assets is a result of the fact that increases in swapped deposits are sometimes unaccompanied by the acquisition of foreign currency assets. Given that swapped deposits are classified as foreign currency liabilities, a situation in which foreign currency assets are not purchased with the proceeds of swapped deposits shows up in the data as a reduction of NFA.

There are two distinct aspects of this relationship between swapped deposits and NFA: one that may be called 'permanent' and one 'temporary'. The permanent aspect relates to the so-called 'phony' swapped deposit [36] p 345 when no foreign currency asset is purchased over the full period during which the deposit is outstanding. Consider a situation in which the increase in swapped deposits is the result of a shift by a depositor from a Canadian dollar deposit to a swapped deposit at the same bank, probably a common practice. If the bank treats the shift from one type of deposit to another as simply a way of retaining a deposit that might otherwise have been lost, it may do nothing further and there will be a reduction in NFA. This is the permanent aspect of the relationship between swapped deposits and NFA and it presupposes that to some extent the banks treat a swapped deposit as simply another form of Canadian dollar deposit. The temporary aspect of the relationship between swapped deposits and NFA involves a delayed adjustment between

the increase in swapped deposits and the purchase of a foreign currency asset. Suppose once again that the increase in swapped deposits occurs via a shift from a Canadian dollar deposit by a customer of the given bank. Suppose further that the bank expects interest rates to rise shortly in the U.S. market or anticipates increased loan demand in the near future at its New York agency by American customers. The bank might, in these circumstances, wait until the anticipated developments occur before shifting to the U.S. asset. The simplest course for the bank to follow in the interim is to do nothing. That is, the shift from a Canadian dollar deposit to a swapped deposit affects only the bookkeeping, ie, NFA fall. Hence no action need be taken until the bank is ready to purchase the foreign currency asset. At that time the bank will, in effect, sell a Canadian asset and purchase a U.S. dollar asset with the proceeds.

If the increase in swapped deposits involves a shift from a Canadian dollar deposit in Bank A to a swapped deposit in Bank B, then the increase in swapped deposits is less likely to affect the NFA position since Bank B has to make a decision about what to do with its additional funds. If Bank B uses the funds to purchase a foreign currency asset, NFA will be unchanged; whereas if the bank purchases a Canadian dollar asset with the funds, NFA will decline. In any event, the effect on NFA will occur as a result of a deliberate action, not of inaction.

The regression implicit in the above argument is as follows:

$$NFA = f_3(SD, \Delta SD, \Delta SD_{-1}, \ldots, \Delta SD_{-k}) \qquad (40)$$

The first argument in this function represents the permanent aspect of the relationship between swapped deposits and NFA. The

last k + 1 arguments represent the delayed adjustment aspect of swapped deposit flows and allow for lags up to k periods long. The expected sign of the partial derivative in each case is negative.

B. Empirical Results

The new variables used in this chapter are as follows:

EXPRI Excess primary reserves of Canadian banks as a percentage of deposits,

EXSEC Excess secondary reserves of Canadian banks as a percentage of deposits.

EXTER Excess tertiary assets of Canadian banks as a percentage of major Canadian dollar assets,

NFAFB Net foreign assets of foreign branches and agencies of Canadian banks,

NFAHO Net foreign assets of head office and branches in Canada,

NFASYS Net foreign assets of the banking system,[11] and

TFCASYS Total foreign currency assets of the banking system, billions of dollars.

The interest rates used in this chapter are monthly averages of weekly rates.

I have presented above the theory that treats NFA as having three separate aspects: interest arbitrage by the banks, liquidity management in response to Bank of Canada policy, and a relationship to swapped deposits. The equation suggested by the theory is therefore

$$NFA = \alpha + \beta_1 NFA^{*} + \beta_2 RAFC + \beta_3 RFS - \beta_4 RACAN + \beta_5 EXPRI + \beta_6 EXSEC + \beta_7 EXTER - \beta_8 SD - \beta_9 \Delta SD - \beta_{10} \Delta SD_{-1} - \ldots - \beta_{9+k} \Delta SD_{-k} + (1-\delta) NFA_{-1} \quad (41)$$

All the βs are expected to be positive and the last term incorporates the stock adjustment notion into the equation.

In Table 7 I present the result of the regression of NFASYS, NFAHO, and NFAFB on the explanatory variables.[12] The precise form of the variables will be explained in the discussion of the results. In the first three equations I use monthly data for the period January 1965 to December 1971. The last equation gives the results of the NFASYS equation for the period June 1962 to December 1971. In the discussion I shall focus on the equation for NFASYS for the period 1965 to 1971.[13]

The first three variables in the NFASYS equation (after the constant) represent the arbitrage part of the explanation of NFA. The particular form of the variables used was RAFC*TFCASYS, RACAN*TFCASYS, and RFS*TFCASYS. Multiplying the interest rates by a scale variable gives the equation the following very desirable property. The effect on NFA of a 1 percentage point change in an interest rate is proportional to the scale variable. For example, $\partial NFA / \partial RAFC = \beta_2 TFCASYS$. If the foreign currency assets held by the banks double, then the partial derivative of NFA with respect to a change in interest rates also doubles. The supposition that the size of arbitrage movements will grow as the size of the banks grows is much more plausible than the supposition that the size of arbitrage movements with respect to interest rate changes is unaffected by the growth of the system. The use of the particular scale variable TFCASYS is the result of experimentation with a number of scale variables including head

Table 7

NFA REGRESSIONS

	Dependent Variable			
	NFASYS	NFAHO	NFAFB	NFASYS
	Jan./65 to Dec./71	Jan./65 to Dec./71	Jan./65 to Dec./71	June/62 to Dec./71
C	38.19	9.72	24.75	-42.97
	(1.5)	(0.4)	(2.0)	(1.9)
RUSTB*TFCASYS	6.87	5.70	0.15	5.13
	(4.6)	(3.8)	(0.3)	(3.4)
RCPRI*TFCASYS	-11.62	-10.43	0.62	-7.85
	(5.3)	(4.8)	(0.9)	(3.8)
RFS*TFCASYS	0.64	0.17	0.04	0.07
	(0.7)	(0.2)	(0.1)	(0.1)
EXSEC*TFCASYS	5.53	5.94	-0.68	4.67
	(6.2)	(6.3)	(1.7)	(5.3)
EXTER*TFCASYS	3.95	3.59	-0.28	2.40
	(6.2)	(5.5)	(1.6)	(4.2)
SD	-0.178	-0.123	-0.040	-0.075
	(4.7)	(3.2)	(2.4)	(2.1)
ΔSD	-0.144	-0.180	0.003	-0.285
	(2.3)	(2.8)	(0.1)	(5.0)
NFA_{-1}	0.240	0.345	0.256	0.591
	(2.7)	(4.1)	(2.3)	(9.1)
SEE	48.0	50.8	22.1	51.3
R^2	.919	.909	.356	.885
DW	1.93	2.12	2.00	1.86

office assets and claims on residents of North America held at head office and New York agencies. In all the specifications tried, the total foreign currency assets of the banking system performed best.

To determine which interest rates were appropriate, I included in the equation all the short-term Canadian, U.S., and Euro-dollar interest rates for which monthly data are available. Rather surprisingly, only RUSTB and RCPRI proved to be significant. The rate on call loans (RUSCL) had the wrong sign when it was added to the 'best' equation. When RUSPRI was added to the equation, it had the correct sign and was almost significant. However, it reduced the magnitude of the coefficient on RUSTB. One must therefore think of RUSTB as capturing the effect of a change in the level of American interest rates in general rather than as standing for the rate on U.S. treasury bills, narrowly defined. The Euro-dollar rate (RED) had the correct sign but was insignificant. Similarly the rates on foreign currency deposits at Canadian banks (RL) and on Canadian dollar certificates of deposit (RCCD) had the correct sign but were insignificant.

It would appear, therefore, that Canadian banks shift from foreign currency liquid assets into prime loans in Canada when the rate on the latter rises relative to the rate on the former. The values of the multipliers in equilibrium (ie, taking account of the lagged dependent variable) are presented in Table 8. Two equilibrium numbers are shown - the first at the mean TFCASYS over the period 1965 to 1971 ($8.711 billion, the figure which was reached in February 1969) and the second for TFCASYS at the end of 1971 ($14.445 billion). The equation for NFASYS implies

Table 8

EQUILIBRIUM MULTIPLIERS FROM NFA REGRESSIONS

(Millions of Canadian dollars except for multiplier of SD)

	Dependent Variable		
	NFASYS	NFAHO	NFASYS
	At mean of TFCASYS (February 1969)		
	Jan./65 to Dec./71	Jan./65 to Dec./71	June/62 to Dec./71
RUSTB	78.74	75.81	
RCPRI	-133.19	-138.71	
RFS	7.34	2.26	
EXSEC	63.38	79.00	
EXTER	45.27	47.74	
SD	-0.234	-0.188	
	As at December 31, 1971		
RUSTB	130.57	125.71	181.18
RCPRI	-220.86	-230.02	-277.25
RFS	12.17	3.75	2.47
EXSEC	105.10	131.00	164.93
EXTER	75.07	79.16	84.76
SD	-0.234	-0.188	-0.183

that at the end of 1971 an increase of 1 percentage point (100 basis points) in RUSTB will increase NFA by $131 million and that the equivalent change in RCPRI will lower NFA by $221 million in the new equilibrium. Of the total effect, 76.0% will occur in the first month, 94.2% in the first two months, 98.6% in the first three months, and 99.7% in the first four months following the change in interest rate.

The theory on arbitrage by banks indicates that the coefficient on U.S. interest rates and the coefficient on Canadian rates should be equal and opposite in sign. However, the null hypothesis, that they are equal, is rejected in the NFASYS equation with a t-statistic of 4.59 compared to a critical t of 1.99 at the 5% significance level. This result is rather puzzling. One possible explanation for the difference in the coefficients is that an interest rate on some foreign currency asset has been omitted. But this explanation is implausible for two reasons. First, given the high correlation among such rates, RUSTB would likely have picked up most of its effect. Second, in almost all specifications the addition of a rate on a second foreign currency asset leads to a reduction of the coefficient on RUSTB. Furthermore the sum of the coefficients on RUSTB and on the new variable has roughly the same relationship to the coefficient on RCPRI as the coefficient on RUSTB had before the introduction of the new variable. A more likely explanation for the relative sizes of the two coefficients is that RCPRI may be picking up some of the effect of tightness I am attempting to capture with the use of EXPRI, EXSEC, and EXTER. This possibility is supported by the fact that when EXTER is transformed to include the effect of interest rates on liquidity

management, the coefficients on RCPRI and RUSTB tend to move towards equality.[14] It is therefore reasonable to use the coefficient of RUSTB as a conservative estimate of the effect of interest rates on bank arbitrage.

According to the theory of interest arbitrage the ratio of the coefficient on RFS to the coefficient on RUSTB measures the degree to which the movement by the banks between Canadian and foreign currency assets in response to interest rate changes is covered in the forward exchange market. The results apparently suggest that only a very small proportion of such asset shifts are covered. However, a more plausible explanation of the size of the coefficient on RFS is based on the existence of simultaneous equation bias in the equation for the NFA position. The relationship running from RFS and the interest rates to NFA was examined in the light of the interest arbitrage theory. But there is a reverse relationship running from NFA to RFS. Assume an autonomous increase in NFA. The banks buy spot U.S. dollars and sell forward U.S. dollars - transactions that lead to an upward movement in the spot rate and a downward movement in the forward rate. Thus an increase in NFA leads to a decrease in RFS. It can be shown that this second relationship between NFA and RFS biases the coefficient on RFS in the NFA equation downward in the limit. Under certain plausible assumptions, it is also the case that the simultaneity tends to bias the coefficient on RUSTB downward and that on RCPRI upward (algebraically) in the limit. Therefore the regression estimates appear to underestimate the magnitude of the effect of interest rate changes on NFA. The best approach to the simultaneity problem is to estimate the entire system of equations with a

consistent estimator in order to avoid the inconsistency of ordinary least squares in such a situation. But the specification of the entire foreign exchange sector would be required, a task that is well beyond the scope of this study.[15]

Attempts to find an appropriate proxy for NFA*, the desired level of NFA, did not succeed. Various combinations of investment in controlled corporations, Canadian securities payable in foreign currencies held at head office, and rest-of-world securities payable in foreign currencies held at head office[16] were incorporated into the equation but in no case was the coefficient significant. The use of TFCASYS as a proxy for NFA* was also unsuccessful. I conclude therefore either that NFA* does not exist (ie, desired NFA is zero) or that it is not a simple function of the variables one would expect to be most appropriate a priori.

I now consider the variables used to incorporate chartered bank liquidity management into the explanation of NFA. The variables EXPRI, EXSEC, and EXTER are defined as percentages. Their means are 0.10%, 2.06%, and 15.95%, respectively, over the period 1965 to 1971. The minimum and maximum values over this period are .06% and .15% for EXPRI, 0.36% and 4.18% for EXSEC, and 12.28% and 19.05% for EXTER.

Various forms of the three variables EXPRI, EXSEC, and EXTER were tried. Generally speaking, EXPRI was insignificant or had the wrong sign whereas EXSEC and EXTER entered with the correct sign and with large t-statistics. The insignificance of EXPRI is not surprising because I use monthly data. Bank of Canada pressure is reflected in the banking system via the cumulative excess primary ratio, that is, the average over the elapsed days

of the reserve-averaging period. One would therefore expect that the use of NFA to counteract central bank pressure would be directly related to the number of days remaining to the end of the averaging period. Monthly data are probably far too imprecise to capture effects as subtle in their timing as the response to EXPRI appears to be.

The form of EXSEC and of EXTER that proved to be best in the regressions was EXSEC*TFCASYS and EXTER*TFCASYS. This form can be justified in two slightly different ways. First, by using it I am asking what is the percentage change in foreign currency assets that results from a 1 percentage point change in EXSEC or EXTER. That is, I assume that a decline of 1% in the excess secondary assets or excess tertiary assets causes a constant decline over the sample period in the percentage of foreign currency assets via a reduction of NFA. If the variables were not scaled, a 1 percentage point change in EXSEC or EXTER would lead to a constant absolute decline over the sample period in foreign currency assets. Because NFA is defined in millions of dollars, TFCASYS is defined in billions of dollars, and EXSEC and EXTER are defined in percentage points, the regression coefficients must be divided by 10 to get the percentage impact on foreign currency assets of a 1 percentage point change in EXSEC or EXTER. For example, in the first equation in Table 7 a 1 percentage point change in EXSEC results in a 0.55 percentage point change in total foreign currency assets in the period of the change and a 0.73 percentage point change in the new equilibrium. The equivalent figures for a 1 percentage point change in EXTER are a 0.395 and a 0.52 percentage point change in total foreign currency assets. A second way of looking at the

equation involves rewriting EXTER as the ratio of excess Canadian dollar tertiary assets to total major Canadian dollar assets (TCA). Adjusting for the fact that EXTER is in percentage points and NFASYS is in millions of dollars, one can compute that the effect on NFASYS of a $1 change in Canadian liquid assets is .395*TFCASYS/TCA in the period of the change and .52*TFCASYS/TCA in equilibrium. This formulation shows explicitly that if the foreign currency segment of the business of Canadian banks grows more rapidly than the Canadian dollar segment of their business, NFA will have an increasingly important role relative to Canadian liquid assets in responding to changes in central bank policy. This can also be seen by comparing the equilibrium effect on NFA of a $1 change in excess Canadian dollar tertiary assets in February 1969 and December 1971. Since the foreign currency assets of the Canadian banks grew by 65.8% over this period while Canadian dollar assets grew by only 37.9%, the effect on NFASYS of a $1 change in excess Canadian dollar tertiary assets increased from $0.172 to $0.208. Also, as can be seen in Table 8, the equilibrium effect on NFASYS of a 1 percentage point change in EXTER increased from $45 million in February 1969 to $75 million in December 1971. The same analysis carried out for EXSEC (by writing EXSEC as the ratio of excess secondary reserve to statutory Canadian dollar deposits (CDEP)) shows that the effect on NFASYS of a $1 change in excess secondary reserves is 0.55*TFCASYS/CDEP in the period of change and 0.73*TFCASYS/CDEP in equilibrium. Again the growth of TFCASYS relative to Canadian dollar deposits leads to increasing use of NFASYS. The equilibrium effect on NFASYS of a $1 change in excess secondary reserves increased from $0.241 in February 1969 to $0.291 in

December 1971. Also a 1 percentage point decrease in EXSEC resulted in an equilibrium decrease in NFASYS of $63 million in February 1969 and of $105 million in December 1971.

Note that the interpretation of these results does not involve causation but concomitance. It is not the change in EXSEC or EXTER that produces a change in NFA but the change in the tightness or ease of Bank of Canada monetary policy. The equations indicate that adjustments of NFA are one element of chartered bank response to a change in policy and that a given response in NFA is seen to occur along with a given change in EXSEC or EXTER. That is, I have tried to measure the response of NFA indirectly, via changes in the Canadian dollar assets of the banking system following policy changes by the central bank, rather than directly.

Attempts were made to capture the interaction of liquidity management and interest rates in the reaction pattern of NFA to EXTER. In the theoretical section I have argued that the relative magnitudes of the change in Canadian liquid assets and the change in NFA in response to a change in central bank policy should be a function of interest rates on Canadian and U.S. liquid assets. To incorporate this aspect of bank behaviour, EXTER was replaced by the product of EXTER and various interest rates as well as this product multiplied by TFCASYS. Although some of the variables performed well, in all cases the SEE of the equation was substantially higher than that of the 'best' equation, ie, the equation using EXTER*TFCASYS by itself. Perhaps the form of the interaction between EXTER and the interest rates is too complicated to be captured in any simple fashion.

The last element in the explanation of NFA is the relation between NFA and swapped deposits. As can be seen in the first column of Table 7, both SD and Δ SD have the correct sign and are significant. In experiments with current and lagged Δ SD only current Δ SD was significant. The combination of SD, Δ SD, and the lagged dependent variable leads to the following time path of the effect on NFASYS of an increase in swapped deposits at time zero:[17]

0	-.322
1	-.255
2	-.239
3	-.235
4	-.234
.	.
.	.
.	.
∞	-.234

Suppose the increase in swapped deposits is $10. During the period in which the increase occurs, $6.78 is invested in foreign currency assets and the remaining $3.22 appears on the books as a decline in NFASYS. In the following period a further $0.67 is shifted into foreign currency assets, followed by $0.16, $0.04, and $0.01 in the next three periods. Thus, of the initial $10 deposit, $6.78 is immediately invested in foreign currency assets, a further $0.88 is invested in foreign currency assets in the following four periods, and $2.34 is retained indefinitely in Canada. The $0.88 represents the temporary effect on NFASYS of the increase in swapped deposits and the $2.34 reflects the average magnitude of swapped deposits over the sample period that did not result in investment in foreign currency assets.

Of the three elements in the theory of NFA, the swapped deposit component has the least stable coefficients over the various specifications tried. For example, the regression for

NFASYS in the period June 1962 to December 1971 (the fourth column in Table 7) shows both SD and Δ SD to be significant, but the relative importance of the temporary aspect and the permanent aspect of swapped deposits is very different. In this equation a $10 increase in swapped deposits reduces NFASYS permanently by $1.83. The delay in investing in foreign currency assets accounts for a further reduction of $1.77 in NFASYS in the period of the change.

The possibility that the effect of SD and Δ SD on NFA derived primarily from the year 1969, when swapped deposits increased from $763 million to $1,551 million, was tested by omitting 1969 from the 1965-1971 regression. The coefficients in this regression were very similar to those for the whole period. The coefficient on SD was -.182 and that on Δ SD was -.146. Since the coefficient on the lagged dependent variable increased from .240 to .292, the magnitude of the permanent aspect of swapped deposits increased from $2.34 to $2.57 on a $10 deposit. The temporary aspect declined from $0.88 to $0.71.

I attempted to examine the supposition that the tendency to leave swapped deposits unaccompanied by the acquisition of foreign currency assets increases at a time of tight monetary policy in Canada. That is, when the Bank of Canada increases the restrictive pressure on the banking system, the banks tend to use swapped deposits to counteract the squeeze. This supposition involves an interaction between SD and Δ SD and variants of EXTER. Although there were some indications that such interaction might have occurred, the introduction of the interaction variable generally increased the SEE of the equation or caused one of the other variables to become insignificant.

Another question on which the results throw some light is whether NFASYS or NFAHO is the variable that the banks attempt to adjust. Clearly NFAFB cannot be explained by the usual explanatory variables, since half the coefficients in the NFAFB regression in Table 7 have the wrong sign and only two coefficients (those on SD and the lagged dependent variable) have the right sign and are significant. Furthermore, when NFAFB is regressed on NFAHO, the result is insignificant. Similarly, the regression of NFAFB on NFASYS gives an insignificant result. I therefore believe that it is reasonable to treat NFAFB simply as a random variable with a mean of -$25.2 million and a standard deviation of $26.2 million.[18,19] Now suppose for the moment that the banks operate on NFAHO (hypothesis A) in the manner discussed in the theoretical and empirical sections of this chapter. Since NFASYS equals NFAHO plus NFAFB, the error variance in the NFASYS regression will equal the error variance in the NFAHO regression plus the variance of NFAFB (assuming that the two variances are uncorrelated). On the other hand, if the banks operate on NFASYS (hypothesis B), then the error variance in the NFAHO regression will be equal to the error variance in the NFASYS regression plus the variance of NFAFB. In Table 9, I present the results of calculations based on the two hypotheses using the regression equations for the period 1965 to 1971. Under hypothesis A, one would expect the variance of NFASYS to be equal to $3,264 million, which is $962 million more than the actual variance. Under hypothesis B, one would expect the error variance of NFAHO to be equal to $2,989 million, which is $412 million more than the actual variance. Thus the data indicate support for the latter hypothesis, that the banks operate on NFASYS. This

Table 9

COMPARISON OF NFAHO AND NFASYS

A. The hypothesis is that banks operate on NFAHO

	Error Variance
NFAHO	2576.95
NFAFB	687.38
Sum	3264.33
NFASYS	2301.85
Discrepancy	962.48

B. The hypothesis is that banks operate on NFASYS

	Error Variance
NFASYS	2301.85
NFAFB	687.38
Sum	2989.23
NFAHO	2576.95
Discrepancy	412.28

suggests that head office maintains effective control over the NFA of the banking system.

The above argument is further strengthened by three considerations. First, in all the specifications for which comparisons were made, the error variance of the NFASYS equation was smaller than that of the NFAHO equation. Second, most of the initial experimentation was done with NFAHO, which, if anything, tends to bias the error variance of the NFAHO equation downward. Third, one must take account of the fact that for the period 1962 to July 1967 the variable NFASYS has been adjusted so that it is conceptually consistent with the data after July 1967. Any measurement errors in this series automatically lead to corresponding errors in NFAFB, since the NFAHO series did not require adjustment. Such errors in the data would have no effect on the comparison in part A of Table 9 but would increase the sum of the error variance of NFASYS and the variance of NFAFB in part B of Table 9 and would therefore tend to increase the size of the discrepancy shown in part B. Since measurement error biases the results away from the acceptance of hypothesis B, the fact that the data support hypothesis B buttresses further the conclusion that the banks operate on NFASYS.

I conclude the discussion of the NFA regressions with observations on some of their less important aspects. First, in none of the regressions was autocorrelation a problem as shown by the autoregressive parameter of .036 when the autoregressive transformation is applied to the NFASYS equation for 1965-1971. Second, apparently there were no structural changes over the period. The two possible breaks examined were both in 1968. Applying the Chow test to the break caused by the imposition of

the guidelines, I obtained an F of 0.41, compared to a critical F of 2.02 (5%). The t-statistic for the change in the coefficient of EXSEC when the provisions of the 1967 Bank Act on variable secondary reserves came into effect was 0.18 compared to a critical t of 2.00 at the 5% level. Third, when the NFASYS equation is run for the period June 1962 to December 1971 (Table 7, column 4), the main changes from the 1965-1971 regression are in the slower speed of adjustment and the reversal of the relative magnitudes of SD and ΔSD. The equilibrium multipliers from this equation (Table 8, column 3) are generally somewhat larger than those for the shorter period.

The regression equation used throughout this chapter was applied to the weekly data for NFASYS. I present the results in Table 10 for the period November 8, 1967 to December 29, 1971. The starting date was chosen so that no adjustments are required for the NFASYS series. In Table 10 the first regression is the usual monthly regression for the period November 1967 to December 1971. It is presented so that comparisons may be made with the weekly regression over the same period. The equilibrium multipliers from the monthly equation as at the end of 1971 are presented in the second line of Table 10. The 1967-1972 monthly equation has a slightly faster speed of adjustment than the 1965-1972 monthly equation (80% compared to 76%), and the SEE is higher (53.2 compared to 48.0) although the equilibrium multipliers are virtually identical.

In the third line of Table 10 I present the results of the weekly regression of NFASYS on the usual variables. The equilibrium multipliers as at the end of 1971 are presented in the fourth line of Table 10. The sign of the coefficient on RFS

Table 10

NFASYS REGRESSIONS AND EQUILIBRIUM MULTIPLIERS

Regression	C	RUSTB* TFCASYS	RCPRI* TFCASYS	RFS* TFCASYS	EXSEC* TFCASYS	EXTER* TFCASYS	SD	ΔSD	NFA_{-1}	SEE	R^2	DW
Monthly	23.60	7.39	-12.36	0.69	5.67	4.21	-0.181	-0.157	0.203	53.2	.938	1.96
	(0.3)	(3.6)	(4.0)	(0.5)	(5.3)	(4.7)	(3.6)	(1.9)	(1.7)			
		133.94	-224.02	12.51	102.76	76.30	-0.227					
Weekly	73.13	1.32	-3.03	-0.68	1.70	0.91	-0.058	-0.340	0.729	43.6	.948	2.12
	(2.7)	(1.8)	(2.8)	(1.5)	(4.0)	(3.0)	(3.1)	(4.9)	(15.4)			
		70.36	-161.51	-36.25	90.61	48.51	-0.214					

is incorrect and the equilibrium multipliers are substantially smaller in the weekly equation than in the monthly equation. Both these results are probably attributable to the greater simultaneity of RFS and NFASYS in the period of a week than in the period of a month. The change in swapped deposits is entered only for the current week since the variable had the wrong sign and was insignificant for earlier weeks. The effect on NFA of an increase in swapped deposits at time zero has the following weekly time path:

0	-.398
1	-.348
2	-.312
3	-.285
4	-.266
5	-.252
6	-.242
7	-.234
8	-.229
.	.
.	.
.	.
∞	-.214

The weekly regression indicates a somewhat larger delayed investment aspect of swapped deposits (.184 compared to .111) and a slightly smaller tendency to leave the deposits permanently in Canadian dollar assets (.214 compared to .227) than does the monthly regression. The implied monthly speed of adjustment is approximately 75.6%, which is slightly smaller than the adjustment for the first month in the monthly equation (79.7%).

Appendix to Chapter 4

THE NET FOREIGN ASSETS OF FOREIGN BRANCHES

My analysis of the net foreign assets of foreign branches (NFAFB) can be carried one step further by relating it to the transactions denominated in Canadian dollars at the foreign branches and agencies. I make use of the following identity:

Net foreign assets of foreign branches

≡ net C$ liabilities of foreign branches

≡ C$ deposits of head office (HO) in foreign branches (FB)

+ C$ deposits of others (both banks and non-banks) in FB

- C$ loans by FB - C$ securities held at FB

- C$ deposits by FB in HO

- C$ deposits by FB in other banks.

where

C$ is Canadian dollar.

I assume throughout that the amount of Canadian dollar securities held at FB is negligible. When Canadian dollar transactions between HO and FB are combined into a single item, net Canadian dollar investment by HO in FB, which is equal to Canadian dollar deposits of HO in FB minus Canadian dollar deposits of FB in HO, I obtain the following revised identity:

NFAFB ≡ Net C$ investment by HO in FB

- C$ deposits by FB in other banks

+ C$ deposits of others in FB - C$ loans by FB.

The first two items to the right of the identity sign are not available. However the third and fourth items to the right of the identity sign are available on an end-of-quarter basis for

the years 1960 to 1971. Given the data[20] for NFAFB, a series for the sum of the first two items for the period 4Q63 to 4Q71 can be derived by subtraction. Two competing hypotheses regarding the relationship of head office and foreign branches can now be examined.

(1) The foreign branches (and agencies) receive Canadian dollar funds from head office that they use to make Canadian dollar loans.[21] Similarly, the foreign branches pass on to head office (or to other banks) the Canadian dollar deposits received from other banks and from non-banks. Under this hypothesis NFAFB would be a constant and the regression of the variable (Net C$ investment by HO in FB - C$ deposits by FB in other banks) on the Canadian dollar deposits of others in foreign branches and on Canadian dollar loans by foreign branches should yield coefficients of -1 and +1, respectively.

(2) Head office does not vary its Canadian dollar investment in foreign branches in order to offset Canadian dollar loans made by foreign branches. Similarly, Canadian dollar deposits at foreign branches are not redeposited at head office or at other banks. Under this hypothesis foreign branches change foreign currencies into Canadian dollars when they make Canadian dollar loans and change Canadian dollars into foreign currencies when they receive Canadian dollar deposits. Under this hypothesis the regression of NFAFB on Canadian dollar deposits in foreign branches and on Canadian dollar loans by foreign branches should yield coefficients of +1 and -1, respectively.

The variables used in the regressions are defined as follows:

C$DEPFB Deposits in Canadian dollars at foreign

branches by non-banks and banks (excluding head office).

C$LOANFB Canadian dollar loans by foreign branches.

NETINVHO-DEPBYFB Net Canadian dollar investment by head office in foreign branches minus Canadian dollar deposits at banks (excluding head office) by foreign branches.

NFAFB Net foreign assets of foreign branches of Canadian banks.

All these variables are defined as of the end of the quarter.

The results of the regression equations for the period 4Q63 to 4Q71 are as follows:

$$\underset{(2.8)}{-\ 31.11} + \underset{(0.7)}{0.28}\ C\$DEPFB + \underset{(0.2)}{0.04}\ C\$LOANFB \qquad (A20)$$

$$SEE = 31.1 \qquad R^2 = .032 \qquad DW = 1.53$$

$$NETINVHO - DEPBYFB = \underset{(2.8)}{-\ 31.11} - \underset{(1.8)}{0.72}\ C\$DEPFB + \underset{(4.5)}{1.04}\ C\$LOANFB \qquad (A21)$$

$$SEE = 31.1 \qquad R^2 = .421 \qquad DW = 1.53$$

$$\underset{(2.8)}{-\ 35.59} + \underset{(1.1)}{0.46}\ C\$DEPFB + \underset{(0.0)}{0.01}\ C\$LOANFB + .262\ u_{-1} \qquad (A22)$$

$$SEE = 30.1 \qquad R^2 = .091 \qquad DW = 1.94$$

$$NETINVHO - DEPBYFB = \underset{(2.8)}{-\ 35.59} - \underset{(1.3)}{0.54}\ C\$DEPFB + \underset{(3.9)}{1.01}\ C\$LOANFB + .262\ u_{-1} \qquad (A23)$$

$$SEE = 30.1 \qquad R^2 = .456 \qquad DW = 1.94$$

In equation (A22) and (A23) I use the Hildreth-Lu autoregressive technique. The first thing to note is that the equations for NFAFB and (NETINVHO-DEPBYFB) are not independent. Because of the way the NETINVHO-DEPBYFB was constructed, the constant must be the same in the two equations, the difference between the coefficients on C$DEPFB must be 1, and the difference between the coefficients on C$LOANFB must be -1. The second thing to note is that the constant is biased downward in absolute value in both equations because NFAFB is biased downward due to the omission of the items "other foreign currency assets at FB" and "other foreign currency liabilities at FB" from the data.

The results indicate strongly that Canadian dollar loans at foreign branches are made with Canadian dollar funds from head office (in accordance with hypothesis 1). The coefficient on C$LOANFB in the NFAFB equation (A22) has the wrong sign and is very insignificant. Virtually no Canadian dollar loans are made with funds obtained by selling foreign currency assets (or by increasing foreign currency liabilities) and exchanging the proceeds for Canadian dollars in the foreign exchange market. The situation regarding Canadian dollar deposits at foreign branches is less clear-cut. Regression (A22) indicates that 46% of the deposits are exchanged into foreign currencies and used to purchase foreign currency assets. The other 54% is passed on to head office or to other banks in the form of Canadian dollar deposits. As can be seen by the t-statistics, assertions regarding Canadian dollar loans can be made with much greater confidence than those regarding Canadian dollar deposits.

It is now possible to tie this discussion to the earlier discussion regarding NFAFB where it was shown that NFAFB could

not be explained by the variables that explain NFASYS or NFAHO. The above regressions demonstrate that NFAFB cannot be explained by using the hypothesis that Canadian dollar transactions at foreign branches are carried out by adjusting NFAFB. My earlier conclusion that NFAFB is simply a random variable is therefore strengthened.

Chapter 4 Footnotes

1 The terms long, short, and flat position refer to the situation in which assets in a given currency exceed, fall short of, or equal liabilities in the same currency.

2 The term 'banking system' refers to the consolidated position of the chartered banks in which transactions of head office and all branches of the banks, domestic and foreign, are included. Transactions between branches are netted out. The term head office includes head office and branches in Canada.

3 The generalization to more than one asset can be carried out in the same way as was done in Appendix 1 to Chapter 2.

4 This assumption is not valid for RACAN since the prime rate on loans is under the control of the bank. However because RACAN is an administered rate, it can be considered as fixed at most times.

5 NFA* may of course be zero. This is an empirical and not a theoretical question.

6 Note that I am assuming that OCD is not a function of RL or RCCD. This assumption can be relaxed without difficulty.

For simplicity of exposition I am also assuming that CCD is not a function of RL and that NSD and SD are not functions of RCCD. The relaxation of these assumptions complicates the mathematics substantially without adding very much economic insight. The regression equation for RL, which is derived from the maximization procedure with these assumptions relaxed, is the same as the regression equation for RL in Chapter 2 except that RCCD is omitted and the interest rates on Canadian dollar assets and on instruments competing with CCD are included. The results of such a regression equation are very similar to those in Chapter 2.

7 Of course, the ultimate test of the theory remains the empirical analysis in Section B of this chapter.

8 In discussing liquidity management, I draw heavily on Dingle, Sparks, and Walker [14].

9 This proportion is administered by the Canadian Bankers' Association on the basis of the recent share of Government of Canada transactions handled by each bank. The proportions are approximately equal to each bank's share of total bank deposits.

10 Due to the drawdown, the other banks of course lose their proportion times the amount of the transaction and the

degree of tightness for the system as a whole is unchanged.

11 The data for the three NFA variables have been adjusted to make the series consistent over the entire period for which these data are available. Details of the adjustments appear in the Notes on Empirical Variables.

12 Note that NFA_{-1} represents the appropriate lagged dependent variable, ie, $NFASYS_{-1}$, $NFAHO_{-1}$, and $NFAFB_{-1}$, respectively.

13 I present the usual summary statistics except for the coefficient of variation. The latter is omitted because it is not particularly useful when the denominator is the mean of a series that takes on both positive and negative values as net foreign assets do.

14 The general fit of the equation as measured by SEE or R^2 deteriorates when EXTER is transformed to include the effect of interest rates.

15 Use of the instrumental variable technique to deal with the endogeneity of RFS led to an increase in the magnitude and significance of the coefficient of RFS. It also resulted in slightly larger and more significant

coefficients on the interest rates. The results are thus consistent with theoretical expectations.

16 American securities are used as a liquid asset and are much larger than either of the other two categories of securities.

17 The introduction of the lagged dependent variable into the equation destroys the simple interpretation of the coefficients of SD and ΔSD as the permanent and temporary effect of swapped deposits on NFA. Instead one can compute the time path of NFA following an increase in SD and then deduce the permanent and temporary effect from this time path.

18 The reason that the mean is treated as meaningful is that it probably represents the omission of the categories "other foreign currency assets" and "other foreign currency liabilities" from the data. This omission probably results in a downward bias in NFAFB. At the end of 1964, the last date for which information on these items is available, the difference between these two items at foreign branches was $12.0 million.

19 In the Appendix to this chapter I analyze NFAFB in terms of Canadian dollar transactions at foreign branches.

20 The data for NFAFB are flawed by measurement error.

21 This situation could arise in two ways. Either the foreign branches make the loans on their own and request the funds from head office, or the loans and the funds are directed to the foreign branches by head office.

Chapter 5

FOREIGN CURRENCY ASSETS

In Chapter 2 I discussed the determination by the chartered banks of interest rates on foreign currency deposits. The interaction of these rates with demand functions for deposits by wealth-holders (discussed in Chapter 3) determines total foreign currency deposits at the banks. In Chapter 4 I examined the determination by the banks of their net foreign asset position. The sum of foreign currency deposits and net foreign assets is equal to foreign currency assets. In this chapter I discuss the allocation by the banks of their foreign currency assets among the various assets available to them - principally current loans, call loans, securities, and deposits at banks.

An overview of the allocation of assets by the banks was given in Chapter 1 (see especially Figures 5 and 6) and will now be summarized. In the period prior to the guidelines the banks first met the demand for current loans by Canadians and foreigners. During that period the remaining assets (liquid assets) were then allocated among call loans, securities, and deposits at banks. A sharp distinction was made between current loans and liquid assets because the former were determined predominantly by borrowers whereas the allocation of the latter was made by the banks. For the guidelines period total assets were first allocated geographically (North America versus the rest of the world) on the basis of Guidelines 1 and 2 and interest rate considerations. North American assets were used first to meet the demand for current loans by North American

borrowers. The remaining North American assets were allocated among call loans, U.S. securities, and deposits at North American banks. Rest-of-world assets were allocated among Euro-dollar deposits and Euro-dollar loans. Whereas other loans were determined primarily by the demand for funds by borrowers, Euro-dollar loans were determined by the Canadian banks. In effect the investments in Euro-dollar loans were made in a market setting that permitted the banks to adjust their portfolios with relative ease. Portfolio adjustment of this sort was not easily achieved by the banks in the case of North American loans where the initiative for loans generally comes from the borrower.

In this chapter I first set out the simple theory behind the borrowers' demand for loans. This is followed by the more complex theory regarding the allocation by the chartered banks of the rest of their assets. The empirical section is divided between the period prior to the guidelines and the guidelines period. For the latter period I investigate first the geographical allocation of assets and then, separately, the distribution of North American assets and rest-of-world assets.

A. Theory

1. The demand for loans

Equations for the loan functions are very simple. The demand for funds in the form of foreign currency loans at Canadian banks is assumed to be a function of a scale variable, interest rate variables, credit-tightness variables (ie, the degree of difficulty of getting loans in other forms), and the lagged dependent variable. Because it proved to be difficult to

find an appropriate scale variable, a trend is used in some of the equations to approximate that part of the growth in loans which is simply a result of economic growth.

2. The allocation of assets by the banks

I propose to use the standard theory of asset allocation in which the desired quantity of each asset held is a function of the scale variable and the interest rates on all the assets. In symbols,

$$A_i^* = f_i(S, r_1, \ldots, r_M) \qquad i = 1,\ldots,M \tag{42}$$

where

A_i^* is desired quantity of asset i

S is the scale variable

r_j is the rate of interest on asset j $\qquad j = 1,\ldots,M$

I expect that

$$\frac{\partial A_i^*}{\partial S} > 0; \quad \frac{\partial A_i^*}{\partial r_i} > 0; \quad \frac{\partial A_i^*}{\partial r_j} \gtreqless 0 \quad j \neq i \tag{43}$$

The desired amount of each asset is expected to increase as the scale variable increases. An increase in the interest rate on asset i will increase the amount of asset i desired, whereas an increase in the interest rate on asset j may reduce (substitute), increase (complement), or leave unchanged the amount of asset i desired.

Generally speaking, the scale variable or variables are so chosen that the sum of the scale variables is equal to the sum of the individual assets. For example, one can specify foreign currency deposits as S_1 and NFA as S_2. Then one has

$$\sum_{i=1}^{M} A_i^* \equiv S_1 + S_2 \tag{44}$$

The set of equations (42) can be rewritten in linear terms as

$$A_i^* = \alpha_i + \beta_{i1} S_1 + \beta_{i2} S_2 + \gamma_{i1} r_1 + \ldots + \gamma_{iM} r_M \qquad i = 1,\ldots,M \tag{45}$$

Now the adding-up constraints are imposed on the system of equations [6] p 103.

$$\sum_{i=1}^{M} \alpha_i = 0$$

$$\sum_{i=1}^{M} \beta_{ij} = 1 \qquad j = 1,2 \tag{46}$$

$$\sum_{i=1}^{M} \gamma_{ij} = 0 \qquad j = 1,\ldots,M$$

An increase in one of the scale variables must be allocated completely among the desired assets. An increase in one of the interest rates raises the amount desired of some assets and reduces the amount desired of other assets so that the sum of the desired assets is unchanged.

Thus far I have set up a group of equations for desired holdings of assets. In models of asset allocation one expects that a change in a parameter will not lead to the immediate establishment of new equilibrium quantities. Instead, there will be some form of adjustment over time that eventually will lead to the establishment of a new equilibrium. The particular adjustment mechanism used in this chapter has been called the "complete partial adjustment" model [37] or "the interrelated demand" model [41] (See also [6].) This model can be written

$$\Delta A_{it} = \delta_{i1}(A^{*}_{1,t} - A_{1,t-1}) + \ldots + \delta_{ii}(A^{*}_{i,t} - A_{i,t-1}) + \ldots$$
$$+ \delta_{iM}(A^{*}_{M,t} - A_{M,t-1}) \qquad i = 1,\ldots,M \tag{47}$$

$$\delta_{ii} > 0; \qquad \delta_{ij} \gtrless 0, \quad j \neq i \tag{48}$$

Ceteris paribus, the banks will increase A_i if desired A_i is greater than actual A_i (measured as at the end of the previous period)[1] and will reduce A_i if desired A_i is less than actual A_i. The novelty of the formulation is that the change in A_i is also connected to the relationship between desired holdings and actual holdings of some or all of the other assets. If δ_{ij} is positive, then asset i will be increased when asset j is below its desired level. If δ_{ij} is negative, asset i will be decreased when asset j is below its desired level.

This discussion can perhaps be made more plausible by citing an example.[2] Consider a system of asset holdings in which the lender holds a short-term very liquid asset (cash), a long-term less liquid asset (bonds), and an illiquid asset (mortgages). A reasonable behaviour pattern for this model would be for the lender to moderate his acquisition of mortgages if his holdings of cash are less than desired. Thus in the equation for mortgages, one would find the coefficient on the cash 'gap' (the difference between desired and actual cash) to be negative. However in the cash equation the coefficient on the mortgage 'gap' may well be positive.[3]

The adding-up constraints of the theory require that

$$\sum_{i=1}^{M} A_{it} \equiv \sum_{i=1}^{M} A^{*}_{it} \equiv S_{1t} + S_{2t} \tag{49}$$

The sum of the actual amounts held must be equal to the sum of the desired amounts, which, in turn, must be equal to the sum of the scale variables. If A^*_{jt} increases by one unit and all the other A^*_{it} remain unchanged,[4] then the changes in the actual amounts of assets held must be equal to

$$\delta_{1j} + \delta_{2j} + \ldots + \delta_{Mj} \tag{50}$$

which must therefore be equal to 1 (because of equation (49)). This argument implies that

$$\sum_{i=1}^{M} \delta_{ij} = 1 \qquad j = 1,\ldots,M \tag{51}$$

The sum of each column of adjustment coefficients must be equal to 1.

Usually δ_{ii} is a fraction between zero and 1. If the column sum is to equal 1, all the other speeds of adjustment in the column must add up to a positive fraction. This means that the positive δ_{ij} $(i \neq j)$ must outweigh the negative δ_{ij} when δ_{ii} is less than 1.

The combining of equation (45) and (47) gives

$$\begin{aligned}\Delta A_{it} = {} & \delta_{i1}(\alpha_1 + \beta_{11}S_{1t} + \beta_{12}S_{2t} + \gamma_{11}r_{1t} + \ldots + \gamma_{1M}r_{Mt} - A_{1,t-1}) + \ldots \\ & + \delta_{ii}(\alpha_i + \beta_{i1}S_{1t} + \beta_{i2}S_{2t} + \gamma_{i1}r_{1t} + \ldots + \gamma_{iM}r_{Mt} - A_{i,t-1}) + \ldots \\ & + \delta_{iM}(\alpha_M + \beta_{M1}S_{1t} + \beta_{M2}S_{2t} + \gamma_{M1}r_{1t} + \ldots + \gamma_{MM}r_{Mt} - A_{M,t-1}) \qquad i = 1,\ldots,M\end{aligned} \tag{52}$$

This can be written as

$$A_{it} = \sum_{j=1}^{M} \delta_{ij}\alpha_j + \sum_{j=1}^{M} \delta_{ij}\beta_{j1}S_{1t} + \sum_{j=1}^{M} \delta_{ij}\beta_{j2}S_{2t} + \sum_{j=1}^{M} \delta_{ij}\gamma_{j1}r_{1t}$$

$$+ \ldots + \sum_{j=1}^{M} \delta_{ij}\gamma_{jM}r_{Mt} - \delta_{i1}A_{1,t-1} - \delta_{i2}A_{2,t-1} \qquad (53)$$

$$- \ldots + (1-\delta_{ii})A_{i,t-1} - \ldots - \delta_{iM}A_{M,t-1} \qquad i = 1,\ldots,M$$

The terms $\sum_{j=1}^{M} \delta_{ij}\beta_{j1}$, $\sum_{j=1}^{M} \delta_{ij}\gamma_{j1}$, etc. give the impact effect of a change in S_{1t}, r_{1t}, etc. on A_{it}, whereas β_{i1} and γ_{i1} give the equilibrium effect. It is easy to show that the column sums of the coefficients on the variables S_{1t} and S_{2t} must equal 1, and that the column sums of the coefficients on the interest rates and lagged dependent variables must equal zero. That is, the adding-up constraints hold in the period of impact as well as in equilibrium. They can also be shown to hold in all the intervening periods.

The problem of imposing the adding-up constraints in the regression can be handled in a straightforward fashion. Theory requires that the sum of the coefficients on the scale variables be equal to 1 and that the sum of the coefficients on the other variables (including the lagged dependent variables) be equal to zero. One can either run a regression subject to these constraints, ie, minimize the sum of squares subject to these adding-up constraints, or one can include all the variables in each equation. In the latter case, it can easily be shown that the adding-up constraints are automatically fulfilled. I adopt the latter approach in this study. Using the regression results

I can obtain the time paths to equilibrium and equilibrium multipliers either by simulation or, if no nonlinear terms are used, analytically.

B. Empirical Results

The following new variables are introduced in this chapter:

ASSETEXNA	Excess claims on residents of North America.
ASSETLIQ	Total foreign currency liquid assets.
ASSETRW	Rest-of-world assets of Canadian banks.
BANKDEP	Deposits at banks.
BANKDEPNA	Deposits at North American banks.
CL	Call loans.
EDDEP	Euro-dollar deposits by Canadian banks.
EDLOAN	Euro-dollar loans by Canadian banks.
FRNY	Free reserves of New York banks.
FRUS	Free reserves of U.S. banks.
LOANCAN	Foreign currency loans to residents of Canada.
LOANEDNY	Euro-dollar loans by Canadian banks plus loans by New York agencies.
LOANNR	Foreign currency loans to non-residents of Canada.
LOANNY	Loans by New York agencies.
OCT	October dummy.
PROXYLOANUS	Proxy variable for foreign currency loans to residents of the United States.
SEC	Securities.
SECUS	U.S. securities.

1. The period prior to the guidelines

(a) Loans to residents of Canada

Over the period June 1962 to December 1971 foreign currency loans to residents of Canada averaged $760 million with a peak value of $1,257 million in September 1970. There is very little information on why such borrowing occurred and who did the borrowing. My approach, therefore, is to confront the data with a number of hypotheses.

The first hypothesis is that these loans are made at the demand of borrowers to take advantage of interest rate differences between Canadian dollar loans and foreign currency loans. The interest rate equations of Chapter 2, which emphasize the U.S. prime rate, indicate that foreign currency loans are made at a rate related to the U.S. prime rate. There is also independent information about this rate suggesting that it is related to the U.S. prime rate.[5] Consequently, the loans are treated as a function of the difference between the U.S. prime rate and the Canadian prime rate. I allow for the possibility that the comparison is made on a covered basis by entering the forward spread expressed as an annual interest rate (RFS) as well. If foreign currency loans to Canadian residents are a function of relative rates, one would expect a positive sign on the Canadian prime rate, a negative sign on the U.S. prime rate, and a negative sign on RFS. The relative magnitude of the coefficients on the interest rates and on RFS will indicate the proportion of loans made as a result of interest rate changes that is covered in the forward exchange market.

The second hypothesis is that borrowers shift into foreign currency loans at Canadian banks when they have difficulty in obtaining the bank loans they commonly use, namely, Canadian dollar loans at Canadian banks and U.S. dollar loans at New York banks.[6] For example, as Canadian banks face a tighter monetary policy, some borrowers get shifted to foreign currency loans from Canadian dollar loans. This shift can be either on the initiative of the bank or on the initiative of the borrower. A Canadian borrower might take the initiative if a bank were to indicate that it would reduce the amount of any Canadian dollar loan it would make. Canadian borrowers also obtain loans at New York banks. Increased tightness in U.S. monetary policy might make these U.S. dollar loans more difficult to obtain so that borrowers would turn to foreign currency loans at Canadian banks.

The third hypothesis is that Canadian borrowers might have their loans denominated in U.S. dollars rather than Canadian dollars in order to speculate on changes in the exchange rate. That is, if they expect the U.S. dollar to depreciate (appreciate) relative to the Canadian dollar, they will borrow more (less) in U.S. dollars.

The fourth hypothesis is that foreign currency loans are made to Canadian exporters who wish to eliminate the risk of fluctuations in the exchange rate. Most Canadian exports are denominated in foreign currencies, in particular in U.S. dollars. To cover against exchange rate movements an exporter can sell U.S. dollars forward. Alternatively, he can create a U.S. dollar liability (a loan) to offset the U.S. dollar claim created by the exports. If loans to exporters are an important part of foreign

currency loans at Canadian banks, the value of Canadian exports should enter into the loan equation.

The equation for loans to Canadian residents based on the four hypotheses outlined above is therefore as follows:

$$\text{LOANCAN} = \alpha + \beta_1 T + \beta_2 X + \gamma_1 \text{RCPRI} - \gamma_2 \text{RUSPRI} - \gamma_3 \text{RFS} - \gamma_4 \text{EXTER} - \gamma_5 \text{FRNY} + \gamma_6 \Delta \text{XR} + (1-\delta)\text{LOANCAN}_{-1} \quad (54)$$

In experimenting with this equation I found that total exports (X) at no time entered significantly with the right sign. This suggests that borrowing by exporters is not an important element in foreign currency loans to residents of Canada or that only exporters of specific commodities (ie, commodities not highly correlated with total exports) obtain foreign currency loans at Canadian banks.

The dropping of exports from the regression leads to the following equation for the period June 1962 to December 1971:

$$\underset{}{\text{LOANCAN}} = \underset{(4.0)}{192.27} + \underset{(1.2)}{.245}\, T + \underset{(1.8)}{6.60}\,(\text{RCPRI-RUSPRI-RFS}) - \underset{(3.6)}{8.11}\,\text{EXTER} - \underset{(3.5)}{.194}\,\text{FRNY} + \underset{(31.0)}{.896}\,\text{LOANCAN}_{-1} \quad (55)$$

SEE = 29.3 $\quad R^2 = .989$ $\quad$ COV = 3.86% $\quad$ DW = 1.98

The test of the null hypothesis, that only the covered interest rate differential is relevant, yielded an F of 1.23 compared to a critical F of 3.09 (5%). The test of the null hypothesis, of no structural break in 1968, gave an F of 0.95 compared to a critical F of 2.19 (5%). I conclude that only the covered interest rate differential is relevant and that a single equation

can be used to explain loans to residents of Canada for the entire period.

The equilibrium multiplier on the interest rate differential is $63.5 million. That is, an increase of 100 basis points in the Canadian prime rate relative to the covered U.S. prime rate (the rate charged on U.S. dollar loans plus the forward cover) leads to an increase in foreign currency loans of $63.5 million. Both tightness variables enter significantly and with the correct sign. A decrease of 1 percentage point in the ratio of excess tertiary assets to total Canadian dollar assets at Canadian banks (EXTER) would lead to an increase in foreign currency loans by Canadian banks of $78.0 million. Similarly, a decrease of $100 million in free reserves at New York banks would lead to an increase in foreign currency loans by Canadian banks of $186.5 million. It is interesting to note that the free reserves of New York banks (FRNY) perform much better in this equation than the free reserves of all U.S. banks (FRUS). This indicates that the New York banks are the alternative source of funds for Canadian borrowers rather than U.S. banks in general.[7] I conclude that a major determinant of foreign currency borrowing is tightness at Canadian and New York banks. As Canadian and U.S. monetary policy squeeze the domestic banking systems, borrowing either shifts or is shifted into U.S. dollar loans at Canadian banks.

I attempted to capture the effect of speculation by inserting the change in the exchange rate into the regression. The coefficient on ΔXR was negative but not significant in the usual equation. When LOANCAN was transformed into U.S. dollar terms, however, the exchange rate variable became significant.

$$\underset{}{\text{LOANCAN(US\$)}} = \underset{(3.7)}{162.83} + \underset{(1.2)}{.240\ T} + \underset{(2.1)}{7.51\ (\text{RCPRI-RUSPRI-RFS})} - \underset{(3.4)}{6.93\ \text{EXTER}}$$

$$- \underset{(3.5)}{.185\ \text{FRNY}} - \underset{(2.1)}{12.62\ \Delta\text{XR}} + \underset{(32.0)}{.903\ \text{LOANCAN(US\$)}_{-1}} \qquad (56)$$

$$\text{SEE} = 27.9 \qquad R^2 = .990 \qquad \text{COV} = 3.89\% \qquad \text{DW} = 1.97$$

An increase of 1 cent in the exchange rate for the U.S. dollar leads to a decline in foreign currency loans of $12.6 million. At least part of the relationship between loans and ΔXR is probably spurious and derives from the accounting conventions discussed in the Appendix to Chapter 3. But, to the extent that this relationship is not spurious, one can conclude that some borrowers do speculate on the exchange rate and that their expectations are extrapolative. Thus, an increase in the exchange rate for the U.S. dollar leads to expectations of a further increase and therefore to a decline in liabilities denominated in U.S. dollars. The effect of the increase in the exchange rate wears away over time.

(b) Loans to non-residents of Canada

In the equation for banking system loans to non-residents in the period prior to the guidelines I use trend as a scale variable and the differential between the U.S. prime rate and the Euro-dollar rate as the relative cost variable.

$$\underset{(3.1)}{\text{LOANNR(US\$)}} = \underset{(2.8)}{189.79} + \underset{(1.5)}{2.66\ T} - \underset{}{14.34\ (\text{RUSPRI-RED})} + \underset{(10.2)}{.778\ \text{LOANNR(US\$)}_{-1}} \tag{57}$$

$$\text{SEE} = 31.1 \qquad R^2 = .987 \qquad \text{COV} = 2.40\% \qquad \text{DW} = 1.76$$

An increase of 100 basis points in the U.S. prime rate (to which the rate on head office loans to non-residents is connected) relative to the Euro-dollar rate leads to an equilibrium decline in non-resident loans of $64.6 million.

(c) The allocation of liquid assets by the banks

When loans to residents and loans to non-residents are subtracted from total assets, the remainder is foreign currency liquid assets.[8] In this section I discuss the allocation of liquid assets among call loans, securities, and deposits at banks.[9]

The basic identity used to analyze the asset allocation of the banks is the following:

CALL LOANS + SECURITIES + DEPOSITS AT BANKS

≡ LIQUID ASSETS

≡ FOREIGN CURRENCY LIABILITIES[10] + NET FOREIGN CURRENCY ASSETS (NFA - net gold assets) - CURRENT LOANS

In the set of asset allocation regressions I attempt to explain each of the liquid assets as a function of each of the scale variables, the interest rates on the liquid assets, and the lagged values of the three liquid assets.

In examining the regression results, the first step is to test the hypothesis that the scale variables - foreign currency liabilities, net foreign currency assets, and current loans - affect the dependent variables in the same way. The alternative

hypothesis is that a dollar increase in funds derived from an increase in foreign currency liabilities, a dollar increase in funds derived from an increase in net foreign currency assets, and a dollar increase in funds derived from a reduction in current loans are each allocated differently among call loans, securities, and deposits at banks. The value of the F-statistic for the test of the null hypothesis, that funds from all sources are allocated in the same way, is 2.55 for the system of equations. The critical F values are 2.14 (5%) and 2.90 (1%). Although the decision is a borderline one, I decided not to reject the null hypothesis.[11] Consequently the three scale variables are aggregated into one variable - total liquid assets (ASSETLIQ).

The results of the regression of the three liquid assets on ASSETLIQ, interest rates, and lagged variables are presented in Table 11. The regressions cover the period February 1962 to April 1968. The first three columns in Table 11 are the regressions, and the next three columns are the equilibrium multipliers. The time paths to equilibrium are shown in Figure 17.

An examination of the interest rate coefficients shows that all the partial derivatives with respect to own rates of interest are positive as expected and all cross-partial derivatives except one are negative. The t-statistics on the interest rates are not particularly high but the magnitudes of the coefficients appear to be reasonable. The equilibrium interest rate effects are substantial. A 1 percentage point change in the interest rate on call loans leads to an increase in the new equilibrium of $330 million in call loans, mainly at the expense of deposits, which I

Table 11

ALLOCATION OF LIQUID ASSETS IN THE PERIOD PRIOR TO THE GUIDELINES

	Dependent Variable					
	CL	SEC	BANKDEP	CL	SEC	BANKDEP
C	183.80	212.51	-396.31			
	(1.2)	(1.5)	(2.7)			
ASSETLIQ	.375	.317	.308	.082	-.048	.966
	(7.3)	(6.3)	(6.0)			
RUSCL	58.91	-21.49	-37.42	330.15	-36.98	-293.17
	(1.4)	(0.5)	(0.9)			
RUSTB	23.30	28.95	-52.25	117.76	150.27	-268.03
	(0.5)	(0.6)	(1.1)			
RED	-82.51	-12.06	94.57	-447.98	-133.84	581.82
	(2.2)	(0.3)	(2.5)			
CL_{-1}	.459	-.291	-.168			
	(7.1)	(4.6)	(2.6)			
SEC_{-1}	-.375	.445	-.070			
	(4.6)	(5.6)	(0.9)			
$BANKDEP_{-1}$	-.361	-.331	.692			
	(6.2)	(5.8)	(11.8)			
SEE	73.3	72.0	73.5			
R^2	.826	.717	.962			
COV	8.31	9.06	5.19			
DW	1.97	2.20	1.89			

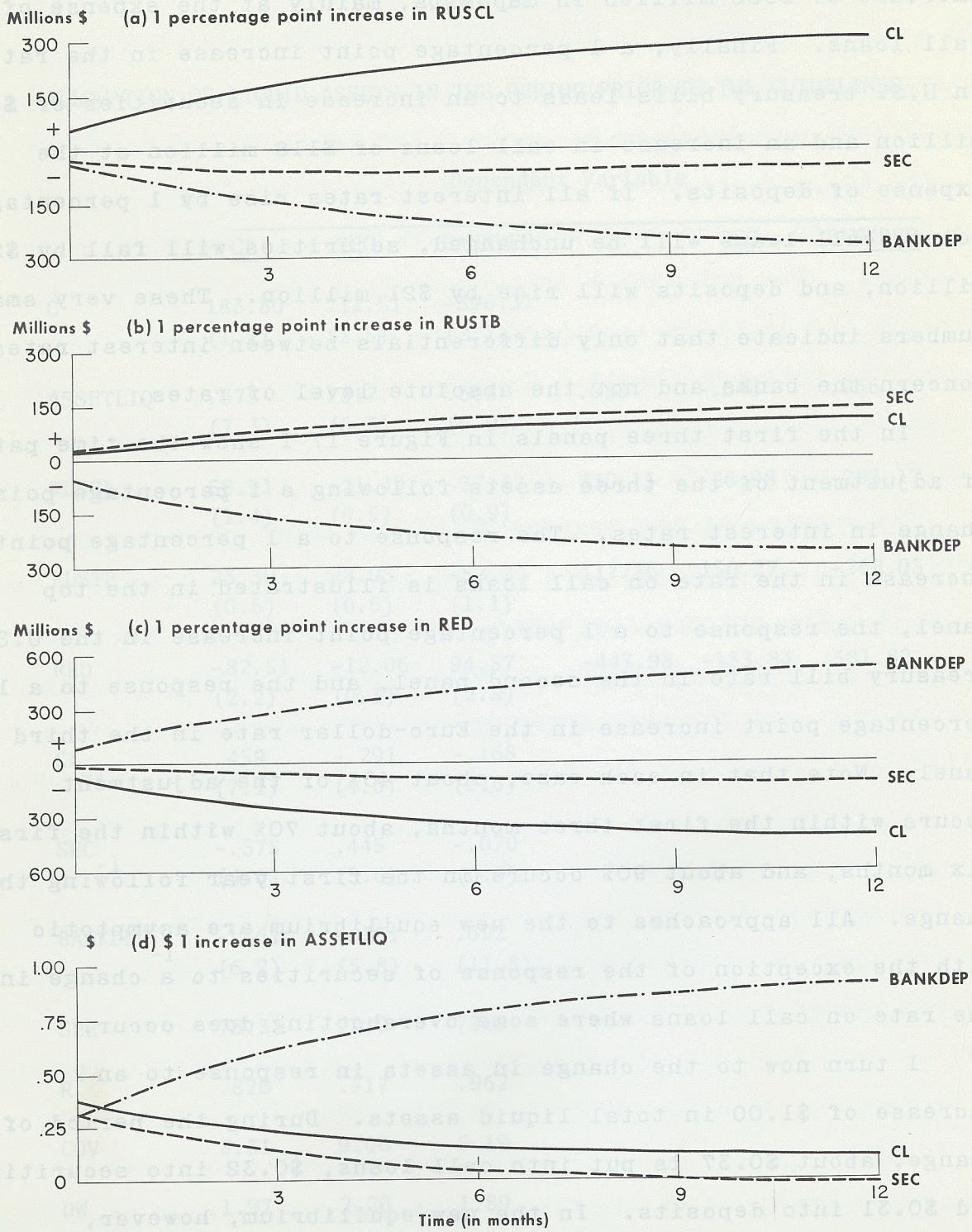
interpret to be principally Euro-dollar deposits.[12] A 1 percentage point change in the rate on Euro-dollars leads to an increase of $582 million in deposits, mainly at the expense of call loans. Finally, a 1 percentage point increase in the rate on U.S. treasury bills leads to an increase in securities of $150 million and an increase in call loans of $118 million at the expense of deposits. If all interest rates rise by 1 percentage point, call loans will be unchanged, securities will fall by $21 million, and deposits will rise by $21 million. These very small numbers indicate that only differentials between interest rates concern the banks and not the absolute level of rates.

In the first three panels in Figure 17 I show the time path of adjustment of the three assets following a 1 percentage point change in interest rates. The response to a 1 percentage point increase in the rate on call loans is illustrated in the top panel, the response to a 1 percentage point increase in the U.S. treasury bill rate in the second panel, and the response to a 1 percentage point increase in the Euro-dollar rate in the third panel. Note that in each case, about 45% of the adjustment occurs within the first three months, about 70% within the first six months, and about 90% occurs in the first year following the change. All approaches to the new equilibrium are asymptotic with the exception of the response of securities to a change in the rate on call loans where some overshooting does occur.

I turn now to the change in assets in response to an increase of $1.00 in total liquid assets. During the period of change, about $0.37 is put into call loans, $0.32 into securities and $0.31 into deposits. In the new equilibrium, however, virtually the entire increase in liquid assets ends up in Euro-

Figure 17

RESPONSE PATHS OF LIQUID ASSETS TO CHANGES IN EXOGENOUS VARIABLES IN THE PERIOD PRIOR TO THE GUIDELINES



dollar deposits. The path of adjustment, as shown in the bottom panel of Figure 17, once again involves a smooth movement to the new equilibrium.

In the period analyzed the regression results indicate that call loans and securities have been used as an initial repository of funds that have then been shifted over time towards Euro-dollar deposits. The equilibrium changes in call loans and securities with respect to changes in total liquid assets have been negligible. Similar conclusions can be drawn from the crude data. At the beginning of the period, the Canadian banks held 69.8% of their liquid assets in call loans and securities whereas in April 1968 only 39.6% of liquid assets were held in these two assets. An equivalent statement is that total liquid assets increased by 28.6% over this six-year period but call loans and securities declined by 26.9%. The shift from call loans and securities to Euro-dollar deposits during these years was basically a function of increased awareness of the Euro-dollar market. At the beginning of the period it was a relatively new and untried market, but by the end of the period the Euro-dollar market was a permanent feature of the financial landscape and the Canadian banks were willing to put a substantially larger proportion of their liquid assets there.

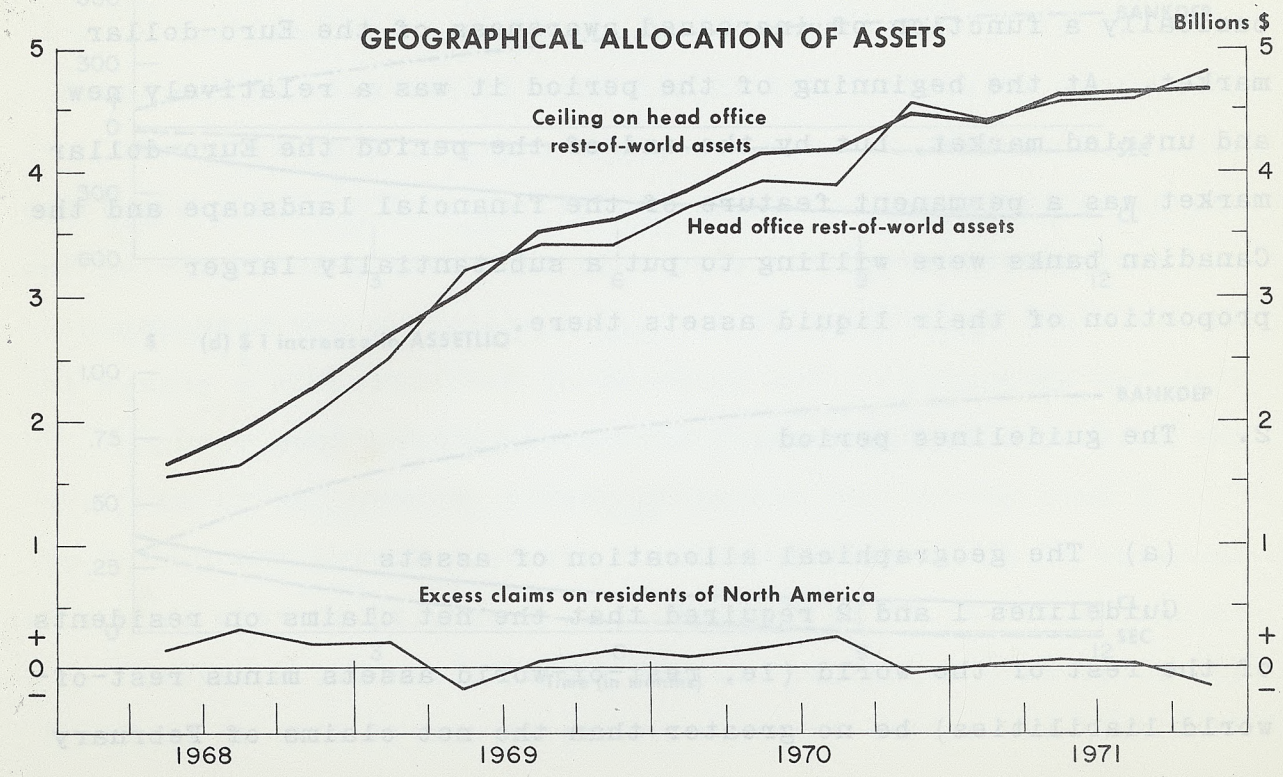
2. The guidelines period

(a) The geographical allocation of assets

Guidelines 1 and 2 required that the net claims on residents of the rest of the world (ie, rest-of-world assets minus rest-of-world liabilities) be no greater than the net claims of February

1968. In other words, rest-of-world assets had to be less than or equal to rest-of-world liabilities plus the net claims of February 1968 (which is a negative number). In Figure 18 I show head office claims on residents of the rest of the world and the ceiling on rest-of-world assets imposed under Guidelines 1 and 2. The difference between actual rest-of-world assets and the ceiling on rest-of-world assets is a variable that I call excess claims on residents of North America. This title is appropriate because the ceiling on rest-of-world assets implies a floor on North American assets and the maintenance of rest-of-world assets below the ceiling is equivalent to the maintenance of North American assets above the floor. Excess claims on residents of North America provide the link between the geographical allocation of deposits and the geographical allocation of assets.[13]

Figure 18



Over the period of study (May 1968 to December 1971) interest rates in the Euro-dollar market were, on average, substantially higher than interest rates in North America. Consequently, the banks had an incentive to keep as close as possible to the ceiling on rest-of-world assets, since holding North American assets instead of rest-of-world assets meant a loss in income. On the other hand, keeping rest-of-world assets too close to the ceiling might entail a loss of flexibility. For example, if the maturities of rest-of-world assets and liabilities were not perfectly matched, a situation might arise in which rest-of-world deposits might have to be booked at very high rates in order to satisfy the guidelines even though rest-of-world assets yielded a lower return. A similar situation might occur if an unexpected reduction of deposits forced the banks either to borrow expensive overnight money or to violate the guidelines. There are therefore advantages to keeping rest-of-world assets somewhat below the ceiling. A situation would thus arise in which an asset (in this case an asset in North America above the floor level) would be held for its non-pecuniary return (ie, in order to increase flexibility) at some cost in interest. The amount of the asset held would be inversely related to the interest foregone in holding the asset in accordance with the usual theoretical result [21].

The floor on net claims on residents of North America is equal to the net claims on residents of North America in February 1968 ($170.0 million) for the period May 1968 to August 1970, and to net claims adjusted to include Puerto Rico and the U.S. Virgin Islands ($119.1 million) for the period from September 1970 on. I ignore the relatively small adjustment for net earnings

offshore and for Export Development Corporation guarantees. The dependent variable of regression (58) is net claims on residents of North America minus the floor level of net claims (ASSETEXNA), where the floor level is, as explained, $170.0 million to August 1970 and $119.1 million thereafter. Over the period May 1968 to December 1971, the mean value of ASSETEXNA was $161.4 million and the variable ranged from -$172 million to $738 million. I regressed ASSETEXNA on interest rates and on a dummy variable (OCT) which takes the value 1 for October and zero otherwise. The regression results were as follows:

$$\underset{}{\text{ASSETEXNA}} = \underset{(1.4)}{-141.23} + \underset{(5.6)}{180.26}\ \text{RUSTB} - \underset{(4.4)}{98.20}\ \text{RED} + \underset{(4.7)}{312.95}\ \text{OCT} \qquad (58)$$

$$\text{SEE} = 126.8 \qquad R^2 = .589 \qquad \text{DW} = 1.65$$

An increase of 100 basis points in the U.S. treasury bill rate leads to an increase of $180 million in excess claims on residents of North America; an equivalent increase in the Euro-dollar rate leads to a $98 million decline in the excess claims on residents of North America.[14] The October dummy captures the window dressing that occurs at the chartered bank year-end in October. A casual examination of the data makes it clear that call loans are the destination of most of the October shifts for the years 1968 to 1971.[15]

The above regression provides the link between deposits by region and assets by region. One can now take as explained total North American assets and total rest-of-world assets. I therefore turn to an analysis of asset-by-asset allocation within each region given the total assets of the region.

(b) The allocation of rest-of-world assets

Given total claims on residents of the rest of the world (defined to include those held by head office and those held by foreign branches), I now wish to examine the division of total assets into Euro-dollar loans and Euro-dollar deposits.[16] Unfortunately, the data for the banking system do not allow one to distinguish between deposits in North America and deposits outside North America or between loans in New York and loans outside North America. To get any results, therefore, the regression equations must be specified with care and strong assumptions must be made about omitted variables. The validity of the results thus depends crucially on whether the assumptions are in fact correct.

There are two hypotheses to be examined regarding the determination of Euro-dollar loans. The first and simpler hypothesis is that desired Euro-dollar loans (EDLOAN*) are related to total rest-of-world assets (ASSETRW).[17]

$$EDLOAN^{*} = \eta + \beta ASSETRW \tag{59}$$

Desired Euro-dollar deposits (EDDEP*) are implicitly also a function of rest-of-world assets.

$$EDDEP^{*} = -\eta + (1-\beta)ASSETRW \tag{60}$$

The adjustment of actual loans to desired loans is assumed to occur entirely within a rest-of-world setting. This gives the equation

$$\Delta EDLOAN = \delta_1(EDLOAN^{*} - EDLOAN_{-1}) + \delta_2(EDDEP^{*} - EDDEP_{-1}) \tag{61}$$

Equations (59),(60), and (61) can be combined to give equation (62).

$$EDLOAN = \alpha + \gamma ASSETRW + (1-\delta_1)EDLOAN_{-1} - \delta_2 EDDEP_{-1} \quad (62)$$

Unfortunately, as mentioned above, there are no data for EDLOAN or EDDEP. The sum of the loans made in New York (LOANNY) and Euro-dollar loans gives LOANEDNY, which is equal to total current loans minus head office loans to Canadians and Americans. Similarly, the sum of deposits at North American banks (BANKDEPNA) and Euro-dollar deposits gives total deposits at foreign banks (BANKDEP). Equation (62) can be manipulated to give

$$LOANEDNY = \alpha + \gamma ASSETRW + (1-\delta_1)LOANEDNY_{-1} - \delta_2 BANKDEP_{-1} + LOANNY - (1-\delta_1)LOANNY_{-1} + \delta_2 BANKDEPNA_{-1} \quad (63)$$

As a proxy variable for LOANNY I use (LOANNY+BANKDEPNA) and as a proxy variable for both $LOANNY_{-1}$ and $BANKDEPNA_{-1}$ I use $(LOANNY+BANKDEPNA)_{-1}$. Values for these proxy variables can be derived by assuming that all call loans are made in New York and that all securities outside head office are held in New York. One then gets the following relationship:

LOANNY + BANKDEPNA = Assets at New York agencies (64)
- Call loans at New York agencies
- Securities at New York agencies
+ Deposits at North American banks by head office
= Claims on North American banks and agencies by head office
- Total call loans
- (Total Securities - Securities at head office)
- Foreign notes held at head office.

The key assumption is that the assets of New York agencies are roughly equal to their liabilities to head office. In other

words, I ignore both the liabilities of the New York agencies to all depositors outside head office and the assets corresponding to these liabilities. For purposes of this section, the assumption is not unreasonable and the magnitude of such outside deposits is unlikely to change my results very much.[18]

The regression equation thus becomes

$$\text{LOANEDNY} = \xi_1 + \xi_2\text{ASSETRW} + \xi_3\text{LOANEDNY}_{-1} + \xi_4\text{BANKDEP}_{-1} + \xi_5(\text{LOANNY}+\text{BANKDEPNA}) + \xi_6(\text{LOANNY}+\text{BANKDEPNA})_{-1} \quad (65)$$

The theory of omitted and proxy variables [23] can be used to show that the biases in the coefficients of ASSETRW, LOANEDNY_{-1} and BANKDEP_{-1} in equation (65) are a function of the coefficients of ASSETRW, LOANEDNY_{-1} and BANKDEP_{-1} in the auxiliary regressions of LOANNY, LOANNY_{-1}, and BANKDEPNA_{-1} on the right-hand side variables in equation (65). Or, to put it another way, the more closely are the omitted variables (LOANNY, LOANNY_{-1}, and BANKDEPNA_{-1}) related to the proxy variables (LOANNY+BANKDEPNA and $(\text{LOANNY}+\text{BANKDEPNA})_{-1}$) the smaller are these biases. Fortunately, for the period under study, the behaviour of rest-of-world assets differed markedly from the behaviour of LOANNY+BANKDEPNA. The variable ASSETRW showed a strong trend over the period, whereas LOANNY+BANKDEPNA showed a cyclical pattern with a sharp increase followed by an equally sharp decrease. The correlation over the period between (LOANNY+BANKDEPNA) and ASSETRW is only .31. It appears therefore that, in the auxiliary regression of LOANNY on the right-hand side variables of equation (65), the coefficient on (LOANNY+BANKDEPNA) would be dominant and the coefficients on the other variables would likely be small. Similarly LOANNY_{-1} and BANKDEPNA_{-1} are likely related mainly to $(\text{LOANNY}+\text{BANKDEPNA})_{-1}$

and the other coefficients in the auxiliary regressions are likely to be small. If these assertions are true (and of course they are not testable without further information, which is lacking), then the relevant coefficients from equation (65) are subject to only a relatively small bias.

The results of the regressions for the period May 1968 to December 1971 are presented in Table 12. The impact multipliers of an increase in rest-of-world assets are .081 and .919. That is, 8% of an increase in assets is placed in Euro-dollar loans in the period of change and 92% is placed in Euro-dollar deposits. In equilibrium, however, 33.6% of total assets is in the form of Euro-dollar loans and 66.4% is in the form of Euro-dollar deposits.[19] The time path of the adjustment is smooth as shown in the top panel of Figure 19. About 60% of the adjustment occurs within the first three months.

The second hypothesis regarding the determination of Euro-dollar loans is based on the assumption that the desired level of total foreign currency loans is related to the level of total foreign currency assets. Since loans to North American borrowers are treated as determined by the demand for loans by borrowers, the level of desired Euro-dollar loans is assumed to be equal to total loans desired minus North American loans. The adjustment pattern once again involves the adjustment of Euro-dollar deposits and Euro-dollar loans. These assumptions result in a regression equation identical to (65) except that ASSETTOT appears on the right-hand side. Here the coefficient on ASSETTOT is equal to .013, which is substantially smaller than expected on the basis of the theory. The t-statistic is only 0.3. The coefficients on the rest of the variables take on values very

Table 12

ALLOCATION OF REST-OF-WORLD ASSETS IN THE GUIDELINES PERIOD

	Dependent Variable	
	LOANEDNY	BANKDEP
C	276.09	-276.09
	(2.4)	(2.4)
ASSETRW	.081	.919
	(2.2)	(25.2)
$LOANEDNY_{-1}$	.739	-.739
	(7.7)	(7.7)
$BANKDEP_{-1}$	.010	-.010
	(0.2)	(0.2)
LOANNY + BANKDEPNA	.014	.986
	(0.3)	(23.6)
$(LOANNY+BANKDEPNA)_{-1}$	-.091	.091
	(1.6)	(1.6)
SEE	44.4	44.4
R^2	.996	.999
COV	1.49	0.76
DW	2.27	2.27

close to those in the earlier regression. I conclude, therefore, that the second hypothesis is not tenable and that banks relate Euro-dollar loans to rest-of-world assets. They do not appear to relate total loans to total assets in the period under study.

(c) The allocation of North American assets

(i) Loans to residents of Canada

The regression for loans to residents of Canada in the guidelines period is the same as that presented in equation (55) and discussed in detail earlier in this chapter.

(ii) Loans to residents of the United States

Loans to residents of the United States are determined mainly by the demand for funds by Americans. Most of these loans in the guidelines period were made by the New York agencies of Canadian banks and therefore no relevant data are available. Apparently most of the variation in the proxy variable for foreign currency loans to residents of the United States (PROXYLOANUS) (defined as loans made at the New York agencies plus head office loans to residents of the United States plus deposits at North American banks) can be attributed to the rise and fall of current loans made in New York. I utilize the Report of the New York Superintendent of Banks [33] for an independent verification of this assumption. The increase in the composite variable between December 1968 and December 1969 was about $800 million. Over the same period the sum of call loans and foreign securities was virtually unchanged. Consequently the increase in total New York agency assets plus the increase in head office claims on U.S. banks was approximately $800 million, of which by far the larger part was in the form of agency assets. The growth

in the assets of all the New York agencies of all foreign banks during the period was US$1,319 million (C$1,415 million). Canadian agencies appear to have been responsible for half, or more than half, of this expansion. Of the C$1,415 million increase for all the agencies, C$205 million went to cash and balances with other banks and C$1,082 million went to loans and overdrafts. These data suggest that a substantial increase took place in current loans made by the New York agencies of Canadian banks during 1969.[20]

Since evidence regarding the rate charged on loans at Canadian banks suggests that it is related to the U.S. prime rate, there is no interest rate incentive to switch from an American bank to the New York agency of a Canadian bank. However, any difficulty in borrowing at U.S. banks might cause U.S. borrowers to shift their business to the New York agencies of Canadian banks. The proxy variable for loans to U.S. residents is therefore made a function of monetary tightness in the United States.

$$\begin{aligned} \text{PROXYLOANUS(US\$)} = {} & 113.23 + .630\ T - .224\ \text{FRUS} \\ & (0.5) \quad (0.3) \quad (2.5) \\ & + .804\ \text{PROXYLOANUS(US\$)}_{-1} \\ & (10.2) \end{aligned} \tag{66}$$

SEE = 172.9 R^2 = .838 COV = 11.95% DW = 2.45

A decrease of $100 million in the free reserves of U.S. banks leads to an equilibrium increase of $114.3 million in foreign currency loans to U.S. residents by Canadian banks.[21] The U.S. free reserves series performed substantially better than the free reserves of New York banks in equation (66). This suggests that

borrowers at the New York agencies of Canadian banks have not all been from New York. As a result of the tightness of U.S. monetary policy, corporations were apparently directed to the New York agencies of Canadian banks by their own banks because the latter were unable to meet the demand for funds. As long as the tight monetary policy lasted (1969 and 1970) the Canadian banks made substantial loans. When U.S. monetary policy eased in 1971 these borrowers took their business back to their own banks and thus by the end of 1971 loans to Americans by the New York agencies of Canadian banks had returned to the level of mid-1968.[22]

(iii) Liquid assets

North American liquid assets (North American assets minus current loans to residents of Canada minus current loans to residents of the United States) are allocated among deposits at banks, call loans, and securities. Unfortunately, because of the way the data are collected, one cannot isolate deposits at North American banks. This item is composed of deposits by head office at U.S. banks and deposits by New York agencies at U.S. banks. After June 1965 the former component is combined in the data with head office deposits at New York agencies. The latter component is not available from Canadian sources. However, by examining data for all New York agencies (Canadian and other) published by the New York Superintendent of Banks [33], one can at least get some notion of the deposits by the New York agencies of Canadian banks at U.S. banks.

I carried out the exercise for December 1964, December 1969, and December 1971. In December 1964 head office deposits at U.S. banks totalled $119.1 million and head office deposits at

Canadian bank branches and agencies in the United States equalled $1,798.6 million. In December 1964 all foreign agencies in New York held US$450 million in cash and deposits out of total assets of US$3,898 million. Since Canadian agencies accounted for about half the total and since they were probably more sophisticated in their portfolio management than the agencies of other foreign banks in New York, one can treat the maximum deposits of the Canadian agencies as half of the US$450 million or about US$225 million[23] or about C$242 million. The total deposits at U.S. banks by the Canadian banking system therefore equalled about C$361 million.[24]

The same type of analysis shows that chartered bank deposits at U.S. banks were between $680 and $815 million in December 1969 and between $435 and $525 million in December 1971. These figures are very sensitive to the assumption made about the proportion of head office U.S. dollar claims on U.S. banks (including U.S. agencies and branches of Canadian banks) that is in the form of deposits at the New York agencies. I assume that between 90% and 95% of the total claims on U.S. banks are deposits at the New York agencies of Canadian banks.[25]

The growth of deposits at U.S. banks between 1964 and 1969 is substantially more rapid than the growth of liabilities to North Americans. However the decline in deposits between 1969 and 1971 mirrors the decline in liabilities to North Americans as opposed to the growth of total liabilities in the system. I conclude very tentatively that the deposits at U.S. banks are more closely related to the size of liabilities to North Americans than to the total liabilities of the banking system.

Turning now to the allocation of the remainder of the liquid assets between securities and call loans I employ the usual model that makes each of these marketable assets a function of total marketable liquid assets (ie, total liquid assets minus deposits), interest rates, and lagged dependent variables. The variable used for securities in these equations is U.S. securities (SECUS), which is equal to total securities minus head office holdings of Canadian securities payable in foreign currencies minus head office holdings of rest-of-world securities.[26,27] In the first two columns of Table 13 the results of the regressions are presented for the period May 1968 to December 1971.[28] The equilibrium results of changes in the scale variable and the two interest rates are shown in the third and fourth columns of Table 13. The adjustment paths are shown in the bottom three panels of Figure 19.

An increase of $1 in total marketable liquid assets causes an increase initially of $0.76 in call loans and $0.24 in securities. Over time, the call loans are reduced and securities are increased until in equilibrium $0.56 remains in call loans and $0.44 has been put into securities. An increase of 1 percentage point in the interest rate on U.S. call loans leads to an initial increase in call loans of $15 million and an ultimate increase of $29 million. An increase of 1 percentage point in the interest rate on U.S. treasury bills, leads to an initial increase in securities of $26 million and an ultimate increase of $50 million. The movement to the new equilibrium is smooth, and virtually complete adjustment occurs within six months.

I now summarize the conclusions regarding asset allocation in the guidelines period. Given deposits by residents of North

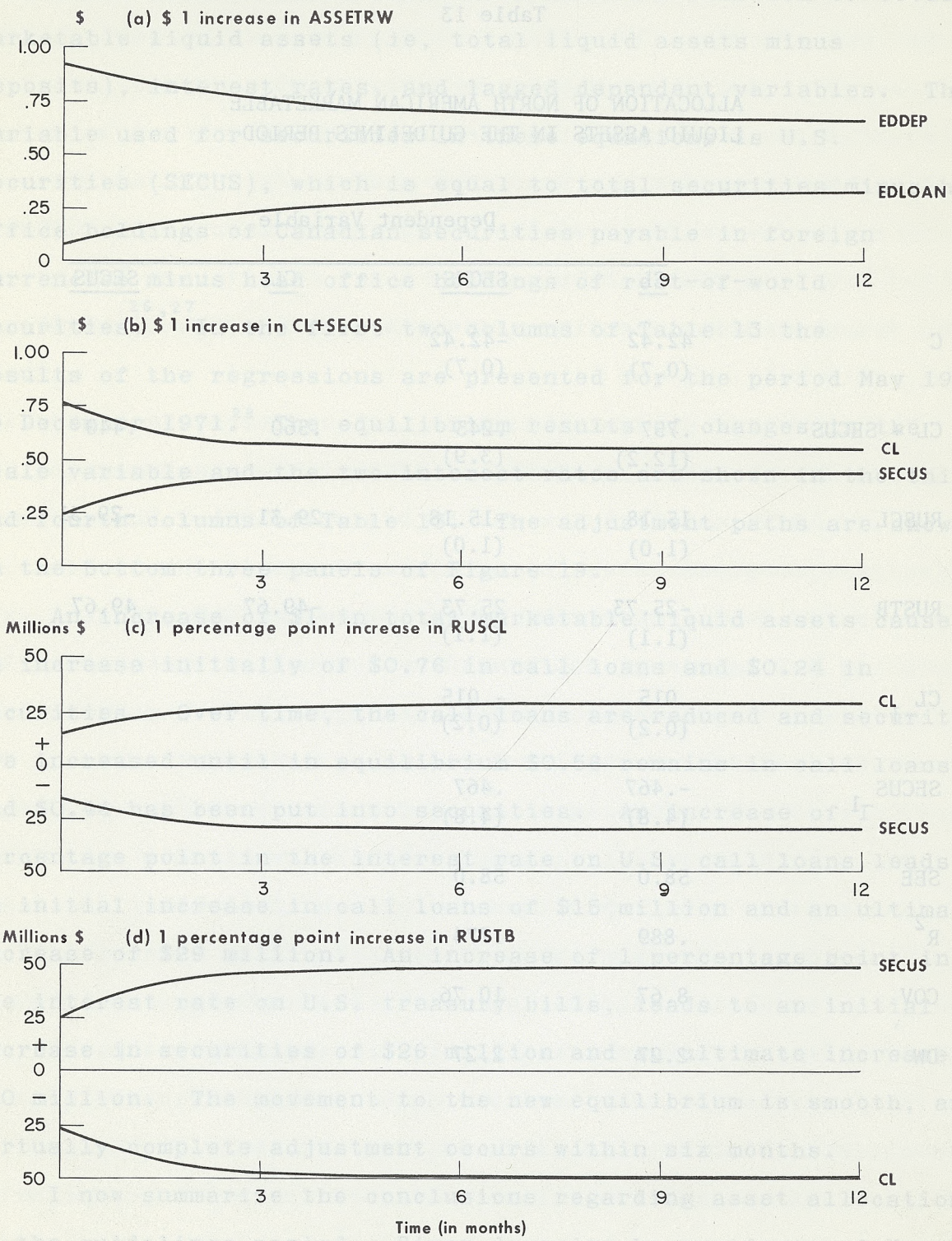
Table 13

ALLOCATION OF NORTH AMERICAN MARKETABLE LIQUID ASSETS IN THE GUIDELINES PERIOD

	Dependent Variable			
	CL	SECUS	CL	SECUS
C	42.42 (0.7)	-42.42 (0.7)		
CL + SECUS	.757 (12.2)	.243 (3.9)	.560	.440
RUSCL	15.18 (1.0)	-15.18 (1.0)	29.31	-29.31
RUSTB	-25.73 (1.1)	25.73 (1.1)	-49.67	49.67
CL_{-1}	.015 (0.2)	-.015 (0.2)		
$SECUS_{-1}$	-.467 (4.8)	.467 (4.8)		
SEE	58.0	58.0		
R^2	.889	.774		
COV	8.67	10.76		
DW	2.27	2.27		

Figure 19

RESPONSE PATHS OF ASSETS TO CHANGES IN EXOGENOUS VARIABLES IN THE GUIDELINES PERIOD



America, deposits by residents of the rest of the world, and the NFA position, assets are distributed between North America and the rest of the world on the basis of guideline restraints modified by interest rate considerations. An increase in the rate on U.S. treasury bills or a decrease in the rate on Euro-dollar deposits leads to a rise in the holdings of North American assets relative to the guideline floor level. Total rest-of-world assets are then divided between Euro-dollar deposits and Euro-dollar loans. The Euro-dollar loans are initially about 8% of the increase in rest-of-world assets but rise to about 34% in equilibrium. Total North American assets are allocated in the following fashion: First, current loans are made to meet the demand for funds by borrowers in the United States and Canada. Deposits at U.S. banks appear to be related somewhat more closely to the liabilities to North Americans than to the total liabilities of the banking system.[29] Then the remaining marketable liquid assets are divided between securities and call loans on the basis of a desired ratio of about 56% call loans, 44% securities (in equilibrium) and on the basis of interest rates on the two assets. I leave unexplained (ie, I treat as exogenous) such relatively minor items as gold assets and liabilities, foreign currency notes and coin, investment in controlled corporations, float, and head office holdings of securities other than U.S. securities.

The results in Chapters 2, 3, and 5 can now be combined to explain the forces behind the behaviour of chartered bank foreign currency assets and liabilities in North America between 1969 and 1971. In my explanation of the 1969 to 1971 experience I assert that loans to residents of the United States were the principal

factor accounting for the rise and fall of foreign currency deposits by Canadian residents. The tightness of U.S. monetary policy caused American borrowers to turn to the New York agencies of Canadian banks in 1969 and to remain there in 1970. The existence of this high-yield asset (loans to American borrowers) enabled the Canadian banks to pay high rates on swapped deposits and non-swapped deposits in Canada. These rates drew large amounts of funds into foreign currency deposits from other instruments and these funds were used by the Canadian banks to make the loans sought by American borrowers. In 1971 the easing of monetary policy in the United States resulted in a substantial decline in borrowing at the New York agencies of Canadian banks. Since the rates on other U.S. assets (call loans, securities, deposits at U.S. banks) were below the rate on current loans, the banks could not afford to pay the same high rates as previously for foreign currency deposits. This resulted in a rapid decline of these deposits as Canadian wealth-holders switched into other financial instruments.

Chapter 5 Footnotes

1 In this model the own speed of adjustment δ_{ii} is usually, but not always, less than 1.

2 This example is taken from Swan [37].

3 This implies that the adjustment coefficients are not required to be symmetrical [41] p 131.

4 Of course for this to happen $S_1 + S_2$ must increase by one unit as well.

5 Since no compensating balances are required on these loans, the rate may be above RUSPRI by an amount related to the proportion of compensating balances required on loans made by U.S. commercial banks.

6 According to the Treasury Bulletin [38] loans to Canadian residents by U.S. banks were US$507 million on December 31, 1968.

7 Such loans may be made through representatives of New York banks travelling in Canada.

8 Initially I attempted to explain the allocation of total assets among current loans and the three liquid assets. It became apparent that the regression for loans was the result of the behaviour patterns of borrowers and could not be explained by the behaviour of banks.

9 I examined the possibility that there was a geographical allocation of assets based on the source of funds (North American deposits, rest-of-world deposits, and NFA) even in the period prior to the guidelines. The regressions indicated that there was no difference in geographical allocation based on the source of funds.

10 Foreign currency liabilities are equal to foreign currency deposits plus the algebraic sum of a number of small asset and liability items, namely minus foreign bank notes and coin minus investment in controlled corporations minus the foreign currency float.

11 A contributing factor to this decision is that the results of the regressions, which include current loans as a separate variable, imply odd equilibrium behaviour in response to a decline in current loans.

12 For purposes of comparison, note that for the period prior to the guidelines the mean of call loans is $882.4

million, the mean of securities is $794.9 million, and the mean of deposits is $1,417.0 million.

13 The discussion is couched in terms of head office assets and liabilities. I assume that the assets and liabilities of foreign branches (excluding New York agencies) are the result of transactions with residents of the rest of the world only.

14 The rate on call loans had the wrong sign and the rate on U.S. prime loans had the correct sign but was insignificant when entered into the regression. The lagged dependent variable was generally also insignificant indicating complete adjustment within a month.

15 The October dummy did not help significantly to explain the geographical asset allocation of funds during the period prior to the guidelines.

16 I assume throughout that the amount of call loans and securities held outside North America is very small relative to total assets and can safely be ignored.

17 The omission of interest rate variables in the equation for desired Euro-dollar loans is due to the fact that a very tight link binds the rates on Euro-dollar deposits and

Euro-dollar loans [19] p 9 and note 16. Since the differential is virtually constant, there is no interest rate incentive to shift between the two categories of Euro-dollar assets.

18 Note that I get ASSETRW by subtracting LOANNY + BANKDEPNA from the sum of LOANEDNY and BANKDEP. Thus any measurement error in the proxy variable LOANNY + BANKDEPNA will lead to an equal and opposite error in ASSETRW. Also note that ASSETRW does not include securities held at head office that are claims on residents of the rest of the world.

19 These proportions are similar to the proportions of loans and deposits of the overseas branches of U.S. banks. As at December 31, 1971, the loans of these branches amounted to 41.3% of their total assets [39].

20 One complicating factor is that these loans may include loans of federal funds to banks the magnitude of which would be a function of chartered bank behaviour and not of borrower behaviour. I was unable to deal with this possibility given the data constraints.

21 Using a twelve-period quadratic distributed lag on FRUS I estimate the total effect as $130 million, which is only slightly larger than the $114 million from equation (66).

The quadratic lag suggests a humped time pattern rather than the declining pattern of the geometric lag.

22 The average level of free reserves for the years 1968 to 1971 is -$206 million, -$871 million, -$616 million, and -$207 million, respectively. The decline of about $660 million in 1969 implies an increase in loans by Canadian banks of about $750 million.

23 The annual balance sheets of foreign currency assets and liabilities collected until the end of 1964 show foreign branch deposits denominated in U.S. dollars of $357.2 million. This suggests that about $115 million was placed in the Euro-dollar market by the foreign branches of Canadian banks at this time.

24 Note that I assume that the New York agencies held no Euro-dollar deposits and that the foreign branches of Canadian banks outside the United States held no U.S. bank deposits. Both these assumptions are reasonable in the Canadian context.

25 In the calculations I also assume that about 10% of the funds of New York agencies come from sources other than head office.

26 SECUS does include some unidentifiable amount of rest-of-world securities held at foreign branches but I expect that the variability of this item is not great. It also includes a small amount of foreign-pay Canadian securities held at chartered bank foreign branches.

27 SECUS would have been a more appropriate variable than SEC for the period prior to the guidelines but there was no way to separate U.S. securities from rest-of-world securities before September 1963.

28 December 1969 is omitted from the regression because of the difficulty in getting a value for RUSCL for that month.

29 If there were accurate data on deposits at U.S. banks, I would attempt to combine the decision on deposits with the decision on call loans and securities. It seems reasonable that the rate of interest on bank deposits would be a factor in the allocation of liquid assets.

Chapter 6

CONCLUSIONS

In this chapter I draw together some of the conclusions I have reached and some of the implications of these conclusions for government policy. The particular subjects discussed are the determinants of the growth of chartered bank foreign currency assets and liabilities, the role of Canadian banks in the Euro-dollar market, some of the relationships between net foreign assets and Canadian monetary policy, and the effect of changes in interest rates and other policy variables on the Canadian, U.S., and rest-of-world balance of payments.

A. Multipliers

The equations presented in Chapters 2 to 5 explain the determination of interest rates on foreign currency deposits, the demand for foreign currency deposits at Canadian banks, the net foreign asset position, the demand for foreign currency loans at Canadian banks, and the allocation of foreign currency liquid assets by the banks. Together they form a system of equations that determines all the main variables connected with the foreign currency business of the Canadian banks. This system of equations may be written in stylized form as follows:

$$Y_1 = \Sigma\beta_{1i}X_i + u_1$$

$$Y_2 = \gamma_{21}Y_1 + \Sigma\beta_{2i}X_i + u_2$$

$$Y_3 = \gamma_{31}Y_1 + \gamma_{32}Y_2 + \Sigma\beta_{3i}X_i + u_3$$

$$\vdots \qquad \vdots$$

The Ys are the dependent or endogenous variables of the system of equations and the Xs include both the independent or exogenous variables and the lagged endogenous variables. This system of equations is a recursive one, ie, it can be written so that each endogenous variable is a function of only the exogenous variables and those endogenous variables explained earlier. Thus there is no simultaneity in the system and it can be solved equation by equation for any change in an exogenous variable.[1] Because of the change in structure consequent upon the introduction of the guidelines, I use two systems of equations - one for the period prior to the guidelines; the other for the guidelines period.

One variable, the interest rate implied by the forward spread (RFS), is determined simultaneously with the other variables in the real world but not in the equation system. For purposes of this section of the study, I use a reduced form equation for the effect on RFS of the relevant exogenous variables of the system. The equation is estimated for the period 1962-1971 using monthly averages of the interest rates and RFS.

$$\begin{aligned} RFS = &- .01 + .71\ RCFP - .45\ RUSFP \\ &\quad (0.0)\ \ (8.9)\ \ \ \ \ (4.0) \\ &- .26\ RED + .21\ RFS_{-1} + .67\ u_{-1} \\ &\quad (5.6)\ \ \ \ (3.1) \end{aligned} \tag{67}$$

$$SEE = .215 \qquad R^2 = .924 \qquad DW = 2.05$$

This equation has the property that equal increases in interest rates in Canada, the United States, and Europe leave RFS unchanged. The equilibrium effect on RFS of a 100 basis point increase in RCFP, RUSFP, and RED is 90, -57, and -33 basis points, respectively.[2]

Because the model is recursive, it is easy to compute the time paths of the effect of a change in an exogenous variable on endogenous variables. Wherever scale variables enter an equation multiplicatively (as in the NFASYS equation) they are set at their mean value for the the period under investigation (the period prior to the guidelines or the guidelines period). The equilibrium effect of changes in exogenous variables on endogenous variables will be used extensively throughout this chapter.

B. The Determinants of the Growth of the System

The model developed in Chapter 2 for the determination of interest rates leads naturally to an explanation of the size of chartered bank foreign currency assets and liabilities. The explanation is based on three components: interest rate differentials, the movement of scale variables, and official guidelines.

According to the model in Chapter 2, a margin exists between the interest rates on foreign currency assets in which the banks invest and the interest rates on instruments that compete with chartered bank foreign currency deposits for the funds of depositors. If this margin is sufficiently wide, a bank can profitably expand its operations by acting as an intermediary between the ultimate lender and the ultimate borrower. The wider the margin, the greater is the profit on transactions in foreign currency assets and liabilities. Thus chartered bank foreign currency assets and liabilities will expand when the margin widens between the interest rate on the assets in which they invest and the interest rate on instruments competitive with

foreign currency deposits. Conversely chartered bank foreign currency assets and liabilities will contract when the margin narrows.

The discussion thus far would lead one to expect chartered bank foreign currency assets and liabilities to show a cyclical pattern of increases when the margin between interest rates on assets in which the banks invest and interest rates on instruments competitive with deposits widens and of decreases when the margin narrows. In fact, as even a cursory glance at the data shows, rapid growth was the main characteristic of foreign currency deposits over the 1960s. To explain this phenomenon one must consider the movement of scale variables in the various deposit demand functions. Recall that the demand for foreign currency deposits at Canadian banks is a function of a scale variable (WEALTHCAN and WEALTHRW in the case of Canadian and rest-of-world deposit functions, respectively), interest rate differentials, and sometimes other variables. The growth of the scale variable produces a growth of deposits even at constant interest rate differentials. An increase of $1 billion in the Canadian scale variable (a proxy for the liquid assets held by residents of Canada) would lead to an increase of $8.8 million in foreign currency deposits at chartered banks by Canadians. An increase of $1 billion in the rest-of-world scale variable (defined as Euro-dollar and Euro-currency deposits by residents of the rest of the world at banks in eight European countries, Canada, and Japan) would lead to an increase of $107 million in foreign currency deposits at Canadian banks of which $41 million would be held in Canada and $66 million at the foreign branches of Canadian banks.

The two elements discussed thus far provide an explanation of the growth of chartered bank foreign currency deposits by residents of Canada and residents of the rest of the world. To explain deposits at Canadian banks held by residents of the United States, one must invoke the 1965 U.S. balance of payments programme. These deposits increased from $1,575 million in September 1963 (the first available figure) to a peak of $1,948 million at the end of January 1965. The first set of restraints on corporations and financial institutions was announced in February 1965 and deposits by Americans declined sharply to $1,070 million by the end of 1965. Deposits by Americans continued to fall slowly, reaching a low point of $540 million in December 1968. They then moved up gradually over the next three years reaching $1,491 million at the end of 1971.[3] It is clear that the decline after 1965 was due in the main to the U.S. balance of payments programme that persuaded Americans to reduce their holdings of deposits at foreign banks.

I conclude that the continuous growth of chartered bank foreign currency assets and liabilities over the 1960s was mainly the result of the rapid growth of the Euro-dollar market in general. Deposits by Canadians were more cyclical and responded mainly to movements of relative interest rates. Foreign currency deposits by Americans were strongly influenced by the U.S. balance of payments programme during the period.

C. Canadian Banks and the Euro-dollar Market

The equations in Chapter 3 throw some light on the position of Canadian banks in the Euro-dollar market. The share of Canadian banks in Euro-dollar and Euro-currency deposits of

residents of the rest of the world in the banks in eight European countries, Canada, and Japan fell from 16.8% at the end of 1964 to 11.6% at the end of 1971. According to equations (26) and (28) in Chapter 3, a 100% increase in total Euro-dollar and Euro-currency deposits by residents of the rest of the world would be accompanied by a 57% increase in rest-of-world deposits at head office and branches in Canada and by an 83% increase in rest-of-world deposits at foreign branches of Canadian banks. Thus the growth of rest-of-world deposits at Canadian banks did not kept pace with the total growth of Euro-dollar and Euro-currency deposits by residents of the rest of the world. This relative decline was consistent with the growth in the share of Euro-dollar business transacted by branches of U.S. banks in Europe.

D. Canadian Monetary Policy and the Canadian Balance of Payments

Chartered bank transactions in foreign currency assets and liabilities impinge on the Canadian economy mainly in two ways - as part of the chartered bank response to monetary policy, and as part of the determination of the Canadian balance of payments.

1. Canadian monetary policy

The banks respond to tight monetary policy by reducing their holdings of secondary and tertiary assets. (A long discussion of this matter appears in Chapter 4.) When they sell Canadian liquid assets the banks also tend to reduce their holdings of foreign currency assets, which results in a decline in NFA. As shown in Table 8 (in Chapter 4), at the end of 1971 a 1 percentage point reduction in the secondary reserve ratio would lead to a $165 million reduction in net foreign assets.

Similarly a 1 percentage point reduction in the excess tertiary asset ratio, which is very similar to the free liquid asset ratio published in the Bank of Canada Review [4], would lead to a $85 million reduction in net foreign assets. Under these circumstances, in order to achieve a given effect on chartered bank domestic assets the scale of central bank policy operations must be greater than would be the case if foreign currency liquid assets were not available to the banks.

A second aspect of the use of the net foreign asset position relates to its effect on the growth rate of monetary aggregates. When domestic tertiary assets are sold in response to central bank pressure, the domestic money stock is reduced below what it otherwise would have been. If, instead, net foreign assets are reduced and if the Canadian authorities accumulate U.S. dollars[4] and finance the increase in reserves by running down their Canadian dollar deposits at the banks,[5] then private money holdings at the Canadian banks will be unchanged although the total money stock (government plus private deposits) will have fallen. Thus when, under the assumed conditions, monetary policy is tightened the reduction by the banks of net foreign assets instead of domestic assets produces a decline in government deposits in place of a decline in private deposits.

A third aspect of the use of the net foreign asset position concerns the effect of changes in the monetary stance of the Bank of Canada on the Canadian balance of payments. In the period prior to the guidelines a decrease of 1 percentage point in the excess secondary reserve ratio and in the excess tertiary asset ratio led to capital inflows of $59 million and $103 million, respectively. The corresponding figures for the part of the

guidelines period being examined are $130 million and $139 million, respectively. The decrease in the secondary reserve ratio affects the balance of payments entirely via its influence on the net foreign assets of the banks. The decrease in the excess tertiary asset ratio affects the balance of payments primarily via the increase in foreign currency loans to Canadian residents (financed by a decline in chartered bank foreign currency liquid assets held in the United States) and secondarily via its influence on chartered bank net foreign assets. Thus a change in the stance of monetary policy directly affects the Canadian balance of payments. Changes in interest rates have an even greater effect on the balance of payments and it is to this aspect of the matter I now turn.

2. The Canadian balance of payments

The net capital outflow arising from transactions of head office (and branches in Canada)[6] in foreign currency assets and liabilities is equal to the increase in claims on non-residents of Canada minus the increase in liabilities to non-residents of Canada. Because of the balance sheet identity, that total foreign currency assets equal total foreign currency liabilities plus NFA, the net capital outflow can be shown to be equal to the increase in the net foreign asset position of head office plus the increase in foreign currency liabilities to Canadians minus the increase in foreign currency claims on Canadians (loans and securities). Thus one can examine the balance of payments effect of Canadian bank transactions in foreign currency assets and liabilities by focussing on the NFA position of the banks and their dealings with residents of Canada instead of on their dealings with non-residents.[7]

Using the multiplier analysis set out in Section A of this chapter, I now turn to a discussion of the long-run (equilibrium) effect on the Canadian balance of payments of an increase of 100 basis points in all Canadian interest rates at a time of unchanged U.S. and Euro-dollar interest rates. In the period prior to the guidelines such an increase in Canadian interest rates would have resulted in a capital inflow to Canada of $110 million almost entirely at the expense of the rest of the world. The capital outflow from the United States would have been only $3 million. Most of the inflow would have resulted from a decline in chartered bank net foreign assets, the counterpart of which would have been an increase in rest-of-world deposits (as a result of a higher interest rate on foreign currency deposits at Canadian banks) and a reduction in rest-of-world assets. Foreign currency deposits by residents of Canada were virtually unchanged in this experiment because the interest rate on swapped deposits increased by 99 basis points leaving the relative position of swapped deposits and split swaps vis-à-vis other Canadian instruments almost unchanged.

During the guidelines period, an increase of 100 basis points in Canadian interest rates led to a capital inflow to Canada of $587 million and a capital outflow from the United States of the same amount. The rest-of-world balance of payments was unchanged signifying the success of the guidelines in segregating North America from the rest of the world.[8] The main channels through which the capital inflow made its way were the reduction in the net foreign asset position ($176 million) and the reduction in swapped deposits and non-swapped deposits ($227 million and $178 million, respectively). The decrease in

deposits was the result of an increase in the interest rate on swapped deposits of only 75.3 basis points compared to an increase of 100 basis points in other Canadian rates. The decline in deposits and NFA was mirrored by a decline in chartered bank liquid assets held in the United States.

E. The U.S. and Rest-of-World Balance of Payments

The role of Canadian banks as a conduit of funds between the United States and the rest of the world (especially the Euro-dollar market) has been noted in the literature [2] and [29]. In the period prior to the guidelines this role was very significant. An increase of 100 basis points in U.S. interest rates with other rates unchanged led to an improvement of $611 million in the U.S. balance of payments via the operations of Canadian banks. Of this sum, $70 million involved an outflow from Canada and $541 million an outflow from the rest of the world. The increase in U.S. rates caused an increase in the interest rate on foreign currency deposits at Canadian banks that, in turn, led to a large increase in rest-of-world deposits. These funds, which would normally have been placed by the chartered banks in Euro-dollar deposits, were placed instead in call loans and U.S. securities because of the increase in U.S. interest rates relative to the Euro-dollar rate.

An increase of 100 basis points in the Euro-dollar rate with other rates unchanged in the period prior to the guidelines led to an improvement in the rest-of-world balance of payments of $627 million, of which $615 million came from the United States and $12 million from Canada. The increase in the Euro-dollar rate led to an increase of 38 basis points in the interest rate

on foreign currency deposits at Canadian banks. The decline in the latter interest rate relative to the Euro-dollar rate resulted in a decline in rest-of-world deposits that more than offset the increase in deposits by Canadians and Americans. At the same time a substantial shift of chartered bank assets took place from call loans and securities to Euro-dollar deposits following the increase in the Euro-dollar interest rate.

The imposition of the guidelines in 1968 had the effect of substantially changing the amount and direction of capital movements resulting from interest rate changes (at times when the guidelines were binding constraints). An increase of 100 basis points in U.S. interest rates led to a $664 million capital inflow to the United States of which $484 million reflected an outflow from Canada and $180 million a capital outflow from the rest of the world. The increase in the U.S. interest rates led to an increase in the interest rates on both non-swapped deposits and swapped deposits, which, in turn, led to an increase in deposits by residents of Canada. These funds were placed in U.S. assets (on the assumption that deposits by residents of the United States were held below the February 1968 level in accordance with Guideline 3). At the same time there was a shift of $180 million from rest-of-world assets into U.S. assets because of the increase in U.S. interest rates. An increase of 100 basis points in the Euro-dollar rate led to a $98 million capital inflow to the rest of the world of which $93 million reflected an outflow from Canada and $5 million an outflow from the United States.

Clearly the role of the Canadian banks as a conduit of funds between the United States and the Euro-dollar market was

significant in the period prior to the guidelines. The introduction of guidelines had the intended effect of blocking off to a great extent this channel between North America and the rest of the world. When the guidelines were binding, the movement of funds between the United States and Europe in response to changes in interest rate was small. Even when the guidelines were not binding the banks could shift into rest-of-world assets only the funds they had previously shifted to the United States from the rest of the world.

F. Final Remarks

The purpose of this study has been to inquire into the determinants and implications of chartered bank transactions in foreign currency assets and liabilities. I have tried to show the relative importance of foreign currency assets as a portion of chartered bank total assets, the position of Canadian banks as part of the Euro-dollar market, the significance of these transactions for Canadian monetary policy and the Canadian balance of payments, and the role of Canadian banks in transmitting funds between the United States and the rest of the world. In all these ways the role of the banks has been significant as the scale of the dollar flows indicates. Despite guidelines and other restrictions, chartered bank foreign currency operations have grown substantially over the period of study and, barring a decline in the size of the Euro-dollar market, there is every reason to believe that the future rates of growth will continue to be high. The effect of the 1968 guidelines was to make chartered bank transactions in foreign currency assets and liabilities conform more closely to

conditions in the Euro-dollar market and less closely to conditions in Canada and the United States. It is likely that the removal of the guidelines will cause this tendency to be reversed and that these transactions will respond once again to conditions both in North America and in Europe. The role of the chartered banks as a conduit of funds between North America and the Euro-dollar market will, as a consequence, likely be re-established.

Chapter 6 Footnotes

1 If estimation by ordinary least squares is to give consistent estimates the error terms must be uncorrelated both contemporaneously and over time. See Fisher [17].

2 It would have been preferable to construct a system of equations for the entire capital account of the Canadian balance of payments. In such a model RFS would have been an endogenous variable and a reduced-form equation would not have been required. But the construction of a complete model is well beyond the scope of this study. The use of the reduced-form equation for RFS is likely to bias towards zero the effect on the balance of payments of changes in various exogenous variables.

3 The figures from September 1970 on include Puerto Rico and the Virgin Islands as part of the United States.

4 If other participants in the foreign exchange market purchase U.S. dollars, the result will be different.

5 The Canadian authorities typically finance an increase in foreign exchange reserves in the short run by this method.

6 Foreign branches of Canadian banks are excluded from the discussion because they are non-residents of Canada and therefore only their transactions with Canadian residents enter the Canadian balance of payments. The total sum involved is believed to be small.

7 Statistics Canada in its official presentation of the balance of payments focussed on transactions with residents of Canada plus NFA until March 1973. Since then they have focussed on transactions with non-residents.

8 Further discussion of this point appears in Section E of this chapter.

NOTES ON EMPIRICAL VARIABLES

There are two principal sources of data on the foreign currency assets and liabilities of the Canadian banks. The first source, which pertains to the assets and liabilities of the consolidated banking system, is the month-end return as set out in Schedule M of the Bank Act [8]. In this return transactions are netted out between head office and branches, head office and agencies, and between branches. The main foreign currency items from Schedule M are published monthly in the Bank of Canada Review [4] in the table "Chartered banks: Total foreign currency assets and liabilities". The full return, including both Canadian dollar and foreign currency assets and liabilities, is published monthly in The Canada Gazette, Part I [11].

The banking system data used in this study differ in two respects from those published in The Canada Gazette, Part I and the Bank of Canada Review. First, since 1965 gold assets and liabilities have been subtracted from the appropriate category in Schedule M to obtain a figure for foreign currency assets and liabilities excluding gold. Thus gold deposits and gold loans by Canadian banks have been removed from deposits and loans and aggregated with gold bullion to form a separate gold assets item. Gold liabilities have been treated similarly. The size of these gold items is typically not very great. Second and much more important, there have been several conceptual changes over the years that have caused series breaks in the published data. I have adjusted the data in order to get consistent series back to December 1960. The particular changes that have been taken into account are: (1) general reserves have become a liability item

rather than a deduction-from-assets item; (2); Canadian securities payable in foreign currencies have been treated as foreign currency assets; (3) the foreign currency component of securities of and loans to controlled corporations has been treated as a foreign currency asset. The adjustments in the data have resulted in relatively small increases in various categories of assets and no changes in liabilities. The main effect of the adjustments is to increase net foreign assets by an amount varying between $66 million and $213 million. Thus the series for net foreign assets is changed substantially from the published series; this will obviously affect the empirical results. A printout of the adjusted data showing details of the methods of adjustment is available upon request from the Bank of Canada.

The second main source of data is the end-of-month return as required under Section 105 of the Bank Act of foreign currency assets and liabilities booked at head office and branches in Canada. This return includes: a detailed geographical division of assets and liabilities; assets and liabilities divided into U.S. dollar, sterling, and other foreign currencies; assets divided into (a) claims on banks and on foreign branches and agencies of Canadian banks, (b) loans, and (c) securities; and liabilities divided into (a) deposits by banks and by foreign branches and agencies of Canadian banks, and (b) deposits by others. A substantial amount of these data is published in the Bank of Canada Review in the tables entitled "Chartered banks: Total foreign currency assets and liabilities booked in Canada" and "Chartered banks: U.S. dollar assets and liabilities booked in Canada".

As well as the sources noted above supplementary monthly information is available on the magnitude of swapped deposits included in foreign currency deposits by Canadian residents.

In this study I also use data on Canadian dollar deposits at foreign branches by non-banks and banks (excluding head office and other branches) and Canadian dollar loans by foreign branches. These data are available as at the end of quarter in a return to the Bank of Canada of "Canadian Dollar Debit and Credit Balances" (not published).

The weekly data on net foreign assets and swapped deposits are taken from the weekly return to the Bank of Canada of "Chartered Bank Selected Assets and Liabilities". These are published in the Bank of Canada Review in the tables entitled "Chartered bank assets: Weekly series" and "Chartered bank liabilities: Weekly series", respectively.

The interest rates used in this study are collected from a variety of sources by the Bank of Canada. They are typically the rates prevailing on Wednesday of each week. The figures for the last Wednesday of each month are published in the Bank of Canada Review in the table entitled "Selected Canadian and international interest rates, including bond yields and interest arbitrage".

Several variables were derived from the publications of foreign central banks. Thus FRNY, FRUS, and RUSPRI are taken from the Federal Reserve Bulletin [16] and WEALTHRW is derived from data published in the Bank for International Settlements Annual Report [5].

LIST OF VARIABLES

ACAN	Canadian dollar assets.
AFC	Foreign currency assets.
ASSETCAN	Foreign currency claims on residents of Canada at head office.
ASSETEXNA	Excess claims on residents of North America.
ASSETLIQ	Total foreign currency liquid assets.
ASSETNA	North American foreign currency assets of Canadian banks.
ASSETRW	Rest-of-world foreign currency assets of Canadian banks.
ASSETRWHO	Rest-of-world foreign currency assets of head office.
ASSETTOT	Total foreign currency assets.
BANKDEP	Deposits at banks.
BANKDEPNA	Deposits at North American banks.
CCD	Canadian dollar certificates of deposit. Non-personal term and notice deposits at Canadian banks.
CD	Certificate of deposit.
CDEP	Statutory Canadian dollar deposits.
CL	Call loans.
C$DEPFB	Deposits in Canadian dollars at foreign branches (excluding those by head office).
C$LOANFB	Canadian dollar loans by foreign branches.
DEP	Total foreign currency deposits at Canadian banks.
DEPCAN	Foreign currency deposits by residents of Canada at head office.
DEPFC	Foreign currency deposits at Canadian banks.
DEPNA	Foreign currency deposits by residents of North America at Canadian banks.
DEPRW	Foreign currency deposits by residents of the rest of the world at Canadian banks.
DEPRWFB	Foreign currency deposits by residents of the rest of the world at foreign branches of Canadian banks.

DEPRWHO	Foreign currency deposits by residents of the rest of the world at head office.
DEPUS	Foreign currency deposits by residents of the United States at Canadian banks.
EDDEP	Euro-dollar deposits by Canadian banks.
EDLOAN	Euro-dollar loans by Canadian banks.
EXPRI	Excess primary reserves of Canadian banks as a percentage of deposits.
EXSEC	Excess secondary reserves of Canadian banks as a percentage of deposits.
EXTER	Excess tertiary assets of Canadian banks as a percentage of major Canadian dollar assets.
FRNY	Free reserves of New York banks.
FRUS	Free reserves of U.S. banks.
LOANCAN	Foreign currency loans to residents of Canada.
LOANEDNY	Euro-dollar loans by Canadian banks plus loans by New York agencies.
LOANNR	Foreign currency loans to non-residents of Canada.
LOANNY	Loans by New York Agencies.
LOG	Natural logarithm.
M	Canadian imports.
MC	Marginal cost.
MCCCD	Marginal cost of Canadian dollar certificates of deposit.
MCDEPFC	Marginal cost of foreign currency deposits.
MCDEPNA	Marginal cost of foreign currency deposits by residents of North America.
MCDEPRW	Marginal cost of foreign currency deposits by residents of the rest of the world.
NETINVHO-DEPBYFB	Net Canadian dollar investment by head office in foreign branches minus Canadian dollar deposits at banks (excluding head office) by foreign branches.
NFA	Net foreign assets of Canadian banks.

NFAFB	Net foreign assets of foreign branches and agencies of Canadian banks.
NFAHO	Net foreign assets of head office and branches in Canada.
NFASYS	Net foreign assets of the banking system.
NNI	Net new Canadian issues of securities payable in foreign currencies excluding Government of Canada issues.
NSD	Non-swapped deposits by residents of Canada at Canadian banks.
OCD	Canadian dollar deposits other than certificates of deposit.
OCT	October dummy.
P	Net profit from transactions in Canadian dollar and foreign currency assets and liabilities.
PROF	Net profit from transactions in foreign currency assets and liabilities.
PROXYLOANUS	Proxy variable for foreign currency loans to residents of the United States.
RA	Interest rate on total foreign currency assets.
RACAN	Interest rate on Canadian dollar assets.
RAFC	Interest rate on foreign currency assets.
RANA	Interest rate on North American foreign currency assets.
RARW	Interest rate on rest-of-world foreign currency assets.
RCCD	Interest rate on ninety-day deposit receipts at Canadian banks. (Interest rate on Canadian dollar certificates of deposit.)
RCFP	Interest rate on ninety-day Canadian finance paper.
RCNSD	Interest rate on instruments competing for the funds of Canadian holders of non-swapped deposits.
RCPRI	Interest rate on prime business loans at Canadian banks.
RCRW	Interest rate on instruments competing for the funds of rest-of-world depositors.

RCSD	Interest rate on instruments competing for the funds of Canadian holders of swapped deposits.
RCUS	Interest rate on instruments competing for the funds of U.S. depositors.
RED	Interest rate on three-month Euro-dollar deposits in London.
RFS	Interest rate equivalent of the forward spread between the U.S. dollar and the Canadian dollar.
RFS£$	Interest rate equivalent of the forward spread between the pound sterling and the U.S. dollar.
RL	Interest rate on ninety-day foreign currency deposits at Canadian banks.
RLCAN	Interest rate on ninety-day foreign currency deposits at Canadian banks by residents of Canada.
RLNA	Interest rate on foreign currency deposits at Canadian banks by residents of North America.
RLRW	Interest rate on ninety-day foreign currency deposits at Canadian banks by residents of the rest of the world.
RLUS	Interest rate on ninety-day foreign currency deposits at Canadian banks by residents of the United States.
RL£	Interest rate on sterling deposits.
RL£CB	Interest rate on sterling deposits at a large Canadian bank.
RL$CB	Interest rate on U.S. dollar deposits at a large Canadian bank.
ROCD	Interest rate on Canadian dollar deposits other than certificates of deposit.
RSD	Interest rate on ninety-day swapped deposits at Canadian banks.
RUK	Interest rate on three-month deposits with local authorities in the United Kingdom.
RUSCD	Interest rate on U.S. certificates of deposit.
RUSCL	Interest rate on call loans at New York banks.
RUSFP	Interest rate on ninety-day U.S. finance paper.
RUSPRI	Interest rate on prime business loans at U.S. banks.

RUSTB	Interest rate on three-month U.S. treasury bills.
SD	Swapped deposits by residents of Canada at Canadian banks.
SEC	Securities.
SECUS	U.S. securities.
T	Trend (=1 in January 1962).
TCA	Total major Canadian dollar assets.
TFCASYS	Total foreign currency assets of the banking system, billions of dollars.
WEALTHCAN	A proxy for the liquid assets of Canadians. This is defined as the sum of currency outside banks, Canadian dollar deposits at chartered banks (adjusted to exclude Government of Canada deposits and Canadian dollar float), foreign currency deposits by Canadians at chartered banks, deposits at trust companies and mortgage loan companies, and Canada Savings Bonds outstanding.
WEALTHRW	A proxy for the liquid assets of residents of the rest of the world. This is defined as the sum of their Euro-dollar deposits and Euro-currency deposits at banks in Belgium-Luxemburg, France, Germany, Italy, Netherlands, Sweden, Switzerland, United Kingdom, Canada, and Japan.
X	Canadian exports.
XR	Exchange rate of the U.S. dollar in Canadian cents, average noon rate.

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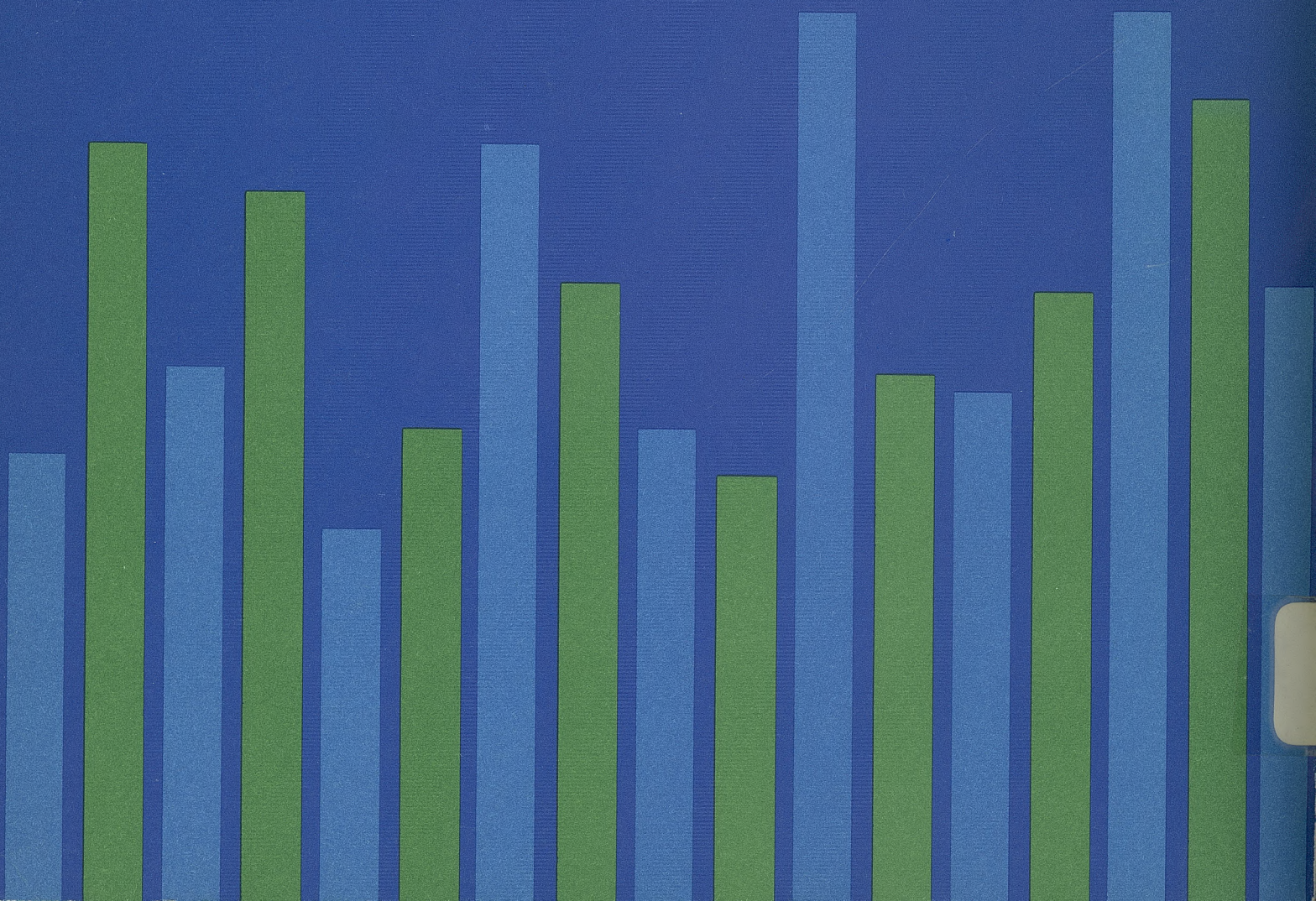

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