Bank of Canada
Technical Reports

Rapports techniques
Banque du Canada

August 1975

Technical Report 4

A MONTHLY MODEL OF THE CANADIAN FINANCIAL SYSTEM

Kevin Clinton   Paul Masson

Department of Banking and
Financial Analysis

CONTENTS

ACKNOWLEDGEMENTS

We would like to thank William R. White, Charles Freedman, Ritha Khemani, and Lloyd Kenward for their advice and assitance. We are also grateful to our editor, Margaret Bailey, who has improved the style and clarity of this study, and to Yvonne Rowe for her typing assistance.

ABSTRACT

In this study we describe preliminary estimates of a model of the Canadian financial system. At the present time, the model explains the behaviour of the authorities, the chartered banks, the public, and the trust and mortgage loan companies. The variables explained include monetary aggregates, several interest rates, and the major assets of the chartered banks and of the trust and mortgage loan companies.

The model differs from existing Canadian models in that we use monthly data rather than quarterly or annual data. We think the shorter observation period permits the econometric estimates to capture the dynamic adjustment processes more accurately. In particular, the mean lags implied by our equations tend to be considerably shorter than those in existing models.

We have also written a description of this model entitled: "Un Modèle Mensuel du Secteur Financier au Canada", which is to be published in l'Actualité Economique in 1976.

AVANT-PROPOS

Ce travail se propose de présenter une première estimation d'un modèle du système financier canadien. Au stade actuel, le modèle permet d'expliquer le comportement des autorités, des banques à charte, du public et des sociétés de fiducie ou de prêt hypothécaire. Parmi les variables expliquées, on trouve des agrégats monétaires, plusieurs taux d'intérêt, ainsi que les principaux avoirs des banques à charte et des sociétés de fiducie ou de prêt hypothécaire.

Ce modèle diffère des autres modèles de l'économie canadienne en ce sens qu'il utilise, contrairement à ces derniers, des données mensuelles au lieu de données trimestrielles ou annuelles. Nous pensons que le raccourcissement des périodes d'analyse permet d'appréhender les processus dynamiques d'ajustement avec plus de précision. Soulignons en particulier que le retard moyen sur lequel reposent nos équations tend à être beaucoup plus court que celui qu'on retrouve dans les autres modèles.

Nous avons également décrit ce modèle dans un article intitulé "Un modèle mensuel du secteur financier au Canada", qui doit être publié dans l'Actualité économique en 1976.

CHAPTER 1

INTRODUCTION AND SUMMARY

1. BACKGROUND

The Monthly Financial Model is a detailed structural model of the Canadian financial system, designed to be used for short-run forecasting and policy simulations. There are thirty-six stochastic equations and forty-six identities in the model. Major variables explained are interest rates, deposits in the chartered banks and near-banks, chartered bank assets, and Government of Canada securities. The model is estimated with monthly data over the period January 1968 to December 1973.

Because of the practical orientation of the model, specifications have been chosen with a view to obtaining reasonably stable and plausible relationships. Furthermore, we have tried to make the structure as economical as possible, given the requirements of the users of the model. This is manifested by the fact that there are only about twenty significant exogenous variables - a great advantage in a forecasting situation. The disadvantage is that, on occasion, specifications to be preferred on purely theoretical grounds have been rejected in favour of simpler specifications.

Real sector variables are taken to be exogenous. Given the mounting evidence that long lags occur between changes in the financial system and their effect in the real sector, the procedure is tenable for short-run experiments. But this characteristic restricts the model's usefulness to the short run.

To be useful over a time horizon of more than, say, a year, one would need to incorporate real sector feedbacks.

Although monthly data have not been used extensively for financial model building in Canada,[1] they seem to present substantial advantages both in estimation and use. With respect to estimation, reactions in financing markets are apt to be so rapid that use of quarterly (and, a forticri, annual) data will cause serious bias in estimates of dynamic structure.[2] Furthermore, we can confine our estimation to more recent and relevant experience: some data series extend no further bank than 1967 [6] (in large part as a consequence of the 1967 Bank Act revisions). With respect to use, a monthly model provides rather detailed information about the short-term implications of alternative assumptions.

2. OVERVIEW

The model is arranged in sectors with equations representing the behaviour of the Government of Canada, the public sector, the chartered banks, and the trust and mortgage loan companies (TMLs). An account is also kept of the Bank of Canada's balance sheet.

Privately held deposits in the chartered banks and TMLs are assumed to be determined by the demand of the private sector, postulated to be a function of interest rates, income, wealth, and so on. Thus demand for their liabilities determines the size of the various intermediaries. We then attempt to explain how the banks and TMLs dispose of their depcsits into the various investments available to them. These decisions also are influenced by interest rates. Interest rates themselves are determined within the model by explicit equations rather than through the interaction of supply and demand. This procedure has some theoretical justification in the case of rates offered by intermediaries on their deposits (see Chapter 3), but the overriding consideration here is that interest rates solved implicitly from supply-demand relationships are apt to track historical data poorly and to behave unpredictably in simulation. The factors affecting the level of Canadian interest rates within the model are the financing requirements of the Government of Canada and private business, the liquidity of the banking system, and interest rates in the United States. Government of Canada financing requirements are taken to be exogenous, but the sources of funds - bonds, treasury bills, Canada Savings Bonds, etc. - are linked through a set of accounting identities and behavioural relationships.

3. ESTIMATION METHODS

Ordinary least squares have been used in making most estimations, although for a number of equations an autoregressive transformation was applied to cope with residual serial correlation. The data are not seasonally adjusted so that where necessary monthly seasonal dummies are employed. Nearly all regressions were estimated over the period January 1968 to December 1973.

4. A SUMMARY FORECAST

In order to assess the validity of the model, an ex post forecast was prepared for 1974, a year outside the period over which the parameters were estimated. Since 1974 was a year of turmoil in financial markets with some variables taking values well outside the range of previous experience, the forecast is a rigorous out-of-sample test of the model. In this exercise, exogenous variables are given their realized values, but realized values for endogenous variables are used only for initial conditions. A dynamic simulation then generates forecasts for endogenous variables that can be checked for accuracy by comparison against actual values. Charts of actual and predicted values for some important variables are presented below.[3]

The selection of variables pictured in the following six charts should give an impression of the overall forecasting ability of the model. Two interest rates - the ninety-day finance company paper rate and the rate on five-to-ten year Government of Canada bonds - are charted as representative short- and long-term interest rates. Currency and demand deposits (M1) and total bank deposits are charted to illustrate how well monetary aggregates are predicted. Finally, chartered bank general loans and liquid assets are charted to illustrate the model's ability to forecast the credit side of the chartered bank balance sheet.

FCCTNCTES

1. A monthly model of the monetary sectcr of the U.S. economy has been constructed at the Board cf Gcvernors of the Federal Reserve System, see Pindyck and Roberts [27].

2. See, e g, Zellner and Montmarquette [34], Mundlak [23], and Telser [30].

3. The symbol RMS stands for the root-mean-square forecasting error.

Chart 1

90-DAY FINANCE COMPANY PAPER RATE

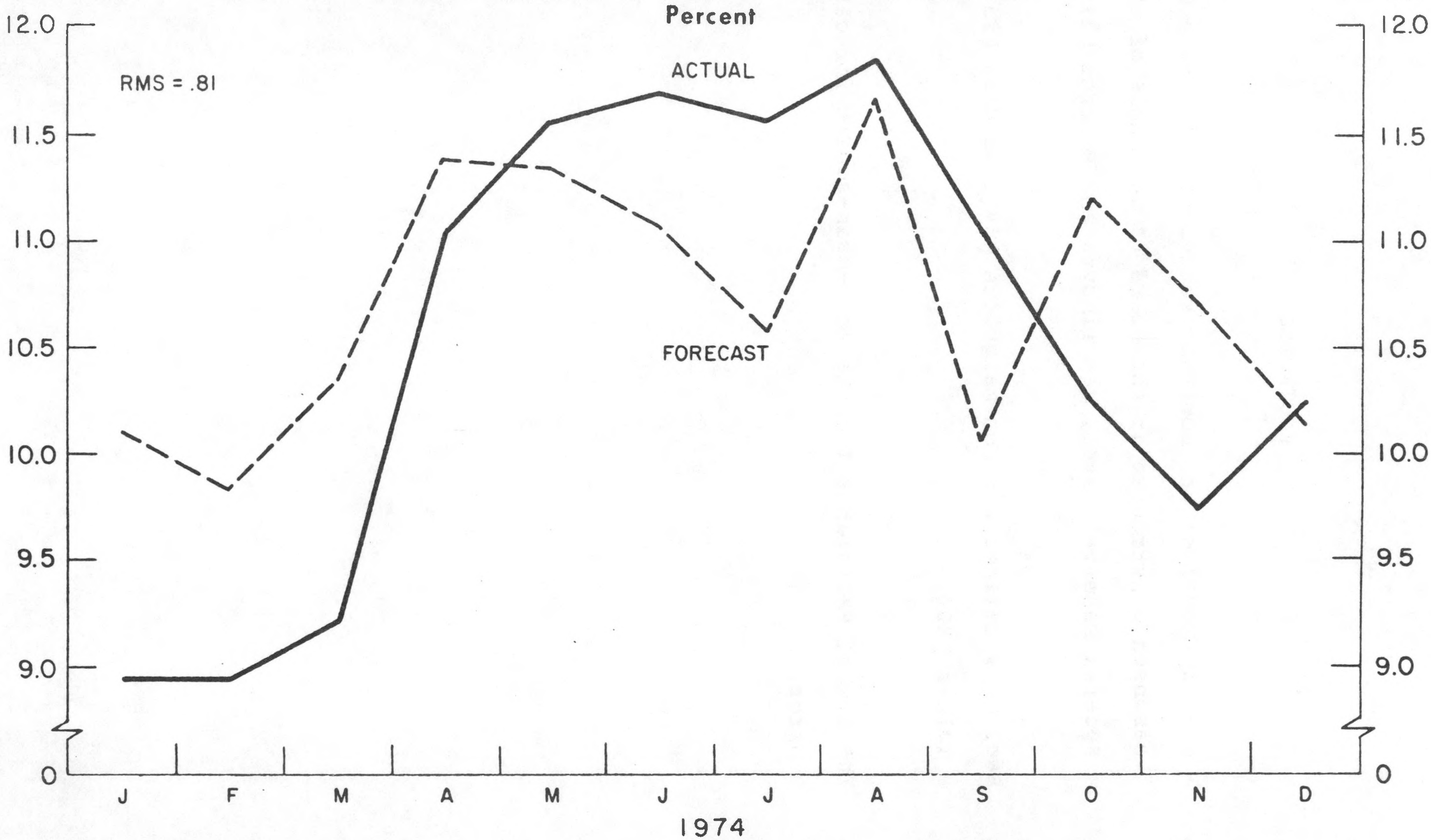


Chart 2

5 TO 10 YEAR FEDERAL GOVERNMENT BOND RATE

Percent

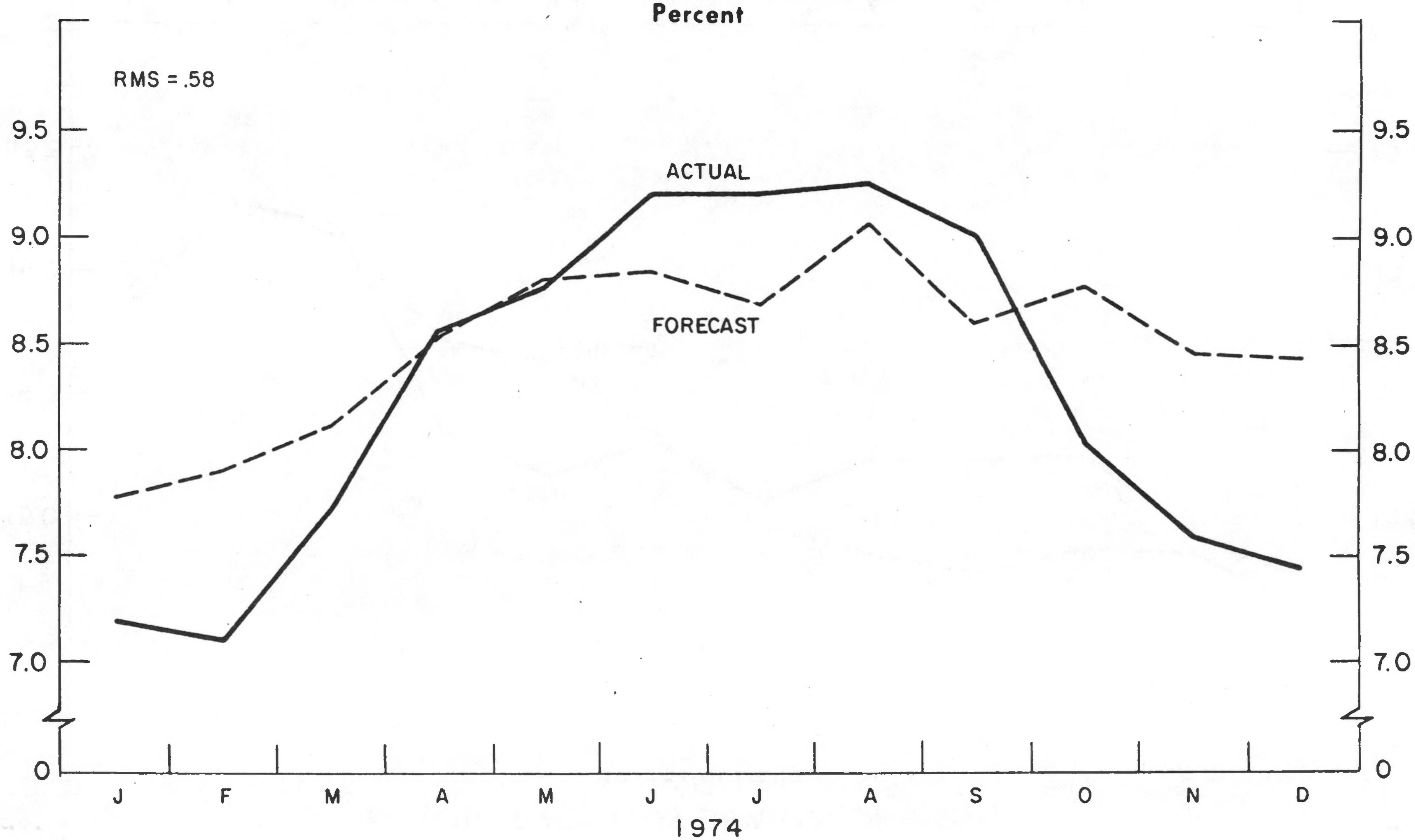


Chart 3

M1 (CURRENCY PLUS DEMAND DEPOSITS)

Billions of Dollars

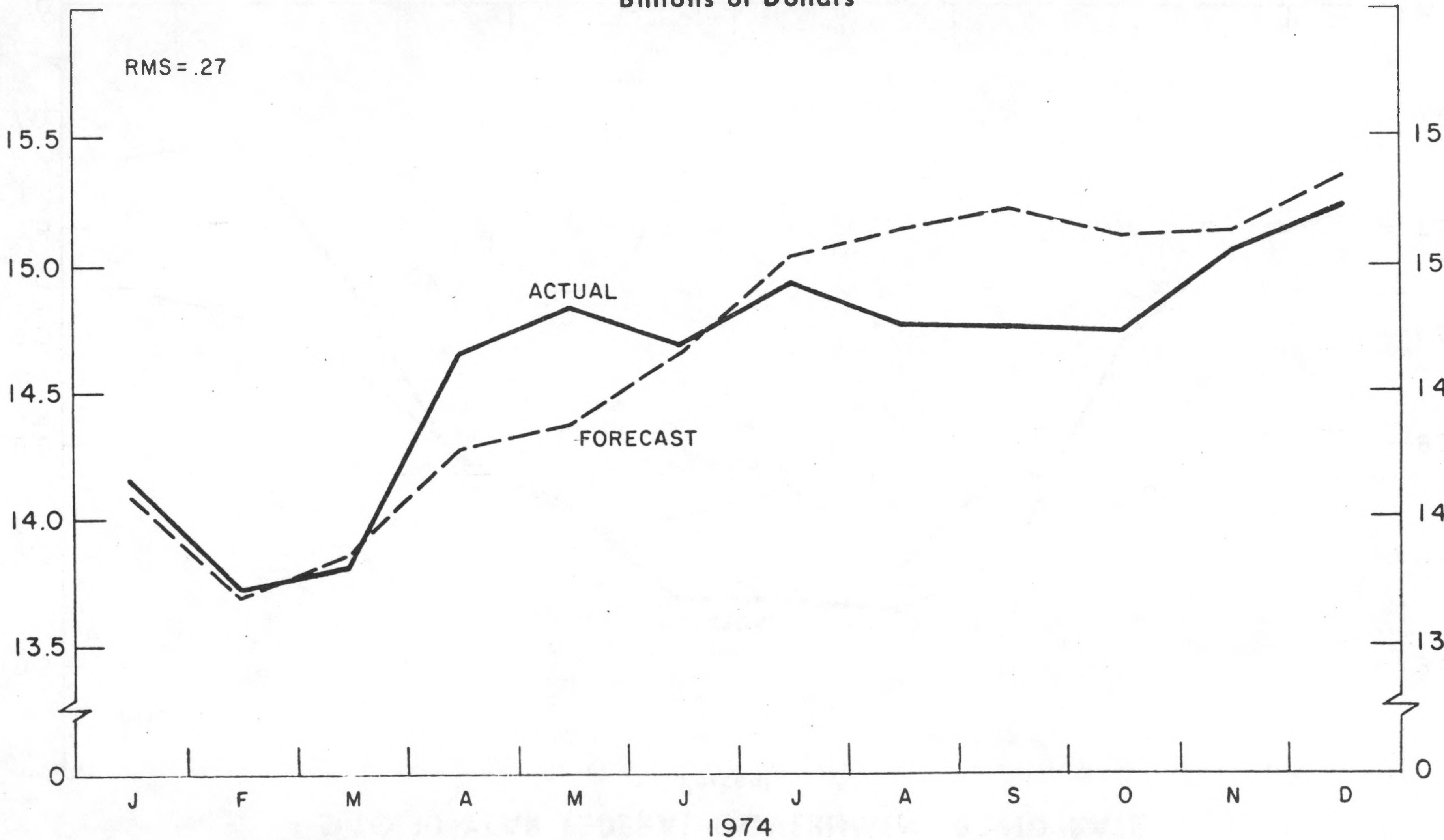


Chart 4

TOTAL CANADIAN DOLLAR BANK DEPOSITS

Billions of Dollars

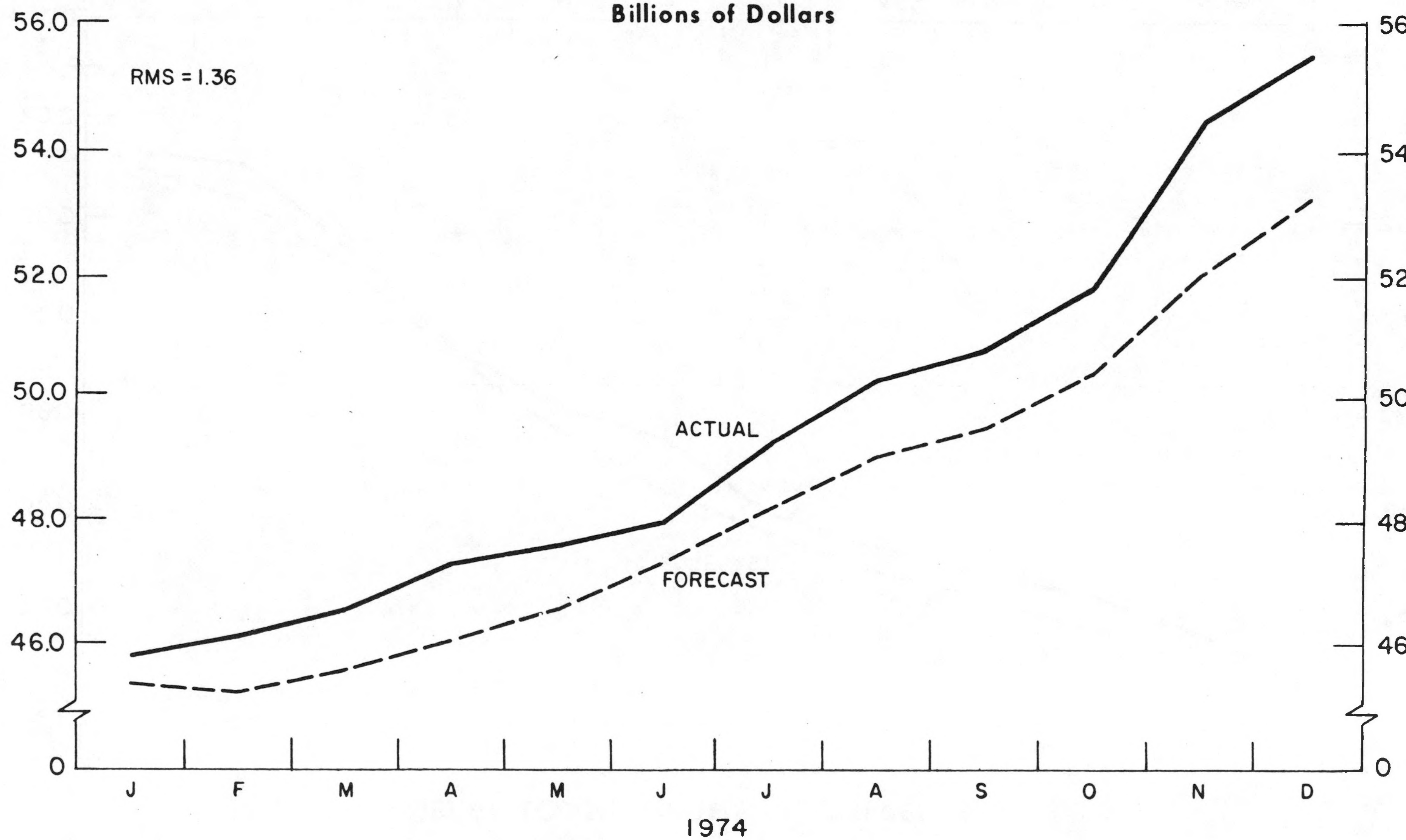


Chart 5

GENERAL LOANS OF THE CHARTERED BANKS

Billions of Dollars

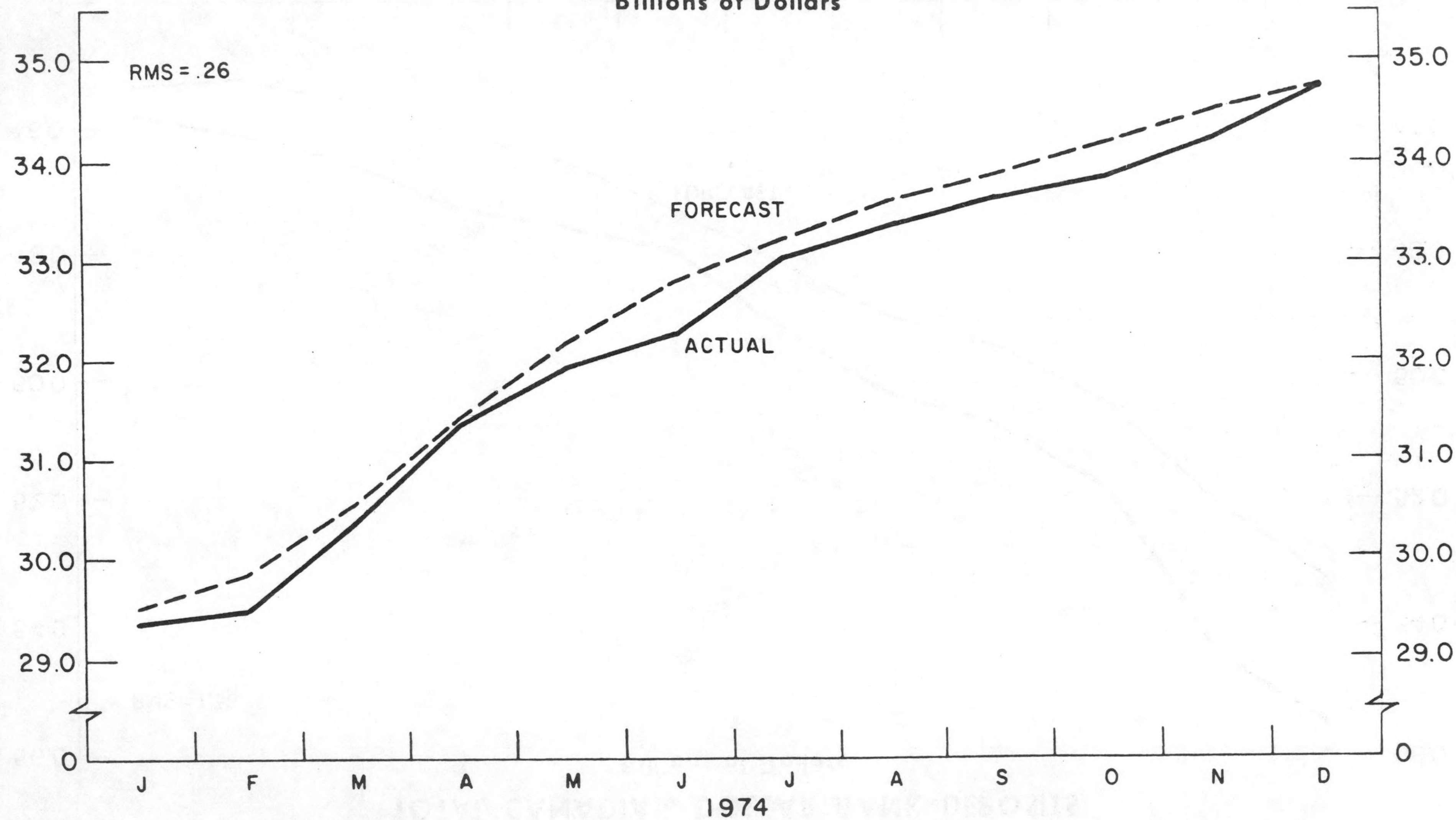
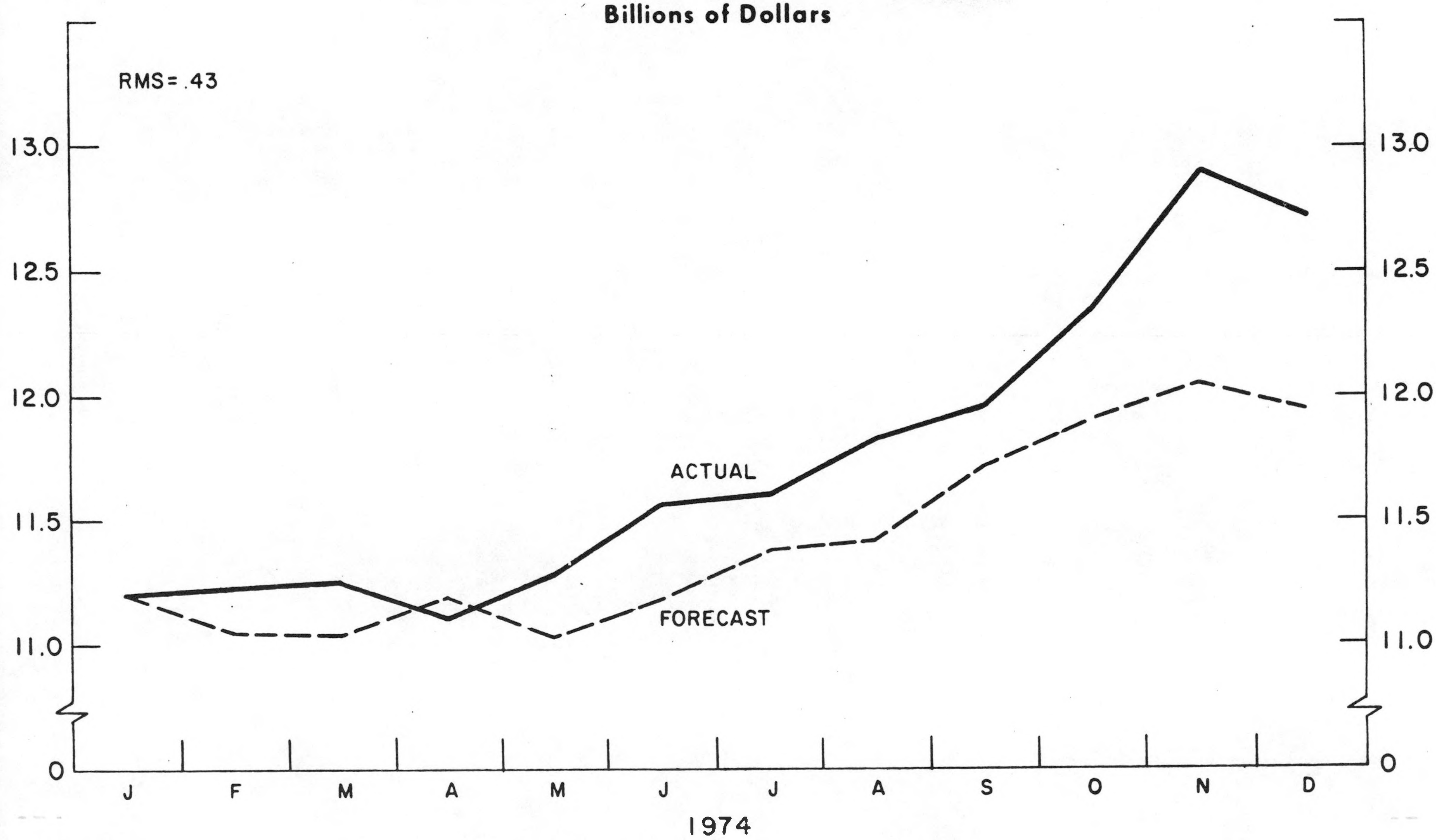


Chart 6

LIQUID ASSETS OF THE CHARTERED BANKS

Billions of Dollars



CHAPTER 2

THE FINANCING REQUIREMENTS OF THE GOVERNMENT OF CANADA, THE BANK OF CANADA BALANCE SHEET, AND GOVERNMENT OF CANADA SECURITIES ISSUES

The model is designed for the consideration in some detail of the ways in which a government deficit can be financed and what each option means for the relevant securities market. We have not consolidated Bank of Canada market operations with those of the Government of Canada, so that, for instance, a purchase by the Bank of Government of Canada bonds enters explicitly into the model. Such disaggregation by institution and financial instrument is useful in monetary policy analysis because it allows one to assess whether the issue of bills, short-term Government of Canada bonds (short Canadas), long-term Government of Canada bonds (long Canadas), Canada Savings Bonds, or a faster run-down of government deposits at the chartered banks is the more desirable action from the point of view of debt management.

The given exogenous financing requirement is taken to be the budgetary surplus or deficit adjusted to a cash basis by various non-budgetary items, including foreign exchange financing. (See Bank of Canada Review [3] Table 2). Since the budgetary surplus or deficit must be met either by reducing government deposits with financial intermediaries and the Bank of Canada or by increasing the amount of Canadian dollar securities held outside government accounts, the relevant financing identity must mirror this constraint. The level of government balances is taken to be an exogenous policy instrument, and the amount of Canada Savings Bonds is also taken to be exogenous.[1] The quantity of outstanding treasury bills is determined in the model essentially by demand, reflecting the fact that in recent years they have been primarily held by the banks to satisfy secondary reserve requirements.[2] Furthermore, excess secondary bank reserves amount to less than 1 percent of statutory bank deposits. As a result the government is constrained at times to issue treasury bills simply to meet the banks' need for secondary reserve assets.[3] With government deposits, Canada Savings Bonds, and treasury bills determined, the issue of marketable bonds must fulfil the government's financing requirements. An exogenous balancing item is added that includes both foreign-pay issues of government bonds and a residual that reflects the use of average-of-Wednesday data in some places rather than end-of-month data.

The acquisition of bonds or treasury bills by the Bank of Canada is clearly an element in monetary policy, closely related to the determination of the cash reserves of the banking system. In the model we treat the purchase of bonds by the Bank as being tied to the monetary policy goals embodied in its reserve management operations. We assume in this context that the cash reserves at the banks are set so as to meet a particular money market interest rate target, whether the aim is ultimately to influence the cost of credit or the supply of money. Consequently, if the money market adjusts quickly so that the Bank can achieve its interest rate target with only a short lag, the quantity of cash reserves in the system will be the quantity desired by the banks. That is, on a monthly basis the banks will be in equilibrium with respect to their holdings of reserves and money-market instruments. In this context it is natural to take the note holdings of the chartered banks and their deposits at the Bank of Canada as being determined endogenously by chartered bank decisions; the Bank of Canada's holdings of government bonds are made to vary on a one-for-one basis with the movement in these liabilities. Conversely, interest rates reflect the goals of the Bank of Canada. Interest rate targets are not completely exogenous, however, as they are related to, for instance, the rate of growth of the money supply, foreign interest rates, and real variables. Hence at least one of the interest rate equations embodies a "reaction function" reflecting desired monetary policy. (See Goldfeld and Blinder [13].)

Monetary policy is implicitly included in the model in the following manner: the Bank of Canada formulates an interest rate target as a function of conditions in the financial and real sectors of the economy. In order to attain this target the Bank sets bank reserves by changing its holdings of government bonds and by transferring government deposits between itself and the chartered banks. The target is quickly achieved so that observed monthly average cash reserves are the reserves desired by the banks. Cash reserve changes in the model are actually associated with changes in Bank of Canada holdings of government bonds, which implies that the observed level of reserves was achieved by open market operations or by the purchase of new issues. It is easy, however, to modify in a judgemental fashion the results of a simulation by inserting different values for Bank of Canada holdings of government deposits or by using the "balancing item" or both, if the implied change in bond holdings seems unreasonable. The Bank of Canada balancing item includes foreign exchange swaps with the government.

BANK OF CANADA BALANCE SHEET

Assets	Liabilities
Treasury bills	Notes held by the public
(ABCTB)	(ANFCUR-ANFCOIN)
Government bonds	Deposits of & notes held by banks
(ABCSC+ABCLC)	(ABD+ABN)
Balancing asset	Government deposits
(ABCBI)	(DFGBCM)

Thus the identities that relate the change in the government bond-holdings of the Bank to its other balance sheet items are:

$$ABCSC = PBSC*(ABN+ABD+ANFCUR-ANFCOIN+DFGBCM-ABCTB-ABCBI)$$

$$ABCLC = ABN + ABC + ANFCUR - ANFCOIN + DFGBCM - ABCTB - ABCBI - ABCSC$$

The variable PBSC allows for flexibility in simulation: the proportion of short Canadas to total bonds acquired can be set to its historical average or to any desired ratio giving different impacts on the markets for short and long Canadas.

The total issue of Canadas is similarly divided between short Canadas and long Canadas, though in this case the issue of long Canadas is inserted as an exogenous variable. Over the historical period the total issue takes its observed value; for simulation purposes it can be made to follow any desired path depending on the policy one chooses to simulate. Bonds not acquired by the Bank of Canada are acquired by government accounts, the banks, or the public. The effective demand of the banks and the public must be made to equal the value of bonds not taken up by the Bank of Canada and the Government of Canada, if, as we assume, the market clears. We have accomplished this by renormalizing the demand functions of the public for short and long Canadas on the short and long Canadas interest rates, respectively, so as to determine the interest rate that must prevail if the public is to acquire the remaining bonds in each category. (See Chapter 3 for these equations.)

FOOTNOTES

1. See below, Chapter 4.

2. At the end of 1974, the banks had acquired 94 percent of bills held outside the Bank of Canada and government accounts. See Bank of Canada Review [3], Table 20.

3. See Bank of Canada Press Release, Nov. 29, 1974. [2]

CHAPTER 3

INTEREST RATES

1. INTRODUCTION

Econometric models of the financial system often have a short-term interest rate as a key element in the interest rate structure. This short-term rate is viewed as being determined, for example, by the condition that obtains when the market for bank reserves clears (as in the Federal Reserve Board monthly model, which is described in [27]), or by a central bank reaction function (as in RDX2 [16]. Other interest rates are then linked to the key rate. Long-term rates are thus usually derived from the short-term rate, using a more or less complicated distributed lag supposed to represent the expectations theory of the term structure of interest rates. This framework generally focuses on explaining the rates of marketable securities such as treasury bills and bonds.

In several important respects the structure developed for use in The Monthly Financial Model does not follow these conventions. First, it seems appropriate under current circumstances to put more emphasis on the role of interest-bearing short-term deposits in explaining short-term interest rates. The need for such a switch of emphasis can be readily appreciated by comparing the outstanding quantities, or breadth of ownership, of relevant short-term assets. Consider, for example, short-term deposits in the chartered banks. At the end of 1973 holdings of non-personal term and notice deposits in the chartered banks amounted almost to $10 billion.[1] These holdings were primarily in large denomination term deposits. At the same time holdings of treasury bills outside the banking system amounted to less than $100 million, and holdings of commercial paper plus finance company paper[2] to about $3.5 billion. The banks (and other intermediaries) evidently have these considerations in mind when setting rates on their wholesale short-term deposits rather than the determination of yields on primary securities, which should be the centrepiece for a model of short-term interest rates.

The foregoing argument leads into the second somewhat novel aspect of our model. By focusing on intermediary behaviour we attempt to get a more satisfactory description of liability management than is usual in financial sector models. The specifications we employ to explain the behaviour of deposit interest rates are based on the theory of liability management developed by Freedman [11] and Slovin [29]. Furthermore, we emphasize credit variables rather than monetary variables in the process of interest rate formation. Finally, explicit consideration is given to the role of international capital movements through covered arbitrage and spot speculation in the determination of the Canadian short-term interest rate structure.

For long-term interest rates, we use traditional term structure concepts, with rational distributed lags[3] on short-term rates that represent expectations of future rates. The equations for long-term Government of Canada bond rates also include supply-of-debt variables intended to capture the effect of the quantity of debt on the term structure of interest rates.

Having explained the motivation behind our specifications and what we regard as the merits of our approach, we must in fairness point out that the structure is not without its weaknesses. Perhaps the most important flaw is the fact that Bank of Canada policy reactions are not explicitly built into the equations for short-term interest rates. To the extent that the estimated parameters embody the average responses of the central bank to changes in the independent variables, policy reactions are accounted for implicitly. But it is clear that a more rigorous treatment of the central bank reaction function would be preferable. The forward exchange rate is treated as being exogenous, which is a further weakness. This is done because existing empirical specifications of the modern theory of forward exchange do not mesh well with the analysis of interest rate determination for the small country case. In testing the modern theory of forward exchange, domestic interest rates are assumed to be determined either exogenously (an assumption that is not appropriate in building a financial sector model designed in part to explain interest rate movements) or by purely domestic factors (an assumption that does not seem applicable to Canada).[4] Given the context, it is preferable to treat the forward exchange rate rather than interest rates as being exogenous. Improvements in this area of the model await the development of a less limiting theory of forward exchange. Such work as we have done indicates that this is difficult territory where no neat solution is in sight. In practice, we have not found that taking the forward exchange rate as given is a severe impediment. This is so because the model is designed primarily to be used as a device for short-term forecasts and the examination of policy questions in a short-term forecasting context. In the forecasting context and in the absence of other overriding considerations, the best guess is that the forward exchange rate will be equal to the spot exchange rate. Accordingly in forecast simulations the forward rate is generally set equal to the spot rate.

In the following section, a simple theory of deposit interest rate determination following the work of Freedman [11] is presented. This theory is used to develop the empirical specifications in the interest rates equations.

2. THE THEORY OF DEPOSIT INTEREST RATES

Consider an intermediary that faces a demand curve for its liability, D, of the form

$$D = D(i, I) + u \qquad (3.1)$$

where

i is the interest rate to be offered depositors by the intermediary,

I is the rate offered on competing assets (often these would be deposits in other intermediaries), and

u is a shift parameter representing exogenous inflows of deposits.

We assume that the demand function is well-behaved, with the usual properties $\partial D/\partial i>0$, $\partial D/\partial I<0$. A further assumption is that the intermediary receives a rate of return on its assets, r, determined by the market. Then a profit-maximizing intermediary will be confronted with the job of selecting the interest rate deposits that maximize net returns (R) where

$$R = (r-i)D \tag{3.2}$$

This simple illustrative model ignores the complications arising from such factors as reserve requirements, heterogeneous assets and liabilities, etc., but generalization to cope with these things does not change the relevant conclusions. The essence of the theory is the assumption that the rate of return on important assets is determined by the market whereas the rate of return on deposits is determined by the intermediary.

Casual empiricism suggests that the above characterization goes a long way in explaining a pervasive feature of intermediary behaviour. Intermediaries almost always quote a rate on their deposits and accept at that rate all deposits offered. Of course they are ready to change their rate in response to flows of funds but their decision variable is the deposit rate. An analogous argument can be applied to assets not acquired in organized markets: loans to customers being the outstanding example. It is often argued that loans are demand determined, but to the extent that intermediaries set the interest rate and other conditions on their loans they have some control over the quantity that is demanded. In this case the decision variable is the terms of these loans. On the other hand, a significant quantity of assets is in fact acquired in organized markets and the intermediary decides on the quantity to be purchased. With the single exception of the banking system, which holds a large percentage of outstanding marketable Government of Canada debt, it is reasonable to assume that the rate of return on these assets is determined exogenously by the market.

The necessary and sufficient conditions[5] for net profits to be maximized are

$$\frac{\partial R}{\partial i} = (r-i)\frac{\partial D}{\partial i} - D = 0 \qquad (3.3)$$

and

$$\frac{\partial^2 R}{\partial i^2} = (r-i)\frac{\partial^2 D}{\partial i^2} - 2\frac{\partial D}{\partial i} < 0 \qquad (3.4)$$

The first-order condition can be solved for the optimal deposit rate i*

$$i^* = r - D/(\partial D/\partial i)$$

Differentiating the first-order condition to find the effect of i* of a change in r we obtain

$$\frac{di^*}{dr} = \frac{\partial D/\partial i}{2\partial D/\partial i - (r-i)\partial^2 D/\partial i^2}$$

whereas the effect of a change in I is

$$\frac{di^*}{dI} = \frac{(r-i)\,\partial^2 D/\partial i\partial I - \partial D/\partial I}{2\partial D/\partial i - (r-i)\partial^2 D/\partial i^2}$$

given that $\partial^2 D/\partial i\partial I$ is positive (or a small negative number) and that the second-order conditions (3.4) are fulfilled, it can be seen that both derivatives are positive. An increase in the rate of return either on assets held or on assets competing with deposits causes the optimal deposit interest rate to increase. Another interesting result is that an exogenous inflow of deposits causes a reduction in the optimal rate

$$\frac{di^*}{du} = \frac{-1}{2\partial D/\partial i - (r-i)\,\partial^2 D/\partial i^2} < 0$$

This means that the optimal reaction to a deposit inflow is not just acceptance for investment into earning assets but payment of a lower rate to depositors. The inflows will be somewhat reduced, but profit will be increased because of lower interest payments. This derivation has very useful implications. Any exogenous change that causes a deposit outflow will cause an increase in the optimal deposit rate. And likewise, any exogenous change that reduces deposits available for investment by preempting existing deposits will have the same qualitative impact. Such changes include the imposition of an increased legal reserve requirement, or an exogenous increase in the quantity of an asset that the intermediary does not precisely control in the short run. For example, if there is an unforeseen increase in the demand for bank loans, the banks have several options: they can accommodate the increased demand by increasing their supply or they can raise their loan rate to choke off demand. In general, some combination of both would be optimal. Given that to some extent loan supply is increased, the banks have then the further options of financing their loan extensions by selling other assets or by raising liabilities via an increased deposit rate. Again, in general, some combination of both would be optimal. To the extent that the last option - the liability management option - is adopted, increased bank lending requires a higher deposit rate. Thus exogenous increases in certain asset items have a qualitatively similar effect to exogenous outflows of deposits.

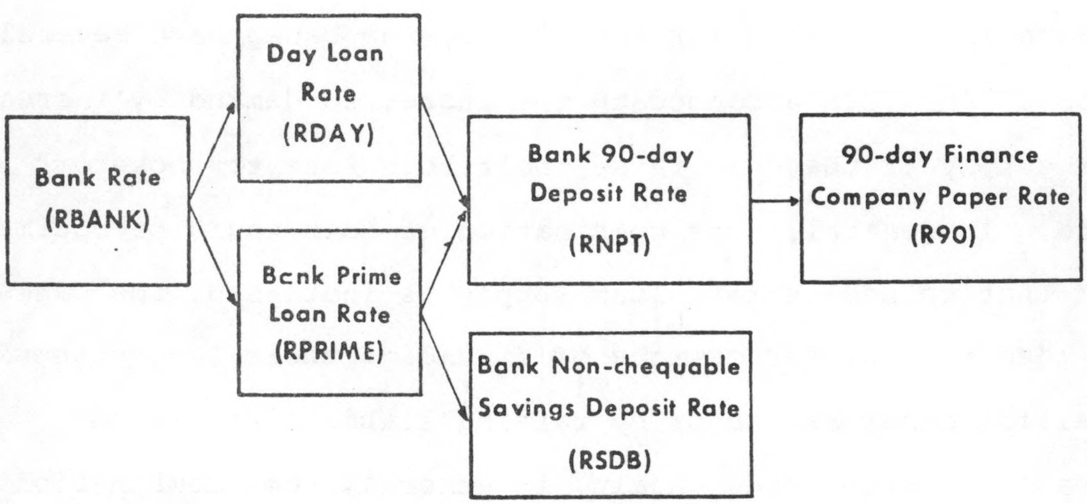
3. ESTIMATED INTEREST RATE EQUATIONS

A. Short-Term Interest Rates

All financial sector models have built into them an essentially recursive structure for interest rates, for the good practical reason that otherwise the properties of the model become intractable and potentially nonsensical. We follow this procedure even though we would not argue that our chain of equations represents a set of causal relations: a simultaneous model would in principle be better. The principal features of the structure adopted in the monthly model for domestic short-term rates can be represented in the flowchart below.

Chart 7

STRUCTURE OF SHORT-TERM INTEREST RATE EQUATIONS



In reading this flowchart one should bear in mind that other variables, either exogenous or determined in conjunction with the rest of the model, enter the equations; in the context of the complete model there are feedbacks from quantity variables and the structure is not truly recursive. However, the impact of the quantity variables on interest rates is so small that the flowchart is a useful simplication.

Short-term rates determined within the model include those on day loans (RDAY), treasury bills (RTB), ninety-day finance company paper (R90), chartered bank prime loans (RPRIME), non-personal term and notice deposits (RNPT), and non-chequable personal savings deposits (RSDB). Interest rates offered on short-term trust company deposits (RTL1) and savings deposits (RSDTL) are also endogenous. In keeping with the argument above that the model's system of interest rate determination should not be regarded as a causal chain, we would point out that a policy involving, say, higher short-term interest rates should not be simulated by raising the constant term in only a single equation. The constant terms of all short-term rates should be simultaneously adjusted.

The theory outlined in the previous section suggests that unforeseen changes in liabilities and predetermined asset items will affect the interest rate settings of the chartered banks. For the chartered banks such changes will show up, at least in the short run, in their balance sheets as changes in liquid assets. Thus movements in liquid assets can serve as a proxy for the variable u in equation (3.1), as long as liquid assets are appropriately scaled so that the trend in the size of the banking system is not made to affect the level of interest rates and only unexpected movements are included. The particular liquidity variable used for interest rates related to the chartered banks is free liquid assets (liquid assets net of reserve requirements) as a ratio to total bank assets. So as to capture only unexpected movements in liquid assets a simple twelve-month moving average of its own past values is subtracted from the current value of the ratio. Any change in bank liquidity from recent values thus has an effect on the level of interest rates, but, according to this specification, the level of bank liquidity has no long-run effect on the level of interest rates. This can be interpreted as an adaptive procedure by which banks, as they become used to a new level of liquidity do not feel constrained to remedy the situation by changing interest rates on deposits or on loans. Individual specifications are discussed in detail below.

Rational distributed lags are used in several of the equations in preference to Almon specifications [1], because the lags of adjustment embodied in estimates of the latter are often implausibly long. Typical examples are provided by RDX2 and by Modigliani and Sutch [22], where the lag between long-term and short-term rates is stretched over five and four years, respectively. When using rational lags it is necessary to check two things: 1. that autocorrelation in the error term does not give rise to spurious inferences about rational lag structures; 2. that estimated lag profiles are economically meaningful - in particular, dynamically stable.

Tests on the equations reported below of the competing hypotheses of lagged adjustment and autocorrelated residuals, using Hendry's GIVE procedure,[6] did not reject the hypothesis of lagged adjustment, and indicated that ommission of the lagged dependent variable constituted a dynamic misspecification. As for dynamic stability, the required tests are simple because of the low order of the polynomials used in the lag operator. In all cases the distributed lag systems have characteristic roots within the unit circle and are therefore stable. Nor are the lag systems otherwise nonsensical, although the adjustment of interest rates is estimated to take place much more rapidly than is indicated by alternative distributed lag hypotheses. This is especially true for the adjustment of long-term rates to changes in short-term rates. Where the distributed lag weights are uniformly non-negative mean adjustment lags are presented, in other cases a chart of the lag weights is presented to convey the shape of the adjustment profile.[7] A note on each equation follows. The equations are expressed in TROLL notation. See APPENDIX C.

RDAY (Equation 22)

The rate of interest on chartered bank day loans is written as a function of bank rate (RBANK), the covered U.S. treasury bill rate,[8] and the bank liquidity variable (REL). Bank rate was the only variable found to enter the equation with a significant lag. All variables are statistically significant and it is particularly interesting that bank liquidity should enter so strongly with a t-ratio greater than 4.

RPRIME (Equation 23)

The prime lending rate of the chartered banks is written as a function of the U.S. prime rate (RPRIME2), bank rate, and bank liquidity. A rational distributed lag is employed yielding a mean lag for RPRIME2 that is given by[9]

$$\frac{AR06 + 2(AR07)}{1 - AR06 - AR07} = \frac{.528 + 2(.094)}{1 - .528 - .094} = 1.9$$

Because a lagged value for bank rate is included in the regression, the mean lag for RBANK differs from that for RPRIME2, and is given by

$$\frac{AR03}{AR02 + AR03} + \frac{AR06 + 2(AR07)}{1 - AR06 - AR07} = 1.2$$

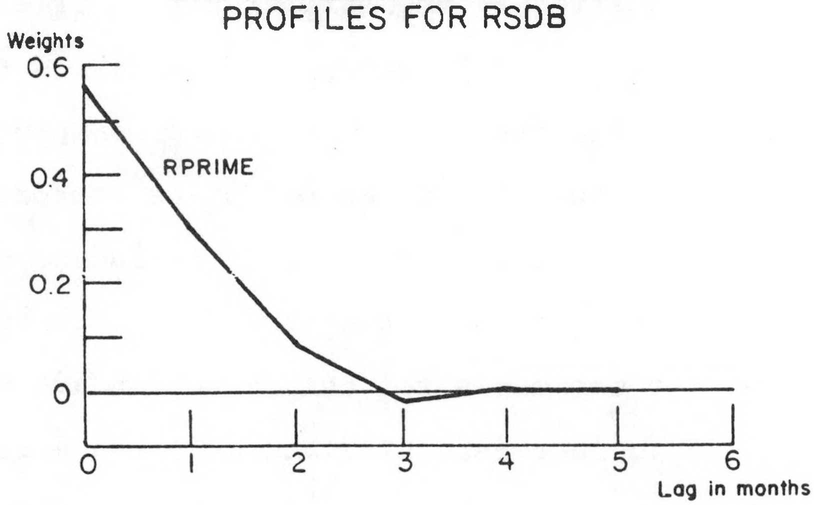
Thus, a lag of scarcely more than a month is implied for the mean effect of a change in bank rate on prime rate. The results are summarized in the following table, which shows the (directly estimated) short-run coefficient, and the implicit long-run coefficient, which is the cumulative sum of all partial effects in the process of adjustment.

	Short-run Coefficient	Long-run Coefficient	Mean Lag (Months)
RPRIME2	.23	.61	1.9
RBANK	.20	.25	1.2

RSDB (Equation 24)

The rate on non-chequable personal savings deposits at chartered banks is written as a distributed lag function of the prime rate, which represents the yield on the major earning asset of the banks. No rate on assets competing with personal savings deposits is included because of the dominance of the banking system in this area. A 100-basis-point increase in RPRIME is estimated to cause an initial increase in RSDB of fifty-seven basis points, and a long-run increase of ninety-five basis points. A mean lag cannot be derived as before, as the weights are not all non-negative, but, as shown in Chart 8, adjustment is rapid.

Chart 8
UNSCRAMBLED LAG WEIGHTS
PROFILES FOR RSDB



RNPT (Equation 25)

The rate on non-personal term and notice deposits is a crucial variable in the wholesale deposit market. Theoretical considerations outlined above suggest that RPRIME, the yield on the major earning asset, and RDAY, the yield on an asset that is important for adjustments at the margin, should be used as explanatory variables. The covered U.S. treasury bill rate is used to pick up the influence of international competition in the short-term market. The liquidity variable is included to capture the fact that, if there is a sudden build-up in bank liquidity, the banks will bid less vigorously for relatively expensive blocks of money in wholesale markets. Estimation of an equation for RNPT is complicated by the fact that under the Winnipeg Agreement (June 1972 to January 1975) and an earlier arrangement (starting in June 1969 and lasting about ten months) there were agreed maximum interest rates on time deposits. Our initial procedure was to gap out these periods from the regression. As expected, RNPT was consistently and substantially overpredicted by the estimated equation in the earlier period of effective ceiling rates. Yet, strangely enough, the equation tracked the period of the Winnipeg Agreement (also cut of sample) rather accurately, with underprediction as common as overprediction.[10] This suggests that the agreement had less influence on the rate structure than has sometimes been accorded to it. Because of these findings, our estimates for this equation are based on data from January 1968 to December 1973, and only the earlier ceiling period (June 1969 to April 1970) is gapped out. The table below is a summary of estimates.

	Short-run Coefficient	Long-run Coefficient	Mean Lag (Months)
RPRIME	.65	.53	n.a.
RDAY	.19	.26	.4
RTB2	.23	.32	.4

There would seem to be some overshooting in the setting of RNPT with respect to changes in RPRIME, since the short-run effect is greater than the long-run. It is apparent that adjustment is rapid.

R90 (Equation 26)

Rates of interest on short-term private paper are amongst the rates most responsive to financial developments in Canada. These rates are also greatly affected by international capital flows, both covered and uncovered. It is therefore important to have a variable to represent the level of short-term interest rates in the rest of the world in an equation for the ninety-day finance company paper rate. The variable used is the U.S. treasury bill rate (RTB2) entering in covered form to capture the effect of arbitrage flows of short-term capital, and in raw form to capture the effect of spot speculation. Both are evidently significant, since the t-ratios exceed 3.7 and 6.9, respectively. A 1 percent increase in RTB2 causes, according to the estimated coefficients, an increase in R90 of approximately .43 percent. Competition from the banks in the money market is embodied in the rate on non-personal deposits, also significant statistically. The remaining variable in this equation (FRQ/YDPSAD) is the ratio of business sector financing requirements to GDP. One of the sources of funds to meet these requirements is short-term commercial paper, so that when they are high, rates on short-term paper are pushed upwards. Although the estimated coefficient for this variable has the expected positive sign, it is only marginally significant (t-ratio of 1.9).

RTL1 (Equation 27)

The specification for the rate of interest on less-than-one-year deposits at trust companies is a straightforward application of the theory of deposit interest rates. Short-term paper is the major asset for investment of these deposits and the major competing asset is the chartered bank non-personal term and notice deposit. Thus the rates to be included in this equation are R90 and RNPT, actually entered in a distributed lag specification. The results are summarized in the table below.

	Short-run Coefficient	Long-run Coefficient	Mean Lag (Months)
R90	.30	.75	1.2
RNPT	.36	.17	n.a.

Although there is, according to the estimates, a rapid response to changes in RNPT, it is evident that in the long run the most important determinant of short-term rates offered by trust companies is the rate they receive on the short-term paper they hold rather than the competing rate offered by the banks.

RSDTL (Equation 29)

Savings deposits in trust and mortgage loan companies are invested primarily in mortgages and their major competition comes from personal savings deposits in banks (RSDB). Movements in interest rates on mortgages (RMC) and on RSDB therefore explain most of the movement in RSDTL.

	Short-run Coefficient	Long-run Coefficient	Mean Lag (Months)
RMC	.07	.19	1.8
RSDB	.56	.64	.3

RTB (Equation 30)

The variables used in the structural equation for the treasury bill rate are the covered and raw U.S. treasury bill rates, the day loan rate, and bank rate. Only the bank rate was found to exert its influence with a significant lag. Both speculation and arbitrage capital flows are apparently significant in determining movements in RTB - the effect through both channels of an increase in RTB2 of 1 percent is an increase in RTB of .23 percent. Bank rate has a strong short-run impact but it tapers off quickly, so that an increase of 1 percent causes an increase of .88 percent in the treasury bill rate within one month but of only .41 percent in two months.

B. Long-Term Interest Rates

Five interest rates for assets with a term to maturity of more than one year are included in the model. Two are interest rates on Government of Canada bonds: RS, for one-to-three-year maturities, and RML, for five-to-ten-year maturities. The three remaining rates are an average yield on corporate, municipal, and provincial bonds (RCS)[21], the rate on conventional mortgages (RMC), and the rate on over-one-year deposits at trust companies (RTL2). Rational distributed lags are used in all equations.

The structure is specified to reflect the partial segmentation that exists in the Canadian bond market between Government of Canada bonds and other bonds. Thus, RS is determined by a distributed lag on RTB rather than on the possible alternative R90, which is generally considered to be more representative of general movements in short-term rates. The structure of the market is such that private short-term paper is not as close a substitute for short Canadas as are treasury bills. In turn, RS feeds into RML, and both rates are affected by relative supplies of Government of Canada debt. A link with private sector rates is provided in the specification for RCS, which includes RML as an explanatory variable. Further links are provided by the presence of RS in the mortgage rate equation and in the equation for the rate on long-term trust company deposits.

RS (Equation 31)

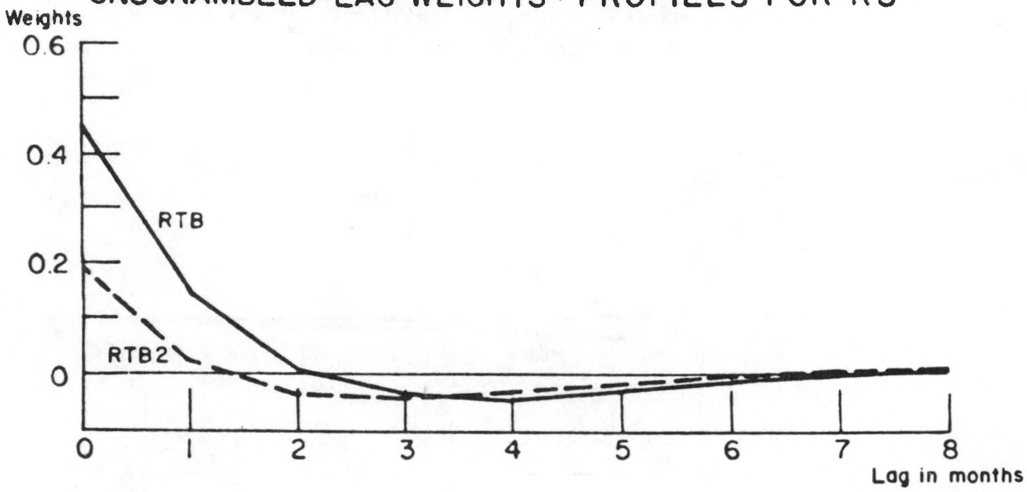
A rational distributed lag on the Government of Canada and U.S. treasury bill rates is assumed to embody the expectations theory of the term structure.[11] A summary of the results is presented in the table below.

	Short-run Coefficient	Long-run Coefficient
RTB	.45	.22
RTB2	.19	.03

The short-run coefficients are larger than the long-run coefficients. Since the lag weights are not uniformly non-negative, the concept of a mean lag is not operative. Chart 9 is a graph of the shape of the lag distribution.

Chart 9

UNSCRAMBLED LAG WEIGHTS : PROFILES FOR RS



The supply-of-debt variable[12] ANFSC/ANFSC(-1), as is often the case, is not statistically significant. However the magnitude of the coefficient is substantial so that this variable plays an important role in the overall structure of the model.

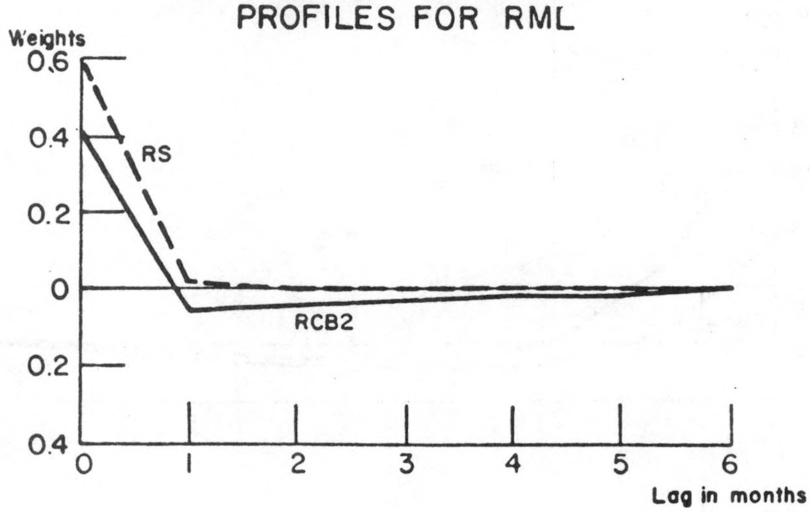
RML (Equation 32)

Similar conceptually to the preceding equation, in equation 32 we employ RS and RCB2 as the relevant Canadian and U.S. rates. Implicit parameters are shown in the table below.

	Short-run Coefficient	Long-run Coefficient	Mean Lag (Months)
RS	.58	.60	.5
RCB2	.41	.29	n.a.

Graphically, the lag distributions take the shape of Chart 10.

Chart 10
UNSCRAMBLED LAG WEIGHTS
PROFILES FOR RML



In this equation the supply-of-debt variables were found to be statistically significant, only when both ANFSC/ANFSC(-1) and ANFLC/ANFLC(-1) are included.[13] Understandably, the coefficient on the latter variable is much larger than that on the former, as it is changes in the quantity of long-term debt that exert the greater leverage on the long-term interest rate.

RCS (Equation 33)

Arbitrage across domestic Government of Canada and U.S. bonds is assumed to be the sole determinant of this rate. As can be seen from the summary table below, a unit increase in both explanatory variables has approximately a unit effect on RCS in the long run.

	Short-run Coefficient	Long-run Coefficient
RML	.12	.40
RCB2	.36	.56

RMC (Equation 34)

The conventional mortgage rate is linked to RS and RCS, and the estimated relationship gives a small initial impact for both. However, starting with the second-period lag, the coefficients mount strongly so that the sum of the long-run coefficients is unity.

	Short-run Coefficient	Long-run Coefficient	Mean Lag (Months)
RS	.02	.24	2.0
RCS	.01	.76	2.2

A supply variable - the proportionate change in mortgage lending over the past year by banks and TMLs - enters with the correct sign but is statistically insignificant.

RTL2 (Equation 28)

In the case of this variable we are again dealing with the deposit-rate setting of an intermediary. Variables representing rates on earning assets and competing assets are required and RMC and RS are chosen to fill these roles.

	Short-run Coefficient	Long-run Coefficient
RS	.20	.33
RMC	.67	.67

4. CENTRED INTEREST RATES

Interest rates are centred to mid-month in the asset demand functions of the chartered banks as the assets are all measured as averages over the Wednesdays in the month. In each case the mnemonic of the relevant month-end interest rate is augmented by a terminal M. Thus five identities are used to convert RBANK into RBANKM, etc., (Equations 17 to 21).

FOOTNOTES

1. Source: Bank of Canada Review [3]. Canadian dollar issues only are counted in these comparisons.

2. Finance companies are themselves intermediaries of course, so to some degree the figure for short-term paper is an overstatement of the volume of short-term primary securities.

3. These are lag structures that can be written as ratios of polynomials in the lag operator, see Jorgenson [18], not to be confused with the notion of rational expectations due to Muth [24].

4. Examples of the former assumption are in Kesselman [19] and Haas [15], and of the latter in TRACE [28].

5. Assuming an interior solution.

6. This involves a likelihood-ratio test of the validity of the restrictions imposed on the parameters of an equation estimated with an autoregressive transformation. See Hendry [17].

7. Lloyd Kenward wrote the subroutine that unscrambles the rational lag weights. It is these weights that are charted.

8. Since interest rates are expressed in percentage terms at annual rates, the covered rate for a three-month holding period is ((405.5 + RTB2)*PFXF/PFX - 405.5), where PFXF is the ninety-day forward U.S. dollar in terms of Canadian dollars, and PFX is the spot rate for the U.S. dollar in Canadian dollars.

9. See Griliches [14] p 31.

10. In one experiment a dummy variable was inserted for the period of the agreement and the equation was run without gapping the period. The sign on the coefficient of the dummy was positive. If the ceiling were truly effective this coefficient would be negative, to indicate a depressing effect on the interest rate.

11. As an incidental point, the evidence strongly supports the use of the treasury bill rate in place of the ninety-day paper rate in this equation. If R90 is included in the regression it picks up a negative coefficient, albeit a statistically insignificant one.

12. ANFSC is the outstanding quantity of federal government bonds of less than three years to maturity held by the public.

13. ANFLC is the quantity of federal government debt of over three years to maturity held by the public.

APPENDIX TO CHAPTER 3

22: RDAY = AR1+AR2*((405.5+RTB2)*PFXF/PFX-405.5)+AR4*(REL-SUM(I = -12 TO -1 : REL(I))/12.)+AR5*RBANK+AR6*RBANK(-1)

NOB = 72 NOVAR = 5
RANGE = 1968 1 TO 1973 12
RSQ = 0.93316 CRSQ = 0.92917 F(4/67) = 233.851
SER = 0.3920 SSR = 10.295 DW(0) = 1.13

COEF	VALUE	ST ER	T-STAT
AR1	-2.14582	0.25214	-8.51041
AR2	0.15454	0.06181	2.50008
AR4	-0.12208	0.02601	-4.69325
AR5	0.50468	0.16795	3.00501
AR6	0.52838	0.17242	3.06451

23: RPRIME = AR01+AR04*RPRIME2+AR02*RBANK+AR03*RBANK(-1)+AR06*RPRIME(-1)+AR07*RPRIME(-2)+AR08*(REL-SUM(I = -12 TO -1 : REL(I))/12)

NOB = 72 NOVAR = 7
RANGE = 1968 1 TO 1973 12
RSQ = 0.97646 CRSQ = 0.97429 F(6/65) = 449.458
SER = 0.1611 SSR = 1.686 DW(0) = 1.96

COEF	VALUE	ST ER	T-STAT
AR01	0.54929	0.18141	3.02788
AR04	0.23089	0.03814	6.05332
AR02	0.20759	0.07810	2.65788
AR03	-0.11296	0.08594	-1.31453
AR06	0.52827	0.11508	4.59053
AR07	0.09574	0.09073	1.05522
AR08	-0.00561	0.01205	-0.46567

```
24:  RSDB = AR21+AR22*RPRIME+AR23*RSDB(-1)+AR24*RSDB(-2)
```

```
NOB = 72       NOVAR = 4
RANGE =   1968 1 TO 1973 12
RSQ =     0.98212      CRSQ =     0.98133      F(3/68) =   1244.920
SER =     0.1314       SSR =       1.175       DW(0) =   1.85
```

COEF	VALUE	ST ER	T-STAT
AR21	-1.02035	0.14295	-7.13803
AR22	0.56826	0.05394	10.53560
AR23	0.52173	0.10509	4.96477
AR24	-0.11295	0.07501	-1.50572

```
25:          RNPT = AR11+AR17*((405.5+RTB2)*PFXF/PFX-
             405.5)+AR12*RPRIME+AR13*RDAY+AR14*RNPT(-1)+
             AR15*RPRIME(-1)+AR16*(REL-SUM(I = -12 TO -1
              : REL(I))/12.)
```

```
NOB = 62       NOVAR = 7
RANGE =   1968 1 TO 1969 6,   1970 5 TO 1973 12
RSQ =     0.91493      CRSQ =     0.90565      F(6/55) =      98.587
SER =     0.3503       SSR =       6.751       DW(1) =   1.67
```

COEF	VALUE	ST ER	T-STAT
AR11	-0.47782	0.44722	-1.06843
AR17	0.23090	0.07500	3.07867
AR12	0.64897	0.22544	2.87866
AR13	0.18541	0.07896	2.34812
AR14	0.27693	0.12244	2.26164
AR15	-0.26808	0.26497	-1.01171
AR16	-0.09524	0.03357	-2.83688

26: R90 = AR31+AR32*((405.5+RTB2)*PFXF/PFX-405.5)+AR33 *RTB2+AR34*RNPT+AR35*100*FRQ/YDPSAD

NOB = 72 NOVAR = 5
RANGE = 1968 1 TO 1973 12
RSQ = 0.97151 CRSQ = 0.96981 F(4/67) = 571.269
SER = 0.2771 SSR = 5.144 DW(0) = 1.63

COEF	VALUE	ST ER	T-STAT
AR31	-2.49085	0.45163	-5.51528
AR32	0.16922	0.04475	3.78179
AR33	0.26181	0.03769	6.94670
AR34	0.92525	0.05898	15.68660
AR35	1.12009	0.61921	1.80888

27: RTL1 = AR41+AR42*R90+AR43*RNPT+AR44*RNPT(-1)+AR45* RTL1(-1)+AR46*RTL1(-2)

NOB = 72 NOVAR = 6
RANGE = 1968 1 TO 1973 12
RSQ = 0.9918 CRSQ = 0.99118 F(5/66) = 1597.430
SER = 0.1275 SSR = 1.074 DW(0) = 1.93

COEF	VALUE	ST ER	T-STAT
AR41	0.17875	0.12281	1.45552
AR42	0.30364	0.04463	6.80317
AR43	0.35511	0.05678	6.25385
AR44	-0.28790	0.06507	-4.42455
AR45	0.69665	0.09966	6.99025
AR46	-0.10167	0.05196	-1.95682

29: RSDTL = AR61+AR62*RMC+AR63*RSDB+AR64*RSDB(-1)+AR65 *RSDTL(-1)

NOB = 72 NOVAR = 5
RANGE = 1968 1 TO 1973 12
RSQ = 0.96702 CRSQ = 0.96505 F(4/67) = 491.075
SER = 0.1340 SSR = 1.202 DW(0) = 2.18

COEF	VALUE	ST ER	T-STAT
AR61	0.12974	0.43511	0.29819
AR62	0.06953	0.06555	1.06063
AR63	0.55690	0.07136	7.80447
AR64	-0.32509	0.09656	-3.36662
AR65	0.64199	0.08282	7.75177

30: RTB = AR70+AR67*((405.5+RTB2)*PFXF/PFX-405.5)+AR68 *RBANK+AR69*RDAY+AR66*RTB2+AR79*RBANK(-1)

NOB = 72 NOVAR = 6
RANGE = 1968 1 TO 1973 12
RSQ = 0.96281 CRSQ = 0.95999 F(5/66) = 341.740
SER = 0.3074 SSR = 6.237 DW(0) = 0.74

COEF	VALUE	ST ER	T-STAT
AR70	-1.25178	0.27290	-4.58685
AR67	0.17008	0.05132	3.31428
AR68	0.88294	0.14483	6.09641
AR69	0.51869	0.08489	6.11027
AR66	0.05625	0.04145	1.35730
AR79	-0.46959	0.12930	-3.63186

31: RS = AR71+AR72*RTB2+AR73*RTB+AR74*RS(-1)+AR75*RS(-2)+AR76*ANFSC/ANFSC(-1)+AR77*RTB(-1)+AR78*RTB2(-1)

NOB = 72 NOVAR = 8
RANGE = 1968 1 TO 1973 12
RSQ = 0.95859 CRSQ = 0.95406 F(7/64) = 211.629
SER = 0.2083 SSR = 2.776 DW(0) = 1.80

COEF	VALUE	ST ER	T-STAT
AR71	0.79475	0.37464	2.12137
AR72	0.19283	0.06110	3.15610
AR73	0.44849	0.10031	4.47109
AR74	1.02135	0.09454	10.80340
AR75	-0.32384	0.09307	-3.47945
AR76	0.16381	0.29801	0.54969
AR77	-0.30310	0.10339	-2.93151
AR78	-0.16740	0.05997	-2.79138

32: RML = AR81+AR82*RML(-1)+AR83*RS+AR84*RS(-1)+AR85*RCB2+AR86*RCB2(-1)+AR87*ANFSC/ANFSC(-1)+AR88*ANFLC/ANFLC(-1)

NOB = 72 NOVAR = 8
RANGE = 1968 1 TO 1973 12
RSQ = 0.96687 CRSQ = 0.96325 F(7/64) = 266.846
SER = 0.1287 SSR = 1.061 DW(0) = 2.21

COEF	VALUE	ST ER	T-STAT
AR81	-1.42353	1.12458	-1.26583
AR82	0.58901	0.10099	5.83220
AR83	0.58402	0.05876	9.93994
AR84	-0.33827	0.08773	-3.85565
AR85	0.41448	0.11479	3.61086
AR86	-0.29357	0.11131	-2.63743
AR87	0.43026	0.25694	1.67454
AR88	1.45779	0.91609	1.59132

33: RCS = AR91+AR92*RCS(-1)+AR93*RCS(-2)+AR94*RML+AR95*RML(-1)+AR96*RCB2+AR97*RCB2(-1)

NOB = 72 NOVAR = 7
RANGE = 1968 1 TO 1973 12
RSQ = 0.99003 CRSQ = 0.98911 F(6/65) = 1075.800
SER = 0.0535 SSR = 0.186 DW(0) = 1.76

COEF	VALUE	ST ER	T-STAT
AR91	0.39361	0.11594	3.39489
AR92	1.07445	0.10049	10.69210
AR93	-0.32280	0.06778	-4.76272
AR94	0.11992	0.02969	4.03909
AR95	-0.02139	0.03482	-0.61425
AR96	0.36086	0.04831	7.47022
AR97	-0.22505	0.05658	-3.97747

34: RMC = AR101+AR108*(ATLM+ABM)/(ATLM(-12)+ABM(-12))+AR102*RMC(-1)+AR103*RMC(-2)+AR104*RS+AR105*RCS+AR106*RS(-1)+AR107*RCS(-1)

NOB = 72 NOVAR = 8
RANGE = 1968 1 TO 1973 12
RSQ = 0.98208 CRSQ = 0.98012 F(7/64) = 501.187
SER = 0.0751 SSR = 0.360 DW(0) = 1.77

COEF	VALUE	ST ER	T-STAT
AR101	0.77857	0.24413	3.18912
AR108	-0.06213	0.15372	-0.40420
AR102	0.70023	0.11396	6.14434
AR103	-0.10510	0.08905	-1.18027
AR104	0.01751	0.03622	0.48326
AR105	0.01277	0.10065	0.12687
AR106	0.07908	0.03679	2.14934
AR107	0.29520	0.11684	2.52656

28: RTL2 = AR51+AR52*RS+AR53*RS(-1)+AR54*RMC+AR55*RMC(-1)+AR56*RTL2(-1)+AR57*RTL2(-2)

NOB = 72 NOVAR = 7
RANGE = 1968 1 TO 1973 12
RSQ = 0.97543 CRSQ = 0.97316 F(6/65) = 430.045
SER = 0.1072 SSR = 0.747 DW(0) = 2.22

COEF	VALUE	ST ER	T-STAT
AR51	-0.11150	0.35371	-0.31522
AR52	0.19688	0.04606	4.27410
AR53	-0.16319	0.05109	-3.19424
AR54	0.66541	0.15361	4.33179
AR55	-0.60625	0.14794	-4.09803
AR56	1.04481	0.10920	9.56767
AR57	-0.13140	0.11100	-1.18376

CHAPTER 4

PRIVATE SECTOR LIQUID ASSETS

1. INTRODUCTION

Outstanding quantities of private sector liquid assets are assumed to be determined, given interest rates and wealth, by demand functions in a portfolio-balance framework similar to that of Brainard and Tobin [4]. These demand functions can be written as

$$y_{it} = W\sum_{k}^{K}\sum_{j}^{T}\beta_{ikj}\,x_{k,t-j} + \sum_{j}^{T}\beta_{ij}W_{t-j} \tag{4.1}$$

where

y_{it} is the quantity of asset i demanded at time t

The variables x_k (k = 1, 2, ..., K) include interest rates, income, and other variables influencing the distribution of wealth (W) between its components. Lags of up to T periods characterize the process of adjustment. Only liquid assets are assumed to enter into the choice set at this stage; real assets are taken to be predetermined. Thus the relevant balance sheet constraint is that the sum of liquid assets be equal to disposable liquid wealth, ie $\Sigma y_i = W$. This constraint allows one demand function to be defined implicitly, and only n - 1 functions need be estimated. Assets for which equations are not explicitly estimated include foreign currency liabilities of the chartered banks held by residents and credit union deposits.[1]

Equations representing the demand for assets are estimated over the period January 1968 to December 1973; the data used are not seasonally adjusted so that where necessary monthly seasonal dummy variables are employed scaled up by an appropriate factor. For consistency with bank asset demand functions (Chapter 5) average-of-Wednesday data are used for bank deposits; for other deposits month-end data are used.

Distributed lags in this sector are estimated by means of the Almon technique. The degree of the polynomial and the maximum lag length were specified to be 2 and 12, respectively. A second-degree polynomial consistently produced a smaller error variance than other specifications, whereas the error variance was not much affected by the choice of the maximum length of the lag. A twelve-month maximum lag was chosen because it is plausible a priori. All equations have been transformed to cope with autocorrelation in the residuals. An autoregressive coefficient of .8 sufficed in most instances to reduce autocorrelation to acceptable levels. Outstanding exceptions are the equations for personal savings deposits at the chartered banks (DPB), and for savings deposits and over-one-year deposits at trust and mortgage loan companies (DSTL and DTL2). In these instances, all concerned basically with the allocation of personal savings, the regression was run in first-difference form. This problem may indicate that there is some deficiency in our treatment of personal savings, and given the importance of these variables it is an area where further research would be worthwhile. The block of equations covers currency in circulation, chartered banks, trust and mortgage loan companies,[2] and short-term paper. A more useful functional classification can be made: the equations divide into: (a) a pair of equations for M1 (37 and 38), (b) three equations for business sector liquid assets (40, 42 and 44), and (c) three equations for liquid assets held by the public (39, 41 and 43). Each of these categories is examined.

2. EMPIRICAL ESTIMATES

(a) Currency and Demand Deposits (M1)

These are explained by separate equations for currency deposits and demand deposits. They are the economy's primary means of exchange and are therefore specified as responding to transactions requirements, as measured by nominal gross domestic product (YDPSAD). A short-term interest rate (R90) is also included in the equation for demand deposits.

ANFCUR (Equation 37)

A one-month lag seems to capture adequately the delayed adjustment for currency holdings, and a priori longer lags would not be expected. No significant interest elasticity was found for currency.

DDB (Equation 38)

For demand deposits twelve-month lags in both the transactions variable and the interest rate are used. The implicit long-run income elasticity in equation 38 is approximately .8, validating our interpretation of this equation as representing transactions demand under the Baumol-Tobin hypothesis. The interest rate used to summarize the opportunity cost of holding money is the ninety-day finance company paper rate (R90), and it has a significant negative effect on holdings of demand deposits. In short, this equation has the properties that one would expect from an equation for a narrow definition of money.[3]

(b) Business Liquid Assets

Non-personal term and notice deposits at chartered banks, under-one-year term deposits in TMLs, and short-term commercial and finance company paper are the assets considered to belong to the business sector. Each stands in substitute relation to the others. The specified demand functions for these assets contain total liquid wealth (W) as an explanatory variable, entering unlagged. Lagged values of W are not statistically significant if employed in these equations, reflecting the fact that business sector liquid assets are apt to respond rapidly to an inflow of new wealth. However portfolio readjustments occasioned by a change in relative interest rates involve significant lags, and the humped profiles of the estimated lag structures indicate that the mode of the lag distribution is about five months.

DNPTB (Equation 40)

For non-personal term and notice deposits the estimated demand function is written with RNPT (the own rate), RTL1 (the rate on under-one-year trust company deposits), and R90 as explanatory variables. The opportunity cost interest rates (R90 and RTL1) are not entered into the regression separately because of their high collinearity - they are instead entered as an average, with weights of .7 and .3 chosen to represent the approximate proportions of outstanding issues. High t-ratios on the interest rates demonstrate that a significant degree of substitutability exists in the wholesale deposit market.

Furthermore, the sum of the distributed lag weights on the own rate is only slightly greater than the negative of the sum of weights on competing rates, indicating that an equal change in all rates would not significantly change investment in chartered bank non-personal term and notice deposits. The wealth variable also has a significant effect.

DTL1 (Equation 42)

Trust and mortgage loan company (TML) deposits of under a year compete primarily with non-personal term and notice deposits at the chartered banks. Thus the interest rates in the estimated demand function are RTL1 and RNPT. Again the results demonstrate the importance of interest rates in determining the levels of short-term asset holdings.

ANPAP (Equation 44)

The interest rates in the equation for short-term private paper are the own rate (R90) and the rate on the principal competing asset (RNPT). Results for this equation follow the pattern described above for the other components of business sector assets. These interest rates and the wealth variable exert a significant influence in the expected direction on investment in short-term paper.

3. PERSONAL SAVINGS

Grouped in this section are assets primarily held by personal savers. There are significant differences in liquidity between over-one-year TML liabilities, which include trust company guaranteed investment certificates and mortgage loan company debentures and long-term deposits, and savings deposits. Although chartered bank personal savings deposits do include personal fixed-term deposits, the former usually carry an encashment privilege not offered on TML term deposits, so that savings deposits, whether at banks or at TMLs, are virtually all encashable on demand - in marked contrast to over-one-year TML deposits, which are truly fixed-term deposits.

Besides interest rates and scale variables, these equations also contain the net change in outstanding Canada Savings Bonds (CSBs) as an explanatory variable. The rationale for including the latter is that CSBs are exogenous to the model. In a constrained estimation of a complete set of private sector asset demand equations the coefficients on CSBs across all equations would sum to -1, reflecting the fact that every dollar going into CSBs has to come from somewhere in the portfolio. We do not have a complete set of equations, but it is important to capture the effect of CSB sales on personal savings deposits, the asset most directly affected. Clearly, an alternative procedure would be to make CSBs outstanding an endogenous variable explained in the same way as other personal sector assets, and with the yield on CSBs entered into the relevant equations. Whatever the theoretical attractions of this alternative procedure, practical difficulties rule it out: first, CSBs are often on sale for only a few months of the year so that a continuous time series on their yield is not available; and second, the discontinuous movements in CSBs, with large and irregular jumps every November, make the outstanding quantity very difficult to explain statistically.

A further feature of the equations in this sector is that a distributed lag on the wealth variable is used. We found that adjustments to changes in total liquid assets take place more slowly in the case of personal savings assets than short-term deposits.

DPB (Equation 39)

Personal savings deposits in chartered banks are written as a distributed lag function of the spread between the rate on non-chequable personal savings deposits (RSDB) and the rate on short-term Government of Canada bonds (RS), as well as the distributed lag on total liquid assets. The remaining variable in the equation is (ACSB(-1) + ACSB)/2, ie, outstanding end-of-month CSBs centred to mid-month for consistency with DPB, which is also averaged over the month. As for the estimated coefficients in equation 39, interest rate effects are statistically significant (although less so than in the case of short-term deposits), and the wealth variable behaves in a predictable manner. It would appear from the point estimate on the change in outstanding CSBs that, for every $1 of CSBs sold, the banks lose 60¢ of personal savings deposits. Furthermore this coefficient seems quite well determined, the standard error being a little over 7¢.

DSTL (Equation 41)

Trust and mortgage loan company savings deposits are explained by means of a specification different from that for personal savings deposits at banks. The scale variable used is YDPSAD. This variable performs better than the wealth variable (W), probably because there is a significant transactions component in the demand for this asset - it does include some chequable deposits. Interest rate effects are embodied in the spread between rates on non-chequable deposits in trust companies (RSDTL) and banks (RSDB). Lags are specified to be of the Koyck type, so that the lagged dependent variable is used in the regression. This specification proved to be much superior in explaining DSTL to that obtained from use of the Almon method. All the coefficients are statistically significant. The implicit mean lag of adjustment is about five months, which conforms roughly to the mean lags implicit in the personal sector equations for deposits estimated by means of the Almon method.

DTL2 (Equation 43)

Deposits of over one year at TMLs appear to compete in a market for longer-term assets.* Thus the interest rates in this demand function are the own rate (RTL2) and the rate on Government of Canada bonds (RS). The empirical results confirm that these interest rate effects are significant. Sales of CSBs do not seem to have any effect on DTL2 - there is a negative coefficient much smaller than its standard error. This finding suggests that CSBs compete primarily with demand assets such as savings deposits rather than with term deposits, a plausible suggestion in view of the encashment feature of CSBs.

4. OTHER EQUATIONS

A. Mortgage Lending by Trust and Mortgage Loan Companies

By far the largest asset in TML portfolios is mortgages, which is the only TML asset included in the model. The specification here is a truncated version of the specification presented in Clinton [8] - the approvals-repayments mechanism that generates mortgages in the latter model is bypassed in our model. We specify equation 71 directly in terms of outstanding mortgages (ATLM). As in the Clinton paper [8], TMI mortgages are written as a distributed-lag function of deposits and of interest rates. The deposit variable is the sum of savings deposits and over-one-year term deposits (ie, DSTL+DTL2), and the differential between the mortgage rate (RMC) and bond rate (RCS) is used to capture interest rate effects. Interest rates are scaled by deposits. Because of a severe problem of autocorrelation in the residuals, first differences of the variables are used. Lagged weights are estimated by means of the Almon procedure.

B. The Wealth Variable

Financial wealth is accumulated savings. Therefore the change in financial wealth should be related to the current flow of savings by an identity. Because of the limited coverage of the wealth variable (W) and because national accounts data on savings are not easily reconciled with financial balance-sheet data, this identity cannot be exploited. As a simple second-best alternative, we relate changes in W to current GDP using a stochastic equation (Equation 45). There is a strong seasonal pattern to W and so seasonal dummy variables are included.

FOOTNOTES

1. This block of equations does not contain equations for Government of Canada bonds held by the public. These are eliminated by the market-clearing condition: the interest rate on Government of Canada bonds is assumed to adjust so that the public pick up any bonds the banks do not.

2. The demand functions for TML liabilities follow the specifications developed by Clinton [8]. A different technique for estimating distributed lags is employed, but similar lag structures emerge.

3. Goldfeld [12] analyzes American data exhaustively and Clinton [7] presents some concurring results for Canada. In more recent research White [32] examines specifications for M1 in great detail.

4. Using a different specification from the one presented here, Clinton [8] found that there appears to be a significant degree of substitutability between over-one-year TML deposits and corporate bonds.

APPENDIX TO CHAPTER 4

37: ANFCUR = A10+(A11*Q1+A12*Q2+A13*Q3+A14*Q4+A15*Q5+A16*Q6+A17*Q7+A18*Q8+A19*Q9+A20*Q10+A21*Q11)*YDPSAD+A22*YDPSAD+A23*YDPSAD(-1)

NOB = 72 NOVAR = 14
RANGE = 1968 1 TO 1973 12
RSQ = 0.98487 CRSQ = 0.98147 F(13/58) = 290.348
SER = 25.1662 SSR = 36733.500 DW(0) = 1.76

GLS PARAMETERS

RHO1 0.8000

COEF	VALUE	ST ER	T-STAT
A10	-181.16100	74.71430	-2.42471
A11	-2.97743E-04	1.17776E-04	-2.52805
A12	-9.09339E-04	1.19370E-04	-7.61782
A13	-0.00102	1.18184E-04	-8.58866
A14	-7.56551E-04	1.17230E-04	-6.45354
A15	-3.87909E-04	1.16715E-04	-3.32354
A16	-6.84475E-05	1.14855E-04	-0.59594
A17	7.50149E-04	1.14255E-04	6.56557
A18	6.26796E-04	1.16525E-04	5.37909
A19	4.67345E-04	1.14210E-04	4.09199
A20	2.31806E-04	1.14009E-04	2.03323
A21	2.03272E-04	1.14111E-04	1.78135
A22	0.02047	0.00386	5.30398
A23	0.02031	0.00394	5.15787

COEF	METHOD	PARAMETERS
ALL	GLS	AUTO1

7: DEL(1 : ANFCOIN) = ANFC1+ANFC2*DEL(1 : ANFCUR)

NOB = 72 NOVAR = 2
RANGE = 1968 1 TO 1973 12
RSQ = 0.03645 CRSQ = 0.02268 F(1/70) = 2.648
SER = 3.1786 SSR = 707.235 DW(0) = 1.91

COEF	VALUE	ST ER	T-STAT
ANFC1	3.18156	0.42666	7.45692
ANFC2	0.00995	0.00612	1.62718

38: DDB = A30+(A31*Q1+A32*Q2+A33*Q3+A34*Q4+A35*Q5+A36*Q6+A37*Q7+A38*Q8+A39*Q9+A40*Q10+A41*Q11)*YDPSAD+SUM(I = -11 TO 0 : A43(I)*R90(I))*YDPSAD+SUM(I = -11 TO 0 : A42(I)*YDPSAD(I))

NOB = 72 NOVAR = 16
RANGE = 1968 1 TO 1973 12
RSQ = 0.93948 CRSQ = 0.92327 F(15/56) = 57.951
SER = 105.5350 SSR = 6.237E+05 DW(0) = 2.23

GLS PARAMETERS

RHO1 0.8000

COEF	VALUE	ST ER	T-STAT
A30	920.48500	399.95300	2.30149
A31	0.00106	4.97602E-04	2.12724
A32	-0.00298	5.08054E-04	-5.87022
A33	-0.00329	5.23622E-04	-6.27453
A34	-0.00144	5.21484E-04	-2.77080
A35	-0.00194	5.02310E-04	-3.85860
A36	-0.00101	4.90836E-04	-2.06365
A37	2.77954E-04	4.82480E-04	0.57610
A38	7.73855E-04	4.99794E-04	1.54835
A39	0.00159	5.10274E-04	3.10837
A40	0.00137	5.09702E-04	2.69192
A41	0.00228	4.96732E-04	4.59097
A43	9.49419E-05	1.39746E-04	0.67939
(-1)	6.52331E-06	9.27502E-05	0.07033
(-2)	-6.72576E-05	5.83313E-05	-1.15303
(-3)	-1.26401E-04	4.44627E-05	-2.84285
(-4)	-1.70907E-04	5.19935E-05	-3.28708
(-5)	-2.00775E-04	6.54880E-05	-3.06583
(-6)	-2.16006E-04	7.59564E-05	-2.84381
(-7)	-2.16599E-04	8.06921E-05	-2.68426
(-8)	-2.02554E-04	7.87998E-05	-2.57049
(-9)	-1.73872E-04	6.99186E-05	-2.48678
(-10)	-1.30552E-04	5.38785E-05	-2.42309
(-11)	-7.25950E-05	3.05895E-05	-2.37320
A42	0.04852	0.01439	3.37160
(-1)	0.03499	0.00943	3.70815
(-2)	0.02318	0.00517	4.48387
(-3)	0.01310	0.00163	8.04842
(-4)	0.00474	0.00143	3.31259
(-5)	-0.00189	0.00361	-0.52358
(-6)	-0.00679	0.00513	-1.32302
(-7)	-0.00997	0.00599	-1.66617
(-8)	-0.01143	0.00616	-1.85673
(-9)	-0.01116	0.00564	-1.97794
(-10)	-0.00916	0.00444	-2.06182
(-11)	-0.00544	0.00256	-2.12330

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COEF	METHOD	PARAMETERS
ALL	GLS	AUTO1
A43	PDL	LAGS=12,DEGREE=2,OPTION=TAIL
A42	PDL	LAGS=12,DEGREE=2,OPTION=TAIL

POLYNOMIAL STATISTICS AND COEFFICIENTS

A43	MEAN LAG =	6.976	ST. ER. =	208.421
	SUM OF LAG COEF =	-1.E-03	ST. ER. =	4.5E-04
A42	MEAN LAG =	-4.715	ST. ER. =	2.720
	SUM OF LAG COEF =	0.069	ST. ER. =	6.2E-03

40: DNPTB = A70+(A71*Q1+A72*Q2+A73*Q3+A74*Q4+A75*Q5+A76*Q6+A77*Q7+A78*Q8+A79*Q9+A80*Q10+A81*Q11)*W+SUM (I = -11 TO 0 : A82(I)*RNPT(I))*W+SUM(I = -11 TO 0 : A83(I)*(0.7*R90(I)+0.3*RTL1(I)))*W+A84*W

NOB = 72 NOVAR = 17
RANGE = 1968 1 TO 1973 12
RSQ = 0.87927 CRSQ = 0.84415 F(16/55) = 25.035
SER = 194.3360 SSR = 2.077E+06 DW(0) = 1.25

GLS PARAMETERS

RHO1 0.8000

COEF	VALUE	ST ER	T-STAT
A70	-2363.18000	687.55400	-3.43708
A71	-0.00396	0.00144	-2.75600
A72	-4.77666E-04	0.00138	-0.34543
A73	0.00284	0.00141	2.01802
A74	0.00311	0.00141	2.20640
A75	0.00318	0.00139	2.28033
A76	0.00358	0.00136	2.62302
A77	8.61999E-04	0.00133	0.64676
A78	-1.97860E-05	0.00132	-0.01498
A79	-0.00195	0.00134	-1.45096
A80	-4.87606E-04	0.00139	-0.35199
A81	-0.00276	0.00137	-2.01266
A82	0.00233	0.00157	1.47784
(-1)	0.00350	0.00129	2.70980
(-2)	0.00443	0.00125	3.55247
(-3)	0.00510	0.00135	3.78830
(-4)	0.00553	0.00148	3.72633
(-5)	0.00571	0.00159	3.59140
(-6)	0.00564	0.00163	3.45817
(-7)	0.00532	0.00159	3.34351
(-8)	0.00475	0.00146	3.24814
(-9)	0.00394	0.00124	3.16914
(-10)	0.00287	9.26393E-04	3.10327
(-11)	0.00156	5.12424E-04	3.04784
A83	-6.80129E-04	0.00135	-0.50547
(-1)	-0.00211	0.00101	-2.08319
(-2)	-0.00326	9.18186E-04	-3.55120
(-3)	-0.00415	0.00101	-4.11345
(-4)	-0.00476	0.00115	-4.12992
(-5)	-0.00511	0.00127	-4.00999
(-6)	-0.00519	0.00134	-3.88151
(-7)	-0.00500	0.00133	-3.77089
(-8)	-0.00454	0.00123	-3.67992
(-9)	-0.00381	0.00106	-3.60546
(-10)	-0.00281	7.92102E-04	-3.54405
(-11)	-0.00154	4.40422E-04	-3.49283
A84	0.09267	0.02576	3.59795

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COEF	METHOD	PARAMETERS
ALL	GLS	AUTO1
A82	PDL	LAGS=12,DEGREE=2,OPTION=TAIL
A83	PDL	LAGS=12,DEGREE=2,OPTION=TAIL

POLYNOMIAL STATISTICS AND COEFFICIENTS

A82	MEAN LAG =	5.304	ST. ER. =	3.806
	SUM OF LAG COEF =	0.051	ST. ER. =	0.013
A83	MEAN LAG =	5.760	ST. ER. =	7.031
	SUM OF LAG COEF =	-0.043	ST. ER. =	0.010

42: DTL1 = A100+SUM(I = -11 TO 0 : A101(I)*RTL1(I))*W+
SUM(I = -11 TO 0 : A102(I)*RNPT(I))*W+A103*W

NOB = 72 NOVAR = 6
RANGE = 1968 1 TO 1973 12
RSQ = 0.53532 CRSQ = 0.50012 F(5/66) = 15.207
SER = 47.3009 SSR = 1.477E+05 DW(0) = 1.75

GLS PARAMETERS

RHO1 0.8000

COEF	VALUE	ST ER	T-STAT
A100	-645.60800	146.19500	-4.41608
A101	3.25530E-04	3.93508E-04	0.82725
(-1)	5.43391E-04	3.15915E-04	1.72005
(-2)	7.16707E-04	2.74765E-04	2.60844
(-3)	8.45482E-04	2.64816E-04	3.19271
(-4)	9.29712E-04	2.72149E-04	3.41619
(-5)	9.69399E-04	2.82563E-04	3.43074
(-6)	9.64544E-04	2.86638E-04	3.36503
(-7)	9.15144E-04	2.79095E-04	3.27897
(-8)	8.21202E-04	2.57058E-04	3.19461
(-9)	6.82716E-04	2.18913E-04	3.11866
(-10)	4.99688E-04	1.63711E-04	3.05226
(-11)	2.72116E-04	9.08653E-05	2.99471
A102	-5.33508E-04	3.95440E-04	-1.34915
(-1)	-6.98854E-04	3.27789E-04	-2.13202
(-2)	-8.26053E-04	3.02031E-04	-2.73499
(-3)	-9.15106E-04	3.06353E-04	-2.98710
(-4)	-9.66012E-04	3.22717E-04	-2.99337
(-5)	-9.78773E-04	3.37027E-04	-2.90414
(-6)	-9.53387E-04	3.41057E-04	-2.79539
(-7)	-8.89855E-04	3.30389E-04	-2.69335
(-8)	-7.88176E-04	3.02620E-04	-2.60451
(-9)	-6.48352E-04	2.56377E-04	-2.52890
(-10)	-4.70381E-04	1.90840E-04	-2.46479
(-11)	-2.54264E-04	1.05494E-04	-2.41022
A103	0.02856	0.00440	6.49703

COEF	METHOD	PARAMETERS
ALL	GLS	AUTO1
A101	PDL	LAGS=12,DEGREE=2,OPTION=TAIL
A102	PDL	LAGS=12,DEGREE=2,OPTION=TAIL

POLYNOMIAL STATISTICS AND COEFFICIENTS

A101 MEAN LAG = 5.418 ST. ER. = 33.461
SUM OF LAG COEF = 8.E-03 ST. ER. = 2.5E-03

A102 MEAN LAG = 5.093 ST. ER. = 38.981
SUM OF LAG COEF = -9.E-03 ST. ER. = 3.0E-03

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44:            ANPAP = A130+(A131*Q1+A132*Q2+A133*Q3+A134*Q4+A135
               *Q5+A136*Q6+A137*Q7+A138*Q8+A139*Q9+A140*Q10+A141*
               Q11)*W+SUM(I = -11 TO 0 : A142(I)*R90(I))*W+SUM(I
                = -11 TO 0 : A143(I)*RNPT(I))*W+A144*W

   NOB = 72      NOVAR = 17
   RANGE =  1968 1 TO 1973 12
   RSQ =    0.69415      CRSQ =    0.60518      F(16/55) =      7.802
   SER = 106.5930        SSR = 6.249E+05        DW(0) =  2.13
```

GLS PARAMETERS

RHO1 0.8000

COEF	VALUE	ST ER	T-STAT
A130	-1313.94000	381.86700	-3.44082
A131	4.57570E-05	7.71733E-04	0.05929
A132	-1.86669E-04	7.60745E-04	-0.24538
A133	2.81904E-04	7.72128E-04	0.36510
A134	-0.00105	7.64432E-04	-1.37794
A135	-4.13211E-04	7.44958E-04	-0.55468
A136	6.47564E-04	7.33206E-04	0.88320
A137	7.31488E-04	7.23732E-04	1.01072
A138	6.75524E-04	7.23749E-04	0.93337
A139	6.96935E-04	7.38445E-04	0.94379
A140	6.81240E-05	7.56786E-04	0.09002
A141	5.12040E-04	7.43643E-04	0.68856
A142	-1.55967E-05	6.06839E-04	-0.02570
(-1)	4.61476E-04	4.58312E-04	1.00690
(-2)	8.52045E-04	4.27998E-04	1.99077
(-3)	0.00116	4.80041E-04	2.40836
(-4)	0.00137	5.52827E-04	2.48481
(-5)	0.00150	6.11164E-04	2.46207
(-6)	0.00155	6.40279E-04	2.41969
(-7)	0.00151	6.33833E-04	2.37811
(-8)	0.00138	5.88817E-04	2.34176
(-9)	0.00116	5.03657E-04	2.31091
(-10)	8.62443E-04	3.77462E-04	2.28485
(-11)	4.74474E-04	2.09692E-04	2.26272
A143	-5.98319E-04	7.65843E-04	-0.78125
(-1)	-9.39653E-04	6.45557E-04	-1.45557
(-2)	-0.00121	6.29278E-04	-1.92262
(-3)	-0.00141	6.74714E-04	-2.08821
(-4)	-0.00154	7.34310E-04	-2.09298
(-5)	-0.00159	7.78692E-04	-2.04667
(-6)	-0.00158	7.93018E-04	-1.99167
(-7)	-0.00149	7.69863E-04	-1.94062
(-8)	-0.00134	7.05304E-04	-1.89629
(-9)	-0.00111	5.97134E-04	-1.85852
(-10)	-8.10982E-04	4.44033E-04	-1.82640
(-11)	-4.41055E-04	2.45170E-04	-1.79897
A144	0.06711	0.01427	4.70410

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COEF	METHOD	PARAMETERS
ALL	GLS	AUTO1
A142	PDL	LAGS=12,DEGREE=2,OPTION=TAIL
A143	PDL	LAGS=12,DEGREE=2,OPTION=TAIL

POLYNOMIAL STATISTICS AND COEFFICIENTS

A142	MEAN LAG =	6.019	ST. ER. =	30.533
	SUM OF LAG COEF =	0.012	ST. ER. =	5.0E-03
A143	MEAN LAG =	5.355	ST. ER. =	30.439
	SUM OF LAG COEF =	-0.014	ST. ER. =	6.7E-03

39: DEL(1 : DPB) = A50+(A51*Q1+A52*Q2+A53*Q3+A54*Q4+A55*Q5+A56*Q6+
A57*Q7+A58*Q8+A59*Q9+A60*Q10+A61*Q11)*W+SUM(I = -11 TO 0 : A63(I)*DEL
(1 : RSDB(I)-RS(I)))*W+SUM(I = -11 TO 0 : A62(I)*DEL(1 : W(I)))+A64*
DEL(1 : (ACSB(-1)+ACSB)/2)

NOB = 72 NOVAR = 17
RANGE = 1968 1 TO 1973 12
RSQ = 0.87553 CRSQ = 0.83932 F(16/55) = 24.160
SER = 68.2277 SSR = 2.560E+05 DW(0) = 1.63

COEF	VALUE	ST ER	T-STAT
A50	20.94570	24.59580	0.85159
A51	2.29458E-04	4.71838E-04	0.48631
A52	4.60960E-04	5.20335E-04	0.88589
A53	-1.90915E-04	4.54563E-04	-0.42000
A54	5.70145E-04	4.49334E-04	1.26887
A55	-4.51800E-04	4.76271E-04	-0.94862
A56	-0.00160	4.53214E-04	-3.53426
A57	-6.91738E-05	4.79971E-04	-0.14412
A58	-3.86129E-04	4.46620E-04	-0.86455
A59	-4.68636E-04	4.46715E-04	-1.04907
A60	-1.15497E-04	4.54298E-04	-0.25423
A61	0.00157	7.22030E-04	2.17795
A63	4.36197E-04	3.01728E-04	1.44566
(-1)	5.07139E-04	2.22145E-04	2.28292
(-2)	5.58573E-04	1.82706E-04	3.05723
(-3)	5.90500E-04	1.82269E-04	3.23972
(-4)	6.02920E-04	2.01885E-04	2.98645
(-5)	5.95831E-04	2.22891E-04	2.67320
(-6)	5.69235E-04	2.35555E-04	2.41657
(-7)	5.23132E-04	2.35534E-04	2.22105
(-8)	4.57521E-04	2.20804E-04	2.07206
(-9)	3.72402E-04	1.90344E-04	1.95647
(-10)	2.67775E-04	1.43589E-04	1.86487
(-11)	1.43642E-04	8.02101E-05	1.79082
A62	0.02425	0.03303	0.73408
(-1)	0.02971	0.02144	1.38545
(-2)	0.03380	0.01172	2.88509
(-3)	0.03654	0.00491	7.44562
(-4)	0.03792	0.00606	6.26166
(-5)	0.03794	0.01038	3.65425
(-6)	0.03660	0.01365	2.68068
(-7)	0.03390	0.01542	2.19883
(-8)	0.02984	0.01559	1.91415
(-9)	0.02442	0.01414	1.72678
(-10)	0.01764	0.01106	1.59429
(-11)	0.00950	0.00635	1.49571
A64	-0.58710	0.06627	-8.85970

Continued on next page

COEF	METHOD	PARAMETERS
ALL	GLS	AUTO1
A63	PDL	LAGS=12,DEGREE=2,OPTION=TAIL
A62	PDL	LAGS=12,DEGREE=2,OPTION=TAIL

POLYNOMIAL STATISTICS AND COEFFICIENTS

A63	MEAN LAG =	5.346	ST. ER. =	293.875
	SUM OF LAG COEF =	-4.E-03	ST. ER. =	5.3E-03
A62	MEAN LAG =	6.901	ST. ER. =	2.779
	SUM OF LAG COEF =	0.269	ST. ER. =	0.194

41: DSTL = A90+A91*DSTL(-1)+A92*YDPSAD+A93*(RSDTL-RSDB)*YDPSAD+A94*DEL(1 : ACSB)

NOB = 72 NOVAR = 5
RANGE = 1968 1 TO 1973 12
RSQ = 0.9933 CRSQ = 0.9929 F(4/67) = 2483.780
SER = 32.6546 SSR = 71443.600 DW(0) = 1.91

COEF	VALUE	ST ER	T-STAT
A90	6.71895	23.61720	0.28449
A91	0.84449	0.05136	16.44250
A92	0.00335	0.00119	2.81894
A93	6.21498E-04	1.29901E-04	4.78440
A94	-0.05044	0.00954	-5.28754

43: DEL(1 : DTL2) = A110+SUM(I = -11 TO 0 : A111(I)*DEL(1 : W(I)))+SUM(I = -11 TO 0 : A112(I)*DEL(1 : RTL2(I)))*W+SUM(I = -11 TO 0 : A113(I)*DEL(1 : RS(I)))*W+A114*DEL(1 : ACSB)

NOB = 72 NOVAR = 8
RANGE = 1968 1 TO 1973 12
RSQ = 0.69942 CRSQ = 0.66655 F(7/64) = 21.275
SER = 43.8424 SSR = 1.230E+05 DW(0) = 1.74

COEF	VALUE	ST ER	T-STAT
A110	-50.79590	16.35020	-3.10676
A111	0.02686	0.01809	1.48515
(-1)	0.02709	0.01179	2.29723
(-2)	0.02686	0.00659	4.07649
(-3)	0.02619	0.00321	8.14746
(-4)	0.02508	0.00383	6.55040
(-5)	0.02351	0.00602	3.90831
(-6)	0.02149	0.00772	2.78393
(-7)	0.01903	0.00863	2.20444
(-8)	0.01612	0.00869	1.85609
(-9)	0.01276	0.00786	1.62470
(-10)	0.00896	0.00613	1.46016
(-11)	0.00470	0.00352	1.33729
A112	0.00191	3.43166E-04	5.56048
(-1)	0.00157	2.78914E-04	5.64420
(-2)	0.00127	2.44911E-04	5.19423
(-3)	0.00100	2.36151E-04	4.24222
(-4)	7.63285E-04	2.41188E-04	3.16469
(-5)	5.56569E-04	2.48588E-04	2.23892
(-6)	3.81654E-04	2.50649E-04	1.52266
(-7)	2.38541E-04	2.42946E-04	0.98187
(-8)	1.27229E-04	2.23014E-04	0.57050
(-9)	4.77196E-05	1.89447E-04	0.25189
(-10)	1.14927E-08	1.41405E-04	8.12752E-05
(-11)	-1.58952E-05	7.83693E-05	-0.20282
A113	-0.00101	2.27074E-04	-4.43915
(-1)	-8.72244E-04	1.82688E-04	-4.77449
(-2)	-7.45885E-04	1.64265E-04	-4.54074
(-3)	-6.28940E-04	1.65972E-04	-3.78944
(-4)	-5.21406E-04	1.76469E-04	-2.95466
(-5)	-4.23286E-04	1.86433E-04	-2.27044
(-6)	-3.34578E-04	1.90526E-04	-1.75608
(-7)	-2.55283E-04	1.85983E-04	-1.37262
(-8)	-1.85401E-04	1.71351E-04	-1.08199
(-9)	-1.24932E-04	1.45827E-04	-0.85671
(-10)	-7.38752E-05	1.08937E-04	-0.67815
(-11)	-3.22312E-05	6.03910E-05	-0.53371
A114	-0.00874	0.01946	-0.44926

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COEF	METHOD	PARAMETERS
A111	PDL	LAGS=12,DEGREE=2,OPTION=TAIL
A112	PDL	LAGS=12,DEGREE=2,OPTION=TAIL
A113	PDL	LAGS=12,DEGREE=2,OPTION=TAIL

POLYNOMIAL STATISTICS AND COEFFICIENTS

A111	MEAN LAG =	4.293	ST. ER. =	1.232
	SUM OF LAG COEF =	0.239	ST. ER. =	0.030
A112	MEAN LAG =	2.316	ST. ER. =	34.816
	SUM OF LAG COEF =	8.E-03	ST. ER. =	2.2E-03
A113	MEAN LAG =	3.063	ST. ER. =	61.261
	SUM OF LAG COEF =	-5.E-03	ST. ER. =	1.6E-03

45: DEL(1 : W) = A150+(A151*Q1+A152*Q2+A153*Q3+A154*Q4+A155*Q5+A156*Q6+A157*Q7+A158*Q8+A159*Q9+A160*Q10+A161*Q11)*YDPSAD+A162*YDPSAD

NOB = 72 NOVAR = 13
RANGE = 1968 1 TO 1973 12
RSQ = 0.72026 CRSQ = 0.66336 F(12/59) = 12.659
SER = 279.1070 SSR = 4.596E+06 DW(0) = 2.09

COEF	VALUE	ST ER	T-STAT
A150	-794.65900	199.01500	-3.99296
A151	-0.00157	0.00122	-1.28833
A152	-0.00223	0.00121	-1.85160
A153	0.00287	0.00119	2.40174
A154	8.42735E-05	0.00119	0.07108
A155	2.23565E-04	0.00118	0.18969
A156	-3.73852E-04	0.00117	-0.32020
A157	0.00165	0.00116	1.42301
A158	-0.00180	0.00116	-1.55377
A159	-0.00152	0.00114	-1.32599
A160	-0.00130	0.00113	-1.14345
A161	0.00913	0.00113	8.11662
A162	0.01498	0.00212	7.05591

CHAPTER 5

CHARTERED BANK ASSETS

The equations describing the choice of assets by the banks are similar conceptually to those presented by W.R. White in a Bank of Canada Staff Research Study [33]. The economic framework we adopt is that of the Tobin-Markowitz model [31], [20] of behaviour towards risk. Banks are assumed to maximize the expected utility of profits. If this utility function is quadratic or if security returns are normally distributed, then bank asset demand functions will depend on the expected return on each asset and on their covariances, as well as on a scale variable associated with the total amount of funds to be invested - amount that is assumed to be predetermined. In the specification, which is estimated econometrically, expected returns (proxied by either the current rate of interest or a distributed lag over current and past rates) and the scale variable are entered as regressors. Their coefficients are then implicitly functions of the risky characteristics of the assets, and these characteristics are assumed not to vary over the sample period.

A question of some importance is which balance sheet items[1] are considered as being predetermined and which as being under the control of the banks - the allocation in the choice set is explained by the equations of this chapter. One approach is that of Parkin [26], who in his study of U.K. discount houses makes all assets and liabilities, except net worth, decision variables.

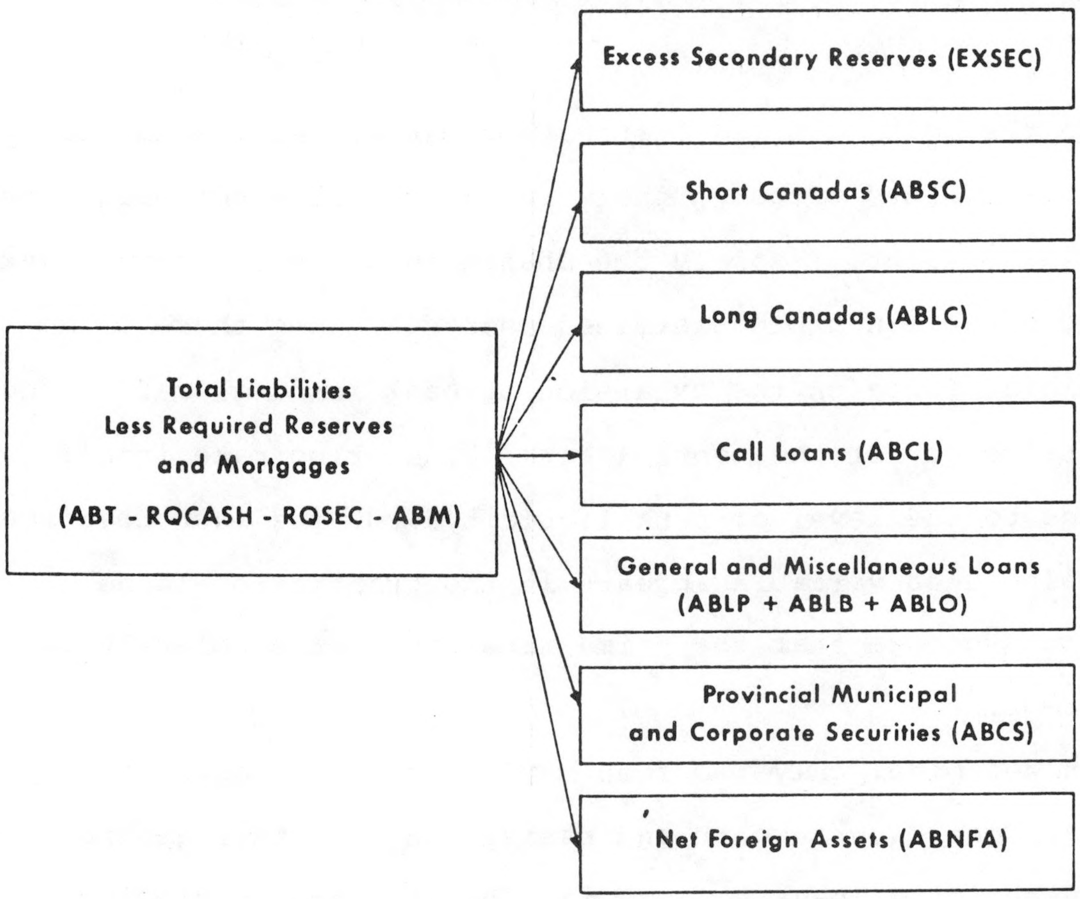
In the Monthly Financial Model we consider liabilities to be determined by the public and the government, whereas the whole range of assets except assets required to satisfy statutory primary and secondary reserve requirements is considered to be allocated in a single choice procedure. Mortgages, however, are treated differently because, although the decision about mortgage investment is presumably made at the time other assets are allocated, approved mortgages are typically disbursed with a lag of several months and this delay is not controlled by the banks. Therefore bank holdings of mortgages are treated as being essentially predetermined, and a technical relationship links mortgage disbursements to current and lagged mortgage approvals.

How to treat business and personal general loans is problematical. On the one hand, there is considerable evidence that bank lending is mainly determined by the demand of borrowers. On the other hand, it seems likely that banks do not yield all control over the amount of their new lending, but rather engage in some rationing, at least in certain periods.[2] If rationing is not continuous, however, estimation of loan equations presents many difficulties (see Fair and Jaffee [9]). In our monthly model we have taken a compromise position and have estimated loan equations as demand functions that, however, include one supply factor - the level of bank liabilities less predetermined assets, which is supposed to measure bank rationing. Furthermore, bank loans are treated like other assets and are included in the choice set rather than considered as being predetermined items.

The scale variable for bank asset allocation is thus total liabilities less required reserves and mortgages, and in Chart II is shown the asset categories to which it is allocated.

Chart II

CHARTERED BANK ASSET ALLOCATION



The decision not to follow Parkin [26] and treat liabilities as objects of choice does not exclude the possibility of liability management. Indeed, the interest rate equations are meant to describe chartered bank rate-setting behaviour and consequently they include variables measuring bank liquidity. When liquidity is low compared to the recent past banks tend to increase deposit rates in order to attract funds. Liabilities should not be treated symmetrically with assets because banks do not directly determine the quantities: they do not buy liabilities in the market but rather accept what is offered at the going rates.

1. BANK LOANS[3]

In the model general loans are taken as being essentially demand determined although there is one variable that reflects supply constraints - namely the change in the size of the banks' balance sheet minus predetermined assets.[4] Thus there is a restraining force on the expansion of bank lending, reflecting in part the policy of the central bank. The prime rate itself responds to the level of bank liquidity, but the fact that the available funds variable appears in the quantity-of-loans equation suggests that the prime rate does not completely clear the market.

In the model only two loan variables are endogenous: personal loans (on a month-end basis) and all other general loans (mainly business loans). Canadian dollar loans to provinces, municipalities, sales finance companies, and grain dealers, as well as loans on the security of Canada Savings Bonds are exogenous. Both business and personal loans include a variable that measures financing needs and a cost-of-borrowing variable.

The business-loans equation indicates significant substitution between bank loans and commercial paper as the coefficient of RPRIME - R90 has the expected negative sign. The variable RPRIME - RPRIME2 is intended to capture substitution between Canadian dollar loans and those made in U.S. currency, whether made by Canadian or U.S. banks. As expected, this substitution is less strong than that involving commercial paper, and the variable is not quite significant. The external financing requirement variable (FRQ) is the sum of national accounts figures for investment in machinery and equipment, non-residential construction, and inventories, less after-tax profits and the variable for inventory valuation adjustment. This variable is interpolated to get monthly data. Its coefficient indicates an initial propensity to fill about 55 percent of these external financing needs from bank loans. In time, these loans will be paid off and in the long run a given investment expenditure will not lead to a permanently higher stock of business loans, because the lagged ABLB term has a coefficient less than a.

The financing requirement variable for personal loans is taken to be consumption of durables and semi-durables. The interest rate variable is a measure of the real cost of borrowing. If the expected increase in the price of consumption is more than the nominal interest rate, then borrowing is attractive even at high interest rates. Unfortunately the rate for consumer loans is not easily available on a historical basis. We assume, however, that movements in the prime rate will reflect movements in consumer loan charges. The ABLP equation is similar conceptually to that for ABLB, but first differences were taken to solve serial correlation problems. In some cases, however, two-period differences worked better, in particular for available funds and the cost of borrowing, indicating some additional inertia effects.

2. MORTGAGE EQUATIONS

Bank mortgage holdings are built up from three stochastic equations. Mortgage approvals are explained by a stock adjustment equation, where desired mortgages are a function of the return on mortgages, the return on an alternative asset of comparable maturity, and total funds available. Disbursements are calculated as a distributed lag on mortgage approvals, and the repayments ratio depends on the current mortgage rate compared to past rates measuring the attractiveness of repayment before term. Given exogencus net sales to third parties, the actual change in mortgage holdings is calculated from the identify:

ABM = = ABM(-1) + DISB - REPB - NSTP

The mortgage approvals equation is a combination of two lagged adjustment processes. The flow of approvals is assumed to be a function of the gap between the desired mortgage stock and the actual lagged stock minus repayments and net sales to third parties, which the banks are taken to foresee correctly. In addition, since a change in mortgage policy depends on instructions from head office to branches and cannot be carried out instantaneously, we hypothesize that approvals only adjust with a lag to the gap between actual and desired mortgages, sc that

$$HAPB = b*HAPB(-1) + a*(MPD-MP(-1) + REPB + NSTP) \quad (5.1)$$

where

MP stands for potential mortgages - that is actual mortgages plus mortgages that have been approved but not yet disbursed.

MPD is the desired level.[5]

Equation (5.1) could also be derived from a model positing that approvals depend on past as well as present discrepancies between actual and desired mortgages, with weights declining geometrically. Such a scheme could be justified by various inertia effects. For instance, advertising outlays, which are a response to having too few mortgages today, will increase mortgage customers for some months to come.

Equation (5.1) was estimated not in linear form but in logarithms. The lagged mortgage stock in linear form had no significant effect, probably because over the period the banks were so far from their desired level that an increase in their actual stock had little abating effect on their flow of approvals. The Bank Act as revised in 1967 had once again made NHA mortgages attractive, as the banks were no longer subject to the interest rate ceiling, and for the first time were allowed to make conventional mortgage loans. The logarithmic transformation, by scaling down large values, allowed the estimates to capture the stock adjustment process, and the lagged stock is statistically significant in this form.

The coefficient on lagged approvals implies a speed of adjustment of the logarithm of approvals to their desired flow of

44 percent a month. The stock of mortgages adjusts much more slowly to its desired level, however, since approvals are disbursed with a lag also (see below). A particular relationship linking desired mortgages to interest rates and available funds[6] is implied by the approvals equation (where each element is assumed to be constant over time so that exponents are given by the sum of the weights):

$$MPD = C*ABT^{2.85}*e^{.055} \qquad (5.2)$$

The symbol C embodies the constant term and seasonal factors. The relationship is multiplicative, and the coefficent of ABT thus indicates an elasticity of around 3. This value is plausible over the sample period 1968-1973 as banks were rapidly expanding their mortgage holdings. There is evidence, however, that their behaviour has changed since the end of 1973. Such a rapid increase can clearly not be continued for long without making mortgages an impossibly large fraction of bank assets. The interest rate variable appears in the HAPB equation in level rather than logarithmic form, because the differential could conceivably be negative. The coefficient implies that an increase in the spread between the mortgage rate and the rate on one- to three-year Government of Canada bonds by 100 basis points will cause banks to increase their mortgage holdings by about 5 percent.

The equation relating the disbursement of mortgages to past approvals is based on the work of W.R. White[7]. Disbursements are a function of the approvals made in the previous twelve months and of seasonal factors. The sum of the weights is considerably less than 1, the difference being accounted for by cancellation of mortgages and by mortgages that were approved by the banks but disbursed by their mortgage subsidiaries.

Repayments are estimated as a ratio to the lagged mortgage stock. An exact formula can be derived relating the flow of repayments embodied in monthly contractual payments to past disbursements and past interest rates. Under certain conditions, the formula simplifies to a constant fraction of the lagged mortgage stock[8]. There is the further element of repayment derived from the principal on a mortgage paid off before maturity. This may be related to the attractiveness of refinancing, and hence to current interest rates relative to the rates prevailing when outstanding mortgages were negotiated. We have opted for a simple specification in which the repayment ratio is a constant except for seasonal factors[9] and the refinancing term is a comparison of the current rate and the average rate prevailing between three and four years ago.

3. REQUIRED PRIMARY RESERVES

In accordance with the Bank Act cash reserves, in the form of Bank of Canada notes and deposits at the Bank of Canada, must be held by the banks during any calendar month against deposit liabilities calculated as the average of the four consecutive Wednesdays ending with the second-last Wednesday of the previous month. Since February 1968, the required reserve ratio for deposit liabilities payable on demand in Canadian currency has been 12 percent, and the required reserve ratio for notice deposits in Canadian dollars has been 4 percent. For purposes of satisfying the reserve requirement, Bank of Canada notes are calculated on the same statutory basis as are deposits. That is, till cash held in, say, June can be netted out from the required level of reserves in July; the difference must be held during the current month (July) in the form of Bank of Canada deposits.

As the calculation of statutory deposits and notes does not coincide with average-of-Wednesdays figures, The Monthly Financial Model must include approximations to the identities defining statutory deposits. These are given by the equations for DSTAT1 and DSTAT2. The coefficients are close to those expected a priori. Similarly, in the TC equation statutory note holdings are related to average-of-Wednesdays figures.

Chartered bank note holdings are closely related to the demand by the public for currency. Chartered banks serve as middlemen between the Bank of Canada, which does not issue notes to individuals, and the public. The Bank of Canada responds passively to requests by the banks for new notes and to their redemptions of old notes. The banks hold notes mainly as an inventory to satisfy requests by bank customers for currency, and the stock fluctuates with payouts and deposits of currency. Consequently banks build up their holdings prior to Christmas, there is a fall at about Christmas time as more currency is held by the public, and some of this is returned to the banks in early January, which then proceed to reconvert a portion of their note holdings into Bank of Canada deposits. The equation for ABN given in the appendix to this chapter reflects these considerations. It contains strong seasonal influences, and reflects the level and the change in currency holdings, because an increase or decrease in the latter must come in the first instance from the banks.

Chartered bank holdings of deposits with the Bank of Canada must be such that the reserve requirement is at least satisfied. Banks need only fulfil the requirement for mean holdings of Bank of Canada deposits over a certain averaging period, so that on some days actual reserves may be less than required reserves. Before 1969 the averaging period was one month, but since January 1969 the averaging period has been half a month.

In practice, each bank holds a small amount of excess reserves in order to guard against unforeseen clearing losses that would force it either to borrow from the Bank of Canada or to incur a 10 percent interest penalty on the amount of shortfall, calculated over the averaging period. It seems reasonable to expect excess reserves to depend positively on the scale of deposits and negatively on the opportunity cost of holding excess reserves, in particular the rate obtainable on day loans or treasury bills. In addition, as the cost of borrowing from the Bank of Canada is related to the bank rate, chartered banks may want to hold more reserves to avoid the risk of borrowing if this rate is high. Alternatively, the differential between the bank rate and money market rates may be interpreted by chartered banks as reflecting the tightness or ease of monetary policy, and hence they may be short of cash at the end of the averaging period. This once again suggests a positive relationship between excess reserves and the bank rate.

On a day-to-day basis, reserves are set by the Bank of Canada via open market operations and cash management, and hence must be considered as being exogenous to the chartered banks. However, since the Bank of Canada sets reserves in order to achieve interest rate or money supply targets, if chartered bank adjustments have worked themselves out over a more extended period so that the banks are in equilibrium, then in some average sense the chartered bank demand for excess reserves will be traced out.[10] Consequently we have estimated an equation relating the average excess reserves of a month and that of the previous month, as a percentage of statutory deposits, to the monthly average day loan rate and bank rate (see equation 51).

4. OTHER ASSET HOLDINGS

Allocation among the remaining assets in the chartered bank balance sheet - liquid assets, Canadian securities, and net foreign assets - is seen as being related to the risk-return considerations embodied in the Tobin-Markowitz framework [31], [20]. Most of the equations are in first difference form, as equations in levels form exhibited pronounced serial correlation of residuals. In general, these asset equations depend on a scale variable and relative interest rates.

In one form of behaviour frequently observed lenders shift into shorter-term instruments as interest rates rise so as to avoid potentially large capital losses on longer-term instruments. Equilibrium requires that someone hold the longer-term instruments: their rates of interest must be such as to compensate for the expected capital loss. However, to the extent that other lenders or borrowers have what Modigliani and Sutch [22] call "preferred habitats" different from those of the banks, the banks may find it profitable to hold more short-term assets as interest rates rise and less such assets when they fall. We try to capture this mechanism in the short Canadas and Canadian securities equations by including the differential between the current rate on the bond and a distributed lag over a shorter-term rate. For instance, $RS - \Sigma w_i RDAY_{-i}$ is intended to capture the expectations of future short rates, and hence capital gains or losses on under-three-year Canada bonds as well as their running yield. The differential between the current yield on these bonds and the expected money-market rate will measure the attractiveness of shifting between short Canadas and day loans. The lag distribution may combine positive and negative weights, as expectations may be both extrapolative and regressive. See Modigliani and Sutch [22]. The interest rate variables were actually specified in terms of the change in the differential. As well, the sum of the lag weights was constrained to be equal to the coefficient on the longer rate (RS is the example above), so that a permanent shift upwards of all rates would not lead to any reallocation in the long run.

The difficulty with the above approach, and the probable reason that interest rate variables are seldom significant in the equations reported in the appendix to this chapter, is that in the bond markets the banks are assumed to be price-takers facing given interest rates. This is clearly unrealistic. Not only are the large banks undoubtedly aware that their transactions in, say, government bonds, will move the rate, but also that the banks as a group are the largest participants in most of these markets. Consequently, instead of getting a significantly positive sign for the own rate in an equation for the holdings of these assets, one may even observe a negative relationship between bank holdings and the rate.[11] We intend to tackle this problem by re-specifying some equations to account for simultaneous determination of asset holdings and interest rates.

Looking briefly at individual equations, excess secondary reserves are estimated in logarithmic form in order to constrain this variable to be positive at all times. Though historically such has always been the case, the linear form of the equation could easily yield negative excess secondary reserves in simulation given the magnitude of the interest rate coefficients. The preferred form (equation 54) makes excess secondary reserves depend on interest rates and a dummy variable for the one-month warning the Bank of Canada gives of impending increases in the secondary reserve ratio. Equations for day loans and treasury bills, which along with excess primary reserves constitute secondary reserves, were not estimated. Rather, the amount of secondaries not held in the form of excess cash is allocated between day loans and treasury bills in the average proportions prevailing over 1968-1973.

In specifying the equations for bank holdings of short Canadas and long Canadas (equations 55 and 56) we follow White and thus allow for some special factors that may influence bank holdings. It has been suggested that the chartered banks may be more willing to pick up new issues of Canadas than outstanding bonds because the banks are confident that the Bank of Canada will supply them with extra reserves for the purpose so that they need not run down their holdings of other assets. (See White [33] Chapter 2, section B.4.) Transactions costs are lower than the cost of trading in outstanding securities, which is another incentive. Consequently we have put net new issues of short Canadas and long Canadas in the respective equations. Transactions costs can also explain why the maturing of bank holdings of short Canadas and the reclassification of long Canadas into the three years and under category should modify the mix of bank assets, all other things being unchanged. (See White [33], Chapter 2, section B.4.)

The coefficient on the variable measuring the reclassification of chartered bank holdings from long Canadas to short Canadas (RECLASS) should have the same magnitude but the opposite sign in the short Canadas and long Canadas equations. The coefficients are of the right sign but differ in magnitude by about .27. In the future, estimates will be constrained to be equal in the two equations.

The Canadian securities variable is an aggregate of provincial, municipal, and corporate bonds; the interest rate is an unweighted average of the McLeod, Young, Weir rates [21] for these three categories. Equation 57 allows for a different impact for available funds (deposits) and preempted funds (loans and required reserves). The two-period difference in both available and preempted funds was used because this improved the fit, and it implies some lags in adjustment. The interest rate variable, which attempts to capture expected capital gains on these long-term bonds as well as their attractiveness relative to day loans, shows a fairly strong substitution between Canadian securities and short-term assets.

The call loan equation is not satisfactory, as none of the variables (aside from the seasonals) is significant. One difficulty is that no satisfactory interest rate series has been constructed - we follow White [33] in using the day loan rate as a proxy. The interest rate variable is the counterpart of the variable in the short Canadas equation, and combines expectation of capital gains on long-term assets as well as relative yield considerations.

No equation has been estimated for the net foreign asset position of the chartered banks, because, if the total size of their portfolio is given from the deposit side and all other assets are determined, net foreign assets are also determined. An alternative estimation procedure consists of estimating all the asset-demand functions in linear form but imposing adding-up constraints on the coefficients. We rejected this approach as it does not permit sufficient flexibility in the form of the demand functions. Treating net foreign assets as the residual component of the balance sheet implies that they play the role of an adjustment item, an interpretation that seems to accord well with the large variations observed in their behaviour. However, this is not inconsistent with a desire on the part of the banks to hit a target level of net foreign assets.[12] On the contrary, ABNFA enters the liquidity variable that influences the rate-setting behaviour of the banks (see Chapter 3): if their foreign liabilities rise rapidly, other things being equal, they will tend to raise the rate they pay on their domestic liabilities. This will attract domestic funds, which will flow to a considerable extent into net foreign assets.

The equations for liquid asset holdings reported above are subject to a number of criticisms. The principal one is perhaps that estimation has not taken into account the simultaneous determination of asset holdings and the interest rate on these assets. Each bank may act as a price-taker, so that oligopolistic behaviour by the banks need not be explicitly modelled. It is certainly true, however, that in the aggregate the banks are such a dominant force in the markets for Canadas, treasury bills, day loans, and call loans that there is serious simultaneous equations bias in estimating their demand for these assets as single equations. In future work we will try to eliminate this bias by using more sophisticated estimation techniques.

FOOTNOTES

1. Unlike White, we do not consolidate the balance sheets of bank mortgage affiliates with those of banks as the former are included in data for trust and mortgage loan companies.

2. In addition to rejecting loan demands that are not credit-worthy, the question is, in effect, whether or not the banks alter the criteria by which they assess credit-worthiness.

3. These equations were estimated in collaboration with Ritha Khemani.

4. It could well be argued that the effect of this variable should be asymmetric, so that it should have an impact only when the change in available funds is less than the desired increase in loans, ie when there is rationing of credit. The problems of estimating such a model are very severe. See Fair and Jaffee [9].

5. The form of the estimating equation is similar to W.R. White's preferred equation, [33] Chapter 4, section 3.b, and that in Clinton [8].

6. As noted before we do not integrate the balance sheets of the banks and bank mortgage affiliates, so that this avail-

able funds variable will differ slightly from that in the White study [33]. The difference, however, will be small.

7. It should be emphasized that unlike White, we try to explain only bank behaviour, and not movements in the consolidated balance sheet of the banks and bank mortgage affiliates. White [33] (Chapter 1, section 2.a) discusses the relative merits of two approaches: namely, full and partial integration of the two balance sheets. We have decided to model the two sets of institutions separately, though this tends to do violence to the facts in that typically the banks make approvals both for themselves and for their affiliates, although the mortgages when disbursed may go on the books of either. As White points out, the desired allocation of mortgages will depend on complicated tax and administrative considerations. If these are stable over time (at least in the post-1967 period) then the bank disbursement equation with constant weights should explain bank holdings satisfactorily. The full integration approach of White seems superior, however, and we have not followed that route because of the difficulty in obtaining the data and updating the model on the continual basis necessary when it is used for forecasting.

8. The problem is mathematically similar to the relation between replacement investment and capital stock. See Jorgenson [18], Feldstein and Rothschild [10].

9. The seasonal factors are only quarterly because none of the monthly dummy variables came close to being significant.

10. This question is discussed in White [33], Chapter 3, section B.1.a.

11. A negative sign was in fact observed for the long Canadas rate in the equation explaining bank holdings of long Canadas for a wide range of specifications. Consequently all interest rate variables were dropped from this equation.

12. A full treatment of the foreign currency operations of Canadian banks is given in Freedman [11].

APPENDIX TO CHAPTER 5

```
60:        ABLB = L20+(L21*ABLB(-1)*Q1+L22*ABLB(-1)*Q2+L23*
           ABLB(-1)*Q3+L24*ABLB(-1)*Q4+L25*ABLB(-1)*Q5+L26*
           ABLB(-1)*Q6+L27*ABLB(-1)*Q7+L28*ABLB(-1)*Q8+L29*
           ABLB(-1)*Q9+L30*ABLB(-1)*Q10+L31*ABLB(-1)*Q11)+L32
           *FRQ+L33*(ABT-RQCASH-RQSEC-ABM)+L34*(RPRIME-R90)*
           ABLB(-1)+L35*(RPRIME-RPRIME2)*ABLB(-1)+L36*ABLB(-1 )
```

```
NOB = 72      NOVAR = 17
RANGE =  1968 1 TO 1973 12
RSQ =     0.99869      CRSQ =     0.9985       F(16/55) =   2613.100
SER = 129.6880         SSR = 9.250E+05         DW(0) =   2.42
```

COEF	VALUE	ST ER	T-STAT
L20	-1096.45000	179.74200	-6.10015
L21	-0.01180	0.00461	-2.55832
L22	0.00464	0.00507	0.91472
L23	0.01125	0.00459	2.45217
L24	0.00273	0.00431	0.63390
L25	1.00222E-04	0.00431	0.02325
L26	4.94558E-04	0.00428	0.11545
L27	0.00331	0.00420	0.78828
L28	-0.00331	0.00422	-0.78529
L29	5.86231E-04	0.00419	0.13982
L30	0.00445	0.00409	1.08874
L31	-0.00645	0.00412	-1.56654
L32	0.55592	0.35826	1.55175
L33	0.13842	0.02659	5.20598
L34	-0.00852	0.00246	-3.46907
L35	-0.00476	0.00313	-1.52281
L36	0.77803	0.04799	16.21150

59: DEL(1 : ABLP) = L0+L15*DEL(1 : ABLP(-1))+(L1*Q1+L2*Q2+L3*Q3+L4*Q4+L5*Q5+L6*Q6+L7*Q7+L8*Q8+L9*Q9+L10*Q10+L11*Q11)*ABLP(-1)+L12*DEL(1 : CDOSD)+L13*DEL(2 : ABT-RQCASH-RQSEC-ABM)+L14*DEL(2 : RPRIME-400*(PCON-PCON(-3))/PCON(-3))*ABLP(-1)

NOB = 70 NOVAR = 16
RANGE = 1968 3 TO 1973 12
RSQ = 0.71245 CRSQ = 0.63257 F(15/54) = 8.920
SER = 48.5846 SSR = 1.275E+05 DW(0) = 2.20

COEF	VALUE	ST ER	T-STAT
L0	13.06240	11.53340	1.13258
L15	0.42735	0.10546	4.05239
L1	-0.01268	0.00359	-3.53520
L2	6.86501E-04	0.00408	0.16806
L3	0.00577	0.00344	1.67911
L4	0.01103	0.00346	3.19075
L5	0.00525	0.00352	1.49117
L6	0.00125	0.00354	0.35389
L7	-0.00462	0.00320	-1.44319
L8	-0.00314	0.00306	-1.02540
L9	0.00900	0.00317	2.83833
L10	-0.00210	0.00299	-0.70343
L11	-0.00544	0.00311	-1.74612
L12	0.11751	0.06294	1.86692
L13	0.04341	0.02213	1.96134
L14	-0.00126	8.09109E-04	-1.55466

```
50:          LOG(HAPB) = AB0+AB1*Q1+AB2*Q2+AB3*Q3+AB4*Q4+AB5*Q5
             +AB6*Q6+AB7*Q7+AB8*Q8+AB9*Q9+AB10*Q10+AB11*Q11+SUM
             (I = -6 TO 0 : C1(I)*(RMC(I)-RSM(I)))*S+SUM(I = -3
              TO 0 : C23(I)*LOG(ABT(I)))+AB12*LOG(ABM(-1)+UC(-1
             )-REPB-NSTP)+AB13*LOG(HAPB(-1))
```

```
NOB = 69      NOVAR = 17
RANGE =  1968 4 TO 1973 12
RSQ =    0.94239      CRSQ =    0.92460      F(16/52) =    53.161
SER =    0.2204       SSR =      2.525       DW(0) =   1.98
```

COEF	VALUE	ST ER	T-STAT
AB0	-42.29350	18.32510	-2.30795
AB1	-0.41587	0.09730	-4.27387
AB2	-0.06108	0.10924	-0.55912
AB3	0.11663	0.10294	1.13305
AB4	0.15020	0.08987	1.67141
AB5	0.08197	0.09235	0.88768
AB6	0.17074	0.09159	1.86415
AB7	0.03642	0.09115	0.39961
AB8	-0.17167	0.08865	-1.93650
AB9	0.21054	0.08741	2.40851
AB10	0.08403	0.09013	0.93234
AB11	0.01143	0.09353	0.12226
C1	-0.01496	0.03951	-0.37871
(-1)	0.00534	0.01810	0.29498
(-2)	0.01959	0.01023	1.91473
(-3)	0.02778	0.01655	1.67882
(-4)	0.02992	0.02076	1.44116
(-5)	0.02600	0.01965	1.32339
(-6)	0.01603	0.01277	1.25556
C23	2.26832	0.99631	2.27671
(-1)	1.70124	0.74723	2.27671
(-2)	1.13416	0.49816	2.27671
(-3)	0.56708	0.24908	2.27671
AB12	-1.99038	0.98575	-2.01915
AB13	0.56807	0.10481	5.41979

COEF	METHOD	PARAMETERS
C1	PDL	LAGS=7,DEGREE=2,OPTION=TAIL
C23	PDL	LAGS=4,DEGREE=1,OPTION=TAIL

POLYNOMIAL STATISTICS AND COEFFICIENTS

```
C1       MEAN LAG =      4.318            ST. ER. =     3.671
         SUM OF LAG COEF =      0.110     ST. ER. =     0.057

C23      MEAN LAG =      1.000            ST. ER. =     0.362
         SUM OF LAG COEF =      5.671     ST. ER. =     2.491
```

```
49:       DISB = B0+B1*Q1*S+B2*Q2*S+B3*Q3*S+B4*Q4*S+B5*Q5*S+
          B6*Q6*S+B7*Q7*S+B8*Q8*S+B9*Q9*S+B10*Q10*S+B11*Q11*
          S+SUM(I = -12 TO 0 : C4(I)*HAPB(I))

NOB = 67        NOVAR = 14
RANGE =   1968 6 TO 1973 12
RSQ =    0.9782       CRSQ =     0.97285      F(13/53) =    182.902
SER =    8.4057       SSR =   3744.750        DW(0) =   2.20
```

COEF	VALUE	ST ER	T-STAT
B0	1.39595	1.83788	0.75954
B1	-7.13348	3.64864	-1.95500
B2	-3.95110	3.69065	-1.07057
B3	-2.42647	3.63055	-0.66835
B4	-5.08334	3.48557	-1.45839
B5	-2.25567	3.49537	-0.64533
B6	0.20827	3.41382	0.06101
B7	10.69560	3.47395	3.07881
B8	2.92187	3.31993	0.88010
B9	3.34539	3.19871	1.04585
B10	1.91139	3.14909	0.60697
B11	2.16324	3.14264	0.68835
C4	0.15224	0.01768	8.61040
(-1)	0.13198	0.01192	11.07250
(-2)	0.11314	0.00696	16.25530
(-3)	0.09573	0.00302	31.72280
(-4)	0.07974	0.00218	36.57210
(-5)	0.06518	0.00441	14.79540
(-6)	0.05205	0.00636	8.18692
(-7)	0.04034	0.00764	5.27645
(-8)	0.03005	0.00821	3.65845
(-9)	0.02119	0.00805	2.63194
(-10)	0.01375	0.00715	1.92365
(-11)	0.00774	0.00551	1.40580
(-12)	0.00316	0.00313	1.01081

COEF	METHOD	PARAMETERS
C4	PDL	LAGS=13,DEGREE=2,OPTION=TAIL

POLYNOMIAL STATISTICS AND COEFFICIENTS

```
C4        MEAN LAG =       3.196         ST. ER. =       0.468
          SUM OF LAG COEF =    0.806     ST. ER. =       0.022
```

48: REPB/ABM(-1) = K0+K1*SQ1+K2*SQ2+K3*SQ3+K4*(RMC-SUM (I = -48 TO -37 : RMC(I))/12)

NOB = 72 NOVAR = 5
RANGE = 1968 1 TO 1973 12
RSQ = 0.10603 CRSQ = 0.05266 F(4/67) = 1.987
SER = 1.90E-03 SSR = 2.412E-04 DW(0) = 1.22

COEF	VALUE	ST ER	T-STAT
K0	0.00801	3.05899E-04	26.18480
K1	-5.70383E-04	3.87401E-04	-1.47233
K2	-4.95141E-04	3.87281E-04	-1.27850
K3	7.64260E-04	3.87349E-04	1.97305
K4	-2.20141E-04	1.70716E-04	-1.28952

35: DSTAT1 = AQ1*(DDB(-1)+DDFGBM(-1)+FLOAT(-1))+AQ2*(DDB(-2)+DDFGBM(-2)+FLOAT(-2))

NOB = 72 NOVAR = 2
RANGE = 1968 1 TO 1973 12
RSQ = 0.99615 CRSQ = 0.99609 F(1/70) = 1.81E+04
SER = 114.9770 SSR = 9.254E+05 DW(0) = 2.34

COEF	VALUE	ST ER	T-STAT
AQ1	0.79024	0.03394	23.28230
AQ2	0.21897	0.03426	6.39097

36: DSTAT2 = AQ6*DPB(-1)+AQ7*DPB(-2)+AQ8*DNPTB(-1)+AQ9 *DNPTB(-2)

NOB = 72 NOVAR = 4
RANGE = 1968 1 TO 1973 12
RSQ = 0.99991 CRSQ = 0.9999 F(3/68) = 2.39E+05
SER = 49.9571 SSR = 1.697E+05 DW(0) = 2.46

COEF	VALUE	ST ER	T-STAT
AQ6	0.73398	0.03845	19.08720
AQ7	0.26557	0.03854	6.89149
AQ8	0.87946	0.02775	31.69590
AQ9	0.12307	0.02792	4.40884

62: TC = N14*ABN(-1)+N15*ABN(-2)

NOB = 60 NOVAR = 2
RANGE = 1969 1 TO 1973 12
RSQ = 0.98232 CRSQ = 0.98201 F(1/58) = 3221.880
SER = 11.1506 SSR = 7211.510 DW(0) = 2.84

COEF	VALUE	ST ER	T-STAT
N14	0.78201	0.04249	18.40390
N15	0.21382	0.04282	4.99320

61: ABN = N0+(N1*Q1+N2*Q2+N3*Q3+N4*Q4+N5*Q5+N6*Q6+N7*Q7+N8*Q8+N9*Q9+N10*Q10+N11*Q11)*ANFCUR+N12*ANFCUR+N13*DEL(1 : ANFCUR)

NOB = 60 NOVAR = 14
RANGE = 1969 1 TO 1973 12
RSQ = 0.96923 CRSQ = 0.96053 F(13/46) = 111.445
SER = 17.2331 SSR = 13661.100 DW(0) = 1.48

COEF	VALUE	ST ER	T-STAT
N0	120.74400	15.84040	7.62254
N1	-0.00188	0.00465	-0.40382
N2	-0.01032	0.00253	-4.07403
N3	-0.00639	0.00207	-3.08851
N4	-0.00273	0.00217	-1.25823
N5	0.00348	0.00220	1.58177
N6	0.00525	0.00212	2.47173
N7	0.01089	0.00294	3.69766
N8	-5.13248E-04	0.00207	-0.24829
N9	-0.00261	0.00202	-1.29237
N10	-0.00130	0.00195	-0.66566
N11	2.16996E-04	0.00188	0.11531
N12	0.14569	0.00474	30.75040
N13	-0.40678	0.11426	-3.56015

```
51:          EXCASH = D0+(D1*Q1+D2*Q2+D3*Q3+D4*Q4+D5*Q5+D6*Q6+
             D7*Q7+D8*Q8+D9*Q9+D10*Q10+D11*Q11)*S+D12*BSTRUC+
             D13*RBANKM*S
```

```
NOB = 59        NOVAR = 14
RANGE =   1969 2 TO 1973 12
RSQ =    0.52977       CRSQ =    0.39393       F(13/45) =      3.900
SER =    0.0100        SSR = 4.529E-03         DW(0) =   1.76
```

GLS PARAMETERS

RHO1   0.7203

COEF	VALUE	ST ER	T-STAT
D0	0.02790	0.02405	1.16022
D1	-0.00726	0.00507	-1.43316
D2	0.00357	0.00495	0.72109
D3	0.00433	0.00481	0.90014
D4	0.00235	0.00482	0.48811
D5	0.00220	0.00478	0.45958
D6	-0.00388	0.00480	-0.80736
D7	-0.00489	0.00470	-1.03957
D8	-0.00144	0.00471	-0.30532
D9	2.64683E-04	0.00475	0.05577
D10	0.00509	0.00477	1.06617
D11	0.00310	0.00476	0.65042
D12	-0.00913	0.00517	-1.76626
D13	0.01885	0.00700	2.69048

COEF	METHOD	PARAMETERS
ALL	GLS	AUTO1

54: LOG(EXSEC) = E0+E1*Q1+E2*Q2+E3*Q3+E4*Q4+E5*Q5+E6*Q6+E7*Q7+E8*Q8+E9*Q9+E10*Q10+E11*Q11+E12*LOG(EXSEC(-1))+E13*(RTBM-RSM)+E15*SRW

NOB = 59 NOVAR = 15
RANGE = 1969 2 TO 1973 12
RSQ = 0.81531 CRSQ = 0.75654 F(14/44) = 13.874
SER = 0.3139 SSR = 4.336 DW(0) = 2.51

COEF	VALUE	ST ER	T-STAT
E0	1.03843	0.43983	2.36100
E1	-0.17991	0.14996	-1.19970
E2	-0.19727	0.13577	-1.45301
E3	0.41211	0.13607	3.02872
E4	0.04166	0.13578	0.30684
E5	0.00209	0.14342	0.01455
E6	0.01101	0.14463	0.07609
E7	-0.09406	0.13643	-0.68945
E8	-0.21404	0.13515	-1.58372
E9	0.31243	0.13651	2.28871
E10	0.06802	0.13504	0.50371
E11	-0.00178	0.13586	-0.01312
E12	0.82081	0.07410	11.07700
E13	0.08921	0.06605	1.35073
E15	0.32946	0.25788	1.27758

```
55:            DEL(1 : ABSC) = G0+G16*DEL(1 : ABSC(-1))+G1*Q1*S+
               G2*Q2*S+G3*Q3*S+G4*Q4*S+G5*Q5*S+G6*Q6*S+G7*Q7*S+G8
               *Q8*S+G9*Q9*S+G10*Q10*S+G11*Q11*S+G13*DEL(1 :
               REDEM)+G14*DEL(1 : RECLASS)+G15*(IF NNIS GT 0
                THEN DEL(1 : NNIS) ELSE 0)+SUM(I = -3 TO 0 : G(I)
               *DEL(1 : RSM-RDAY(I)))*S
```

```
NOB = 70       NOVAR = 17
RANGE =  1968 3 TO 1973 12
RSQ =    0.75613     CRSQ =    0.68251      F(16/53) =    10.271
SER =  43.0236       SSR = 98104.600        DW(0) =  2.57
```

COEF	VALUE	ST ER	T-STAT
G0	-4.67018	5.92930	-0.78764
G16	0.85866	0.10795	7.95434
G1	-14.34690	20.15340	-0.71189
G2	-24.08080	18.55250	-1.29798
G3	-10.53710	17.96220	-0.58662
G4	2.35889	20.98580	0.11240
G5	-7.81500	21.02740	-0.37166
G6	1.83284	18.24310	0.10047
G7	36.84570	16.77670	2.19625
G8	-15.76240	16.45860	-0.95770
G9	3.85783	16.84450	0.22903
G10	-0.13003	19.66060	-0.00661
G11	41.86720	19.52240	2.14458
G13	-0.48525	0.09377	-5.17460
G14	0.91336	0.10317	8.85319
G15	0.04230	0.03020	1.40099
G	9.46652	8.02868	1.17909
(-1)	7.09989	6.02151	1.17909
(-2)	4.73326	4.01434	1.17909
(-3)	2.36663	2.00717	1.17909

COEF	METHOD	PARAMETERS
G	PDL	LAGS=4,DEGREE=1,OPTION=TAIL

POLYNOMIAL STATISTICS AND COEFFICIENTS

```
G        MEAN LAG =      1.000          ST. ER. =     0.812
         SUM OF LAG COEF =  23.666      ST. ER. =    20.072
```

```
56:          DEL(1 : ABLC) = H0+H15*DEL(1 : ABLC(-1))+H1*Q1*S+
             H2*Q2*S+H3*Q3*S+H4*Q4*S+H5*Q5*S+H6*Q6*S+H7*Q7*S+H8
             *Q8*S+H9*Q9*S+H10*Q10*S+H11*Q11*S+H12*DEL(1 : ABT-
             (RQCASH+RQSEC+ABM))+H13*RECLASS+H14*(IF NNIL GT 0
              THEN NNIL ELSE 0)
```

```
NOB = 70       NOVAR = 16
RANGE =   1968 3 TO 1973 12
RSQ =     0.58718      CRSQ =     0.47251      F(15/54) =      5.121
SER =   59.1201        SSR = 1.887E+05         DW(0) =   2.53
```

COEF	VALUE	ST ER	T-STAT
H0	-9.99025	12.13100	-0.82353
H15	0.53828	0.11042	4.87486
H1	-6.32138	27.50130	-0.22986
H2	14.31740	25.92590	0.55224
H3	9.51664	24.70000	0.38529
H4	9.85314	27.68620	0.35607
H5	-40.38440	26.44010	-1.52739
H6	6.13016	23.88780	0.25662
H7	-15.83390	23.12580	-0.68468
H8	22.43380	22.77270	0.98538
H9	-5.45425	23.14170	-0.23569
H10	12.23740	26.54370	0.46103
H11	-43.83040	26.35390	-1.66314
H12	0.01999	0.03539	0.56485
H13	-0.64008	0.11681	-5.47981
H14	0.10290	0.03663	2.80910

57: DEL(1 : ABCS) = I0+I14*DEL(1 : ABCS(-1))+I1*Q1*S+I2*Q2*S+I3*Q3*S+I4*Q4*S+I5*Q5*S+I6*Q6*S+I7*Q7*S+I8*Q8*S+I9*Q9*S+I10*Q10*S+I11*Q11*S+I12*DEL(2 : ABT)+I13*DEL(2 : RQCASH+RQSEC+ABM)+SUM(I = -3 TO 0 : C12(I)*DEL(1 : RCS-RDAY(I)))*S

NOB = 70 NOVAR = 17
RANGE = 1968 3 TO 1973 12
RSQ = 0.49311 CRSQ = 0.34009 F(16/53) = 3.222
SER = 36.2311 SSR = 69572.600 DW(0) = 1.85

COEF	VALUE	ST ER	T-STAT
I0	8.64926	9.48346	0.91204
I14	0.30705	0.13832	2.21985
I1	9.13475	18.78490	0.48947
I2	-16.63330	16.99890	-0.97849
I3	-34.02070	17.35380	-1.96041
I4	-15.93950	17.32600	-0.91998
I5	-12.20430	14.69550	-0.83048
I6	11.38260	14.93420	0.76219
I7	2.40745	14.43700	0.16676
I8	-4.75519	14.11740	-0.33683
I9	4.33126	14.50190	0.29867
I10	12.51350	14.22030	0.87997
I11	25.59150	15.07820	1.69725
I12	0.02832	0.01479	1.91528
I13	-0.08694	0.04634	-1.87611
C12	23.58700	11.02920	2.13859
(-1)	8.49452	5.52263	1.53813
(-2)	-0.46746	7.18078	-0.06510
(-3)	-3.29897	6.00908	-0.54900

COEF	METHOD	PARAMETERS
C12	PDL	LAGS=4,DEGREE=2,OPTION=TAIL

POLYNOMIAL STATISTICS AND COEFFICIENTS

C12 MEAN LAG = -0.083 ST. ER. = 1.252
SUM OF LAG COEF = 28.315 ST. ER. = 18.409

```
58:          DEL(1 : ABCL) = J0+J1*Q1*S+J2*Q2*S+J3*Q3*S+J4*Q4*S
             +J5*Q5*S+J6*Q6*S+J7*Q7*S+J8*Q8*S+J9*Q9*S+J10*Q10*S
             +J11*Q11*S+J12*DEL(1 : ABT-(RQCASH+RQSEC+ABM))+SUM
             (I = -3 TO 0 : J22(I)*DEL(1 : RSM-RDAY(I)))*S
```

```
NOB = 70       NOVAR = 15
RANGE =  1968 3 TO 1973 12
RSQ =    0.46549     CRSQ =    0.32944     F(14/55) =     3.421
SER =  58.1078       SSR = 1.857E+05       DW(0) =  1.88
```

COEF	VALUE	ST ER	T-STAT
J0	-12.14580	11.36380	-1.06882
J1	-95.89230	26.70270	-3.59111
J2	-18.17700	25.86980	-0.70263
J3	-40.05060	24.51400	-1.63379
J4	49.63020	23.86240	2.07985
J5	-25.48390	24.39690	-1.04456
J6	33.45490	23.47480	1.42514
J7	25.12840	22.67780	1.10806
J8	29.36250	22.49950	1.30503
J9	-13.39570	22.92590	-0.58430
J10	46.63840	24.14690	1.93145
J11	-16.72980	25.51430	-0.65570
J12	0.06226	0.03528	1.76475
J22	-0.22693	18.41850	-0.01232
(-1)	-5.51252	8.31836	-0.66269
(-2)	-7.23656	10.05590	-0.71963
(-3)	-5.39906	8.60110	-0.62772

COEF	METHOD	PARAMETERS
J22	PDL	LAGS=4,DEGREE=2,OPTION=TAIL

POLYNOMIAL STATISTICS AND COEFFICIENTS

```
J22     MEAN LAG =     1.969          ST. ER. =     2.788
        SUM OF LAG COEF = -18.375     ST. ER. =    27.728
```

APPENDIX A

MODEL: FINANCE

SYMBOL DECLARATIONS

ENDOGENOUS:
ABCL ABCLC ABCS ABCSC ABD ABDL ABGL ABL ABLB ABLC
ABLP ABM ABN ABNFA ABSC ABTB ANFCOIN ANFCUR ANFLC
ANFSC ANPAP ATLM DBT DDB DISB DNPTB DPB DSTAT1
DSTAT2 DSTL DTL1 DTL2 EXCASH EXSEC FGB FGTB FLARATIO
HAPB M1 M2 RCS RDAY REL REPB RMC RML RNPT RPRIME
RQCASH RQSEC RS RSDB RSDTL RTB RTL1 RTL2 R90 TC
TCDMA UC W

DEFINITION:
ABT ANFCURSA DDBSA DDFGBM DNPTBSA DPBSA DSTATB LIQA
LLA M1SA M2SA NNIS PCM1 PCM2 RBANKM RMLM RNPTM RSM
RTBM S SEASCUR SEASDDB SEASDPB SEASNPT

EXOGENOUS:
ABCBI ABCTB ABLO ACSB ANFTB BI CDOSD DDFGB DFGBC
FLOAT FRBI FRFG FRQ NNIL NSTP PBSC PCON PFX PFXF Q1
Q10 Q11 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 RBANK RCB2
RECLASS REDEM RPRIME2 RRQSEC RTB2 SQ1 SQ2 SQ3 SRW
YDPSAD

COEFFICIENT:
AB0 AB1 AB10 AB11 AB12 AB13 AB2 AB3 AB4 AB5 AB6
AB7 AB8 AB9 ANFC1 ANFC2 AQ1 AQ2 AQ6 AQ7 AQ8 AQ9
AR01 AR02 AR03 AR04 AR06 AR07 AR08 AR1 AR101 AR102
AR103 AR104 AR105 AR106 AR107 AR108 AR11 AR12 AR13
AR14 AR15 AR16 AR17 AR2 AR21 AR22 AR23 AR24 AR31
AR32 AR33 AR34 AR35 AR4 AR41 AR42 AR43 AR44 AR45
AR46 AR5 AR51 AR52 AR53 AR54 AR55 AR56 AR57 AR6
AR61 AR62 AR63 AR64 AR65 AR66 AR67 AR68 AR69 AR70
AR71 AR72 AR73 AR74 AR75 AR76 AR77 AR78 AR79 AR81
AR82 AR83 AR84 AR85 AR86 AR87 AR88 AR91 AR92 AR93
AR94 AR95 AR96 AR97 AT1 AT2 AT3 AT4 A10 A100 A103
A11 A110 A114 A12 A13 A130 A131 A132 A133 A134 A135
A136 A137 A138 A139 A14 A140 A141 A144 A15 A150
A151 A152 A153 A154 A155 A156 A157 A158 A159 A16
A160 A161 A162 A17 A18 A19 A20 A21 A22 A23 A30 A31
A32 A33 A34 A35 A36 A37 A38 A39 A40 A41 A50 A51
A52 A53 A54 A55 A56 A57 A58 A59 A60 A61 A64 A70
A71 A72 A73 A74 A75 A76 A77 A78 A79 A80 A81 A84

```
   A90  A91  A92  A93  A94  B0   B1   B10  B11  B2   B3   B4   B5   B6
   B7   B8   B9   D0   D1   D10  D11  D12  D13  D2   D3   D4   D5   D6
   D7   D8   D9   E0   E1   E10  E11  E12  E13  E15  E2   E3   E4   E5
   E6   E7   E8   E9   G0   G1   G10  G11  G13  G14  G15  G16  G2   G3
   G4   G5   G6   G7   G8   G9   H0   H1   H10  H11  H12  H13  H14  H15
   H2   H3   H4   H5   H6   H7   H8   H9   I0   I1   I10  I11  I12  I13
   I14  I2   I3   I4   I5   I6   I7   I8   I9   J0   J1   J10  J11  J12
   J2   J3   J4   J5   J6   J7   J8   J9   K0   K1   K2   K3   K4   L0   L1
   L10  L11  L12  L13  L14  L15  L2   L20  L21  L22  L23  L24
   L25  L26  L27  L28  L29  L3   L30  L31  L32  L33  L34  L35
   L36  L4   L5   L6   L7   L8   L9   N0   N1   N10  N11  N12  N13  N14
   N15  N2   N3   N4   N5   N6   N7   N8   N9

ALCOEFFICIENT:
   AT5  AT6  A101  A102  A111  A112  A113  A142  A143  A42  A43
   A62  A63  A82   A83   C1    C12   C23   C4    G     J22

EQUATIONS

  1:          RQCASH == 0.12*DSTAT1+0.04*DSTAT2

  2:          RQSEC == RRQSEC*(DSTAT1+DSTAT2)*0.01

  3:          DDFGBM == 0.5*(DDFGB+DDFGB(-1))

  4:          DBT == DDB+DPB+DNPTB+DDFGBM

  5:          ABT == DBT+BI

  6:          REL == (ABT-ABL-ABM-ABCS-RQCASH-RQSEC)*100/ABT

  7:          DEL(1 : ANFCOIN) = ANFC1+ANFC2*DEL(1 : ANFCUR)

  8:          ABCSC == PBSC*(ABN+ABD+ANFCUR-ANFCOIN+0.5*(DFGBC+
              DFGBC(-1))-ABCTB-ABCBI)

  9:          ABCLC == ABN+ABD+ANFCUR-ANFCOIN+0.5*(DFGBC+DFGBC(
              -1))-ABCTB-ABCBI-ABCSC

 10:          FGTB == ABTB+ABCTB+ANFTB

 11:          DEL(1 : FGB) == FRFG+DEL(1 : DDFGB+DFGBC)-DEL(1 :
              FGTB)-DEL(1 : ACSB)+DEL(1 : FRBI)
```

```
12:    NNIS == DEL(1 : FGB)-NNIL

13:    DEL(1 : ANFSC) == NNIS-DEL(1 : ABSC+ABCSC)

14:    DEL(1 : ANFLC) == NNIL-DEL(1 : ABLC+ABCLC)

15:    DSTATB == DSTAT1+DSTAT2

16:    S == DSTATB/31276.4

17:    RBANKM == 0.5*(RBANK+RBANK(-1))

18:    RTBM == 0.5*(RTB+RTB(-1))

19:    RSM == 0.5*(RS+RS(-1))

20:    RNPTM == 0.5*(RNPT+RNPT(-1))

21:    RMLM == 0.5*(RML+RML(-1))

22:    RDAY = AR1+AR2*((405.5+RTB2)*PFXF/PFX-405.5)+AR4*(
       REL-SUM(I = -12 TO -1 : REL(I))/12.)+AR5*RBANK+AR6
       *RBANK(-1)

23:    RPRIME = AR01+AR04*RPRIME2+AR02*RBANK+AR03*RBANK(
       -1)+AR06*RPRIME(-1)+AR07*RPRIME(-2)+AR08*(REL-SUM(
       I = -12 TO -1 : REL(I))/12)

24:    RSDB = AR21+AR22*RPRIME+AR23*RSDB(-1)+AR24*RSDB(-2
       )

25:    RNPT = AR11+AR17*((405.5+RTB2)*PFXF/PFX-405.5)+
       AR12*RPRIME+AR13*RDAY+AR14*RNPT(-1)+AR15*RPRIME(-1
       )+AR16*(REL-SUM(I = -12 TO -1 : REL(I))/12.)

26:    R90 = AR31+AR32*((405.5+RTB2)*PFXF/PFX-405.5)+AR33
       *RTB2+AR34*RNPT+AR35*100*FRQ/YDPSAD

27:    RTL1 = AR41+AR42*R90+AR43*RNPT+AR44*RNPT(-1)+AR45*
       RTL1(-1)+AR46*RTL1(-2)

28:    RTL2 = AR51+AR52*RS+AR53*RS(-1)+AR54*RMC+AR55*RMC(
       -1)+AR56*RTL2(-1)+AR57*RTL2(-2)

29:    RSDTL = AR61+AR62*RMC+AR63*RSDB+AR64*RSDB(-1)+AR65
       *RSDTL(-1)
```

```
30:    RTB = AR70+AR67*((405.5+RTB2)*PFXF/PFX-405.5)+AR68
       *RBANK+AR69*RDAY+AR66*RTB2+AR79*RBANK(-1)

31:    RS = AR71+AR72*RTB2+AR73*RTB+AR74*RS(-1)+AR75*RS(
       -2)+AR76*ANFSC/ANFSC(-1)+AR77*RTB(-1)+AR78*RTB2(-1
       )

32:    RML = AR81+AR82*RML(-1)+AR83*RS+AR84*RS(-1)+AR85*
       RCB2+AR86*RCB2(-1)+AR87*ANFSC/ANFSC(-1)+AR88*ANFLC
       /ANFLC(-1)

33:    RCS = AR91+AR92*RCS(-1)+AR93*RCS(-2)+AR94*RML+AR95
       *RML(-1)+AR96*RCB2+AR97*RCB2(-1)

34:    RMC = AR101+AR108*(ATLM+ABM)/(ATLM(-12)+ABM(-12))+
       AR102*RMC(-1)+AR103*RMC(-2)+AR104*RS+AR105*RCS+
       AR106*RS(-1)+AR107*RCS(-1)

35:    DSTAT1 = AQ1*(DDB(-1)+DDFGBM(-1)+FLOAT(-1))+AQ2*(
       DDB(-2)+DDFGBM(-2)+FLOAT(-2))

36:    DSTAT2 = AQ6*DPB(-1)+AQ7*DPB(-2)+AQ8*DNPTB(-1)+AQ9
       *DNPTB(-2)

37:    ANFCUR = A10+(A11*Q1+A12*Q2+A13*Q3+A14*Q4+A15*Q5+
       A16*Q6+A17*Q7+A18*Q8+A19*Q9+A20*Q10+A21*Q11)*
       YDPSAD+A22*YDPSAD+A23*YDPSAD(-1)

38:    DDB = A30+(A31*Q1+A32*Q2+A33*Q3+A34*Q4+A35*Q5+A36*
       Q6+A37*Q7+A38*Q8+A39*Q9+A40*Q10+A41*Q11)*YDPSAD+
       SUM(I = -11 TO 0 : A43(I)*R90(I))*YDPSAD+SUM(I =
       -11 TO 0 : A42(I)*YDPSAD(I))

39:    DEL(1 : DPB) = A50+(A51*Q1+A52*Q2+A53*Q3+A54*Q4+
       A55*Q5+A56*Q6+A57*Q7+A58*Q8+A59*Q9+A60*Q10+A61*Q11
       )*W+SUM(I = -11 TO 0 : A63(I)*DEL(1 : RSDB(I)-RS(I
       )))*W+SUM(I = -11 TO 0 : A62(I)*DEL(1 : W(I)))+A64
       *DEL(1 : (ACSB(-1)+ACSB)/2)

40:    DNPTB = A70+(A71*Q1+A72*Q2+A73*Q3+A74*Q4+A75*Q5+
       A76*Q6+A77*Q7+A78*Q8+A79*Q9+A80*Q10+A81*Q11)*W+SUM
       (I = -11 TO 0 : A82(I)*RNPT(I))*W+SUM(I = -11 TO 0
        : A83(I)*(0.7*R90(I)+0.3*RTL1(I)))*W+A84*W

41:    DSTL = A90+A91*DSTL(-1)+A92*YDPSAD+A93*(RSDTL-RSDB
```

```
        )*YDPSAD+A94*DEL(1 : ACSB)

42:     DTL1 = A100+SUM(I = -11 TO 0 : A101(I)*RTL1(I))*W+
        SUM(I = -11 TO 0 : A102(I)*RNPT(I))*W+A103*W

43:     DEL(1 : DTL2) = A110+SUM(I = -11 TO 0 : A111(I)*
        DEL(1 : W(I)))+SUM(I = -11 TO 0 : A112(I)*DEL(1 :
        RTL2(I)))*W+SUM(I = -11 TO 0 : A113(I)*DEL(1 : RS(
        I)))*W+A114*DEL(1 : ACSB)

44:     ANPAP = A130+(A131*Q1+A132*Q2+A133*Q3+A134*Q4+A135
        *Q5+A136*Q6+A137*Q7+A138*Q8+A139*Q9+A140*Q10+A141*
        Q11)*W+SUM(I = -11 TO 0 : A142(I)*R90(I))*W+SUM(I
         = -11 TO 0 : A143(I)*RNPT(I))*W+A144*W

45:     DEL(1 : W) = A150+(A151*Q1+A152*Q2+A153*Q3+A154*Q4
        +A155*Q5+A156*Q6+A157*Q7+A158*Q8+A159*Q9+A160*Q10+
        A161*Q11)*YDPSAD+A162*YDPSAD

46:     ABM == ABM(-1)+DISB-REPB-NSTP

47:     UC == UC(-1)+SUM(I = -12 TO 0 : C4(I))*HAPB-DISB

48:     REPB/ABM(-1) = K0+K1*SQ1+K2*SQ2+K3*SQ3+K4*(RMC-SUM
        (I = -48 TO -37 : RMC(I))/12)

49:     DISB = B0+B1*Q1*S+B2*Q2*S+B3*Q3*S+B4*Q4*S+B5*Q5*S+
        B6*Q6*S+B7*Q7*S+B8*Q8*S+B9*Q9*S+B10*Q10*S+B11*Q11*
        S+SUM(I = -12 TO 0 : C4(I)*HAPB(I))

50:     LOG(HAPB) = AB0+AB1*Q1+AB2*Q2+AB3*Q3+AB4*Q4+AB5*Q5
        +AB6*Q6+AB7*Q7+AB8*Q8+AB9*Q9+AB10*Q10+AB11*Q11+SUM
        (I = -6 TO 0 : C1(I)*(RMC(I)-RSM(I)))*S+SUM(I = -3
         TO 0 : C23(I)*LOG(ABT(I)))+AB12*LOG(ABM(-1)+UC(-1
        )-REPB-NSTP)+AB13*LOG(HAPB(-1))

51:     50*(EXCASH+EXCASH(-1))/DSTATB = D0+D1*Q1+D2*Q2+D3*
        Q3+D4*Q4+D5*Q5+D6*Q6+D7*Q7+D8*Q8+D9*Q9+D10*Q10+D11
        *Q11+D12*RDAY+D13*RBANKM

52:     DEL(1 : ABDL) == 0.075*DEL(1 : EXSEC+RQSEC-EXCASH)

53:     DEL(1 : ABTB) == 0.925*DEL(1 : EXSEC+RQSEC-EXCASH)

54:     LOG(EXSEC) = E0+E1*Q1+E2*Q2+E3*Q3+E4*Q4+E5*Q5+E6*
        Q6+E7*Q7+E8*Q8+E9*Q9+E10*Q10+E11*Q11+E12*LOG(EXSEC
```

```
(-1))+E13*(RTBM-RSM)+E15*SRW

55:   DEL(1 : ABSC) = G0+G16*DEL(1 : ABSC(-1))+G1*Q1*S+
      G2*Q2*S+G3*Q3*S+G4*Q4*S+G5*Q5*S+G6*Q6*S+G7*Q7*S+G8
      *Q8*S+G9*Q9*S+G10*Q10*S+G11*Q11*S+G13*DEL(1 :
      REDEM)+G14*DEL(1 : RECLASS)+G15*(IF NNIS GT 0
       THEN DEL(1 : NNIS) ELSE 0)+SUM(I = -3 TO 0 : G(I)
      *DEL(1 : RSM-RDAY(I)))*S

56:   DEL(1 : ABLC) = H0+H15*DEL(1 : ABLC(-1))+H1*Q1*S+
      H2*Q2*S+H3*Q3*S+H4*Q4*S+H5*Q5*S+H6*Q6*S+H7*Q7*S+H8
      *Q8*S+H9*Q9*S+H10*Q10*S+H11*Q11*S+H12*DEL(1 : ABT-
      (RQCASH+RQSEC+ABM))+H13*DEL(1 : RECLASS)+H14*(IF
      NNIL GT 0 THEN DEL(1 : NNIL) ELSE 0)

57:   DEL(1 : ABCS) = I0+I14*DEL(1 : ABCS(-1))+I1*Q1*S+
      I2*Q2*S+I3*Q3*S+I4*Q4*S+I5*Q5*S+I6*Q6*S+I7*Q7*S+I8
      *Q8*S+I9*Q9*S+I10*Q10*S+I11*Q11*S+I12*DEL(2 : ABT)
      +I13*DEL(2 : RQCASH+RQSEC+ABM)+SUM(I = -3 TO 0 :
      C12(I)*DEL(1 : RCS-RDAY(I)))*S

58:   DEL(1 : ABCL) = J0+J1*Q1*S+J2*Q2*S+J3*Q3*S+J4*Q4*S
      +J5*Q5*S+J6*Q6*S+J7*Q7*S+J8*Q8*S+J9*Q9*S+J10*Q10*S
      +J11*Q11*S+J12*DEL(1 : ABT-(RQCASH+RQSEC+ABM))+SUM
      (I = -3 TO 0 : J22(I)*DEL(1 : RSM-RDAY(I)))*S

59:   DEL(1 : ABLP) = L0+L15*DEL(1 : ABLP(-1))+(L1*Q1+L2
      *Q2+L3*Q3+L4*Q4+L5*Q5+L6*Q6+L7*Q7+L8*Q8+L9*Q9+L10*
      Q10+L11*Q11)*ABLP(-1)+L12*DEL(1 : CDOSD)+L13*DEL(2
       : ABT-RQCASH-RQSEC-ABM)+L14*DEL(2 : RPRIME-400*(
      PCON-PCON(-3))/PCON(-3))*ABLP(-1)

60:   ABLB = L20+(L21*ABLB(-1)*Q1+L22*ABLB(-1)*Q2+L23*
      ABLB(-1)*Q3+L24*ABLB(-1)*Q4+L25*ABLB(-1)*Q5+L26*
      ABLB(-1)*Q6+L27*ABLB(-1)*Q7+L28*ABLB(-1)*Q8+L29*
      ABLB(-1)*Q9+L30*ABLB(-1)*Q10+L31*ABLB(-1)*Q11)+L32
      *FRQ+L33*(ABT-RQCASH-RQSEC-ABM)+L34*(RPRIME-R90)*
      ABLB(-1)+L35*(RPRIME-RPRIME2)*ABLB(-1)+L36*ABLB(-1
      )

61:   ABN = N0+(N1*Q1+N2*Q2+N3*Q3+N4*Q4+N5*Q5+N6*Q6+N7*
      Q7+N8*Q8+N9*Q9+N10*Q10+N11*Q11)*ANFCUR+N12*ANFCUR+
      N13*DEL(1 : ANFCUR)

62:   TC = N14*ABN(-1)+N15*ABN(-2)
```

```
63:      ABD == RQCASH+EXCASH-TC

64:      ABGL == 0.5*(ABLP+ABLB+ABLP(-1)+ABLB(-1))

65:      ABL == ABGL+ABLO

66:      LIQA == ABN+ABD+ABDL+ABCL+ABTB+ABSC+ABLC

67:      LLA == ABL+ABM+ABCS

68:      TCDMA == LIQA+LLA

69:      ABNFA == ABT-TCDMA

70:      FLARATIO == (LIQA-RQCASH-RQSEC)/TCDMA

71:      DEL(1 : ATLM) = AT1+AT2*SQ1*ATLM(-1)+AT3*SQ2*ATLM(
         -1)+AT4*SQ3*ATLM(-1)+SUM(I = -11 TO 0 : AT5(I)*DEL
         (1 : DSTL(I)+DTL2(I)))+SUM(I = -6 TO 0 : AT6(I)*
         DEL(1 : RMC(I)-RS(I))*(DSTL+DTL2))

72:      M1 == DDB+ANFCUR

73:      M2 == M1+DPB+DNPTB

74:      SEASCUR == (A11*Q1+A12*Q2+A13*Q3+A14*Q4+A15*Q5+A16
         *Q6+A17*Q7+A18*Q8+A19*Q9+A20*Q10+A21*Q11)*YDPSAD

75:      SEASDDB == (A31*Q1+A32*Q2+A33*Q3+A34*Q4+A35*Q5+A36
         *Q6+A37*Q7+A38*Q8+A39*Q9+A40*Q10+A41*Q11)*YDPSAD

76:      SEASDPB == (A51*Q1+A52*Q2+A53*Q3+A54*Q4+A55*Q5+A56
         *Q6+A57*Q7+A58*Q8+A59*Q9+A60*Q10+A61*Q11)*W

77:      SEASNPT == (A71*Q1+A72*Q2+A73*Q3+A74*Q4+A75*Q5+A76
         *Q6+A77*Q7+A78*Q8+A79*Q9+A80*Q10+A11*Q11)*W

78:      ANFCURSA == ANFCUR-SEASCUR

79:      DDBSA == DDB-SEASDDB

80:      DPBSA == DPB-SEASDPB

81:      DNPTBSA == DNPTB-SEASNPT

82:      M1SA == ANFCURSA+DDBSA
```

```
83:        M2SA == M1SA+DPBSA+DNPTBSA

84:        PCM1 == 100*DEL(12 : M1)/M1(-12)

85:        PCM2 == 100*DEL(12 : M2)/M2(-12)
```

APPENDIX E

ALPHABETICAL LIST OF VARIABLES

These variables have mnemonic titles that follow a naming scheme we have developed and, in the case of RDX2 variables, the scheme developed for RDX2 [16]. The descriptions are of series based on the averages of Wednesdays in a month unless otherwise indicated. Numbers preceded by B or D are CANSIM [5][6] series numbers. For an explanation of TROLL [25] notation see APPENDIX C.

Short Canadas are Government of Canada bonds of less than three years to maturity. Long Canadas are Government of Canada bonds of three years and over to maturity. Canadas are Government of Canada direct and guaranteed bonds outstanding.

ALPHABETICAL LIST OF VARIABLES

An asterisk before a description indicates that the variable is exogenous.

Name	Description	Source
ABCBI	*Bank of Canada balancing asset.	B51+B55+.5*(B254 +B254(-1))-B2
ABCL	Chartered bank call loans.	B411
ABCLC	Bank of Canada holdings of long Canadas.	B6
ABCS	Chartered bank holdings of provincial, municipal, and corporate securities.	B415
ABCSC	Bank of Canada holdings of short Canadas.	B5
ABCTB	*Bank of Canada holdings of Government of Canada treasury bills.	B3
ABD	Chartered bank deposits with Bank of Canada.	B404
ABDL	Chartered bank day loans.	B405
ABGL	Chartered bank general loans.	B425
ABL	Chartered bank general and other Canadian dollar loans.	B420+B426
ABLB	Chartered bank business and miscellaneous general loans (month-end).	B1400-B1405
ABLC	Chartered bank holdings of long Canadas.	B409
ABLO	*Other chartered bank loans.	B421+B422 +B423+B426
ABLP	Chartered bank personal loans (month-end).	B1405
ABM	Chartered bank mortgage loans.	B419+B427
ABN	Chartered bank holdings of	B403

	Bank of Canada notes.	
ABNFA	Chartered bank net foreign assets.	B410
ABSC	Chartered bank holdings of short Canadas.	B408
ABTB	Chartered bank holdings of Government of Canada treasury bills.	B406
ACSB	*Canada Savings Bonds outstanding (month-end).	B2406
ANFCOIN	Coin held outside banks.	B2003
ANFCUR	Currency held outside banks.	B2001
ANFLC	Long Canadas held by the public (month-end).	B2440-B2477 -B2446-B2406
ANFSC	Short Canadas held by the public (month-end).	B2446
ANFTB	*Government of Canada treasury bills held by the public (month-end).	B2477
ANPAP	Commercial paper outstanding (month-end).	B17417+B15002
ATLM	Trust and mortgage loan company mortgages.	Bank of Canada
B1	*Balancing liability of chartered banks.	B400-B465-.5*(B652 +B652(-1))
CDOSD	*Consumption of durables and semi-durables. Seasonally adjusted.	Interpolated from D40284+D40285
DBT	Chartered bank Canadian dollar deposits.	B465+.5*(B652 +B652(-1))
DDB	Chartered bank demand deposits, less items in transit.	B459
DDFGB	*Government of Canada deposits with chartered banks (month-end).	B652
DFGBC	*Government of Canada deposits with Bank of Canada (month-end).	B254
DISB	Chartered bank disbursements	Bank of Canada

	of mortgage loans.	
DNPTB	Chartered bank non-personal term and notice deposits.	B455
DPB	Chartered bank personal savings deposits.	B451
DSTAT1	Chartered bank statutory demand deposits.	B813
DSTAT2	Chartered bank statutory time deposits.	B814
DSTL	Trust and mortgage loan company savings deposits.	Bank of Canada
DTL1	Trust and mortgage loan company time deposits of one year and under.	Bank of Canada
DTL2	Trust and mortgage loan company time deposits of over one year.	Bank of Canada
EXCASH	Chartered bank excess statutory cash reserves (average of days).	B801-B810
EXSEC	Chartered bank excess secondary reserves.	B801-B810 +B406+B405 -.01*B811*B806
FGB	Government of Canada bonds outstanding.	B4+B407+B2478
FGTB	Government of Canada treasury bills outstanding.	B406+B3+B2477
FLARATIO	The chartered bank free Canadian dollar liquid asset ratio.	(B466-B810 -.01*B811*B806)/B499
FLOAT	*Chartered bank Canadian dollar items in transit (month-end).	B460
FRBI	*Government of Canada balancing item.	DEL(B2440+B406 +B407+B2-B2482)
FRFG	*Government of Canada net financing requirement including foreign exchange (month-end).	DEL(B2482-B652 -B254)
FRQ	*External financing requirement of corporations. Monthly rates unadjusted for seasonal variation.	Interpolated from D40023+D40024 +D40027-D40002 -D40182

HAPB	Chartered bank mortgage loan approvals.	Central Mortgage and Housing Corporation.
M1	Currency and demand deposits (The narrow money supply).	B459+B2001
M2	The broad money supply.	B459+B2001 +B451+B455
NNIL	*Government of Canada net new issues of long Canadas.	B6+B409+B2477 -B2446-B2406
NSTP	*Chartered bank net sales of mortgages to third parties.	DISB-DEL(B419 +B427)-REPB
PBSC	*Ratio of Bank of Canada holdings of short Canadas to Canadas outstanding.	B5/B4
PCON	*Consumption deflator. Seasonally adjusted.	Interpolated from D40477
PFX	*Spot foreign exchange rate (average of days).	B3400
PFXF	*Ninety-day forward exchange rate (average of days).	B3401
Q1 to Q11	*Monthly dummies, Qi equals 1 in month i, -1 in month 12, zero elsewhere.	
RBANK	*Bank rate (month-end).	B14006
RCB2	*Average U.S. corporate industrial bond rate (month-end).	B54410
RCS	The unweighted average of rates on provincial, municipal, and corporate securities (centred to mid-month).	[B14014+B14014(-1) +B14015+B14015(-1) +B14016+B14016(-1)]/6
RDAY	Day loan rate.	B14002
RECLASS	*Chartered bank long Canadas moving into the category of short Canadas during month.	Confidential
REDEM	*Chartered bank short Canadas maturing during month.	Confidential
REL	Chartered bank free liquid asset ratio.	100(B466-B810 -.01*B806*B811+B410) /B400

REPB	Repayments of chartered bank mortgage loans.	Bank of Canada
RMC	Conventional mortgage loan rate (mid-month).	B14024
RML	Rate on Government of Canada bonds of five to ten years to maturity (month-end).	B14011
RNPT	Rate on chartered bank ninety-day deposit receipts (month-end).	B14018
RPRIME	Chartered bank prime rate (month-end).	B14020
RPRIME2	*U.S. prime rate.	B54404
RQCASH	Chartered bank required primary reserves (average of days).	B810
RQSEC	Chartered bank required secondary reserves.	.01*B811*B806
RRQSEC	*Required secondary reserve ratio.	B811
RS	Rate on short Canadas (month-end).	B14009
RSDB	Rate on chartered bank non-chequable savings deposits (month-end).	B14019
RSDTL	Rate on trust and mortgage loan company savings deposits (month-end).	Bank of Canada
RTB	Rate on three-month Government of Canada bills (month-end).	B14017
RTB2	*U.S. treasury bill rate.	B54409
RTL1	Rate on trust and mortgage loan company time deposits of one year and under to maturity (month-end)	Bank of Canada
RTL2	Rate on trust and mortgage loan company time deposits of over one year to maturity (month-end).	Bank of Canada
R90	Rate on ninety-day finance company paper (month-end).	B14017

SQ1 to SQ3	*Quarterly dummies, SQi equals 1 in quarter i, -1 in quarter 4, zero elsewhere.	
SRW	*Dummy variable for warning given to chartered banks of increase in the required secondary reserve ratio: 1 in month before an increase, 0 elsewhere.	
TC	Statutory notes (till cash).	B803
TCDMA	Total Canadian dollar major assets.	B499
UC	Undisbursed mortgage commitments of chartered banks.	Bank of Canada
W	Deposits and other liquid assets held by public.	Bank of Canada
YDPSAD	*A monthly measure of current-dollar domestic product (s.a.).	D100051* interpolated D40514, scaled

APPENDIX C

TROLL NOTATION CONVENTIONS

The symbols listed below are used in the text and since they do not follow standard mathematical notation they deserve explanation. For a complete description of TROLL see [25].

(1) Lags

X(-n) stands for X_{t-n}

(2) Differencing

DEL(n:X) stands for $X_t - X_{t-n}$

(3) Distributed Lags

SUM(I = - n TO 0:G(I)*X(I)) stands for $\sum_{i=0}^{n} G_{-i}X_{-i}$

where the lag weights go from G_0 to G_{-n}.

(4) Conditional Statements

The command "IF a THEN expression 1 ELSE expression 2" calculates a numerical value using either expression 1 or expression 2, depending on whether the logical expression a is true or false.

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Printed in Canada Imprimé au Canada