ASSETS AND LIABILITIES OF CHARTERED BANKS:

AN ECONOMETRIC ANALYSIS

by

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In this thesis I extend empirical knowledge of bank portfolio behaviour in Canada, using econometric techniques, in two major respects.

First, I argue that the nature of the legal reserve restraints in Canada (in the period 1954-1965) is such that the demand equation for excess reserves is not identifiable in a model which aggregates over all banks. Therefore, bank earning asset accumulation must be examined directly by estimating equations which explain the demand by banks for the components of their earning asset portfolio.

Second, I investigate the influence of interest rate expectations on the portfolio behaviour of banks and the non-bank public (insofar as the public's behaviour is reflected in its demand for bank liabilities). Further, I extend analysis of the effects of risk on these markets, since the theory of portfolio selection holds

that the risk associated with a given expected return is an important variable in investors' utility functions.

Equations are estimated by ordinary least squares which explain bank demand for the main components of earning assets and the supply and demand for bank liabilities. Explanatory variables in the equations include expectations and risk variables, along with others dictated by the theory of bank and public portfolio behaviour.

The econometric results are mediocre in the case of the bank asset equations and good in the case of supply and demand equations for liabilities. In both cases interest rate expectations and risk are found to exert significant influence though the results are much stronger in the demand equations for liabilities than in the equations which explain bank demand for earning assets.

SHORT TITLE:

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Computations in this thesis were done, using the Massager programme written by M. C. McCracken, on the computer facilities of the Bank of Canada.

The views expressed in this study are my personal views, and no responsibility for them should be attributed to the Bank of Canada.

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CHAPTER 1

INTRODUCTION AND METHODS

Introduction:

In this study I attempt to extend existing empirical knowledge of the portfolio behaviour of the Canadian banking system, a group of institutions which bulks large among financial intermediaries and is the first link in the chain connecting monetary policy with expenditure on goods and services. Existing models of the financial sector frequently use the equations depicting bank portfolio behaviour (in conjunction with equations representing demand for bank liabilities by the non-bank public) to determine a representative short-term interest rate. The notion is that the short-term rate is the price which clears the market for demand deposits, i.e. the short-term rate adjusts so that the supply of demand deposits is equal to the demand. Banks supply liabilities in exchange for their purchases of earning assets and part of this flow of total liabilities is exchanged by the general public for time deposits.[1] Therefore, given bank demand for earning assets and public demand for time deposits, the balance sheet identity determines the 'supply' of demand deposits. If the

[1] Time deposits are assumed to be demand-determined so that supply equals demand. The usual assumption about bank supply of time deposits is that the banks set the interest rate payable on these deposits and have a perfectly elastic supply schedule at that rate.

demand for demand balances (by the public) can be shown to bear a stable relationship to the short-term interest rate[2] (the opportunity cost of holding demand deposits) then this rate can be determined by the equilibrium condition that supply equals demand.[3]

I attempt to add to existing econometric research on the Canadian banking system in two respects. First, I argue that most existing studies do not take adequate account of the way in which the Canadian cash reserve constraint is defined. Where these studies do attempt to incorporate the institutional peculiarities, they use, in my opinion, rather implausible

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[2] That a relationship of this kind is consistent with the Canadian evidence is demonstrated in this study.

[3] In general, the system may be written as follows in terms of flows. Stochastic equations are indicated by the functional notation, f ( ).

$$
\begin{aligned}
\Delta EA &= f(r, \text{etc.}), \\
\Delta TD^D &= f(r_{TD}, \text{etc.}), \\
\Delta TD^S &= \Delta TD^D, \\
\Delta DD^S &= \Delta EA + \Delta R - \Delta TD, \\
\Delta DD^D &= f(r, \text{etc.}), \\
\Delta DD^S &= \Delta DD^D,
\end{aligned}
$$

where,

EA = earning assets of the banking system,
r = short-term interest rate,
R = cash reserves,
TD = time deposits,
r_{TD} = interest rate on time deposits,
DD = demand deposits,

superscripts S, D = supply and demand respectively.

The simplified system has six equations in six unknowns; earning assets, supply and demand of time deposits, supply and demand of demand deposits, and the short-term interest rate. Reserves are an exogenous variable.

hypotheses about the behaviour of the banking system. In Chapter 2 I develop these ideas. I survey the theoretical literature (which is written mainly in the context of the United States banking system) and follow this with a discussion of the reserve constraint in Canada. In light of these considerations I examine critically the existing empirical and descriptive literature on the Canadian system. I conclude the chapter with a general outline of how I propose to formulate a model of bank behaviour.

The second improvement I have made in econometric analysis of bank behaviour is to include variables in the equations representing expected capital gains or losses from future changes in interest rates, and the uncertainty associated with these expectations. The variables may be expected to influence the demand by the non-bank public for bank liabilities as well as the demand for earning assets by banks. The influence of expectations and uncertainty on all of these equations is examined. In Chapter 3 I outline the theory of portfolio selection, which maintains that interest rate expectations and uncertainty are critical variables influencing the distribution of investors' liquid asset portfolios between financial claims which have zero term to maturity ('money') and positive term to maturity ('bonds'). Following this I discuss recent changes in Canadian financial markets which are thought to have contributed to changes in uncertainty. Finally, I discuss the hypotheses tested with respect to the formation of interest rate expectations, and the way in which both expectations and uncertainty variables are measured.

In Chapters 4 and 5 I present the empirical results of testing the hypotheses developed in Chapters 2 and 3. These hypotheses are used, together with others required to complete the specification of the equations, in estimating equations which determine the amounts of some of the components of total bank earning assets and most of the components of bank liabilities.

Method:

All of the estimation in this study is done using ordinary least squares. This involves treating variables as exogenous when they are in fact endogenous with the result that, in many equations, the assumption of independence between explanatory variable and error term is violated. This results in parameter estimates which are not only biased but inconsistent.[4] Consistent estimates would be obtained by using a simultaneous estimator such as two-stage least squares. The usefulness of such estimators, however, is reduced by the fact that little is known about their small-sample properties.[5] This difficulty, plus the fact that consistent estimation requires knowledge of the causal structure throughout the economy and would involve, in effect, a simultaneous test of a complete model, has led me to the same decision many other investigators have reached in like circumstances, i.e. to use ordinary least squares.[6]

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[4]See J. Johnston, Econometric Methods, (New York: McGraw-Hill Book Company, Inc., 1963), Chapter 9.

[5]Ibid., Chapter 10.

[6]See J. Duesenberry, et al, Brookings Econometric Model of the United States, (Chicago: Rand McNally Publishing Co., 1965); R.H. Rasche and H.T. Shapiro, "The FRB-MIT Econometric Model: Its Special Features," paper presented to the American Economic Association, Washington, D.C., December, 1967.

Of course, this decision implies the judgment that the differences between single equation and simultaneous estimators are not so great that variables or functional forms accepted (rejected) here would be rejected (accepted) if simultaneous methods were used. Goldfeld (who also followed this procedure in a similar investigation of the U.S. banking system) notes that "a comparison of certain of the single-equation and structural estimates supported this contention."[7] Therefore, the strategy I use is supported by the results of recent, comparable, studies and by the opinion of leading practising econometricians. Clearly, however, it would be desirable to experiment with simultaneous estimators in future attempts to improve the results reported in this study.

In all of the equations a stock adjustment model is used. This model involves the hypothesis that gross additions to the stock in the current period is some fraction of the difference between the desired stock in the current period and the actual stock at the beginning of the period[8], so that,

$$\Delta y_t = \lambda(y^*_t - y_{t-1}), \qquad (1)$$

where,

y^* = desired stock of y,
λ = coefficient of adjustment.

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[7] S.M. Goldfeld, Commercial Bank Behavior and Economic Activity, (Amsterdam: North Holland Publishing Company, 1966), pp. 36-37.

[8] A.S. Goldberger, Econometric Theory, (New York: John Wiley and Sons Inc., 1964), pp. 275-276.

Since y^*_t is, in practice, unobservable, the model assumes that

$$y^*_t = \beta X_t, \tag{2}$$

where,

X_t = a vector of explanatory variables,
β = the vector of coefficients associated with X_t.

Substitution of (2) in (1) yields,

$$\Delta y_t = \lambda\beta X_t - \lambda y_{t-1} + u, \tag{3}$$

where,

u = error term,

which is the form in which most equations below are estimated. Of course, X_t varies with the equation being considered. Its composition is discussed in the chapters which report the empirical results. Though this form is a simple means of allowing for a response lag due, for example, to lags in the spread of information, it should be noted that the estimates of the coefficient (λ) will be biased.[9] Moreover, if the corresponding residuals are serially correlated, the estimates will not only be biased but will be inconsistent.[10]

In many cases in this study there is reason to believe that the desired stock of a financial asset is a function of a series of lagged values of an explanatory variable as well as the current value. Given the relatively small sample size and the high collinearity among successive

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[9] Johnston, Econometric Methods, pp. 211-215

[10] Ibid., pp. 216-217. Griliches has demonstrated that the coefficient of adjustment will be biased downward if the autocorrelation is positive. Further, the Durbin-Watson statistic will, in these cases, be biased in the direction of indicating no significant serial correlation in the residuals. ("A Note on Serial Correlation Bias in Estimates of Distributed Lags," Econometrica, 29, (January, 1961), pp. 65-73.)

values of the same variable, I use techniques which reduce substantially the number of parameters to be estimated in the least-squares equation. For the most part I use a technique developed by Shirley Almon which constrains distributed lag weights to lie on a polynomial of specified degree.[11] The technique involves forming weighted averages of past values of the variables, the weights being values of Lagrangian interpolation polynomials. These weighted averages ('Almon variables') are then used as independent variables in a linear regression equation and the lag weights subsequently unscrambled from the estimated parameters and the interpolation polynomials. Since all points on a polynomial of degree q are known if q + 1 points can be determined and since there are, in most cases, theoretical grounds for expecting the distributed lag to terminate at some finite point in the past, this technique determines a lag distribution of any length using only q degrees of freedom. In many instances satisfactory fits can be obtained using polynomials of degree two or three.

I test for the significance of seasonality in the various dependent variables by using dummy variables, normalizing on the fourth quarter. This method assumes constant, additive, seasonal factors and so will not reflect the possibility that the seasonal factors are proportional to the size of the dependent variable.

The sample period used in estimating the equations is 1955-65 in the case of demand equations for bank liabilities, and 1957-65 in the case of

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[11] Shirley Almon, "The Distributed Lag Between Capital Appropriations and Expenditures," Econometrica, 33, (January, 1965).

equations representing bank demand for earning assets. In the former case I begin with 1955 largely because data for one of the explanatory variables used (average term to maturity of government debt held by the general public) is not available for prior years. As to the equations dealing with bank asset preferences, I begin no earlier than 1957 because in 1954-56 the system was characterized by adjustment to the structural reforms of the Bank Act revisions of 1954. Most important among these were the introduction of the 8 per cent reserve requirement and of a short-term money market.[12] The banks reacted to the institution of the money market by gradually reducing their cash ratio over the period 1954-55. Then, in mid-1956, there was a further disruption when the banks agreed to a request by the Bank of Canada that they keep a minimum of 15 per cent of their deposit liabilities in the form of 'liquid assets' defined as cash reserves, day-to-day loans and Treasury Bills.[13] The equation representing bank supply of non-personal term deposits is estimated only over the period 1961-65 since the banks did not attempt to influence the composition of their liabilities until 1961.

The equations are estimated on a quarterly basis and all data are averages over the quarter.[14]

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[12] See J.S.G. Wilson, "The Canadian Money Market Experiment," Banca Nazionale del Lavoro Quarterly Review, No. 44, (March, 1958).

[13] Bank of Canada, Evidence of the Governor Before the Royal Commission on Banking and Finance, (Ottawa, 1964), p. 143.

[14] Throughout this thesis dollar variables are measured in millions and interest rates in per cent per year.

CHAPTER 2

THE DETERMINATION OF TOTAL BANK ASSETS: A SURVEY OF THE LITERATURE

Introduction:

In this chapter I first review the theory of how total bank assets are determined and report very briefly the results of applying the theory to United States data. This is followed by a description of the Canadian institutional environment. In particular, I wish to point out the differences between Canada and the United States in the formulation of the legal restraints on the banking system, and to examine the consequences of these differences for the way in which the theory is tested.

In the light of the foregoing, I then give a critical review of existing empirical applications of the theory to the Canadian banking system and conclude that it is highly probable that these applications depict associative and not causal behaviour. Finally, I outline in a general way what I consider to be a more nearly valid test of the theory than any of the existing empirical work provides.

Determinants of Excess Reserves:

Commercial banks in Canada and the United States are required by law to maintain a given minimum percentage of total assets (liabilities) in the form of currency and deposits with the central bank. Clearly, if banks as a group translate all (or a constant proportion of) legal reserves into required reserves by accumulating assets, then total assets are identically equal to a given multiple of the reserves made available by the central bank. Until recently the supply of money was assumed to bear a constant relationship to the volume of legal reserves in the bank system. Johnson states that

> The theory of money supply is virtually a newly discovered area of monetary research. The general practice in monetary theory has been to treat the quantity of money as determined directly by the monetary authority, without reference to the links intervening between reserves provided by the central bank on the one hand, and the total of currency and bank deposits on the other. This treatment has rested on a mechanical analysis of the determination of money supply, very similar to the out-moded treatment of velocity, in which the money supply is related to the reserve base by a multiplier determined by the reserve ratio observed by the banking system, and the ratio between currency and deposits held by the public. In conformity with developments on the side of demand, the trend of recent research on money supply has been towards treating these ratios as behaviour relationships reflecting asset choices rather than as exogenous variables . . . in the process evolving a less mechanical theory of central bank control.[1]

Though current monetary theory views the decision by banks whether or not to use total bank reserves to change earning assets as

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[1] H. G. Johnson, "Monetary Theory and Policy," Chapter 1 in Surveys of Economic Theory, Vol. 1: Money, Interest, Welfare, (London: MacMillan and Company Limited, 1965), p. 21. The assumption of constancy in the reserve ratios desired by banks is used in the analysis by W. F. Crick, "The Genesis of Bank Deposits," Economica, 7, (1927) pp. 191-202; reprinted as Chapter 4 in Readings in Monetary Theory, selected by a Committee of the American Economic Association,

an economic one (subject, of course, to the legal constraints on reserve ratios), it is still conceptually simple to determine, in an econometric model, the amount of earning assets demanded by banks. This is so because the total amount of bank assets is known if three quantities can be determined: 1) total reserves in the banking system, 2) the reserve requirement ratio, 3) the quantity of reserves held by the banks in excess of those required by law. This can be shown easily using the following identities,

$$R_T = R_R + R_E, \qquad (1)$$

$$TA = TD = R_R/r, \qquad (2)$$

where,

R_T = currency plus central bank deposits held by the banking system,

R_R = required reserves,

R_E = excess reserves,

TA = total bank assets,

TD = total bank liabilities,

r = the reserve requirement ratio.

Total bank reserves (R_T) may change as a result of currency drains to or from the non-bank public, or as a result of open market operations by the central bank. In either case, they are exogenous to

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(New York: The Blakiston Company, 1951). Textbook examples of the mechanical analysis of the determination of money supply are: K. E. Boulding, Economic Analysis, 3rd edition, (New York: Harper and Row, 1955), Chapter 17; A. G. Hart and P. B. Kenen, Money, Debt and Economic Activity, 3rd edition, (Englewood-Cliffs, N. J. Prentice-Hall, Inc., 1961), Chapter 4. The latter reference notes the possibility that banks may hold reserves in excess of those legally required but there is little discussion of the determinants of excess reserves.

the banking system. Therefore, if the amount of excess reserves can be determined, the amount of required reserves is obtained residually. Finally, if required reserves are known, total deposits (and hence total assets) are determined by identity (2).[2] This assumes, of course, that deposits and required reserves are generated simultaneously. The relationships imposed on the banking system by the reserve constraint imply that bank demand for total assets (or supply of liabilities by banks) can be determined with only one behavioural equation which explains bank demand for excess reserves.

Excess reserve balances are held by banks for precautionary purposes.[3] Hence they are analogous to money balances held, for the same reason, by individuals and, in general, the theory of 'liquidity preference' should be used in deriving hypotheses about bank behaviour with respect to excess reserve holdings. I discuss the theory of liquidity preference in the following chapter and I anticipate the results of that analysis to the extent of pointing out that, in general, the demand for money balances (where money is defined to be non-interest bearing, demand, balances) is hypothesized to vary inversely with the expected opportunity cost of holding them. Theoretically the expected opportunity cost (which

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[2] This description is a simplification in that commercial bank borrowing from the central bank is assumed to be zero. Where this is not true the quantity of borrowed reserves would also have to be determined.

[3] In a sense reserves are held as transactions balances, to bridge the gap in time between inflows and outflows resulting from deposit changes. Because of the legal requirement and because there is non-unitary probability of reserve flows matching in magnitude over any period in time, I think that reserves in excess of the legal requirement should be regarded as precautionary balances.

is the rate of interest that could be earned on these balances if they were held in the form of interest-bearing financial assets) incorporates not only the current level of the interest rate but also the capital gain (or loss) expected to be realized over the holding-period, and the uncertainty with which that expectation is held.

The theory has been applied to the determination of excess reserves by Meigs and Tobin.[4] In fact the concept used is free reserves which are equal to excess reserves minus borrowing.[5] Meigs tests the hypothesis that "each bank attempts to maintain some desired free-reserve position to provide for expected and unexpected clearings drains and that this desired reserve position is

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[4]A. J. Meigs, Free Reserves and the Money Supply, (Chicago: University of Chicago Press, 1962); J. Tobin, unpublished manuscript, cited in R. A. Johnston, "The Canadian Experience with the Floating Discount Rate," Yale Economic Essays, 6, (Spring, 1966), pp. 3-11.

[5]Most of the theoretical discussion has taken place in the context of the United States banking system where borrowing from the central bank is widespread. In effect free reserves are a measure of the extent to which banks use the reserves supplied at the discretion of the central bank (unborrowed reserves) to generate earning assets (deposits) and hence required reserves. This can be seen in the following identities,

$$R_T = R_U + R_B,$$
$$R_E = R_U + R_B - R_R,$$
$$R_F = R_E - R_B = R_U - R_R$$

where,

R = cash reserves of banks, and

subscripts are,
B = borrowed,
E = excess,
R = required,
T = total,
U = unborrowed,
F = free

related to total deposits, market interest rates, and the discount rate". [6] He uses yields to maturity on short-term government bonds to represent the opportunity cost of holding excess reserves. This assumes, implicitly, either that banks hold the securities to maturity or that expected capital gains are negligible. Meigs also assumes that desired free reserves are proportional to deposits so that the dependent variable in the equation is the ratio of free reserves to total bank deposit liabilities. Meigs notes that this relationship applies only if total unborrowed reserves in the banking system remain constant. If unborrowed reserves change, then the actual free reserve ratio may be different from the desired ratio. This leads Meigs to expand the free reserve function to include a variable which reflects the rate of change in unborrowed reserves. [7]

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[6] A. J. Meigs, Free Reserves and the Money Supply, p. 42. Other attempts to deal theoretically with bank demand for cash reserves are contained in: K. Brunner, "A Schema for the Supply Theory of Money," International Economic Review, 2, (January, 1961) pp. 79-109; and D. Orr and W. G. Mellon, "Stochastic Reserve Losses and Expansion of Bank Credit," American Economic Review, 51, (September, 1961), pp. 614-623. The former article examines algebraically the consequences for bank expansion of many sources and uses of reserves, and the latter examines the effects of uncertainty with respect to reserve flows on the expansion of the banking system. In general, the prospect of unexpectedly incurring reserve losses may be expected to induce banks to hold reserves in excess of those required by law. The analysis described in the text (and the empirical research on the banking system which derives from it) assumes this factor to vary only with the level of deposit liabilities. I sympathize with this assumption since the uncertainty referred to is a result of switches in deposit liabilities among banks and is probably very difficult to handle in an empirical analysis of the aggregate banking system.

[7] A. J. Meigs, Free Reserves and the Money Supply, pp. 53-57.

This theory was first tested by Meigs, on United States data, with fair results. His empirical application of the theory is flawed[8] in that he assumes that actual and desired free reserves are always equal and he fails to test for lags in the adjustment of the actual to the desired quantity. Some lag in response to unborrowed reserves is allowed for where this variable is included in the regressions but no provision is made for a dynamic response to interest rates.[9] It is not obvious that the total response to interest rates takes place in the current time period (a month in Meigs' analysis). Also, Meigs' analysis fails to treat the market interest rate as an endogenous variable (this is true of much of the theoretical analysis, as well as of the empirical work). This criticism applies with some force to models of the monetary sector (including this one), since there is undoubtedly a high degree of simultaneity between bank assets and interest rates.

Subsequent investigators have remedied these deficiencies and have obtained acceptable demand equations for free reserves. For example, Goldfeld's final equations, which disaggregate free reserves and explain excess reserves and central bank borrowing of city banks

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[8]For a good critique of Meigs' work see R. G. Davis, "Open Market Operations, Interest Rates and Deposit Growth," Quarterly Journal of Economics, 79, (August, 1965).

[9]A. J. Meigs, Free Reserves and the Money Supply, Chapter 5.

in the United States, are as follows:[10]

$$\Delta E = .142 - \underset{(8.96)}{1.093E_{-1}} - \underset{(2.50)}{.0002r_s(D+T)} + \underset{(1.95)}{.0076\Delta D^*} + \underset{(2.82)}{.0096\Delta D^*_{-1}}$$

$$\bar{R}^2 = .700$$
$$DW = 2.34$$

$$\Delta B = .049 - \underset{(4.67)}{.411B_{-1}} + \underset{(3.34)}{.117\Delta CL} - \underset{(1.44)}{.153(r_d - r_s)} - \underset{(3.27)}{.049\Delta D^*} - \underset{(1.53)}{11.42RR}$$

$$\bar{R}^2 = .705$$
$$DW = 2.34$$

where,

E = excess reserves,
r_s = U.S. Treasury Bill rate,
D = demand deposits,
T = time deposits,
ΔD^* = a variable measuring changes in unborrowed reserves,
B = commercial bank borrowing from the central bank,
CL = commercial loans,
r_d = the discount rate,
RR = required reserves,
$\bar{R}^2$ = coefficient of multiple determination corrected for degrees of freedom,
DW = Durbin-Watson statistic.

It will be noted that the Treasury Bill rate exerts a negative effect on excess reserve holdings and the differential between the discount and bill rates affects borrowing in a negative direction. Though both effects are in the expected direction, the interest rate variable in the borrowing equation is not quite significant at the ten per cent level. Nonetheless, this approach is sufficiently promising that it has been used in most econometric models of the financial sector for the United States.[11]

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[10] S.M. Goldfeld, Commercial Bank Behavior and Economic Activity, p. 131. The estimates were obtained using two-stage least squares applied to quarterly data for the period from the third quarter of 1950 to the second quarter of 1962. Figures in parentheses are 't' values. Seasonal and other dummy variables are omitted here.

[11] See, for example, F. De Leeuw, "A Model of Financial Behavior," Chapter 13 in Duesenberry, et al, Brookings Econometric Model of the United States, and Rasche and Shapiro, "The FRB-MIT Econometric Model: Its Special Features."

I now discuss whether it is likely to be applicable in the Canadian context.

Excess Reserves in the Canadian System:

Clearly, the theory of liquidity preference is applicable to individual banks in Canada. Therefore, if the theory were being tested at the level of the individual bank a model used for United States banks would be conceptually valid for those in Canada, i.e. an equation could be constructed to represent the bank's demand for excess reserves. Problems arise, however, when balance sheet items for all banks are added and an attempt is made to construct an aggregate model of the banking system.

The model discussed in the previous section requires the assumption that changes in required reserves are generated simultaneously with changes in bank assets. This means that banks, and the banking system, can vary their excess reserve holdings (given total reserves) by buying or selling earning assets, thereby increasing or reducing required reserves. Excess reserves of the banking system may legitimately be considered to be a reflection of the liquidity preference of the system and an equation explaining bank demand for excess reserves can be used, along with the legal reserve constraint and the (exogenous) amount of total reserves, to determine total bank assets.

The formulation of the legal restraints in Canada is such that required reserves during the current averaging period (which is one month) are calculated relative to deposit liabilities of the previous month.[12] The vault cash component of total reserves, which is used in the numerator of the required reserve ratio, is defined in the same way as the banks' deposit liabilities so that the reserve constraint is (approximately),

$$BCD_t + VC_{t-1} \geq rD_{t-1},$$

where, BCD = Bank of Canada deposits of chartered banks,
VC = vault cash,
r = required reserve ratio,
D = total chartered bank deposits.

Therefore, the only element in the reserve constraint which is free to vary in the current period is Bank of Canada deposits of the chartered banks. The current month's holdings of vault cash are of no use in meeting current reserve requirements so that the excess reserve variable is defined in terms of Bank of Canada deposits. Therefore,

$$ERL_t = BCD_t - (rD_{t-1} - VC_{t-1}),$$

where, ERL = legal excess reserves.

Now the term in brackets (required Bank of Canada deposits) is predetermined. Therefore, for excess reserves to be endogenous to the banking system, central bank deposits (BCD) would have be to assumed to be endogenous. But,with current vault cash being irrelevant for purposes of meeting the current reserve requirement, Bank of Canada deposits are the means by which the central bank exerts its influence over the system.

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[12] The precise definition of deposit liabilities used in calculating current required reserves is the "average of such deposit liabilities (Canadian dollar deposits) at the close of business on Wednesdays in each of the four consecutive weeks ending with the last Wednesday but one in the preceding month." An Act Respecting Banks and Banking, 2-3 Elizabeth II (1953-54), Chapter 48, Section 71.

Moreover, since required Bank of Canada deposits are predetermined, the Bank of Canada exerts its influence, in fact, by varying legal excess reserves (ERL). It is true that Bank of Canada deposits, and hence legal excess reserves, are endogenous to the banking system in the sense that banks may exchange deposits for vault cash. I do not regard this as a convincing argument for assuming excess reserves to be endogenous since, whatever the banks' demand for vault cash,[13] the central bank can maintain its control over excess reserves by offsetting the resulting changes. In any case, the fact which is important for the way in which a model of bank portfolio behaviour is estimated, is that the banking system cannot affect the current distribution of reserves between required and excess reserves by buying or selling earning assets. I argue in the next section that existing aggregate models of Canadian bank behaviour do not adequately take account of this fact.

Thus far in the discussion I have tacitly assumed that borrowed reserves are zero. I noted above that in empirical work on the United States banking system borrowed reserves are either determined by a separate stochastic equation or subtracted from excess reserves to produce 'free reserves'. Once again, there is an institutional peculiarity in the

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[13] I assume that banks hold vault cash only for transactions purposes. Since current currency holdings are eligible reserves in calculating required Bank of Canada deposits in the next month, it is possible that banks would build up current holdings of vault cash in order to reduce required central bank deposits in the following month. That banks may do this has been suggested in a recent paper; see D.I. Fand and J.E. Tower, "An Analysis of the Money Supply Process in Canada," a paper presented to the Canadian Political Science Association, Ottawa, (May, 1967), p. 7. This point is discussed in the following section. In a broader sense, excess reserves will be endogenous if chartered bank behaviour influences the central bank's supply of reserves. If the central bank has interest rates

Canadian system. Most of the borrowing is done by a group of fifteen investment dealers who, under the terms of the money market revisions of 1954, have been granted borrowing privileges at the Bank of Canada on the security of Treasury Bills, Government of Canada bonds with term to maturity of three years or less, and bankers' acceptances.[14] Borrowing by the dealers at the Bank of Canada is done formally via a sale of securities and an agreement to repurchase (the transactions are known as purchase and resale agreements - PRA). The same securities used as collateral in Bank of Canada borrowing are used for the same purpose in borrowing from the chartered banks via day loans (so named because they are callable daily on the initiative of either party for redemption the same day). Day loans are one of the important short-run adjustment assets in Canadian banking and are used by the dealers to finance inventories of Government of Canada securities.

Essentially, the mechanism is that a bank which wishes to increase its reserves calls day loans. The dealers refinance their inventory at another bank or, if no other bank wishes to increase its volume of day loans, outside the banking system or at the Bank of Canada. In the latter case total reserves in the system are increased. Since PRA are not entered into directly by the chartered banks, the cost-yield considerations involved in decisions to borrow are not relevant for them and I see no

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[14]For a good descriptive account of the Canadian money market see J.S.G. Wilson, "The Canadian Money Market Experiment."

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as the proximate target of monetary policy then it will have to accommodate bank demands for excess reserves in order to achieve its target and excess reserves will be endogenous. The evidence on central bank targets indicates that the authorities have had an interest rate target since 1961. See Chapter 3 below, pp. 56-57.

reason why earning asset acquisition by the banks should be influenced by the amount of PRA outstanding, as opposed to the amount of legal excess reserves in the system. No matter what the level of borrowing via purchase and resale agreements, the central bank can continue to maintain Bank of Canada deposits (and so excess reserves) at levels it desires, and it is these variables which transmit the Bank of Canada's influence to the chartered banks. Direct borrowing by the chartered banks from the Bank of Canada is so infrequent and persists for such short periods of time that I have chosen to ignore it.[15]

Previous Empirical Work on the Canadian System:

There have been two attempts that I know of, articles by Johnston, and Fand and Tower,[16] to apply to the Canadian data the theory of the determination of excess reserves outlined in the first section of this chapter.

Johnston has estimated equations which use the ratio of free reserves (legal excess reserves minus total borrowing from the central bank including purchase and resale agreements) to total current deposits

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[15]The Bank of Canada states that, "Bank of Canada advances to banks were outstanding on 48 business days during 1965 compared with 15 business days in 1964. The maximum amount outstanding on any one day was $31.7 million and the daily average for the year was $1.77 million compared with $0.02 million in 1964." Bank of Canada, Annual Report of the Governor to the Minister of Finance, (Ottawa, 1965), p. 41.

[16]Johnston, "The Canadian Experience with the Floating Discount Rate," and Fand and Tower, "The Money Supply Process in Canada." Since the empirical content of these papers is similar, I will summarize Johnston and deal critically with the Fand-Tower paper at greater length.

as the dependent variable and Bank Rate and interest rates on earning liquid assets as the independent variables. The equations were fitted to weekly and monthly data over various sample periods corresponding to the different Bank Rate regimes between 1954 and 1964. The only period for which significant effects in the expected direction were found was 1954-56. The validity of these results is dubious, as the author recognizes, due to the fact that over a significant part of the period there was a gradual fall in the free reserve ratio as the banks adjusted to the new reserve requirement rules. Concomitantly, interest rates were rising during the expansion of 1955-56. For sample periods 1956-62 and 1962-64 (periods of floating and fixed Bank Rates respectively) the only variable which exerted a significant influence, in the expected direction, on the free reserve ratio was the long-term bond rate.

The Fand-Tower (F-T) paper has the aims of constructing for Canada what the authors call a 'money supply function', and of estimating elasticities of the money supply with respect to interest rates and unborrowed reserves. The procedure[17] is to derive the algebraic expression relating money supply to total reserves, excess reserves, and currency holdings of the public. Then various assumptions are made about the way in which the components of bank reserves vary and the resulting changes in total bank liabilities are examined. The assumptions made about currency adjustments are of the constant ratio (to total money

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[17]The procedure is similar to that contained in D.I. Fand, "Some Implications of Money Supply Analysis," American Economic Review, Papers and Proceedings, 57, (May, 1967), p. 380.

supply), constant stock variety. The most interesting part of the analysis lies in the calculation of the elasticity of the money stock with respect to changes in interest rates. This elasticity will be positive if the free reserve ratio of the banking system is negatively related to market interest rates. Thus, the critical part of the paper lies in the authors' attempt to formulate an equation relating free reserves of the banking system to Bank Rate and a short-term market rate of interest.

The authors recognize that "some notable institutional differences in the two systems (Canada and the United States) would seem to suggest that the free reserve adjustment mechanism would have but a limited scope in Canada." They then note that, "since the free reserve concept has been used in almost every econometric model of the American monetary sector, it seemed worthwhile to explore its possibilities for the Canadian sector."[18] The authors state that "the legal requirements do not impose constraints on the banks in the current period."[19]

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[18] Fand and Tower, "The Money Supply Process in Canada," pp. 9-10.

[19] Ibid, p. 10. If all banks had zero desired legal excess reserves, if each bank always had perfect knowledge of its cash position and if clearings were accomplished instantaneously, then the money multiplier could be infinite for any positive quantity of legal excess reserves. This possibility neglects two limiting factors. The first is the probable reaction of the central bank to the decline in interest rates and increase in money supply that would result, and the second is that the banks undoubtedly would desire to keep some proportion of total assets in the form of legal reserves even if there were no legal requirement.

but they assume that banks are constrained by their net reserve position. This is certainly plausible, though the precise means by which the banks are constrained is not spelled out. The authors are content to observe only that "in Canada, unlike the U.S., the level of free reserves is not completely under the control of the commercial banks since the banks do not raise their required reserves by expanding their deposits."[20] F-T simply assume that the free reserve ratio is a reasonable approximation to a bank behavioural variable and step over the difficulties involved because of the fact that, of the two components of the free reserve measure, one (legal excess reserves) is controlled by the central bank and the other (borrowing from the central bank) is done mainly outside the chartered banks. It is not obvious that the net result of the interactions involved is a ratio which can be considered to be under the control of the chartered banks in the relevant time period (a quarter in this case).

In any case, F-T "assume that the actual holdings of free reserves are determined by the desired free reserves and set up a regression equation similar to those used in American models."[21] The following equation, which is estimated over the period from the second quarter of 1955 to the fourth quarter of 1966, is typical of their results:

$$\frac{\Delta SRF}{DR} = .69 - \underset{(1.31)^{*}}{.17 r_{dd}} - \underset{(4.08)}{1.47}(r_{dd} - r_m) - \underset{(7.6)}{.76}\frac{(SRF)_{-1}}{DR}$$

$$R^2 = .61$$
$$SEE = .85$$

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[20] Ibid., p. 11.

[21] Ibid., p. 11.

where,

SRF = free reserves = (ERL-B),
ERL = legal excess reserves
B = dealer borrowing from the Bank of Canada + chartered bank borrowing from the Bank of Canada,
DR = total current deposit liabilities of the chartered banks,
r_{dd} = day loan rate,
r_m = rate at which dealers borrow from the Bank of Canada = Bank Rate to 1961 2Q = Bank Rate or .25 + TB rate (whichever is lower) from 1961 2Q to 1966 4Q.

*Figures in parentheses are 't' values.

The equation fits the data from 1955-66 reasonably well in terms of the 't' values and the coefficient of determination, though the authors note that there is considerable variation over the sub-periods. They note also that the largest residuals were correlated with periods of large changes in borrowing and that there was little variability in the excess reserve series relative to that in the borrowed reserves series. They maintain that this is evidence for "going beyond the statutory concepts and developing the notion of available excess reserves and available free reserves."[22]

Perhaps the most interesting point raised in the F-T paper relates to the determinants of vault cash of the banking system. I noted above that vault cash of the current period is irrelevant for purposes of the current required reserve calculation. This being so the authors note that, in addition to holding vault cash for transactions purposes, the banks

> ...may also hold excess reserves in the form of vault cash for precautionary purposes. Indeed, there are some obvious advantages to holding excess reserves in this form rather than as deposits in

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[22] Ibid., p. 16.

> the central bank since it will raise statutory vault cash this month and thus lower next month's required deposits in the central bank.[23]

Accordingly, the authors define a new free reserve concept which they term a 'non-statutory' quantity. On what the authors call a 'statutory basis', free reserves are defined as,

$$SRF = ERL - B,$$

and on the non-statutory basis they are defined as, $RF = ERL + VC_e - B$,

where, RF = free reserves (non-statutory basis),
VC_e = current period vault cash held as a precautionary balance,
SRF = free reserves (statutory basis),
ERL = legal excess reserves,
B = borrowing from the central bank (including PRA).

The difficulty is, of course, to partition vault cash so that the VC_e part may be added to SRF, and the new variable, RF, used as the dependent variable in the free reserve equation. The existence of VC_e would affect the magnitude of bank response to interest rates, and so the elasticity of the money supply with respect to interest rates. F-T estimate VC_e by first assuming that vault cash (for transactions purposes) is a constant proportion of total deposits. Given this, an assumption is required about the size of the constant ratio of vault cash to deposits. The authors assume that "when r_{dd} [the day loan rate] was at its maximum rate of 6 per cent VC_e/DR [the ratio of excess vault cash to deposits] was approximately zero."[24] This enables them to construct a VC_e series

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[23] _Ibid._, p. 7.

[24] _Ibid._, p. 17.

by subtracting this constant ratio from the series of the actual vault cash ratio over the sample period. On estimating the relation between VC_e and the day loan rate, the authors find the expected negative sign on the interest rate[25] though they note that the coefficient of determination was low (about .15) in all the estimated equations in which vault cash was used as dependent variable. This is hardly sufficient evidence for accepting the existence of VC_e. As F-T recognize, one would expect the behaviour of vault cash to be dominated by variations in the seasonal and cyclical demands of the public for currency.[26]

I think that the concept of excess vault cash is of dubious validity in Canada. One chartered bank economist has stated that

> vault cash is a variable that is controlled at the branch level, with each branch managing its own vault cash. The branches themselves cannot make use of excess vault cash, and so they would seem to have no incentive to stock it. At head office, where the management of the overall cash position of the bank is carried out, excess vault cash is of no use in dealing with the problems of the current settlement period. With hundreds of branches scattered from coast to coast, data on current vault cash are not available soon enough to be of any use for daily cash management purposes.[27]

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[25] The standard error of the coefficient is not given but the relation between total vault cash and the day loan rate (shown in Fand and Tower, Appendix 1, Table 3, p. 36) gives a negatively signed, significant (the 't' value is about 3.0), coefficient on the rate.

[26] The authors, however, present no evidence on this point.

[27] Letter to Professor Fand from J.A. Galbraith, (Economist, Royal Bank of Canada), July 7, 1967. This correspondence was kindly made available to me by Dr. Galbraith.

The implication of this statement is, I think, that the amount of vault cash held by any bank is related solely to the requirements of branch managers for transactions purposes.

The first empirical work on the determination of total bank assets in Canada was conducted for the Porter Commission by Johnson and Winder.[28] The authors note three facts, that a) required reserves are predetermined and therefore, b) banks "are required, in effect, to hold a fixed quantity of cash (in the form of Bank of Canada deposits) rather than to maintain a certain cash ratio in any given month" and, c) "the quantity of cash actually available in that month is determined entirely at the discretion of the central bank." They conclude that these facts "make the whole system of monetary management depend crucially on chartered bank expectations concerning the central bank's behaviour."[29] Therefore the authors

> visualize the chartered banks as aiming at achieving a certain 'desired' level of deposits, and adjusting actual deposits to the desired level at a rate which is proportional to the difference between actual and desired deposits. The desired level of deposits, in turn, is the level of deposits appropriate to the level of cash reserves that the banks expect the central bank to provide, and the expected level of short-term interest rates, which may exercise an influence on the extent to which the banks wish to hold cash in excess of the amount required to meet the minimum cash ratio requirement.[30]

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[28]H. G. Johnson and J. W. L. Winder, Lags in the Effects of Monetary Policy in Canada, Working Paper prepared for the Royal Commission on Banking and Finance, (Ottawa: Queen's Printer, 1962), Chapter 6, "The Control of Chartered Bank Deposits."

[29]Ibid., pp. 140-141.

[30]Ibid., p. 142.

In forming their "expectations" variables Johnson and Winder assume that

> expectations are formed according to some mixture of two theories of expectations: that the banks can correctly forecast the amount of cash that the central bank will provide next month, and that they simply assume that it will provide the same amount of cash next month as it provided this month. In application, this simply means assuming that deposits this month depend partly on the cash reserves provided this month for last month and partly on the cash reserves provided in the subsequent month for this month. A parallel assumption is made with respect to interest rate expectations.[31]

In testing this hypothesis the authors examine separately the influence of unborrowed reserves and reserves created by dealer and chartered bank borrowing from the central bank. The hypotheses may be formulated as follows:

(1) $D_t = n(D_t^* - D_{t-1}) + D_{t-1},$

(2) $D_t^* = \alpha + \beta R_t^* + \gamma B_t^* + \delta r_t^*,$

(3) $R_t^* = a(R_t - R_{t-1}) + R_{t-1},$

$B_t^* = b(B_t - B_{t-1}) + B_{t-1},$

$r_t^* = c(r_t - r_{t-1}) + r_{t-1},$

where:

D = statutory deposits,
D^* = desired deposits,
R = unborrowed reserves,
B = borrowed reserves,
r = short-term interest rate,
R^*, B^*, r^* = expected values for R, B and r.

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[31] *Ibid.*, p. 142.

Substituting (3) in (2) and (2) in (1), the following estimating equation is obtained,[32]

$$(4)\ D_t = \alpha n + (1-n)D_{t-1} + n\beta a R_t + n\beta(1-a)R_{t-1} + n\gamma b B_t + n\gamma(1-b)B_{t-1} + n\delta c r_t + n\delta(1-c)r_{t-1}.$$

It is important to note that D_t is statutory deposits at time t (i.e. the deposits relevant for the calculation of required reserves at t) so that in fact it is actual deposits at time t-1. Thus, in effect, the equation is,

$$(5)\ DC_t = f(R_{t+1}, R_t, B_{t+1}, B_t, r_{t+1}, r_t, D_{t-1}),$$

where,

DC_t = actual deposits of the current month.

Now, since total unborrowed reserves (R) at time t+1 are determined largely by what the banking system did in period t, it is unlikely that the causation in this equation is in the hypothesized direction. Moreover, on purely intuitive grounds, this does not seem to me to be a very reasonable or realistic way of operating. Essentially what it says is that banks are continually trying to meet next month's reserve requirement this month.

Surely it is much more reasonable to assume that banks are constrained by the current month's legal requirement, be it a ratio or a fixed amount of reserves. This has been suggested in a review

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[32] Fitting the equation to seasonally adjusted monthly data from 1954-62 the authors obtained an R^2 of .998, virtually all of which was attributable to the lagged dependent variable (its 't' value was about 50). Lagged values of the independent variables all had the wrong signs. Fitted in first differences the R^2 was .52 with R_{t-1} and B_{t-1} not significant. (Johnson and Winder, pp. 145-147.)

of the Johnson-Winder work by D.B. Marsh.[33] Marsh maintains that a bank's response to excess reserves

> is not a deliberate manipulation of deposits: the bank's target is not (as Johnson seems to assume) "the adjustment of actual deposits to a desired level based on an expectation of forthcoming reserves" but (ideally) a zero figure for excess cash over the reserve period. The response of a bank to changes in its cash position takes the form of movements between cash and earning assets; and the relevant lag, therefore, is not between changes in cash and changes in deposits but between changes in cash and changes in cash adjustment assets (securities, day loans) held by the bank.[34]

This, I think, is a much more reasonable way of operating under the Canadian rules. It says that individual banks act so as to meet the current (predetermined) amount of required reserves and that desired excess reserves of individual banks over the monthly averaging period may be positive or zero depending on the bank's expectations with respect to reserve flows in the near future (i.e. over the remainder of the current averaging period) and interest rates.[35] Noting that

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

[34]<u>Ibid.</u>, p. 259.

[35]The quotation cited above seems to imply that banks never voluntarily hold reserves in excess of the amount legally required. In a subsequent note, Marsh indicates that this is not what is meant. Contrary to conventional terminology, he defines "excess cash" as undesired cash: "Zero excess cash allows for variations due to uncertainty, expectations and the like. These apparent variations from the norm are not excess cash... Excess cash may be defined as the difference between desired reserves and actual reserves." (D.B. Marsh, "Johnson's Northern Tour: A Rejoinder," <u>Canadian Journal of Economics and Political Science</u>, 31, (February, 1965), p. 125, note 4.) Johnson and most other economists would call these "variations" excess reserves (H.G. Johnson, "Johnson's Northern Tour: A Traveller's Guide Past the Marshes," <u>Canadian Journal of Economics and Political Science</u>, 30, (August, 1964), pp. 435-438).

"excess cash <u>for all banks together</u> cannot be increased or diminished (during the current month) without action by the central bank."[36] Marsh points out that the set of assets used to make the necessary adjustments is not total assets but a subset (consisting mainly of Canada bonds) which is capable of being bought and sold at short notice with relatively small price variability. This is true, of course, of any banking system, but the Canadian system is distinctive in that the required adjustment in the 'cash-adjustment' set of assets is not necessarily a function of current changes in total assets (liabilities) because changes in assets generate no changes in required reserves in the system in the current period. Because of this, the reaction by the banking system to changes in reserves cannot, in principle, be explained by examining aggregate excess reserve behaviour. Rather, it must be explained by examining the variation in the 'cash adjustment' subset of earning assets.

Though the peculiar definitions of legal and required reserves in Canada mean that the model must be estimated in an unorthodox manner, the mechanism by which the central bank controls the chartered banks is basically similar to that which exists in a system wherein required reserves and deposits are generated simultaneously. The central bank can make it easy or difficult for the chartered banks to meet the current reserve requirement by varying the amount of excess legal reserves in the system. The banks adjust to the availability of excess reserves

[36]D. B. Marsh, "Johnson's Tour of the Northern Dominion," p. 260, note 7. (Emphasis in original.)

by changing the 'cash adjustment' set of assets. A persistent change in 'cash adjustment' assets then generates a substitution between these relatively liquid, low-yielding assets and illiquid, high-yielding assets (such as commercial and personal loans). This is the view put to the Porter Commission by the Canadian Bankers' Association:

> In deciding how much cash it should be holding at any moment of time, a bank will be influenced by the number of business days left in the month, by the state of the money market, and by any cash gains or losses anticipated before the end of the month.
>
> . . . .
>
> If a bank finds it is continually accumulating liquid assets (cash adjustment assets) after accommodating current loan demands, it will at some stage begin to switch out of the liquid assets into less liquid ones seeking more profitable uses for its funds. In the opposite case, where it is continually disposing of liquid assets to meet daily cash deficiencies, the bank will be forced sooner or later to dispose of less liquid assets, either to raise cash or to restore holdings of liquid assets, and eventually it will have to adopt a more restrictive lending policy. How quickly a basic trend in the cash position of a bank influences its investment and lending policies depends on the stock of liquid assets held by the bank, the rate at which the stock is changing, and the view of the bank of the intentions of the central bank.[37]

I conclude from this discussion of the literature and of the Canadian reserve requirement rules that: a) the excess reserves variable must be considered to be exogenous in the Canadian banking system, b) because excess reserves are exogenous they cannot be assumed to reflect the extent to which the banking system uses available cash reserves to purchase earning assets, c) bank portfolio behaviour must,

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[37] See "Submissions to the Royal Commission on Banking and Finance," Canadian Banker, 70, Supplement, (Spring, 1963), pp. 9-10.

therefore, be explained by examining, directly, the variation in the components of total earning assets, and d) the quantity of excess reserves provided by the central bank in the current month affects the demand by the banking system for earning assets in the current month.

CHAPTER 3

LIQUIDITY PREFERENCE BY BANKS AND THE NON-BANK PUBLIC

Theory of Liquidity Preference:

Since this study involves me in an attempt to explain the distribution of liquid asset holdings, on the part of banks and the non-bank public, between non-interest earning claims with zero term to maturity (money) and interest-earning claims with positive term to maturity (bonds),[1] I outline in this Chapter the theory of liquidity preference and the way I have tested it. The results of the tests are reported in subsequent chapters.

I assume that the individual or institution wishes to hold a part of his portfolio of wealth in assets which have no risk of default, and on this basis analyze the distribution of this subset of assets between those which have constant and those which have variable prices. Tobin has called this subset of assets investment balances (as opposed to transactions balances). They are "those (balances) that will survive

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[1] The term to maturity characteristic simply states that, in general, money can be 'redeemed' at full capital value on demand while bonds can only be sold for their full capital value at some time in the future. In effect, this is to say that money has a 'fixed money price' and bonds a 'variable price'.

all the expected seasonal excesses of cumulative expenditures over cumulative receipts over the year."[2] Thus, this analysis is concerned with the Keynesian 'speculative' and 'precautionary' demands for money. Indeed, it is arguable that current analysis of the distribution of liquid assets in portfolios is merely a formalization of the hypotheses outlined in the 'General Theory.' Keynes held that the speculative demand for money is a function of the expected future change in the long-term rate of interest - "What matters is not the absolute level of r but the degree of its divergence from what is considered a fairly safe level of r."[3] Moreover, he appears to have recognized the existence of subjective doubt or uncertainty as a further variable influencing the speculative demand, for he notes that,

> If a need for liquid cash may conceivably arise before the expiry of n years [the term to maturity of the bond purchased], there is a risk of a loss being incurred in purchasing a long-term debt and subsequently turning it into cash, as compared with holding cash. The actuarial profit or mathematical expectation of gain calculated in accordance with the existing probabilities - if it can be so calculated, which is doubtful - must be sufficient to compensate for the risk of disappointment.[4]

These two elements, expected return and risk of capital loss, are held by the modern theory of portfolio selection to be important determinants

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[2]J. Tobin, "Liquidity Preference as Behavior Towards Risk," Review of Economic Studies, February, 1958; reprinted in Monetary Theory and Policy, ed. by R.S. Thorn, (New York: Random House, 1966).

[3]J.M. Keynes, The General Theory of Employment, Interest and Money, (London: MacMillan and Co. Ltd., 1957), p. 201.

[4]Ibid., p. 169.

of the distribution of a portfolio among various financial assets.[5] I use Tobin's exposition of the theory.[6]

Both the risk of loss and the expected return on the total portfolio (bonds plus money) increase, the higher is the percentage of the portfolio invested in bonds. Tobin assumes that the investor is uncertain about capital gains or losses and so bases his actions on his estimate of the probability distribution associated with the expected capital gain. He further assumes that the estimated probability distribution of capital gains or losses always has an expected value of zero and is independent of the level of the interest rate. This enables him to write the expected return

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[5] One might expect investors' utility functions to contain a variable representing expected prices of goods and services. This variable is certainly an important influence on the distribution of the total asset portfolio. However, since both categories of assets being considered here are denominated in nominal terms, expected prices could only influence the distribution of this subset of assets via their influence on the expected rate of return over the relevant holding period, of which they may well be a component.

[6] J. Tobin, "Liquidity Preference as Behavior Towards Risk." Discussing Keynes' contribution to the theory, Tobin states that "when he [Keynes] refers to uncertainty in the market, he appears to mean disagreement among investors concerning the future of the rate rather than subjective doubt in the mind of an individual investor." (p.183.) If this is true, then a risk variable does not enter the demand functions and the individual would never hold both bonds and money in his portfolio since an expected fall in interest rates (leading to capital gains) would result in the entire portfolio being invested in bonds and, conversely, an expected rise in rates would result in investment of the portfolio in money. Hence, the assumed negatively-sloped liquidity preference curve must be regarded as an approximation to a step function aggregating over individuals with diverse expectations about future rates. The shape of the curve may still be reasonable, <u>a priori</u>, since the greater are current rates the greater the number of individuals who may be assumed to expect a fall in the rate, hence the lower the amount of money demanded; see Tobin, pp. 180-182.

on the portfolio as the product of the current level of the interest rate and the proportion of the portfolio invested in bonds. Since,

$$R = \frac{B}{M + B} (r + g) , \tag{1}$$

where ,
R = earnings on the portfolio of money and bonds,
M = money holdings,
B = bond holdings,
r = rate of interest,
g = capital gains,

and since $E(g) = 0$, then,

$$E(R) = \frac{B}{M + B} r = U_R , \tag{2}$$

where, U_R = expected return,

Tobin identifies the risk of the portfolio with the dispersion of possible returns, measured by the expected standard deviation of return (σ_R). It is easily shown that,[7]

$$\sigma_R = \frac{B}{M + B} \cdot \sigma g \quad . \tag{3}$$

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[7] From (1) above the amount of the return (R) on the portfolio is,

$$R = \frac{B}{M + B} (r + g).$$

Therefore,

$$\sigma^2_R = \left(\frac{B}{M + B}\right)^2 \cdot \sigma^2_{(r+g)} , \tag{a}$$

and

$$\sigma^2_{(r+g)} = \sigma^2_r + \sigma^2_g + \text{cov.} (r, g).$$

Now, since σ^2_r is zero by assumption, Therefore, given the variables r and σg, the proportion of bonds in the portfolio $\left(\frac{B}{M + B}\right)$ determines both the expected return on the portfolio (U_R) and the associated risk (σ_R).

From (2) and (3) above, it can be seen that,

$$U_R = \frac{r}{\sigma g} \sigma_R, \qquad (4)$$

so that $\frac{r}{\sigma g}$ is the opportunity locus of attainable combinations of risk and expected return. Coupled with the individual's indifference map displaying his subjective attitudes towards expected return and risk, the opportunity locus determines the optimal combination of these variables for the investor, and the proportion of bonds in his portfolio.

Since utility functions are subjective relationships, it is not practical to establish analytically the shape of the indifference curve for any individual investor. Tobin[8] distinguishes two classes. 'Risk lovers', investors who are willing to accept lower expected return in order to have the chance of higher capital gains, have negatively sloped indifference curves (as in I_4 of Figure 1). 'Risk averters' have positively sloped curves,

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$$\sigma^2_{(r+g)} = \sigma^2_g. \qquad \text{(b)}$$

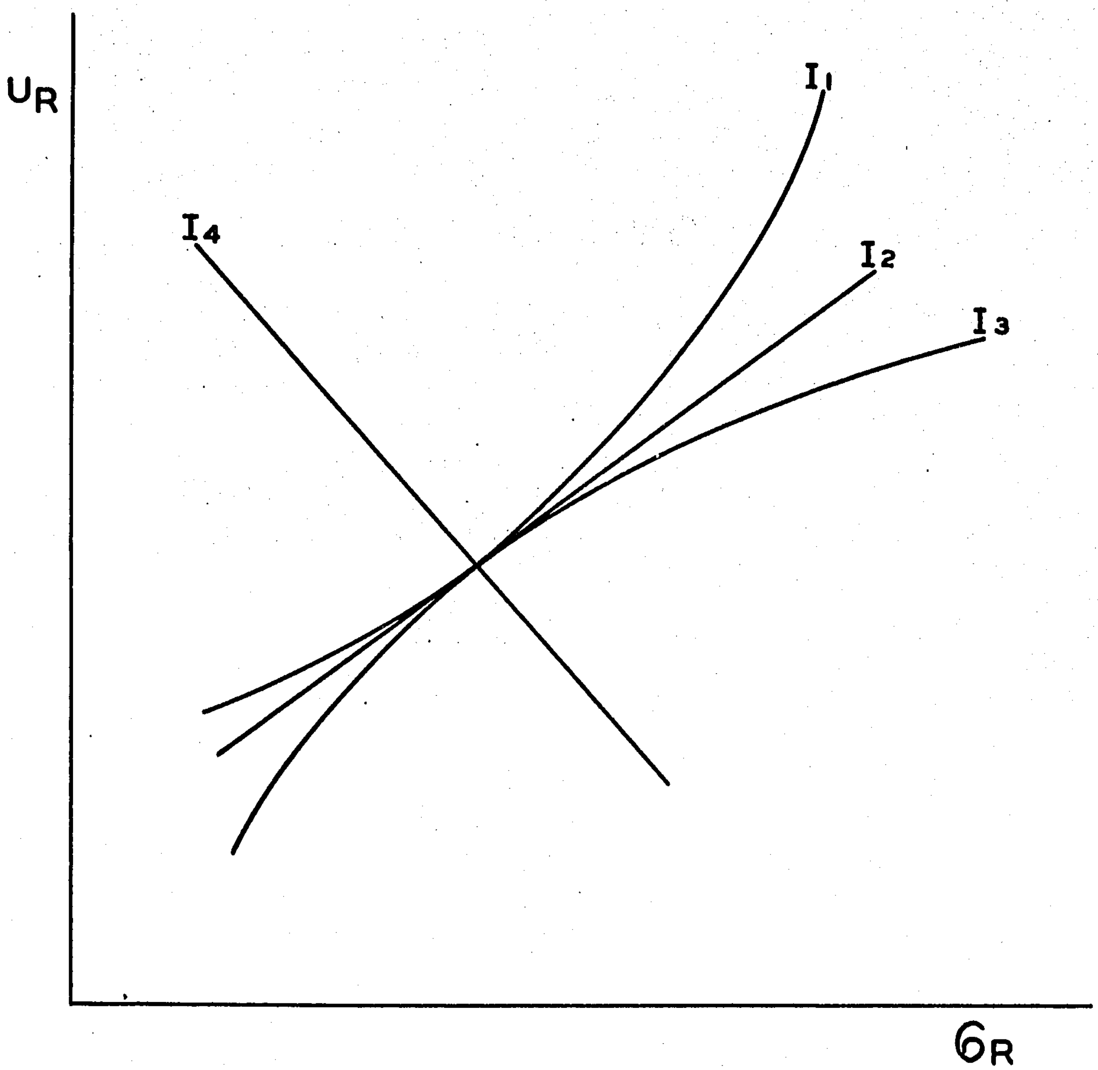
Substituting (b) in (a),

$$\sigma^2_R = \left(\frac{B}{M + B}\right)^2 \cdot \sigma^2_g,$$

so that $\sigma_R = \frac{B}{M + B} \cdot \sigma g$.

[8] _Ibid._, p. 187.

Figure 1
INDIFFERENCE CURVES



linear or convex upward (I_2 and I_3) in the case of 'plungers' (indicating either constant or decreasing marginal rates of substitution between expected return and variance of return) and concave upward (I_2) in the case of 'diversifiers.' Intuitively, it seems probable that the preponderant number of investors will be not only 'risk averters' but 'diversifiers'. On this introspective basis the expected return should enter positively and risk negatively in a demand function for bonds.

The argument can be summarized and the interrelationships among expected return, risk and the distribution of the portfolio shown by using a diagram taken from Tobin. In Figure 2[9] the standard deviation of return on the portfolio is measured on the X-axis, expected return is on the positive segment of the Y-axis and the distribution of the portfolio between money and bonds on the negative segment.

The assumed risk-averting, diversifying, nature of the investor's utility function is embodied in the positively sloped, concave upward shape of the indifference curves (I_i). Opportunity loci facing the investor with slopes equal to the ratio of the current interest rate to variance of bond price [(4) above] are shown by the rays L_i. (3)[10] above states that the risk on the portfolio and the distribution of the portfolio are related by the factor σ_g. This proportionality is shown, for different σ_g, by OA_1 and OA_2. To

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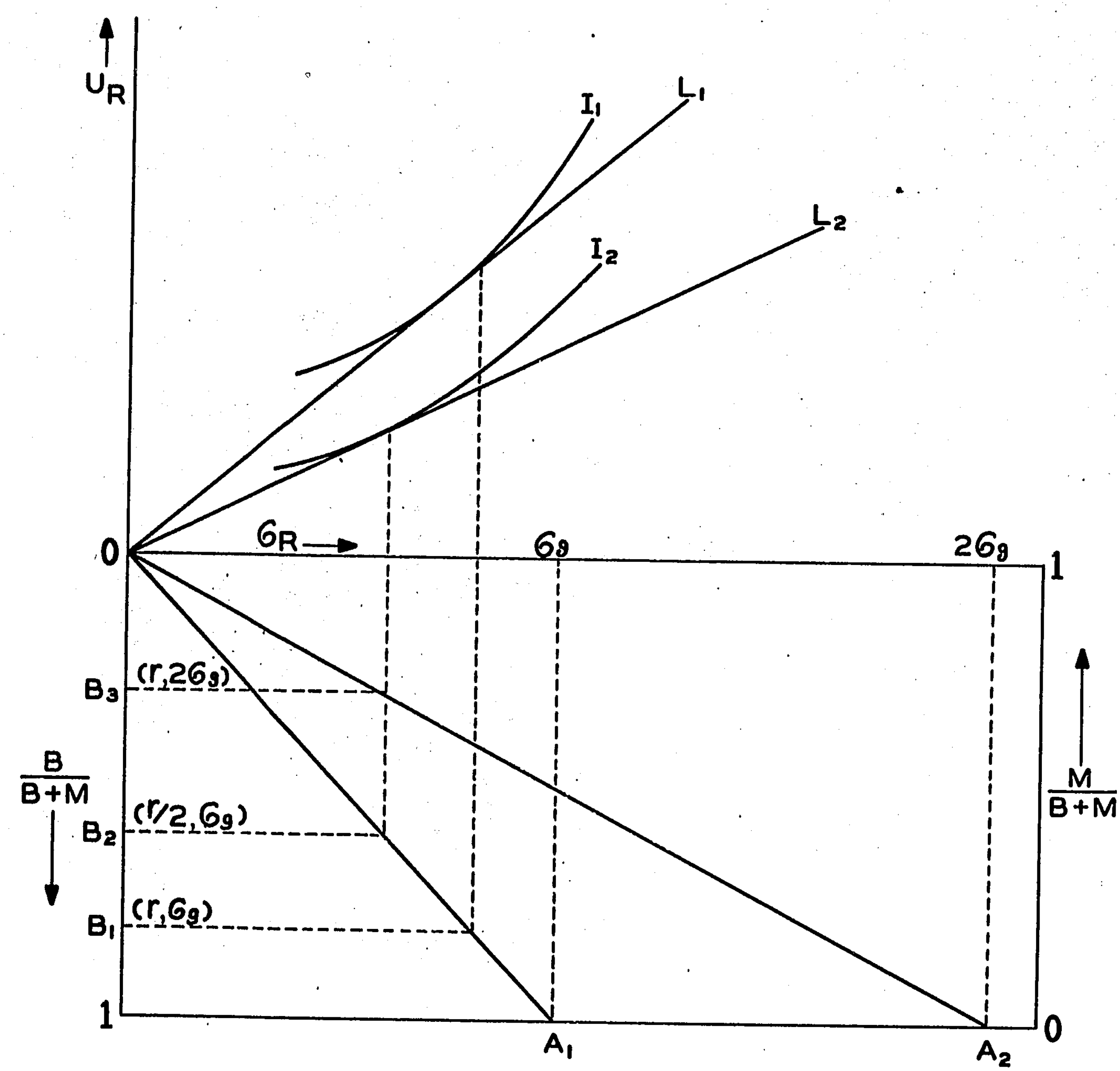
[9] Ibid., p. 195.

[10] Note that by (3) where the total portfolio is invested in bonds, then $\sigma_R = \sigma_g$.

Figure 2
DISTRIBUTION OF MONEY AND BONDS



maximize utility the investor will choose the portfolio consistent with the combination of (U_R, σ_R) given by the point of tangency of the opportunity curve and his indifference curve. Thus, for opportunity curve L_1 where the expected rate of return on bonds is r and the associated risk is σ_g, the investor with indifference map given by the curves I_i will hold the fraction of his portfolio in bonds given by B_1.

Consider the effect on the distribution of the portfolio of changes in the rate of interest and the expected variability of bond prices (σ_g) respectively. Assume first that the rate of interest is halved. This reduces the slope of the opportunity curve by one-half (to $\frac{r}{2\sigma_g}$) so that the new curve is L_2. The investor is forced to a lower indifference curve (I_2) and reduces the proportion of the portfolio held in bonds to B_2. Since σ_g has not changed, the effective OA_i is OA_1.

Now consider the effect of holding the interest rate constant but assuming a doubling of σ_g. The opportunity curve shifts, as before, to L_2 but now there is also a shift in the relationship between $\frac{B}{M+B}$ and σ_R. The slope of OA is halved so that the $\left(\frac{B}{M+B}, \sigma_R\right)$ relationship shifts to OA_2; the risk associated with any given portfolio is now doubled.[11] Hence, the proportion of bonds in the portfolio declines to B_3 from B_1, a much greater decline than occurred when the interest rate was halved. This

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[11]From (3), it is known that $\frac{B}{M+B} = \frac{\sigma_R}{\sigma_g}$. Taking the derivative $\frac{\partial\left(\frac{B}{(M+B)}\right)}{\partial \sigma_R}$ gives the slope of OA equal to $\frac{1}{\sigma_g}$. Clearly, doubling σ_g halves the slope.

example illustrates the potentially large independent effects which a change in risk (or uncertainty associated with a given expected interest rate) can exert on portfolios.

Risk in Canadian Financial Markets:

Little research has been done in investigating the influence of changes in risk on the opportunity set of expected return-risk combinations, and hence on the composition of investors' portfolios. The implicit assumption usually made is that risk, however measured, is relatively constant, an assumption which, in many cases, is probably a tolerable approximation to reality. However, there is evidence to suggest that investors' estimates of risk may have been sufficiently volatile in Canada within the sample period I use to warrant examination of the validity of this assumption. Specifically, I am concerned with the disruptive effects on financial markets associated with the Conversion Loan of 1958.

The Conversion Loan took place in the third quarter of 1958 when

> It was decided that in order to clear away the substantial blocks of Victory Bonds which were approaching maturity and to restore confidence in Government Bonds, all the Victory issues should be converted into longer term securities. During a two-month campaign from mid-July to mid-September reminiscent of the War Bond drives, $5,806 million of the four conversion issues, representing 45 per cent of the outstanding market debt, were issued in exchange for the Victory Bonds... The declared objective was conversion of all Victory Bonds, including the issue with final maturity in 1966 which was not callable until 1961, and to achieve this end the terms were made extremely attractive and the operation was presented as a patriotic endeavour which deserved unanimous support. Moreover, the prices of the Victory Bond issues were

> raised and fixed at very attractive levels so that throughout the operation and for some weeks thereafter the Bank of Canada had to support bond prices in the face of a rapid upward adjustment of interest rates in the United States.[12]

Discussing the loan, Fullerton has noted that

> Bonds were sold to many people and institutions on an emotional and not a rational basis. ...in the event the predictable result occurred. Those who had been holding short-term bonds for short-term reasons, and had been induced to buy conversion issues for reasons of patriotism, pressure or publicity, in ensuing months made every effort to restore their portfolio position to its original shape by selling long bonds and buying shorts.[13]

The Conversion Loan had the effect of increasing the average term to maturity of Government of Canada debt, held by the general public, from about eight years in the early part of 1958 to almost fifteen years in September 1958.[14]

Professor C. L. Barber concludes, after examining a scatter diagram of interest rates plotted against the ratio of money stock (demand deposits plus currency) to GNP, that

> it is ...evident that there was a sharp change in the underlying relationship between these two variables in the interval from the second to the fourth quarter of 1958. This was, of course, the period during which the Conversion Loan was carried out. It seems clear that one of the important effects of the Conversion Loan was to increase substantially the public's demand for cash. Individuals and financial institutions who were induced to exchange short-term

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[12] Report of the Royal Commission on Banking and Finance, (Ottawa: Queen's Printer, 1964), p. 454. Henceforth this Report will be cited as "Porter Report."

[13] D.H. Fullerton, The Bond Market in Canada, (Toronto: The Carswell Company Limited, 1962), pp. 252-253.

[14] Bank of Canada, Statistical Summary Supplement, 1966, p.51.

securities for the much longer term and less liquid Conversion Loan bonds would naturally want to hold more cash in the portfolio to prevent a serious decline in their liquidity position.[15]

Econometric tests for the effects of the Conversion Loan have, thus far, used the average term to maturity of the public debt, as an index of the 'liquidity' of Canada bonds, in demand equations for either demand deposits or the total money stock.[16] This variable has been found to exert a significant influence, in the expected (positive) direction, on the demand for money, as is illustrated in the following equation:[17]

$$\ln M_1 = \underset{(.4)}{.17} - \underset{(4.0)}{.041\ln r_1} + \underset{(2.2)}{.131\ln Y} + \underset{(2.0)}{.004D} + \underset{(9.6)}{.861\ln M_{t-1}},$$

$$\bar{R}^2 = .98,$$

where,

ln = natural logarithm,
M_1 = demand deposits plus currency held by the public,
r_1 = 3-month Treasury Bill rate,
Y = GNP,
D = average term to maturity of public debt held by the public.

I think it questionable, on theoretical and empirical grounds, whether the average term to maturity variable is an adequate index of

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[15] C. L. Barber, A Brief to the Royal Commission on Banking and Finance, March 22, 1962, p. 5.

[16] See H. T. Shapiro, "The Canadian Monetary Sector: An Econometric Analysis," (unpublished Ph.D. dissertation, Princeton University, 1964); I.A. Stewart, "A Quarterly Econometric Model of the Canadian Economy, 1951-1962," (unpublished Ph.D. dissertation Cornell University, 1966), pp. 73-79; H. G. Johnson and J. W. L. Winder, Lags in the Effects of Monetary Policy in Canada, Chapter 8.

[17] This equation is taken from H. T. Shapiro, "The Canadian Monetary Sector: An Econometric Analysis," p. 32. The equation was estimated from quarterly, seasonally adjusted, data for the period 1955 to 1962. Figures in parentheses are 't' values.

the 'liquidity' of Canada bonds. A financial asset is liquid if it can be sold at any time for its full capital (par) value. Money has this property but, in general, bonds do not. In terms of Tobin's theory, the investor, faced with the decision whether to invest a pool of funds in money or bonds over a given period of time, must form an estimate of the probability distribution of future bond prices. Assume, as Tobin does, that the probability distribution is such that it can be described by two parameters, its expected value and a measure of its dispersion. If the dispersion of the distribution were zero (i.e. if the expected value of future bond prices had a probability of one), then bonds would be as liquid as money over that particular holding period. Bonds decline in 'liquidity', relative to money, as the dispersion of the probability distribution increases. Ideally, therefore, a measure of bond 'liquidity' should represent the dispersion of the estimated probability distribution of future bond prices.

Since no information is available about how dispersion should be defined, it is convenient to assume that the probability distribution is normal, so that its dispersion is measured by the standard deviation or variance. There is a further problem in that no data are available which measure investors' estimates of future bond price variability. Hence, a further assumption must be made about how these estimates are generated from present and past experience.

The average term to maturity of public debt indicates, in a crude way, the 'average' price variability of the outstanding stock of public debt because bond prices fluctuate more (for given changes in yield to maturity), the longer is the term to maturity of the bonds. It is a crude measure because there is not a one-to-one relationship between price variability and term to maturity. An increase in the average term to maturity which results from a substitution of, say, three-year bonds for two-year bonds, will produce a greater increase in price variability than will a substitution (of the same amount) of fifteen-year for fourteen-year bonds.[18] The average term to maturity of the debt will change by the same amount no matter which of these substitutions takes place. The non-linearity of the relationship between bond price variability and term to maturity is illustrated in Figure 3. Price variability is represented by the variance[19] (calculated from quarterly data, over the period 1955-65) of one-year holding-period yields on representative bonds of various terms to maturity.[20]

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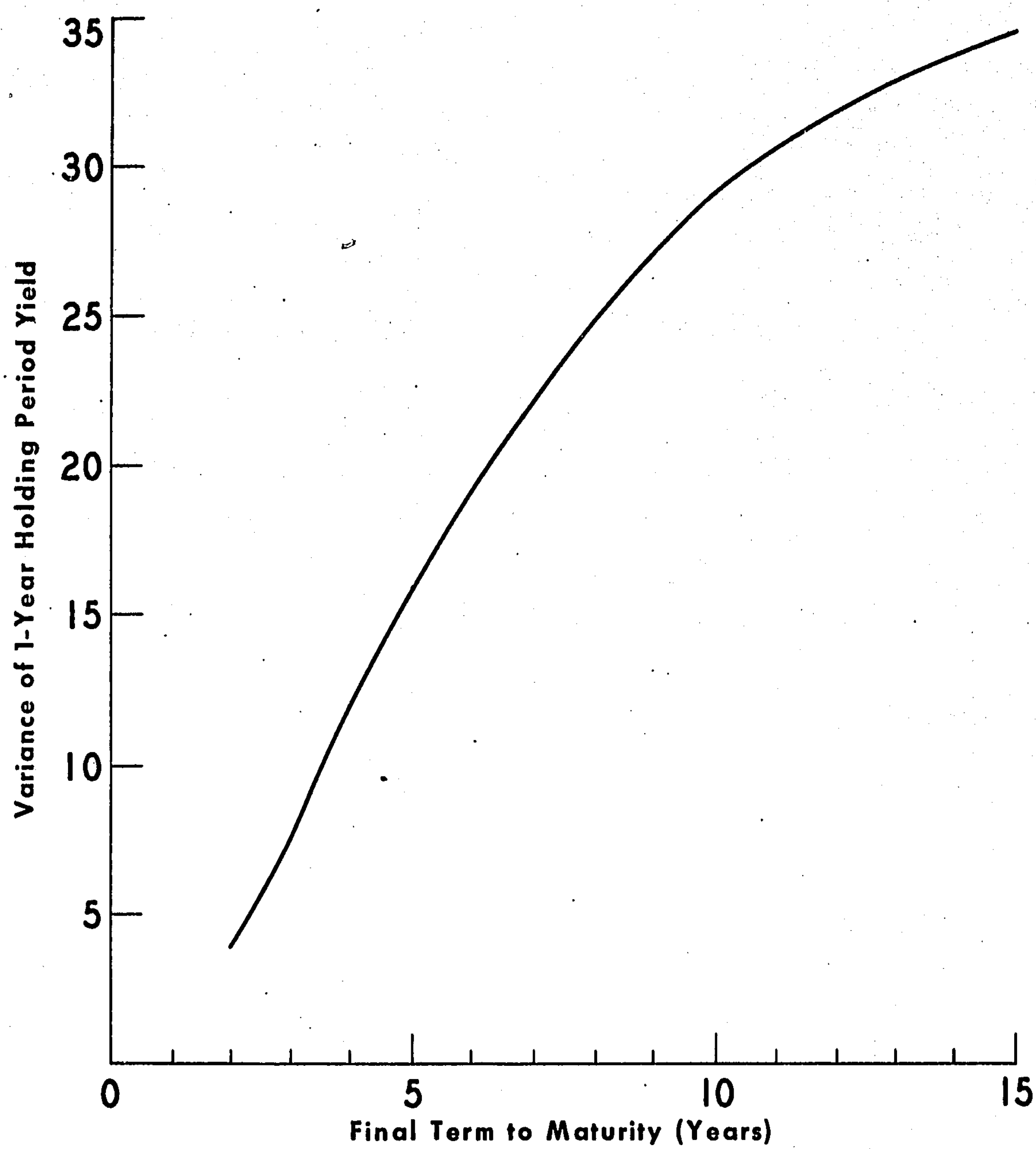
[18]For mathematical proofs of these propositions, see B. G. Malkiel, The Term Structure of Interest Rates, (Princeton, N. J.: Princeton University Press, 1966), pp. 53-57. The inadequacy of the average term to maturity in this respect has been noted by D. G. Luckett, "Maturity Measures of the Public Debt," Quarterly Journal of Economics, 78, (February, 1964), pp. 148-157.

[19]In all of my work I use variance, rather than standard deviation, as a measure of risk. For my purposes, variance is a better measure since standard deviation exaggerates the non-linearity in the variability-term to maturity relationship. In analyzing portfolios, the standard deviation may be preferred since, for a given set of securities and earnings experience, it bears a constant relationship to the size of the portfolio (the ratio of standard deviation to size of portfolio is constant) whereas the variance to size ratio is variable; see H. Markowitz, Portfolio Selection, (New York: J. Wiley and Sons, 1959), pp. 78-82.

[20]The holding-period yield incorporates capital gains or losses as well as coupon income. The series for a bond of given maturity was constructed from 'representative yield' series, assuming the coupon rate to be constant at 4 per cent. Therefore, the variance in the series of holding-period yields is solely a result of price variability. The assumption of a one-year holding-period is arbitrary. Obviously the length of the holding-period varies with each investor. The methods used to construct the 'representative yields' and the holding-period yields are discussed in Appendix A.

Figure 3

YIELD VARIABILITY (1955-1965) AND TERM TO MATURITY



The average term to maturity variable would have to take account of this changing rate of change of price variability in order to be an adequate representation of average price variability.* I do not attempt to construct such a variable, partly because it is not obvious how it should be done, but mainly because movements of the liquidity preference curve of the general public in recent years seem to be inconsistent with movements in the maturity distribution of the public debt over the same period.

I first examine movements in the maturity distribution of the public debt during the period 1957 to 1965. Because of the inadequacies of the summary measure (average term to maturity) I examine, in addition to this, the actual changes in the maturity distribution, in order to attempt to form a better impression of the resulting movements of the variability of bond prices. Table 1, below, shows the absolute and relative distribution of Canada debt held by the general public at various dates during the 1957-1965 period. The average term to maturity of the debt is shown on the bottom line. It can be seen that the average term to maturity of the debt declined to some extent during the period 1958-1965. Over the whole period following the Conversion Loan, however, it remained high relative to the pre-loan level of seven years. Examination of changes in the maturity distribution in Table 1 indicates that debt management operations have been conducted throughout the maturity range. Comparison

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*Given the shape of the variance-term to maturity relationship in Figure 3, however, average term to maturity would probably be an adequate approximation to movements along the curve unless changes in the composition of the debt were concentrated at one of the extremes of the maturity scale. That this was not the case in Canada is shown directly below.

TABLE 1

GOVERNMENT OF CANADA DIRECT AND GUARANTEED SECURITIES HELD BY THE GENERAL PUBLIC

	Dec. 1957		Dec. 1958		Dec. 1960		Dec. 1965	
	$ mill.	%	$ mill.	%	$ mill.	%	$ mill.	%
Treasury Bills	289	4.8	415	6.9	549	7.4	157	2.2
0-3 years	1,859	31.1	1,238	20.6	1,761	23.8	1,423	20.3
3-5 years	704	11.8	184	3.1	586	7.9	461	6.6
5-10 years	1,970	33.0	666	11.1	559	7.6	1,550	22.2
10 years and over	1,153	19.3	3,509	58.3	3,954	53.3	3,404	48.7
Total	5,975	100.0	6,012	100.0	7,409	100.0	6,995	100.0
Average term to maturity (years)	7.0		13.3		11.5		10.3	

Source: Bank of Canada, Statistical Summary Supplement, 1966, p. 51.

of the distribution at the end of 1957 and 1958 indicates that debt with over ten years to maturity increased substantially at the expense of all other maturity classes (with the exception of Treasury Bills, which showed a slight increase) as a result of the Loan. The distribution for December, 1960, shows that subsequent debt management operations reversed a part of this shift with the 0-3 and 3-5 year classes increasing, and both 5-10 year and over ten year groups declining. Changes in the 1960-1965 period resulted in a very large relative increase in the 5-10 year group, an increase achieved at the expense of both long (10 years and over) and short bonds (mainly Treasury Bills). Since the changes in the maturity distribution have consistently resulted from changes in most maturity groups, it would appear that the average term to maturity is a reasonable index of the associated changes in average bond price variability. If this is so, the conclusion can be drawn that average price variability (associated with movement along the variance-term to maturity curve) was still high in the period 1960-1965, relative to its pre-Conversion Loan level.

By 1960, however, Barber's liquidity preference curve had shifted back to its pre-1958 position. A scatter diagram, of the type used by Barber, is shown in Figure 4.[21] The interest rate on short-term Canada bonds is plotted (on the Y-axis) against the ratio of currency (outside banks) and demand deposits to GNP. The quarterly observations for the period 1955-1965 are plotted in three groups corresponding to, a)the period prior to the Conversion Loan (1Q 1955 - 3Q 1958), b)the period from the fourth quarter of 1958 through the fourth quarter of 1960, and c)the period from 1961 through 1965. It will be noted that the first and third groups of observations lie, approximately, on the curve AA.[22] The second group of observations, generated during the period immediately following the Conversion Loan, lie on a curve (BB) which is upward and to the right of AA. It appears, then, that the effects of the Conversion Loan had been dissipated by the end of 1960, notwithstanding the fact that the average term to maturity of the public debt (and presumably, the average price variability of the debt) remained high relative to its pre-Conversion Loan

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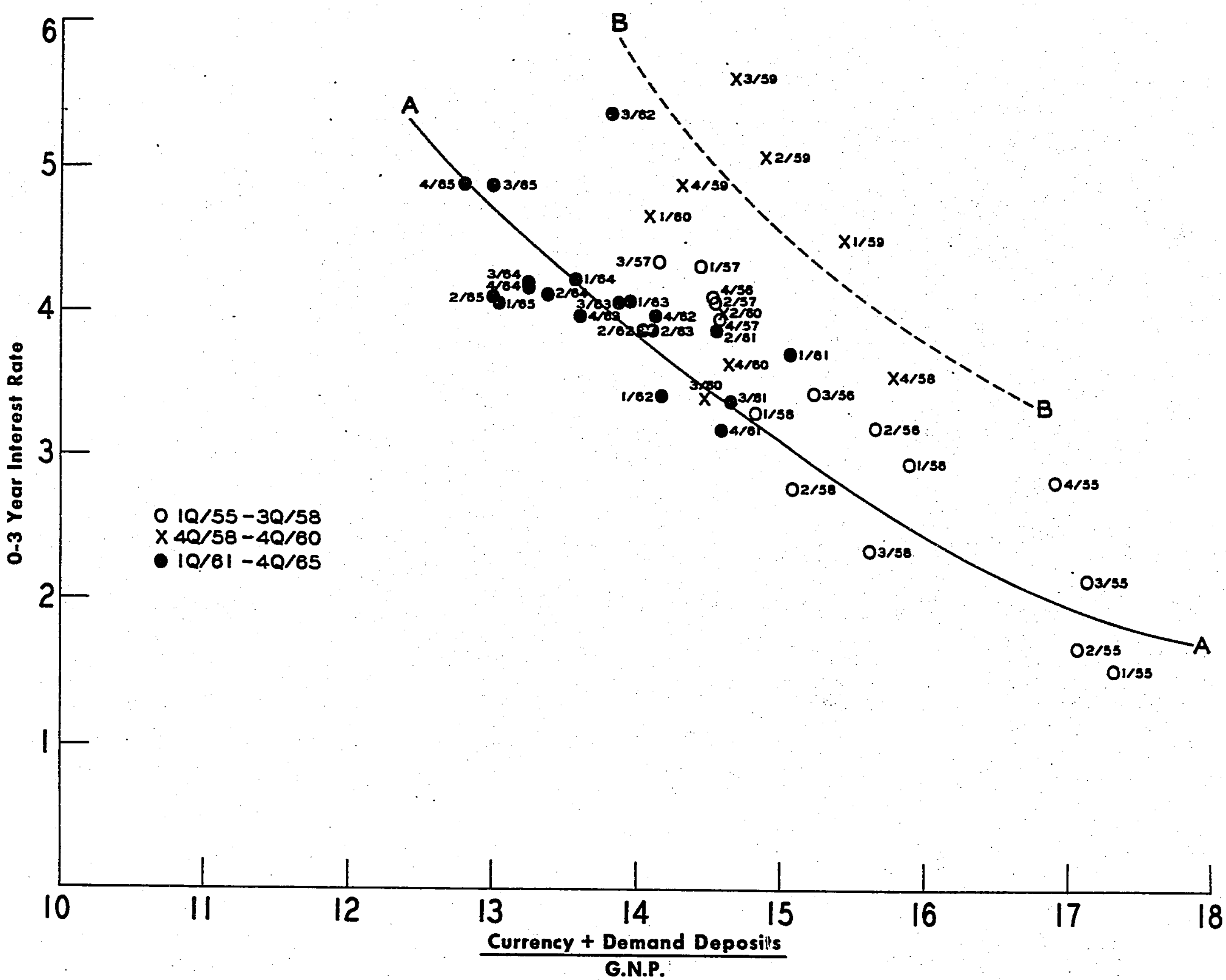
[21] Barber used a long-term interest rate. I argue, in Chapter 5, that a short-term rate is relevant to the demand for money, so I have used a short rate in Figure 4.

[22] The curves are drawn freehand. The extreme observation, for the third quarter of 1962, was a result of the exchange crisis.

Figure 4 - MONEY AND INTEREST RATES



level.[23]

During the course of my investigation into the possible effects of the Conversion Loan on financial asset holdings, I observed that, in addition to the sharp increase in the average term to maturity of the public debt in 1958, there was a marked increase in the price variability of bonds over the whole maturity range at the beginning of 1958. In terms of the variance-term to maturity relationship shown in Figure 3, the change in average term to maturity represents a movement along the curve, while the change in price variability of a given maturity represents an upward shift in the whole curve. Changes in the price variability of bonds of a given maturity will affect the distribution of liquid assets in investors' portfolios if they affect investors' estimates of future price variability. I assume that expectations of future price variability are generated from present and past experience.

The shifts in the curve are illustrated in Chart 1, which shows the changing variance of a one-year holding-period yield on a bond with five years to maturity.[24] It is evident that the variance was small

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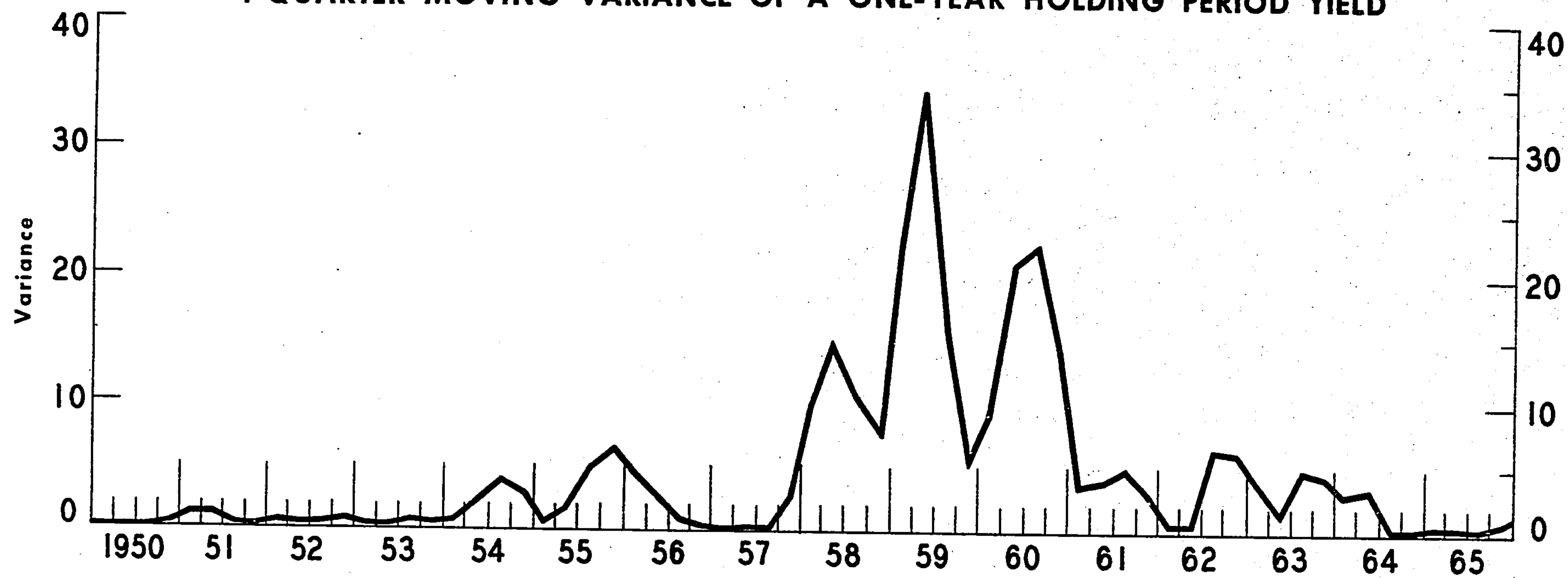
[23]It is possible that the effects resulting from the increased term to maturity remained and that there were other reasons for the observed shift in the curve. A possibility that occured to me is that the increased availability of interest-earning bank deposits at this time caused investors to reduce their holdings of currency and demand balances (see Chapter 5, p. 123). I tested this hypothesis in my demand deposit equation by entering a dummy variable with a value of one beginning in the first quarter of 1961. The variable was not significant at the 10 per cent level.

[24]The series shows the four quarter moving variance of the one-year

Chart 1

4-QUARTER MOVING VARIANCE OF A ONE-YEAR HOLDING PERIOD YIELD



throughout the period 1950-1957. It increased markedly in 1958 and remained large through 1960. From 1961 to 1965, the variance was of the same order of magnitude as in the 1950-1957 period.

It is a reasonable conjecture that these changes in bond price variability were a result of changes in the importance attached to interest rate stability by the central bank in its conduct of monetary policy. As has been noted elsewhere,[25] the Bank of Canada appears to have been more concerned with the money supply than with interest rates in the period 1958-1960.[26] Clearly, with the money supply (chartered bank deposits plus currency held by the public) fixed at a level which the central bank considers appropriate, variation of demand and supply pressures in

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holding-period yield. It is calculated, for period t, as follows:

$$\frac{\sum_{i=0}^{3} (r_{Ht-i} - \bar{r}_H)^2}{4},$$

where, r_H = one-year holding-period yield on a five-year Canada bond,
$\bar{r}_H$ = average of r_H over periods t to t-3.

When this study had been virtually completed I saw a thesis by A. Breton ("Demand for Money in Canada, 1900-1959," Columbia University, 1965), which contains an analysis of uncertainty similar in some respects to that contained in this thesis. In particular, Breton (who uses annual data) constructs a variable, to measure shifts in the variance-term to maturity curve, defined as "the standard deviation of the long-term Government of Canada bond yield, calculated by taking the month-end deviations from the average of month ends centered on June 30th of each year." (Breton, p. 111).

[25] J.H. Young, "Credit Conditions and the Bank of Canada," The Canadian Banker, 74, (Spring, 1967), pp. 198-201.

[26] The Governor stated in his Report for 1959 that "the primary function of a central bank is to regulate the quantity of money." Bank of Canada, Annual Report, 1959, p. 3.

financial markets will be reflected in greater variability of interest rates than would be the case if the authorities were to operate to achieve a given interest rate target. The change of Governors in mid-1961 appears to have been accompanied by a shift in emphasis toward an interest rate or 'credit conditions' approach:

> The operations of the Bank of Canada exert their influence on the level of demand for goods and services through their effect on credit conditions. By credit conditions is meant the whole range of terms and conditions affecting borrowing and lending and the purchase and sale of financial assets: the level and structure of securities prices and yields, institutional lending and deposit rates, and the various requirements . . . which lenders require of borrowers as a condition of making funds available . . .[27]

The observed behaviour of the public's demand for money is consistent with the movements, over time, of the variance-term to maturity curve. Since it does not appear to be consistent with all post Conversion Loan movements along the curve, I think it doubtful that the average term to maturity variable can adequately capture the observed effects of debt management operations on financial markets in the period since 1960. I have, therefore, tried each of the two variables discussed (average term to maturity of the debt and variance of holding- period yield on a single maturity) in relevant equations in an attempt to find the best specification of uncertainty. These two variables represent different dimensions of uncertainty and, theoretically, both should be included in a given demand equation, In fact, however, all

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[27] Evidence of the Governor Before the Royal Commission on Banking and Finance, Bank of Canada, 1964, p. 119. See also Young, "Credit Conditions and the Bank of Canada."

major movements in the two series occurred at the same time (between 1958 and 1960) so that it seemed highly unlikely that both would contribute significantly to explanations of bank and public holdings of financial assets. Therefore, I view these two variables as substitute, summary, measures of uncertainty. In view of the fact that variance of holding-period yields seems to bear a closer relationship to money holdings of the public than average term to maturity in the period since 1960, it is possible that the average term to maturity would perform better (in terms of 't' values) over the whole sample period but that the coefficients generated in an equation using this variable would be significantly different over the two sub-periods (1955-60 and 1961-65). To guard against this possibility I test for stability of the coefficients, over these sub-periods, in those equations where the average term to maturity gives a better 'fit' than the variance.[28]

Measurement of Interest Rate Expectations:

In practice, the convenient theoretical assumption that expected capital gains are zero is hardly likely to hold, so that an attempt should be made to take expectations of future rates into account in specifying demand equations for liquid assets.[29]

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[28] I use the Chow test for this purpose. See J. Johnston, Econometric Methods, pp. 136-138.

[29] Most econometric research to date ignores the potentially large effects of rate expectations. Exceptions to the rule are: S.M. Goldfeld, Commercial Bank Behavior, Chapters 2 and 3, and H.T. Shapiro, "The Canadian Monetary Sector," Chapter 1.

The theory of the term structure of rates has long held that the spread between long and short rates is determined by investors' expectations of future rates. Clearly, if the rate structure is determined in large measure by expectations of future rates, these expectations should also play an important role in demand (and supply) functions for the financial assets involved. The initial formulation of term structure theory held that the current long rate depends on investors' expectations regarding future short rates.[30] More recently, it has been argued that the term structure of rates may be explained by assuming that investors hold expectations about the general level of rates in the future. Estimates of these expectations, estimates of the attached probabilities, and the mathematical relationships between bond prices, yields and term to maturity are sufficient to determine any shape of yield curve.[31] The empirical evidence seems to be consistent with both of these hypotheses.[32] Indeed, it has been shown that the implications of both the Hicks-Lutz and Malkiel hypotheses are that holding-period yields on securities of all maturities will be equalized.[3]

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[30] J.R.Hicks, Value and Capital, (Oxford: Oxford University Press, 2nd edition, 1946); F.A. Lutz, "The Structure of Interest Rates," Quarterly Journal of Economics, 54, (November, 1940).

[31] See B. C. Malkiel, The Term Structure of Interest Rates.

[32] Ibid., Chapter 4; David Meiselman, The Term Structure of Interest Rates, (Englewood Cliffs: Prentice-Hall, Inc., 1962).

[33] D. G. Luckett, "Multi-Period Expectations and Term Structure of Interest Rates," Quarterly Journal of Economics, 81, (May, 1967), pp. 321-329

I think it more reasonable to assume that investors estimate the future general level of interest rates rather than a succession of future short rates.[34] Further, I use a long rate as a proxy for the level of interest rates, though theoretically there is no reason why a short-term rate could not be used.

I have drawn hypotheses about the formation of expectations from the work of Keynes and Duesenberry. I noted above that Keynes argued that investors form their expectations about future interest rates on the basis of the discrepancy between the current level of rates and the long run, historical, level. Duesenberry has pointed out that, on *a priori* grounds, there

> . . . is no reason why the [Keynesian] argument should not be turned the other way ... it would not... be surprising if it turned out that a rise in rates led to an expectation of a further rise and vice versa. It is almost certainly true that most persons who take an interest in security prices will be influenced by both types of consideration.[35]

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[34] A recent survey of interest rate expectations of large financial and non-financial companies, in the United States, suggests that the evidence is consistent with this assumption: ". . . some investors are willing to estimate bond rates, *but not* [Treasury] *bill rates*, one and two years hence. . . . This suggests... that individuals *may be* more likely to estimate long rates over the short run than short rates over the long run." (Emphasis in original.) See E. J. Kane and B. G. Malkiel, "The Term Structure of Interest Rates: An Analysis of a Survey of Interest-Rate Expectations," *Review of Economics and Statistics*, 49, (August, 1967), pp. 347-348. This evidence may mean simply that investors' holding periods are short. If this is true, the case for the approach used here is strengthened.

[35] J. Duesenberry, *Business Cycles and Economic Growth*, (New York: McGraw-Hill Book Company, Inc., 1958), p. 318.

In testing these hypotheses I use a method devised by DeLeeuw for use in his work on the term structure.[36] DeLeeuw suggests that the 'normal' rate hypothesis might be represented by the difference between the current long-term rate and a moving average of past rates, while the Duesenberry (extrapolative) hypothesis might be represented by a similar variable with greater weight being attached to more recent values of past long-term rates. In some of my testing I follow DeLeeuw directly by using variables of the following form:

$$r_L - \left(\frac{1}{\sum_{i=1}^{n}\lambda^i}\right)\left(\sum_{i=1}^{n}\lambda^i \, r_{L-i}\right),$$

where,

r_L = long-term rate of interest,
λ = weighting factor, $0 < \lambda < 1$.

The weights (λ^i) are normalized by multiplying each by the reciprocal of their sum. In testing the 'normal' (regressive) rate hypothesis the weighting factor (λ) should take on values close to unity; for the extrapolative hypothesis the values should be closer to zero. The strategy is to use different values of λ in both extrapolative and regressive variables and to pick the combination which performs best in terms of expected signs and 't' values.

DeLeeuw's method can be reformulated so that a distributed lag can be fitted directly to past rates with less *a priori* specification of the weighting factor. Much of my testing of the interest rate expectations hypotheses is

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[36] Frank DeLeeuw, *A Model of Financial Behavior*, pp. 500-501.

done using the Almon technique (described in Chapter 1) to estimate the distributed lag which is implied by DeLeeuw's method.[37]

To derive the expected shape of the distributed lag, note, first, that in DeLeeuw's method of testing the expectations hypotheses the demand function of investors for government bonds is:

$$G_j^D = \delta + \beta_1(r_L - \sum_{i=1}^{n} N_i r_{L(t-i)}) - \beta_2(r_L - \sum_{i=1}^{n} E_i r_{L(t-i)}) + \gamma V, \qquad (1)$$

where, G_j^D = amount of bonds demanded by investors j,
r_L = current yield to maturity on long-term bonds,

$N_i, E_i = \lambda^i \Big/ \sum_{i=1}^{n} \lambda^i$ = 'normal' and 'extrapolative' weights, respectively,

V = a vector of other relevant variables.

Removing brackets and collecting terms yields:

$$G_j^D = \delta + (\beta_1 - \beta_2) r_{Lt} + \sum_{i=1}^{n} (\beta_2 E_i - \beta_1 N_i) r_{L-i} + \gamma V \quad . \qquad (2)$$

Now a priori the weights (N_i, E_i) on past values of the rate are expected to have the patterns shown by E and N on Figure 5. Taking the difference (E-N), the combination of regressive and extrapolative expectations is expected to be reflected in the U-shaped lag pattern given by (E-N). The minimum point on the lag distribution occurs where E equals zero and the distribution should tail off to zero where N equals zero. It is impossible to know intuitively whether the signs on the lag coefficients should start

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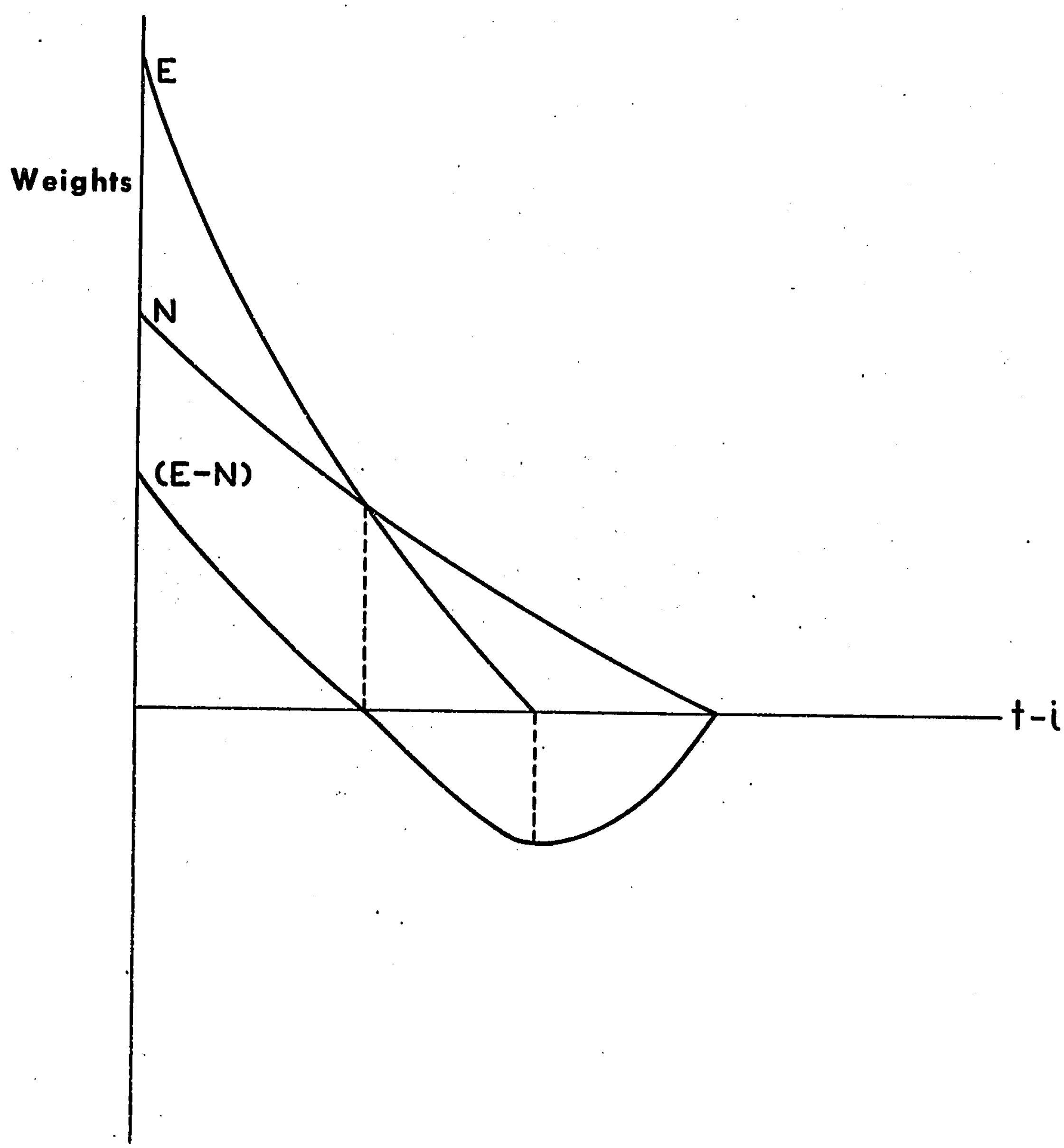
[37] My adaptation of DeLeeuw's method follows that used by Modigliani and Sutch in their test of the determinants of the term structure of rates. See "Innovations in Interest Rate Policy," American Economic Review, 56, (May, 1966), pp. 185-188.

Figure 5

LAG PATTERN IMPLIED BY EXPECTATIONS



out being positive or whether all coefficients should be negative; this depends on which β coefficient is larger. If the dominant element in the formation of expectations is extrapolative then the E curve would be above N and the weights would start out positive (crossing zero where E=N as in Figure 5). On the other hand, if expectations were predominantly regressive then the N curve could lie above E and all lag weights could be negative. Since the coefficient on the current rate is $(\beta_1 - \beta_2)$ a negative sign is consistent with a lag distribution beginning with positive coefficients.

This illustration uses a demand function for bonds; in considering the demand for 'fixed price' financial assets which are alternatives to bonds (e.g., time deposits), a reversal of the signs on β_1 and β_2 should result so that the shape of the distributed lag will be an inverted U.

Therefore, in estimating the distributed lag by the Almon technique, at least a second degree polynomial should be used and the lag distribution constrained to zero after a finite number of periods. Clearly the degree of polynomial and the length of the lag are arbitrary; these are chosen on the basis of 'best fit' in terms of the shape of the distribution, coefficient of multiple determination and the 't' values.

CHAPTER 4

BANK DEMAND FOR EARNING ASSETS

Introduction:

The discussion of the Canadian legal restraints and review of the literature in Chapter 2 led to the conclusion that bank demand for earning assets cannot be summarized in a single equation representing demand for excess reserves, since this variable must be regarded as exogenous in the Canadian system. This means that a set of demand equations must be estimated for the components of earning assets. I have not extended the scope of this thesis to deal with the whole portfolio but have concentrated on isolating the demand determinants of the most important asset classes, measured in terms of size and analytical interest.

The composition of the aggregate bank portfolio is shown in Table 2 as of the end of 1956, 1960 and 1965 - the beginning, middle and terminal dates of the sample period.

Comparison of 1956 and 1965 gives a fair indication of recent trends in the portfolio. The distribution of total assets is similar in 1956 and 1960. The end of 1956 was close to a business cycle peak and December, 1960 to a trough, so that the portfolio is biased in favour of Total Loans at the former date and in favour of More Liquid Assets at the latter

TABLE 2

COMPOSITION OF TOTAL CHARTERED BANK ASSETS

$ Millions (% of Total Assets)

	December 1956			December 1960			December 1965		
More Liquid Assets			3,645 (35.4)			4,428 (34.6)			5,493 (29.6)
Reserves		882 (8.6)			992 (7.8)			1,417 (7.6)	
Day Loans		74 (.7)			172 (1.3)			251 (1.4)	
Treasury Bills		740 (7.2)			967 (7.6)			1,357 (7.3)	
Net Foreign Assets		117 (1.1)			71 (.6)			- 117 (-.6)	
Call Loans		157 (1.5)			138 (1.1)			208 (1.1)	
Canada Bonds		1,675 (16.2)			2,088 (16.3)			2,377 (12.8)	
Total Loans			5,698 (55.3)			7,367 (57.6)			11,885 (64.0)
General Loans		3,998 (38.8)			5,031 (39.3)			9,517 (51.2)	
Business	2,765 (26.8)			3,220 (25.2)			5,627 (30.3)		
Personal	786 (7.6)			1,199 (9.4)			2,801 (15.1)		
Farm	357 (3.5)			420 (3.3)			804 (4.3)		
Other	90 (.9)			194 (1.5)			285 (1.5)		
Other Loans		1,207 (11.7)			1,365 (10.7)			1,553 (8.4)	
Instalment Finance Cos.	394 (3.8)			371 (2.9)			527 (2.8)		
Municipalities	177 (1.7)			217 (1.7)			521 (2.8)		
Grain + C.S.B. + Provinces	636 (6.2)			777 (6.1)			505 (2.7)		
Mortgage Loans		493 (4.8)			971 (7.6)			815 (4.4)	
Non-Canada Securities			964 (9.3)			1,005 (7.8)			1,191 (6.4)
Total Assets			10,308 (100.0)			12,800 (100.0)			18,570 (100.0)

Source: Bank of Canada, Statistical Summary, Supplement date. Since 1956 the banks have increased Total Loans at the expense of More Liquid Assets and Non-Canada Securities (mainly provincial, municipal and corporate bonds), with the ratio of Total Loans to Total Assets increasing from 55 per cent to 64 per cent and the More Liquid Asset and Non-Canada Securities ratios declining from 35 per cent and 9 per cent to 29 and 6 per cent respectively.

Within the More Liquid Asset portfolio the largest relative decline has been in Canada Bonds. It is also noteworthy that the banks were net investors in foreign currency assets in 1956 and that the extent to which this asset has been used as an investment outlet has gradually declined so that, by the end of 1965, Net Foreign Assets were a source of funds for investment in Canadian currency assets, though the net foreign position has always been small in absolute and relative terms.[1]

The large relative increase in the Total Loan portfolio has occurred almost entirely in the Business Loan and, especially, in the Personal Loan subsets of General Loans. Business Loans have increased from some 27 per cent of the total asset portfolio in 1956 to 30 per cent in 1965. Personal Loans have increased spectacularly, rising from 8 per cent of Total Assets in 1956 to 15 per cent in 1965, an increase which is largely attributable to the entry of the banks into the market for consumer instalment loans in the late 1950's.[2] All other loans have been relatively

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[1]For a good description of the foreign currency operations of Canadian banks see R. A. Shearer, "The Foreign Currency Business of Canadian Chartered Banks," Canadian Journal of Economics and Political Science, 31, (August, 1965).

[2]Porter Report, p. 127.

stable or declining proportions of Total Assets during these years.

Assets which may reasonably be expected to be explained endogenously are More Liquid Assets, Business Loans, and Personal Loans. Mortgage Loans exhibit only a slight declining trend since 1960 when the National Housing Act mortgage rate exceeded the 6 per cent ceiling on bank lending rates, thus forcing the banks out of the mortgage market.[3] Hence, there is no sense in making them endogenous, even though, prior to 1960, these loans might be adequately explained stochastically using interest rates and bank portfolio constraints. Non-Canada Securities exhibit virtually no variance over the sample period, so that they also may justifiably be left exogenous. The remaining elements of the loan portfolio are Other Loans and the Farm and Other components of General Loans (in Table 2). One element in the Other Loans group, loans to instalment finance companies, may reasonably be expected to be governed by the same variables as determine Business Loans, so that these two categories could be added if a demand equation were included.

There remains a set of miscellaneous loan assets, including most of the elements of the Other Loans category (loans to junior governments and grain dealers, loans for the purchase of Canada Savings Bonds - C. S. B.) and the Other component of General Loans (which is made up of loans to religious, educational, health and welfare institutions). These assets form a relatively small part of earning assets and a proportion

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[3]Prior to 1967 the banks were prohibited by law from entering the conventional mortgage market.

that has been declining over time from 8.6 per cent in 1956 to 6.0 per cent in 1965. Given the low probability of being able to formulate adequate supply and demand relations for the elements of this heterogeneous set, these assets are also left as exogenous. The total may be adequately projected by using seasonals and a time trend. The exogenous earning assets and their absolute and relative sizes are summarized in Table 3.

TABLE 3

EXOGENOUS EARNING ASSETS
$ Millions, (% of Total Earning Assets)

	Dec. 1956	Dec. 1960	Dec. 1965
Mortgage Loans	493 (5.2)	971 (8.2)	815 (4.8)
Non-Canada Securities	964 (10.2)	1,005 (8.5)	1,191 (6.9)
Other Loans	813 (8.6)	994 (8.4)	1,026 (6.0)
Total	2,270 (24.1)	2,970 (25.2)	3,032 (17.7)

Source: Table 2.

More Liquid Assets:

Consider first the subset of total assets entitled More Liquid Assets in Table 2. The set consists of non-interest earning cash reserves and earning assets for which active secondary markets exist. Since cash reserves are an exogenous variable and since, in any case, one of the things to be explained is the distribution of these liquid assets between reserves and earning assets, I attempt to explain only the earning asset component of this group, (which will be referred to from now on as earning liquid assets). Further, I assume that the elements of this class of earning assets form a homogeneous group, i. e. I assume that a bank which desires to change its liquid assets is indifferent to whether the change takes the form of Canada bonds or short-term loan assets (such as day loans). I think this is a tolerable assumption since Canada bonds and Treasury Bills so dominate the total (at the end of 1965 they accounted for 92 per cent of total earning liquid assets) that they are likely to be the major contributors to variance in the series. Because of the dominance of Canada bonds in the total of More Liquid Assets, I consider the total to represent demand for this asset.[4] The supply of Canada bonds can safely be assumed to be exogenous so that this market is represented by a single, demand, equation.

The set of earning liquid assets makes up what Marsh has called the 'cash adjustment assets' of a bank.[5] A bank which changes its excess reserves does so by changing earning liquid assets in the opposite direction. Since excess reserves are exogenous in the Canadian system, the demand equation for earning liquid assets provides a convenient way of capturing the response of banks to excess reserves, whether emanating

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[4]It should be noted, however, that there are two respects in which the elements of this series are not homogeneous. The first is that day loans and call loans have zero term to maturity; therefore, in a period when interest rates are expected to rise the banks can be expected to shift assets from Canada bonds to these loans. Since day loans are an important short-run adjustment asset for the chartered banks, a more complete model would disaggregate at least to the extent of estimating separately a market for day loans. Presumably chartered bank demand for day loan assets in such a model would be represented by an equation explaining the interest rate on these loans. The second is that the required 15 per cent liquid asset ratio imposes a lower limit on the size of the total of Treasury Bills and day loans. I think it a reasonable assumption that this constraint affects only the distribution of earning liquid assets and not the total amount.

[5]See Chapter 2, above, p. 31.

from a change in their desired excess reserves (given the total in the system) or from a change in total excess reserves initiated by the central bank.

The discussion of Chapter 2 concludes that two important variables in the demand equation for excess reserves are short-term interest rates and the amount of reserves provided by the central bank. Hence, these variables should also be important determinants of bank demand for earning liquid assets.

Earning liquid assets may also be influenced by current changes in business loans outstanding. The total of business loans outstanding is a demand-determined quantity in the short run. The banks agree to meet a given company's demand for loan funds up to a maximum authorized amount. Given the fact that changes in business loans only affect the banks by redistributing cash reserves in the system[6] and not by generating required reserves in the current period, the effect on total bank excess reserves will be zero in the current, monthly, averaging period. Any effect of current loan demand on earning liquid assets would be a result either of (a) individual banks' attempts to regain cash reserves lost in the withdrawal and redeposit (elsewhere in the system) of the deposit counterpart of loan assets or (b) current changes in loans outstanding might generate expectations of future changes in loans. Because of the large size of business loans in the bank portfolio and their volatility, I feel that their influence should be investigated and to do this I have

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[6]They may affect total reserves by their effect on currency drains. I assume that these changes are offset by the central bank or, if not offset, that the resulting reserve change is desired by the authorities.

included the current change in business loans as an independent variable in the earning liquid assets equation. I expect it to enter with a negative sign, reflecting either, or both, of these influences.[7] It is quite possible that the net effect on the earning liquid assets of the system will be zero. The system is composed of a few large banks so that the probability that an increase in loans will be largely withdrawn from any one bank (causing an equal reduction in reserves) must be relatively low. This conclusion should hold especially over a quarter (the time unit used in this study) since one would expect that, over a period as long as this, the ease or difficulty which banks encounter in obtaining the current, fixed, amount of required reserves should be almost entirely reflected in the quantity of excess reserves in the system. On the other hand, it is not much comfort to an individual bank, expecting large drawdowns of loans in the current averaging period, to know that the system can 'easily' meet the reserve requirement. In summary, the loan variable may have an insignificant net effect on earning liquid assets, or a significant negative effect if individual banks act as if an expected increase in loans would be largely withdrawn and redeposited elsewhere in the system.

The results of my experiments are contained in Table 4.* Equation 1 gives the result of testing the simple hypothesis that earning liquid assets are a positive function of the current short-term interest rate and the current quantity of excess reserves in the system, and a negative function of the change in business loans.

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[7] A more elaborate formulation of the generation of loan expectations might allow the extrapolation to be modified by a proxy variable for the current forecast of economic activity.

*All of the equations were also run with all asset variables scaled by total assets. The differences in results were not appreciable.

TABLE 4

EARNING LIQUID ASSETS
(Dependent Variable: ΔELA)

No.	Constant	ΔL_B	CR	$CRxr_{0-3}$	σ_H^2	A	Δr_B	r_{10t}	r_{10t-i}	Q_1	Q_2	Q_3	ELA_{-1}	r_{0-3t}	$\overline{R}^2$	DW	% Error
1.	1,406.30	-.93	-11.94										-.08	-209.50	.70	2.08	3.9
	(4.1)*	(4.1)	(2.3)										(1.1)	(5.4)			
2.	897.20	-.98	23.97	-10.66									-.14		.75	2.01	3.5
	(3.4)	(4.9)	(3.5)	(6.6)									(2.2)				
3.	507.03	-.95	34.01	-13.59				156.58	i=1 16.67 (.2)				-.16		.75	1.97	3.6
	(1.1)	(4.6)	(3.3)	(3.8)				(.7)	2 3.06 (.1)				(1.6)				
									3 - 7.25 (.2)								
									4 -14.27 (.5)								
									5 -18.00 (.6)								
									6 -18.44 (.6)								
									7 -15.58 (.6)								
									8 - 9.44 (.5)								
4.	304.00	-.87	40.82	-15.27	-5.92		-68.24	223.77	i=1 60.38 (.7)				-.11		.77	1.96	3.4
	(.7)	(4.4)	(4.0)	(4.3)	(2.0)		(1.2)	(1.1)	2 20.02 (.4)				(1.2)				
									3 -10.97 (.3)								
									4 -32.58 (1.2)								
									5 -44.81 (1.5)								
									6 -47.67 (1.5)								
									7 -41.16 (1.4)								
									8 -25.27 (1.4)								
5.	301.87	-.95	39.84	-14.76		-1.08	-67.50	224.75	i=1 18.44 (.2)				-.11		.74	1.87	3.6
	(.5)	(4.4)	(2.3)	(3.1)		(.4)	(1.1)	(.8)	2 .89 (.0)				(1.0)				
									3 -12.30 (.3)								
									4 -21.13 (.7)								
									5 -25.61 (.8)								
									6 -25.74 (.8)								
									7 -21.51 (.7)								
									8 -12.93 (.7)								

TABLE 4 (Cont'd)

No.	Constant	ΔL_B	CR	$CR x r_{0-3}$	σ^2_H	A	Δr_B	r_{10t}	r_{10t-i}	Q_1	Q_2	Q_3	ELA_{-1}	r_{0-3t}	$\bar{R}^2$	DW	% Error
6.	604.20	-.65	44.86	-18.06	-5.41		-68.23	294.99	i=1 74.78 (.8)	-87.66	-137.48	- 73.60	-.13		.77	1.85	3.4
	(1.3)	(1.6)	(3.6)	(4.5)	(1.8)		(1.2)	(1.4)	2 19.59 (.4)	(1.3)	(1.4)	(.8)	(1.3)				
									3 -22.51 (.7)								
									4 -51.51 (1.8)								
									5 -67.41 (2.0)								
									6 -70.20 (2.0)								
									7 -59.90 (1.9)								
									8 -36.50 (1.9)								
7.	678.10		56.98	-20.69	-5.46		-70.19	333.65	i=1 89.47 (1.0)	-75.91	-247.94	-191.98	-.19		.76	1.58	3.5
	(1.4)		(5.6)	(5.5)	(1.8)		(1.2)	(1.5)	2 25.92 (.5)	(1.1)	(3.7)	(3.1)	(2.0)				
									3 -22.67 (.7)								
									4 -56.30 (1.9)								
									5 -74.96 (2.2)								
									6 -78.66 (2.2)								
									7 -67.40 (2.1)								
									8 -41.18 (2.1)								

Notation:

- ELA = chartered banks' earning liquid assets (Canada bonds, Treasury Bills, call and day loans, net foreign assets).
- L_B = chartered banks' total business loans.
- CR = chartered banks' cash reserve ratio (deviations from 8 per cent scaled by 100).
- r_{0-3} = average yield on Canada bonds with less than three years to maturity.
- σ^2_H = four quarter moving variance of a 1-year holding period yield.
- A = average term to maturity of Canada bonds held by the general public.
- Δr_B = change in bank rate = 0 during the floating rate period (1957-62).
- r_{10} = average yield on Canada bonds with more than 10 years to maturity.
- $Q_i(i=1, 2, 3)$ = seasonal dummies.
- $\bar{R}^2$ = coefficient of multiple determination corrected for degrees of freedom.
- DW = Durbin-Watson statistic.
- % Error = standard error of estimate as a percentage of the mean of the level of the dependent variable.

*Numbers in brackets are 't' values.

The variable used to represent the reserve position of the banking system is the ratio of current statutory reserves (i.e. including vault cash lagged one month) to statutory deposits (i.e. deposits lagged one month) expressed as a percentage. Because this variable moves within a very small range I have scaled it by 100 and taken deviations from the required minimum ratio (8 per cent). Early experimentation revealed that this variable does considerably better as an explanatory factor (in terms of 't' values) than the absolute quantity of excess reserves, indicating that, *ceteris paribus*, desired excess reserves of the commercial banking system are a positive function of total deposits.

The results obtained from equation 1 are unsatisfactory. In particular, the cash ratio and interest rate variables enter with the wrong signs and the stock adjustment model does not work well. The coefficient on the lagged dependent variable is not significant at the 10 per cent level.

The hypothesis of equation 1 assumes that the interest rate and the cash ratio exert their influence on earning liquid assets independently of one another so that,

$$ELA_t^* = a + bCR_t + cr_{0-3} + dV_t,$$

where V = a vector of other variables,
ELA^* = desired earning liquid assets.

A plausible alternative hypothesis is that the interest rate exerts its influence by altering the banks' response to the cash ratio so that,

$$ELA_t^* = e + fCR_t + gV_t, \qquad (1)$$

and,

$$f = h + kr_{0-3_t}. \qquad (2)$$

Substituting (2) in (1) yields,

$$ELA^*_t = e + hCR_t + fr_{0-3_t} CR_t + gV_t.$$

The results of testing this hypothesis are shown in equation 2. A slight improvement is obtained in that the coefficient on the cash ratio is now positive as well as significant.* The coefficient of adjustment is significantly different from zero at the 5 per cent level and has the expected sign, but its size is surprisingly small, indicating that only 14 per cent of the adjustment of actual to desired ELA takes place in the current quarter. This seems very small (over a period as long as a quarter) in view of the fact that the Canadian system consists of a few large banks. Lags in the spread of information must be non-existent and the banks undoubtedly have fairly large investment departments which keep a close watch on the liquid asset portfolio.

In an attempt to improve these results, I test for the influence of interest rate expectations. D. B. Marsh has stated the opinion that banks are sensitive only to rate expectations. He does not think that

> large Canadian banks are sensitive to the absolute level of rates in adjusting their cash positions. This may be true of small banks, notably in the United States, that would not ordinarily find it profitable to assume the overhead involved in skilled cash management. However, with a significant rise in interest rates, some of these banks, like other corporations, may find the extra overhead worthwhile. This would appear in aggregate figures as lower cash balances relative to total operations; or, in the case of banks, lower cash reserves relative to deposits. For large Canadian banks, the cost of investment relative to income from investment is extremely low, and it pays them to assume the overhead involved in skilled cash management regardless of the absolute level of interest rates (above zero plus cost of investment). As a result, in their money-market operations, the banks will move extremely fast for what may appear to be extremely small interest differentials.[8]

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[8] D. B. Marsh, "Johnson's Tour: A Rejoinder," p. 130.

*It should be noted that, even here, the partial derivative of ELA with respect to CR is negative when account is taken of the multiplicative variable (CR x r_{0-3}).

Clearly, if interest rate expectations are important determinants of earning liquid assets, the changes in Government securities markets, which had the effect of increasing the risk of loss associated with holding Canada bonds, should also affect the banks' liquidity preference schedule over the sample period. This hypothesis is tested by including the variables, average term to maturity of Canada debt and variance of holding period yields, in the demand equation for earning liquid assets. Much of my early experimentation with expectations variables was done using the DeLeeuw formulation of differentials between the current rate and moving averages of past rates. Initially the rate used in these variables was the short-term Canada rate. I thought this was appropriate since a large proportion of bank holdings of Canada bonds are of relatively short term to maturity. This rate consistently produced incorrect signs in the expectations variables. Subsequent experimentation with the long rate produced the expected signs but the variables were never significant.

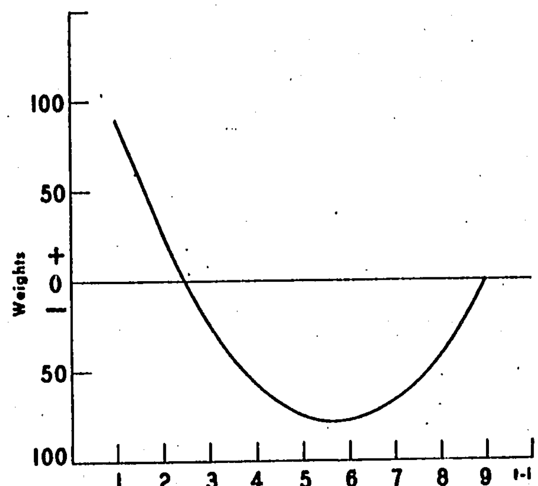
The results listed in Table 4 estimate the distributed lag on long rates using the Almon technique, and test for the influence of the variables (A, σ^2_H) that are used to approximate changing risk on Canada bonds. In addition, they test the effect of including the change in Bank Rate as an attempt to improve the specification of the formation of interest rate expectations. The variable enters the equation only since 1962, when Canada returned to a fixed Bank Rate system from the floating rate system, which had been in effect from 1956 to 1962. The hypothesis is that changes in Bank Rate, which occur infrequently at the discretion of the central bank, are read by financial markets as signals of the central bank's intentions with respect to future interest rates. A rise in Bank Rate is expected to generate expectations of a future increase in interest rates, thereby leading banks to shift assets in the direction of cash reserves, or of earning assets with zero term to maturity. This variable can be expected to exert a negative influence on earning liquid assets.

Equation 3 simply adds a distributed lag on long-term interest rates to equation 2, to account for the influence of expectations. Equations 4 and 5 test for the additional influence exerted by the alternative risk variables and the change in Bank Rate. In all of the equations shown here an eight quarter, second degree, polynomial is used to estimate the lag in interest rates, with the coefficients at t-9 constrained to zero.

The results are disappointing. Equation 4 is the best of the group of equations 3, 4, and 5. The variance of holding-period yields (σ_H^2) does much better than the average term to maturity (A) in capturing the effects of changes in risk on banks' liquidity. Comparison of equations 4 and 5 indicates that the σ_H^2 variable enters, in the expected (negative) direction with a significant coefficient (at the 5 per cent level) while the coefficient on A is insignificant. The change in Bank Rate has the expected sign in each of equations 4 and 5 but is not significant in either. Though the lag distributions in all of these equations have the U shape, consistent with a combination of extrapolative and regressive expectations, in no case are the lag coefficients significantly different from zero even at the 10 per cent level.

A surprising feature of all equations 1 to 5 is that the loan variable enters very strongly with a negative coefficient of close to unity. This is difficult to rationalize given the observations made above about the institutional structure and the legal restraints of the Canadian banking system. Equation 6 of Table 4, which adds seasonal dummies to equation 4, indicates that much of the contribution of the change in business loans is attributable to seasonal movements. Indeed, the inter-correlation of the seasonals and the change in business loans reduces both to insignificance. Removing the loan variable (see equation 7) results in highly significant, negative, seasonal dummies for the second and third quarters. Since these are the periods of strong loan demand, a reasonable interpretation is that individual banks anticipate reserve losses, resulting from strong seasonal loan demands, by liquidating earning liquid assets. Certainly, equation 7 (Table 4), which retains the seasonals and drops the loan variable, gives the best results. Though the overall fit is similar to that obtained in equation 4, the coefficient of adjustment and five of the eight lag coefficients on the long-term interest rate are significant at the 5 per cent level. The lag weights are, effectively, all negative (the first three weights are not significantly different from zero) and the positive sign on the current value of the long rate is consistent with this result. These weights are plotted in Chart 2. They indicate that there are elements of extrapolation and regression in the formation of rate expectations by the banks but that regressive expectations predominate.

Chart 2
LAG WEIGHTS ON $r_{10\,t-1}$*



*From Equation 7, Table 4

The coefficient of adjustment, though significant, remains surprisingly low; it indicates that only about 20 per cent of the total desired adjustment is eliminated in the current period. This is one of two respects in which the equation is unsatisfactory. The other is that the short-term interest rate variable ($ÇR \times r_{0-3}$) retains a highly significant coefficient with a negative sign in all of the equations presented here. Given the strong, negative, simple correlation between liquid assets and the short-term rate, it is likely to be particularly difficult to isolate any independent, positive, effect which exists. However, it may be, as Marsh suggests, that desired excess reserves are, in effect, independent of current short rates and that all interest rate effects are captured by the expectations variables. This is certainly a reasonable hypothesis.

The only trouble is that dropping the variable (CR x r_{0-3}) results in an insignificant coefficient on the bank reserve variable (CR). On the positive side the results indicate (1) that the evidence is consistent with the hypothesis that interest rate expectations are important determinants of the stock of earning liquid assets and (2) that changes in risk associated with Canada bonds (measured by the variance of holding-period yields) significantly affect the banks' willingness to hold these assets.

The Market For Business Loans:

The banks do not directly control the amount of commercial loans outstanding. Rather, they set the amounts of authorized lines of credit under which businesses are free to draw as the need for funds arises. The Canadian Bankers' Association states that,

> In administering credit policy it is usual [for the banks] to establish lines of credit for major customers who have a continuing need for accommodation... The line of credit lets the customer know how much credit he may normally expect in his operations and authorizes the branch manager to make loans to the customer up to the agreed amount as long as there is no adverse change in circumstances. As long as a line of credit is outstanding the bank's management regards itself as committed to making loans within the stated limit...[9]

Therefore, a model of the business loan market can be constructed on the assumption that, in the short-run, the quantity of loan funds supplied by the banks is equal to the quantity of loan funds demanded by business. Given the set of loan terms, current loans outstanding are determined by a single equation representing business loan demand. Over a longer period of time the banks influence the amount of loans outstanding by

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[9] Canadian Bankers' Association, "Submissions to the Royal Commission on Banking and Finance," p. 19.

varying the terms on which they are granted. These terms include the bank lending rate as well as loan authorizations.[10] Because of the lack of variance in the prime loan rate (the only measure of bank lending rates which is available) I dispense with this equation and concentrate on estimating an equation for the supply of loan authorizations.[11]

I now consider the factors which may be expected to determine the composition of earning assets desired by the banks. The same theory has been applied to analyzing this distribution as is used in Chapter 3 to analyze the distribution of the liquid asset sub-set of total assets between

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[10]Loan authorizations and interest rates are the only elements in the set of terms on which loans are granted for which data are available. It is quite possible that others exist; for example the banks have recently begun to require that loan customers maintain compensating balances. See B. Riddell, "Banks Review Loans to Get That 6.6%," Financial Post (Toronto), Oct. 8, 1966, p. 1.

[11]This model of the business loan market was first used in an econometric model by Shapiro, "The Canadian Monetary Sector." I have done no work on business demand for bank loans but Shapiro (page 82) obtained a reasonably good fit using a simple model (fitted to quarterly data from 1955 to 1962) as follows:

$$\Delta TBL_t = \underset{(.9)*}{302.2} + \underset{(2.0)}{182.5}(r_6 - r_4)_t + \underset{(2.3)}{.09}BI_t - \underset{(4.5)}{.90}\,TBL_{t-1},$$

$$\bar{R}^2 = .83$$

where

TBL = total business loans,
r_6 = corporate bond rate,
r_4 = prime loan rate,
BI = total business investment.

* Figures in parentheses are 't' values.

'money' and 'bonds'. The Tobin analysis assumes that the amount of funds to be distributed among various assets is constant. This means, of course, that the expected return (profit) on the portfolio is a function only of the expected rates of return on assets and that the only source of risk is the variability of the rates of return of the assets. The assumption of constancy of the total portfolio is not satisfactory when the investors involved are commercial banks. The variability in the size of a bank's portfolio derives, of course, from the fact that most of its liabilities have either zero or very short term to maturity. Therefore, a bank's expected return (profit) will be a function of the expected change in its liabilities as well as of the expected rates of return on individual assets. Analogously, its risk exposure, measured by the variability of return on the portfolio, will be a function of the variability of its deposits as well as of the variability of rates of return on individual assets.

I am concerned at the moment primarily with the implications of deposit variability for the distribution of bank assets between liquid and loan assets. The former group of assets (made up, in my terminology, of excess reserves and earning liquid assets) is capable of being sold quickly with relatively small risk of loss. The components of the latter group are, in general, non-marketable. In general, the higher is deposit variability, the greater is the risk that a bank will not be able to meet deposit drains with a given stock of liquid assets relative to total assets and, therefore, the greater is the desired relative stock of these assets.

Kane and Malkiel[12] point out, however, that portfolio decisions taken in the current period may affect future deposit variability and, hence, future bank profits. They maintain that these considerations of future profit may result in decisions to allocate a greater proportion of assets to loans than would be indicated by current and expected interest rates and current risk exposure.

Their argument is that refusal to grant a loan impairs the 'quality' of the bank-customer relationship, i. e. it is likely that a bank customer who is refused loan accommodation will take his business elsewhere. Since large loan customers are typically large, and stable, depositors, failure to grant the loan means that future deposit variability of the bank will be increased, thereby reducing expected utility. The authors do not claim that current values of variables are irrelevant; rather, they are concerned to point out that the portfolio optimum is disturbed as soon as a loan request from a favoured customer is received. If the application is refused, the quality of the customer relationship declines (deposit volatility increases) and therefore so does the utility of the original portfolio. If the loan is granted, the volume of marketable securities available to meet deposit drains will be reduced (thereby reducing utility) though, on the other hand, expected future profits will

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[12] E. J. Kane and B. G. Malkiel, "Bank Portfolio Allocation, Deposit Variability, and the Availability Doctrine," Quarterly Journal of Economics, 79, (February, 1965). The effects of deposit variability on bank portfolio selection have also been analyzed by R. C. Porter, "A Model of Bank Portfolio Selection," Yale Economic Essays, 1, (Fall, 1961).

be increased. The point is that the case for refusal of loan applications by favoured customers is far from clear-cut.[13]

Kane and Malkiel also analyze the implications of the stickiness of bank loan rates for portfolio allocation.[14] They note that movements in bank loan rates tend to lag movements in economic activity, and hence loan demand. This means that loan rates do not equilibrate loan markets from period to period. The authors suggest that it is reasonable to assume that rates will vary in such a way that markets will tend to be cleared "on the average", but this means that the bank loan market is typically in a condition of excess supply or excess demand. This means that, while banks will not be able to meet all demands for credit during boom periods, they equally will be unable to achieve their desired (increase volume of loans in periods of recession. Kane and Malkiel argue that bankers have a strong incentive to attain the optimum point on their opportunity curve in a recession period since the yield on loans will be high relative to that on bonds (given the large yield variability on bonds relative to that on bank loans). Moreover, the risk differential between bonds and loans is at a minimum at this time because bond rates will be expected to rise (prices to fall) during the following period of expansion, resulting in a high risk of capital loss on bonds. These considerations

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[13] The importance of the "customer relationship" has also been emphasized and analyzed in some detail by Hodgman. See D. R. Hodgman, Commercial Bank Loan and Investment Policy, (Champaign, Illinois: University of Illinois, 1963), Chapters 10 and 11.

[14] Kane and Malkiel, "Bank Portfolio Allocation, Deposit Variability, and the Availability Doctrine," pp. 125-128.

imply that banks will tend to favour those borrowers during periods of credit restraint whose borrowing is expected to be relatively high during periods of ease. This is another factor complicating the asset allocation decision.

These factors complicate not only the decision-making process within the bank; they also make it difficult to construct a supply equation of loan funds, since many of them are, in practice, unobservable. As an index of the banks' current risk exposure (i. e. their ability to meet deposit drains by sales of marketable securities) I have used the earning liquid assets variable, defined in the previous section. The greater the stock of earning liquid assets, the higher may be expected to be the banks' demand for higher yielding loan assets. It is quite possible that the change in earning liquid assets, as well as the current stock, exerts an influence on bank demand for loan assets.[15]

Clearly, the yield on loan assets is likely to be an important explanatory variable in this equation. To represent this yield I use the only available measure, the prime rate. As Shapiro has noted,

> The chief difficulty with this rate is that it represents two forces which react on bank behaviour in different directions. On the one hand, the higher the prime rate, the more anxious, presumably, the banks will be to increase further their authorized lines. On the other hand, the prime rate is often raised by the banks at precisely that time when they are reaching the limits of their lending capacity and must decrease their rate of loan authorizations.[16]

[15]This has been suggested by the Canadian Bankers' Association. See Chapter 2, above, p. 33.

[16]Shapiro, "The Canadian Monetary Sector," p. 76.

In an attempt to capture the second of these two influences, Shapiro introduces as a variable the difference between total loan authorizations and total loans outstanding. The idea is that, the greater this difference, the lower is the degree of utilization of the banks' capacity to hold loan assets. Therefore, given the loan rate, this variable is expected to exert a positive influence on loan authorizations.

The empirical results of testing these hypotheses are shown in Table 5.[17] Equation 1 uses both the current level and the current change in earning liquid assets as well as the loan rate and the capacity variable. The equation is unsatisfactory in several respects: (1) the stock adjustment formulation fails since there is a positive sign on the lagged stock, (2) the loan rate has the correct sign but is insignificant and, (3) the coefficient on the capacity variable ($TA-L_B$) does not have the expected sign. Though both the portfolio variables (ELA' and ΔELA) are highly significant, only the current level enters with the expected sign. This sign pattern on the level and change in the portfolio variables recurred through all the testing which I did using both in the same equation. The coefficients on these variables in equation 1 can be written as,

$$.05ELA_t + .21\ ELA_{t-1},$$

indicating that what is being captured is the distributed lag response of authorizations to the stock of earning liquid assets.

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[17]Seasonal dummies contributed nothing to the equations and they are omitted in all equations presented here. This is reasonable since banks may be expected to normalize for seasonality in loan demand in reviewing the composition of their portfolios.

TABLE 5

BUSINESS LOAN AUTHORIZATIONS*

No.	Dependent Variable	Constant	TA_{-1}	r_L	$(TA-L_B)_{-1}$	ELA_{-i}	TBA	r_{10t}	r_{10t-i}	ΔELA_t	$\bar{R}^2$	DW	% Error
1.	ΔTA	-1,040.70	.18	62.54	-.38	i=0 .26				-.21	.55	1.48	1.2
		(1.6)	(2.7)	(.6)	(2.4)	(3.3)				(2.9)			
2.	$\frac{\Delta TA}{TBA_{-1}}$	- .19	.21	.02	-.21	i=1 .22		- .01	i=1 -.0020 (.7)		.59	1.77	1.0
		(2.8)	(1.8)	(2.3)	(1.2)	(2.3)		(1.8)	2 .0003 (.2)				
									3 .0010 (1.2)				
									4 .0019 (4.9)				
									5 .0023 (4.2)				
									6 .0024 (3.3)				
									7 .0020 (2.8)				
									8 .0012 (2.6)				
3.	ΔTA	-1,176.61	-.27	287.42	.18	i=0 -.04	.14	-247.82	i=1 -32.34 (1.0)		.70	1.84	1.0
		(1.6)	(2.6)	(2.1)	(1.8)	(.6)	(2.5)	(3.7)	2 -15.70 (.8)				
									3 - 2.65 (.3)				
									4 6.79 (.8)				
									5 12.63 (1.1)				
									6 14.87 (1.1)				
									7 13.52 (1.1)				
									8 8.56 (1.1)				
4.	ΔTA	-1,798.99	-.12	331.64	-.07	i=1 .13	.11	-244.06	i=1 3.84 (.1)		.73	1.98	.9
		(3.3)	(1.1)	(3.1)	(.5)	(1.9)	(1.9)	(4.0)	2 4.95 (.2)				
									3 5.60 (.6)				
									4 5.80 (.8)				
									5 5.55 (.5)				
									6 4.84 (.4)				
									7 3.68 (.3)				
									8 2.07 (.3)				

TABLE 5 (Cont'd)

No.	Dependent Variable	Constant	TA_{-1}	r_L	$(TA-L_B)_{-1}$	ELA_{-i}	TBA	r_{10t}	r_{10t-i}	ΔELA_t	$\bar{R}^2$	DW	% Error
5.	ΔTA	95.28	-.09			i=0 -.06	.09	- 2.32	i=1 -47.46 (1.4)		.63	1.56	1.1
		(.5)	(1.1)			(1.2)	(1.6)	(2.3)	2 -21.88 (1.1)				
									3 - 1.91 (.2)				
									4 12.44 (1.6)				
									5 21.18 (1.8)				
									6 24.30 (1.8)				
									7 21.82 (1.7)				
									8 13.71 (1.7)				

Notation:

TA = chartered banks' business loan authorizations outstanding under authorized limits of $100,000 and over.
TBA = total chartered bank assets.
r_L = prime loan rate.
L_B = chartered banks' business loans outstanding under authorized limits of $100,000 and over.
ELA = chartered banks' earning liquid assets.
r_{10} = average yield on Canada bonds with more than 10 years to maturity.

*The form of the dependent variable is given in the second column. Where the dependent variable is scaled by TBA_{-1} the same scaling has been applied to all dollar magnitudes in the equation.

Equation 2 represents an attempt to improve the specification by scaling the dependent variable, and dollar magnitudes among the independent variables, by total bank assets. Also, I add a distributed lag on long-term interest rates to test for the influence of rate expectations on loan authorizations. This postulates that an expected rise in rates exerts a positive influence on the amount of authorizations desired by the banks, who wish to avoid capital losses on bonds and to reap the higher expected yield on loan assets. The lag weights are constrained to lie on a second degree polynomial and to tail off to zero after eight quarters. The coefficients of the distributed lag (r_{10t-i}) have the expected shape. All are positive and 5 of the 8 coefficients are significant at the 5 per cent level (the only negative coefficient, at t-1, is not significantly different from zero). The observed, negative, sign on the coefficient of the current long-term rate is consistent with a lag distribution containing positive weights. However, in most other respects the equation is no better than the first. The lagged dependent variable and the capacity variable continue to enter with the wrong signs and the coefficient of determination remains relatively low (.59).

The continued presence of a positively signed coefficient on the lagged stock indicates that there was a strong trend in the ratio of authorizations to bank assets over the sample period. It seems, therefore, that the banks were moving to a new equilibrium relationship between assets and authorizations over a significant part of the period. To account for this, I include total bank assets as an independent variable in subsequent equations and revert to the unscaled form of the equation.

This (see equation 3) at least yields a sensible sign on the coefficient of adjustment. According to this equation about 30 per cent of the total adjustment takes place in the current quarter. The equation remains unsatisfactory in some respects, most notable of these is the insignificance of the current stock of earning liquid assets. In addition, the lag weights on the long-term interest rate, though they have the expected shape, are not significant. Lagging the stock of earning liquid assets by one period (equation 4) produces a correctly signed, significant, coefficient on this variable but the rest of the equation deteriorates. The coefficient of adjustment is about half the size obtained in equation 3 and is insignificant, the utilization variable is insignificant, and the lag weights on the long-term interest rate remain effectively zero.

Finally, equations 3 and 4 are re-estimated omitting the prime loan rate and the loan utilization variables. This might produce a better fit since the intercorrelation between the capacity variable, total assets, and the lagged stock of authorizations was extremely high.[18] This formulation requires that the long-term Canada interest rate be an adequate proxy for all interest rates, including the loan rate. The result is shown in equation 5. This equation is not much better than any of the previous ones. The distributed lag on interest rates retains the expected shape and five of the coefficients are significant at the 10 per cent level (the distribution is plotted in Chart 3); but signs and significance levels of the other variables remain much the same. Replacing the current

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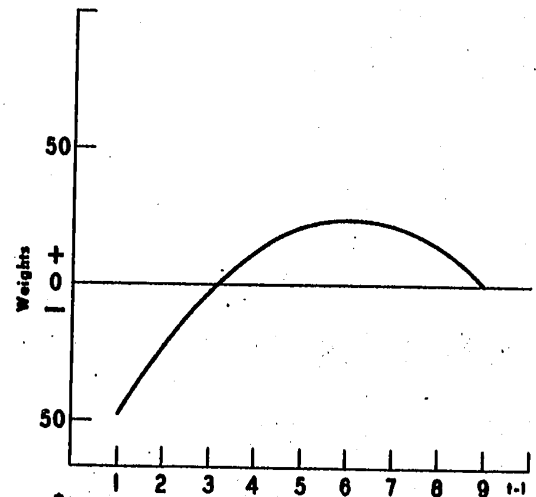
[18] The simple coefficients of correlation between $(TA-L_B)_{-1}$ and TBA and between $(TA-L_B)_{-1}$ and TA_{-1} were both .98.

Chart 3
LAG WEIGHTS ON $r10_{t-1}$*



*From Equation 5, Table 5

stock of earning liquid assets with its value lagged one period yields the correct (positive) sign but the coefficient is not significant and none of the other variables improves.

None of these equations is very satisfactory, a fact which may not be surprising given the strong trend which characterized the dependent variable over the sample period. They do provide some support for the hypotheses tested. It is interesting to note that the evidence (slight as it is) with respect to the banks' formation of interest rate expectations revealed by these equations is consistent with that found in the equations representing bank demand for earning liquid assets.[19] Both equations imply that, though there are elements of extrapolation and regression in the formation of expectations, regressive elements predominate.

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[19] See above, p. 79.

The Market for Personal Loans:

I noted earlier in this chapter that by far the most dramatic growth in bank assets over the past ten years has occurred in loans to households (personal loans) and that the cause of the increase was the large-scale entry by the banks into the market for consumer instalment loans. Though there are several other classes of loans within this category I have not disaggregated the personal loan portfolio. I think it a reasonable assumption that the variance in the personal loan series is attributable almost entirely to growth in consumer instalment loans.

Because of the paucity of information on the consumer loan market I have not attempted to formulate and test a complete model of the personal loan market. Instead, I estimate a reduced form equation explaining the amount of personal loans in banks' portfolios. The observation underlying this equation is that the interest rate charged by banks on consumer loans is much lower than that charged by others who lend to consumers and that this differential was in favour of the banks over the entire sample period. The Porter Report notes that consumer loans made by banks carry "a gross interest and service charge varying from $9\frac{1}{4}$ to $11\frac{1}{4}$ per cent."[20] The same source reports that, "in 1961 the effective annual charges of seventeen [sales finance] companies on a standard new car contract varied from 12.5 per cent to 18.8 per cent, with most companies reporting rates from 13.5 per cent to 16 per cent; rates on a smaller consumer contract ranged from 16 per cent to 23 per cent."[21]

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[20] Porter Report, p. 127.

[21] Ibid., pp. 206-207.

Given these facts, I think it is reasonable to assume that demand for bank personal loan funds with respect to interest rates is perfectly elastic. Further, I assume that the demand for personal loan funds can be adequately represented by entering in the equation the current value of purchases of consumer durable goods. As in my treatment of the market for business loans, I assume that bank demand for personal loans, which are high yielding but relatively illiquid assets, will vary positively with current and lagged values of the stock of earning liquid assets. I have included no interest rates in these equations. Though no time series of the effective rate earned by banks on these loans exists it seems probable that it was relatively constant at about 10 per cent.

The theoretical considerations discussed in the previous section with respect to the variables affecting bank utility lead me to believe that the current interest differential in favour of personal loans vis-a-vis business loans (and the advantages resulting from the predictable cash flow which they generate) will be offset to some, possibly considerable, extent. These considerations involve the increased expected profit and reduced future deposit volatility associated with the maintenance of good relationships with large commercial depositor-borrowers. Further, part of the interest rate differential would probably be wiped out if the risk and administrative cost differentials between business and personal loans were accounted for. Indeed it would not be surprising, I think, if the resulting balance were in favour of business loans, especially in view of the fact, noted above, that the loan terms offered consumers by banks are such that the banks are confronted with a demand curve for consumer credit which is virtually horizontal.

If these observations are correct, then profit maximization (present and future) would lead the banks to rely more heavily on personal than business loans in adjusting the balance of the total portfolio in response to a change in risk exposure (reflected in the stock of earning liquid assets). This hypothesis is tested indirectly by calculating the elasticities (implied by the equations) of personal loans and business loan authorizations with respect to liquid assets.

The results of my experiments are summarized in Table 6. Equations 1 and 2 are typical of the results obtained using the stock adjustment model. In equation 1 the only variable to enter significantly with the expected sign is the lagged stock of earning liquid assets (ELA). Equation 2, which drops the liquid asset term, produces correctly signed and significant coefficients on the lagged stock of personal loans and total bank assets; purchases of consumer durables remain insignificant. A significant, correctly signed, coefficient of adjustment was only obtained when total assets were used as the scale variable. This reflects the fact that the market was characterized by severe disequilibrium over a significant part of the sample period. Having decided to enter the consumer loan market, the banks were moving rapidly to achieve the desired redistribution of assets. This appears to be the explanation for the large coefficient on the total asset variable in equation 2; the implied steady state elasticity of personal loan funds with respect to

TABLE 6

TOTAL PERSONAL LOANS*

No.	Dependent Variable	Constant	Q_1	Q_2	Q_3	CD	ELA_{t-i}			Lp_{t-1}	TBA	$\bar{R}^2$	DW	% Error
1.	ΔLp	-212.01	-16.51	45.10	56.56	-.003	i=1	.08		.05	-.01	.85	1.40	1.6
		(1.4)	(.9)	(3.8)	(3.4)	(0.0)		(3.6)		(.6)	(.4)			
2.	ΔLp	-607.69	- 1.53	45.93	68.23	.08				-.19	.06	.79	1.15	1.8
		(5.2)	(.1)	(3.3)	(3.5)	(.7)				(3.5)	(4.7)			
3.	Lp	-2,510.58	463.23	-135.00	488.96	3.42	i=0	.02	(.4)			.92	1.66	12.0
		(8.9)	(4.4)	(1.6)	(5.0)	(8.9)	1	.06	(1.8)					
							2	.08	(2.7)					
							3	.08	(2.6)					
							4	.07	(2.4)					
							5	.04	(2.2)					
							6	.00	(.00)					
							Σ	.34						

Notation:

Lp = chartered banks' total personal loans outstanding.

Q_i (i=1, 2, 3) = seasonal dummies.

CD = purchases of consumer durable goods.

ELA = chartered banks' earning liquid assets.

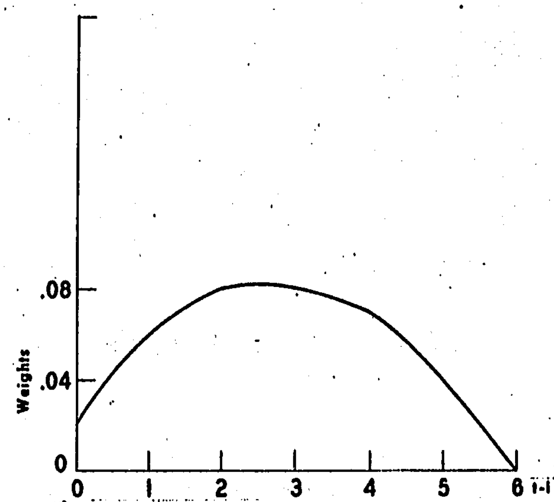
TBA = chartered banks total assets.

*The form of the dependent variable is given in the second column.

total assets is about three. In the neighbourhood of equilibrium I would expect this elasticity to be approximately one, given the values of other explanatory variables. However, even allowing for this strong trend produces negative results in equation 1. This is attributable to strong intercorrelation among the lagged stock, total assets, and consumer durable expenditures.

In the face of these difficulties I dispense with the stock adjustment model and attempt to explain the stock of personal loans by the current flow of expenditures on consumer durable goods, as a proxy for demand factors, and a distributed lag on the stock of earning liquid assets as a proxy for the factors which may be expected to affect the supply of funds by the banks. Equation 3 of Table 6 shows the best results obtained in testing this formulation. A six quarter lag with weights constrained to lie on a second degree polynomial is fitted (by the Almon technique) to the stock of earning liquid assets. As noted above, the stock of earning liquid assets is used to represent the capacity of the banks to invest in high yielding, illiquid, assets. A lagged response is reasonable since a change in this stock will probably be regarded as permanent only if it persists for some time. This hypothesis is supported by the lag distribution of equation 3 (plotted in Chart 4) which indicates that the first quarter response of the stock of personal loan funds to earning liquid assets is small. The response builds to a peak in the second and third quarters and subsequently declines. The response in the current quarter is not significantly

Chart 4
LAG WEIGHTS ON ELA*



* From Equation 3, Table 6

different from zero, the weight at t-1 is significant at the 10 per cent level and the remainder significant at the 5 per cent level.

The coefficient on the consumer durable expenditure variable is highly significant with the expected, positive, sign. It is also very large because the dependent variable is a stock and the consumer durable variable a flow. Strictly, this specification is incorrect since the stock of personal loan funds is related not only to the current flow of expenditures but to many lagged values as well. The fact that data on stocks of consumer durables are not available forces me to use this approximation. The overall fit of this equation is quite good, the coefficient of multiple determination is high (.92) and the Durbin-Watson statistic indicates that serial correlation in the residuals is insignificant.

However, the standard error of estimate is high at 12 per cent of the sample mean.

Finally, I calculate the steady state elasticities of supply of business loan authorizations and personal loan funds with respect to earning liquid assets. The results are shown in Table 7, calculated at the sample means of the variables from equation 4, Table 5 in the case

TABLE 7

Elasticity of:	With Respect to ELA
TA	.713
L_p	.847

of business loan authorizations and from equation 3, Table 6 in the case of personal loans. This evidence suggests that the banks do in fact rely more heavily on personal loans in making portfolio adjustments and is in accord with the theoretical considerations outlined above.[22]

[22]It must be noted that the results are probably biased in the direction of confirming this conclusion since the flow of bank funds into personal loans was undoubtedly extraordinarily large over a significant part of the sample period as the banks sought to achieve portfolio equilibrium.

CHAPTER 5

SUPPLY AND DEMAND FOR BANK LIABILITIES

Introduction:

In this Chapter I develop equations which explain most of the components of chartered bank liabilities. The composition of Canadian dollar deposit liabilities of the chartered banks is shown in Table 8. Demand and personal savings deposits account for over 80 per cent of liabilities throughout the period. The one noticeable change is the large increase in the Non-Personal Term and Notice Deposits category in absolute and relative terms, primarily at the expense of demand deposits. It was not until 1960 that the banks began to offer interest rates on these deposits which were competitive with those on other short-term claims and most of their growth has occurred since that year.

Government of Canada deposits have remained relatively constant over the period. These I leave exogenous since they are used frequently by the Bank of Canada as an instrument in achieving the desired level of chartered bank cash reserves and, in any case, reflect the timing of tax and expenditure flows more than a response to interest rates and the usual proxies for transactions.

In addition, a demand equation for currency (held by the general public) is presented since this asset is normally included in definitions of the money stock.

TABLE 8

CHARTERED BANKS' CANADIAN DOLLAR DEPOSIT LIABILITIES

	Dec. 1956		Dec. 1960		Dec. 1965	
	$ mill.	%	$ mill.	%	$ mill.	%
Government of Canada deposits	246	2.2	510	3.9	797	4.3
Demand deposits	4,465	40.0	4,621	35.8	6,028	32.4
Personal savings deposits	6,007	53.8	7,215	55.8	9,725	52.3
Non-Personal term and notice deposits	444	4.0	576	4.5	2,044	11.0
Total	11,162	100.0	12,922	100.0	18,594	100.0

Source: Bank of Canada, Statistical Summary Supplement.

Demand Deposits:

I represent the market for demand deposits by a single equation representing public demand for this asset and assume that banks supply these deposits elastically at the zero interest rate.[1]

[1]As was pointed out in Chapter 1, the stock of demand deposits is determined jointly by the interaction of bank and public portfolio allocation; the price which clears the market for this instrument being the short-term interest rate. Of course, this mechanism assumes that demand for demand deposits is sensitive to variations in the opportunity cost of holding them, an assumption which is confirmed by the analysis of this section.

Since they are a non-interest bearing instrument, demand deposits may be expected to be held solely as a means of bridging the gap resulting from the imperfect synchronization of receipts and payments. Thus, it might be expected that average demand deposit holdings over a given interval of time would be a linear function of income, given the assumption that income flows at the beginning of the period are spent in an even, continuous, stream over the period.

As is now well known, however, rational economic behaviour would lead to substitution between transactions balances held in the form of demand deposits and balances held in the form of short-term securities in response to variation in short-term interest rates, given the level of transactions and the costs of switching in and out of securities. Baumol and Tobin[2] have shown that average transactions (the argument applies to both currency and demand deposits) balances over a period can be expected to vary inversely with the short-term interest rate and directly with transactions costs and the volume of transactions.

The relationship among cash holdings, interest rates, the volume of transactions, and the costs of switching in and out of securities is illustrated in the following paragraphs assuming the simplest possible

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[2]W. J. Baumol, "The Transactions Demand for Cash: An Inventory Theoretic Approach," Quarterly Journal of Economics, 66, (November, 1952); J. Tobin, "The Interest Elasticity of Transactions Demand for Cash," Review of Economics and Statistics, 39, (August, 1956).

conditions.[3]

Assume that transactions (T) occur in a steady stream per period. The individual obtains cash either from the receipts of borrowing or by withdrawing it from investments in time deposits or securities. The interest cost of the cash (the cost of borrowing or the opportunity cost of interest earnings foregone) is in dollars per dollar withdrawn per period. Cash is withdrawn at a rate of C per period, spaced evenly throughout the period, (year) and each withdrawal of C costs b dollars in broker's fees (assume that b is fixed and is not a function of the amount withdrawn). Obviously, any value of C, such that C is less than or equal to T, is sufficient to meet payments, so long as withdrawals are made frequently enough. The problem is to choose C, (given b, T and i) such that the total cost, in the form of broker's fees and interest, is minimized.

Now the number of withdrawals per time period (say one year) is T/C so that the total transactions cost is bT/C. Since it is assumed that each withdrawal is spent in a steady stream, the average transactions balance is C/2. Therefore, the annual interest cost of holding cash is iC/2.

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[3]This demonstration is taken from Baumol, "The Transactions Demand for Cash: An Inventory Theoretic Approach," pp. 545-547. It analyzes the transactions demand for money on the assumption that money is a 'producer's good'. Transactions demand can also be analyzed on the assumption that money is held for the services it provides, using utility theory. See Don Patinkin, Money, Interest, and Prices, Second Edition, (New York: Harper and Row, 1965), Chapter 5 and 6. Patinkin notes (p. 160) that "the analysis of money as a producer's good. . . yields demand functions of the same general properties as those yielded by the analysis in terms of a consumer's good . . . . . . these two approaches to the transactions demand are operationally equivalent . . ."

Thus the total cost (tc) to the individual of the use of cash when \$C is 'borrowed' at evenly spaced intervals through the year is:

$$tc = \frac{bT}{C} + \frac{iC}{2}.$$

To minimize the cost, take the derivative of tc with respect to C and set it equal to zero so that:

$$\frac{-bT}{C^2} + \frac{i}{2} = 0,$$

$$C = \sqrt{\frac{2bt}{i}}.$$

Therefore the demand for money (demand balances and/or currency) may be expected to vary directly with the square root of the volume of transactions and of the transactions cost of investing and inversely with the interest rate on short-term securities.

The analysis is easily extended to the case where periodic receipts precede expenditure streams on the assumption that a given amount of cash is initially withheld from investment, and can also be used to determine the optimal initial cash balance with similar results. Tobin has further extended the Baumol analysis[4] by showing that the optimal number of movements into and out of bonds is a positive function of the square root of income and the interest rate, and a negative function of transactions costs. It should be noted, finally, that these conclusions

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[4] "The Interest Elasticity of Transactions Demand for Cash," p. 245.

hold only where the interest rate is high enough relative to transactions costs so that net revenue from a given number of transactions is positive.

An aggregate version of this hypothesis can be approximated by making demand balances a linear function of GNP and a short-term interest rate. GNP is satisfactory since it is likely to be highly correlated with transactions and, in any case, the 'square root' formula is easily written in terms of income.[5] Investigators of demand for money in the United States have found that this hypothesis fits the data very well.[6]

Table 9 shows the results of my test of the transactions hypothesis as well as the results of my attempts to isolate the influence of changing risk conditions in securities markets. The test of the transactions hypothesis uses, as independent variables, the level of GNP in current dollars and the interest rate on short-term Canada bonds (equation 1). The results indicate that the evidence is consistent with this hypothesis; all coefficients are highly significant with the expected signs and the coefficient of multiple determination is reasonably high (.79). The Durbin-Watson statistic indicates that serial correlation is not present in the residuals.

Equations 2 and 3 present the results of my tests of the influence of changes in risk on the demand for demand balances. These equations

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[5]See Tobin, "The Interest Elasticity of Transactions Demand for Cash," and R. L. Teigen, 'Demand and Supply Functions for Money in the United States: Some Structural Estimates," Econometrica, 32, (October, 1964), pp. 482-485.

[6]See, for example, Teigen, ibid., and Goldfeld, Commercial Bank Behavior and Economic Activity, Chapter 3.

TABLE 9

DEMAND DEPOSITS - 1
(Dependent Variable: ΔDD)

No.	Constant	Q_1	Q_2	Q_3	DD_{-1}	Y	$r_{(0-3)}$	r_{TB}	A	$\sigma^2_{H(-1)}$	$\bar{R}^2$	DW	% Error
1.	557.33	-165.06	-71.06	-116.05	-.26	.09	-84.91				.79	1.79	1.7
	(4.4)	(4.5)	(2.6)	(3.2)	(3.3)	(4.3)	(6.4)						
2.	547.64	-141.85	-70.47	-137.72	-.36	.11	-84.94		1.72		.85	2.20	1.4
	(5.1)	(4.5)	(3.1)	(4.4)	(5.0)	(5.7)	(7.5)		(3.9)				
3.	564.92	-143.07	-67.62	-134.62	-.30	.10	-98.19			3.75	.83	2.00	1.5
	(4.9)	(4.2)	(2.7)	(4.0)	(4.0)	(5.3)	(7.5)			(2.9)			
4.	472.75	-158.07	-75.37	-135.76	-.27	.09		-76.55		3.33	.78	1.90	1.7
	(3.8)	(4.1)	(2.7)	(3.6)	(3.3)	(4.3)		(6.2)		(2.3)			

Notation:

DD = demand deposits.
Q_i (i=1, 2, 3) = seasonal dummies.
Y = GNP (current dollars).
r_{0-3} = average yield on Canada bonds with less than 3 years to maturity.
r_{TB} = yield on 3-month Treasury Bills.
A = average term to maturity of Canada bonds held by the general public.
σ^2_H = four quarter moving variance of a 1-year holding period yield.

use the average term to maturity variable and the moving variance of Canada bond yields, respectively. The coefficients on each of these variables are highly significant though the variable A, used in equation 2, does slightly better in terms of 't' values. In Chapter 3, however, I conjectured that the rate variability variable might do a better job at explaining the reduced risk associated with bonds in the period subsequent to 1960. I have tested this hypothesis using the Chow test. The results of applying this test to equations 1, 2 and 3 of Table 9 are shown in Table 10 below.

TABLE 10

CHOW TEST - 1

(Accept hypothesis that $\beta=\beta_1=\beta_2$ if $F_c < F_{.05}$ where β, β_1, β_2 = Coefficients generated from sample periods 1955-65, 1955-60, and 1961-65, respectively)

	Computed F (F_c)	Critical F ($F_{.05}$)	DF
Equation 1 (Table 9)	1.87	2.34	(7, 30)
Equation 2 " "	1.65	2.29	(8, 28)
Equation 3 " "	1.48	2.29	(8, 28)

These results indicate that, for all formulations, the hypothesis that the coefficients from the two subperiods 1955-60 and 1961-65 were generated from the same structure can be accepted at the five per cent level of significance.[7] Therefore, since the average term to maturity does better

[7]Where the three-month Treasury Bill rate is used in these equations in place of the short-term bond rate, the Chow test indicates

(in terms of 't' values) than does the variance and, since it does not induce instability in the relationship, equation 2 may be accepted as the best equation in this group.

The coefficients of adjustment in equations 1 to 4 of Table 9 (i.e. the coefficients on DD_{-1}) indicate that about one-third of the adjustment of demand for money to changes in the independent variables takes place in the current period. This method of estimating the length of the response lag constrains the lag on both income and interest rates to be the same. It seems intuitively unreasonable to expect the lagged response to income to be the same as that to interest rates; one might expect there to be a very short lag, if any, in the response of money demand to income but a longer response lag to interest rates.

In Table 11, equation I presents typical results of the limited amount of testing of this hypothesis I have done using the Almon technique of estimating distributed lags. If the hypothesis is true then separate estimation of the lag in response to interest rates should increase the adjustment coefficient substantially. In fact, in this case I would be surprised if the lag in response to income were much more than one or two quarters so that separate estimation of the interest rate lag should result in an adjustment coefficient close to unity.

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that the hypothesis of equality in the coefficients over the two subperiods must be rejected (at the five per cent level) for the relation which uses A to capture the risk effects ($F_c = 2.59$). This may be due to the vagaries of the Bill market more than to undesirable qualities in the average term to maturity variable. In any case, since the Treasury Bill rate yielded a poorer overall fit than the short-term bond rate, I prefer the latter formulation. Comparative results using these two rates are shown in equations 3 and 4 of Table 9.

TABLE 11

DEMAND DEPOSITS - 2
(Dependent Variable: ΔDD)

No.	Constant	Q_1	Q_2	Q_3	DD_{-1}	Y	σ^2_{H-1}	r_{0-3t}	r_{0-3t-i}	r_{10t}	r_{10t-i}	$\bar{R}^2$	DW	% Error
1.	635.34	-128.00	-70.20	-151.81	-.35	.12	3.76	-89.84	i=1 -8.4 (.8)			.82	1.99	1.6
	(3.6)	(2.7)	(2.8)	(3.2)	(3.0)	(3.4)	(2.3)	(5.4)	2 -4.8 (.7)					
									3 -2.0 (.4)					
									4 .1 (.0)					
									5 1.5 (.4)					
									6 2.2 (.6)					
									7 2.2 (.7)					
									8 1.4 (.7)					
									Σ -7.8					
2.	686.35	-110.32	-69.08	-169.95	-.41	.13	3.64	-119.83		134.97	i=1 -67.46 (2.0)	.83	2.11	1.5
	(4.9)	(2.8)	(2.8)	(4.3)	(4.4)	(5.0)	(2.4)	(3.9)		(1.6)	2 -42.29 (2.0)			
											3 -21.89 (1.7)			
											4 - 6.29 (.6)			
											5 4.54 (.4)			
											6 10.58 (.9)			
											7 11.83 (1.2)			
											8 8.31 (1.3)			

Notation:

- r_{10} = average yield on Canada bonds with more than 10 years to maturity.
- DD = demand deposits
- Q_i (i=1, 2, 3) = seasonal dummies.
- Y = GNP (current dollars).
- r_{0-3} = average yield on Canada bonds with less than three years to maturity.
- r_{TB} = yield on 3-month Treasury Bills.
- A = average term to maturity of Canada bonds held by the general public.
- σ^2_H = four quarter moving variance of a 1-year holding period yield.

The results do not confirm the hypothesis. None of the coefficients on lagged values of the interest rate is significantly different from zero and the coefficient of adjustment increases only marginally (from .30 in equation 3 of Table 9 to .35 in equation 1 of Table 11).

Since the risk characteristics of bonds appear to exert an influence on the demand for demand balances, interest rate expectations should also be important in determining public holdings of this instrument. Typical results of my tests for the influence of rate expectations are shown in equation 2 of Table 11. Equation 2 uses the Almon technique to estimate the distributed lag on long-term interest rates. If expectations are important, the lag distribution can be expected to resemble an inverted U, tailing off to zero at the end. The equation presented here is typical and uses a second degree polynomial with the weight at t-9 constrained to zero. It will be noted that only the first three of the coefficients on lagged values of the long-term interest rate (r_{10}) are significant at the 10 per cent level. Similar results were obtained when rate expectations were represented by differentials between the current rate and arbitrarily weighted moving averages of past rates. I conclude, therefore, that rate expectations do not exert a discernible influence on demand deposits. This conclusion suggests that there is no continuing asset demand for demand balances and that the observed effect of the risk variable on these deposits was a temporary result of the severity of the shocks imposed on financial markets by the Conversion Loan, and shifts in proximate targets of the central bank.

In Table 12, immediately below, I compute the estimates of both short-run and steady-state elasticities of demand for money with respect to income and interest rates implicit in equation 3 of Table 9. The elasticities are calculated at the sample means of the variables.

TABLE 12

ELASTICITY OF DEMAND FOR DEMAND DEPOSITS

	Short-Run	Steady-State
With respect to:		
r_{O-3}	-.102	-.346
Y	.268	.908

The interest rate elasticity is quite small, even that implicit in full equilibrium. The steady state elasticity (-.346) indicates that a rise of 50 basis points (from the sample mean) in the short-term interest rate would result in a reduction of demand deposits of some $170 million. With respect to income, the estimate from equation 3 indicates that, in the long run, the elasticity of demand for demand deposits is close to unity. While the theory outlined above would indicate that demand deposits should be less than unit elastic with respect to income, the fact that I find an elasticity of close to one may be due to aggregation over all holders of demand balances. This same factor may explain the relatively low elasticities found with respect to interest rates. This is so since small accounts may be expected to be relatively insensitive to interest rate movements and highly sensitive to income movements, thus tending to reduce the interest rate elasticity and increase the income elasticity.

I conclude this section by reporting on the results of experiments I conducted on demand by the public for currency. Given the difficulties and risks associated with transporting currency, this form of money may be expected to be held only as a means of payment for small transactions. These facts lead me to the hypothesis that currency demand can be explained largely by the volume of transactions in the economy. But, since demand for currency seems to have the same theoretical basis as that for deposits, I have also tested for the response of currency holdings to the short-term rate of interest. The equation below, estimated over the period 1955-65, indicates that a very high proportion of variance in currency holdings can be explained by income and seasonal variables. The interest rate enters with the correct sign but it is not significant at the 10 per cent level.

$$\Delta C = \underset{(3.0)}{72.3} - \underset{(9.2)}{53.0Q_1} + \underset{(2.5)}{10.1Q_2} + \underset{(1.3)}{8.5Q_3} - \underset{(3.0)}{.1C_{t-1}} + \underset{(3.9)}{.02Y_t} - \underset{(1.6)}{3.1r_{0-3t}}$$

$\bar{R}^2 = .95$
% Error = .5
DW = 1.53

where:

C	=	currency held by the public,
Qi(i=1, 2, 3)	=	seasonal dummies,
Y	=	GNP, current dollars,
r_{0-3}	=	average yield on Canada bonds with less than three years to maturity.

Given the large shift in the population towards urban areas in the postwar years, and so the increased availability of banking services, and the increased use of such substitutes for currency as credit cards, currency holdings relative to the total money supply may be expected to have declined over the past decade or so. I have not attempted to test for any of these secular factors and the results indicate that most of the variance can be explained without them.[9] There may be some systematic influence attributable to one or more of these factors, since the Durbin-Watson statistic indicates slight autocorrelation which, given the bias inherent in this formulation, probably means that serial correlation in the residuals is significant.

Personal Savings Deposits:

Personal savings deposits, as the name implies, are held entirely by individuals. They are an interest-yielding, risk-free instrument; they also carry chequing privileges and are in fact used as 'demand' balances by individuals. Thus, this class of deposit has some of the characteristics both of a savings instrument, which may be held as part of the individual's asset portfolio, and of a transactions balance.

Since this class of deposits carries an interest rate, a supply equation is, in principle, required for this market. In fact there is very little variance in this interest rate over the sample period (1955-65),

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[9] A recent study of the U.S. evidence indicates that these factors have not exerted a significant influence on currency demand in the postwar period. See G. G. Kaufman, Demand for Currency, Board of Governors of the Federal Reserve System, Staff Economic Studies.

indicating that the banks have not sought to influence the level of savings deposits to an appreciable extent. For this reason, I have not included a supply equation for this market.

With respect to the reasons for holding these deposits, the Porter Commission notes that

> Personal savings deposits are widely used by individuals both as a savings instrument and as working accounts through which pass the regular flow of their income and spending. While small accounts used for chequing purposes are by far the most numerous, the bulk of the funds on deposit are in a relatively small proportion of accounts whose owners regard them as a more permanent, yet conveniently accessible, form of interest-bearing investment.[10]

The distribution by size of personal savings accounts as at September 30, 1965, is shown in Table 13 below. It will be noted that, of some 12.7 million accounts, over 80 per cent contained less than $1,000, though there were still over two million accounts containing more than $1,000.

TABLE 13

CLASSIFICATION BY SIZE OF PERSONAL SAVINGS DEPOSITS AS OF SEPTEMBER 30, 1965

	Number of Accounts	%
Personal savings deposits of:		
less than $100	6,864,876	53.89
$100-$999	3,759,330	29.51
$1,000-$9,999	1,990,806	15.63
$10,000-$99,999	123,077	.96
$100,000 and over	1,359	.01
Total	12,739,448	100.00

Source: Bank of Canada, Statistical Summary Supplement, 1966, p. 45.

[10] Porter Report, pp. 117-118.

In my initial experiments I assume that much of the variance in personal savings deposits can be accounted for by changes in the transactions demand for money by individuals. Hence, an equation is estimated containing the same variables as proved to be successful in explaining demand deposits.[11] Equations 1 to 3 of Table 14 show the results obtained by fitting the same set of variables to personal savings deposits as were used in demand deposits with the addition of the rate paid on personal savings deposits.

Since trust and loan companies offer instruments similar in many respects to personal savings deposits, I also estimate this equation using a rate on non-bank deposits in place of the short-term Canada rate, and specifically, the average of the rates paid by trust companies on one and five year term certificates.[12] These results are shown in equations 4 to 6 of Table 14.

The results of these experiments are not very good. In particular, the speed of adjustment is low, in no case being greater than 20 per cent in the current period. Further, the Durbin-Watson statistic indicates significant serial correlation in the residuals. This suggests that there

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[11] As with demand balances I allow for asset demand to the extent of including a risk variable.

[12] I also tried the rate on chequable deposits of trust companies. However, the coefficient of correlation between this rate and the personal savings rate was so high (.94) that the differential did not enter significantly nor did the rate when entered alone.

TABLE 14

PERSONAL SAVINGS DEPOSITS - 1
(Dependent Variable: ΔPS)

No.	Constant	Q_1	Q_2	Q_3	PS_{-1}	Y	$r_{0-3}-r_{PS}$	$r_{TR}-r_{PS}$	A	σ^2_{H-1}	$\bar{R}^2$	DW	% Error
1.	-28.34	86.93	167.78	62.89	-.05	.05	-48.56				.64	1.16	.8
	(.4)	(2.7)	(7.0)	(1.8)	(1.3)	(1.9)	(3.7)						
2.	-15.32	141.71	175.66	-6.87	-.18	.12	-32.53		1.84		.71	1.39	.7
	(.2)	(4.2)	(8.1)	(.2)	(3.3)	(3.8)	(2.6)		(3.2)				
3.	-11.22	110.47	171.01	36.50	-.09	.08	-52.77			2.03	.65	1.20	.8
	(.2)	(3.1)	(7.2)	(.9)	(1.8)	(2.4)	(4.0)			(1.4)			
4.	16.88	73.87	167.97	78.61	-.01	.03		-109.59			.66	1.00	.7
	(.2)	(2.3)	(7.2)	(2.2)	(.3)	(1.2)		(4.1)					
5.	18.91	135.63	175.73	-.33	-.16	.11		- 94.21	2.10		.77	1.42	.6
	(.3)	(4.6)	(9.2)	(.01)	(3.3)	(4.0)		(4.3)	(4.5)				
6.	55.54	110.78	173.18	37.50	-.07	.07		-137.24		3.57	.70	1.13	.7
	(.8)	(3.4)	(7.9)	(1.0)	(1.4)	(2.5)		(5.1)		(2.5)			

Notation:

PS = personal savings deposits.
$Q_i (i=1,2,3)$ = seasonal dummies.
Y = GNP (current dollars).
r_{0-3} = average yield on Canada bonds with less than three years to maturity.
r_{PS} = interest rate on personal savings deposits.
r_{TR} = average rate on Trust Company term certificates.
A = average term to maturity of Canada debt held by the general public.
σ^2_H = four quarter moving variance of a 1-year holding period yield.

are other relevant variables not yet considered.[13]

Given the relatively large number of accounts of over $1, 000 in size, and the observations of the Porter Commission, it seems reasonable to expect that a significant part of the variance in the personal savings deposits series would be explained by variables designed to capture the influence of asset preferences of individuals. This means that, in principle, the stock of wealth held by the general public, as well as current income, is an important explanatory variable. Expectations of future changes in interest rates should also be important. The results obtained after adding these new variables are shown in Table 15.

Several compromises are necessary in combining both transactions and asset hypotheses in the same equation. First, statistics of personal net worth are not available for Canada, so that I am forced to approximate this variable by a moving average of recent GNP flows. The concept is similar to Friedman's 'permanent income'.[14] Further, I do not attempt to include both current and past income in the equation because of the high collinearity

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[13]Chow test results for these equations indicate that equation 1 (which uses the short Canada bond rate as a proxy for competitive yields) shows no significant instability over the sample period but that equation 4 does ($F_c = 3.00$, $F_{.05} = 2.29$). In the latter case, addition of either A or σ^2_{H-1} improves the F-ratio sufficiently so that the hypothesis of stability in the coefficients can be accepted.

[14]See Milton Friedman, A Theory of the Consumption Function, (Princeton, N.J.: Princeton University Press, 1957). Friedman uses permanent income as a measure of expected income which is the expected return on total wealth. That it be a reasonable proxy for wealth requires that the rate of return on wealth be fairly constant.

TABLE 15

PERSONAL SAVINGS DEPOSITS – 2
(Dependent Variable: ΔPS)

No.	Constant	Q_1	Q_2	Q_3	PS_{-1}	$r_{TR}-r_{PS}$	Y_P	E	N	A	σ^2_{H-1}	$\bar{R}^2$	DW	% Error
1.	76.09 (1.2)	43.62 (2.2)	165.35 (8.1)	93.55 (4.6)	-.12 (2.2)	-47.54 (1.2)	.10 (2.8)	352.33 (3.6)	-242.94 (2.7)			.75	1.41	.6
2.	57.39 (1.1)	43.91 (2.6)	167.17 (9.9)	90.85 (5.3)	-.21 (4.1)	-53.38 (1.6)	.15 (4.8)	318.28 (3.8)	-205.97 (2.7)	1.47 (4.0)		.82	1.64	.5
3.	98.24 (1.7)	49.69 (2.7)	168.27 (9.1)	88.65 (4.8)	-.16 (3.1)	-81.53 (2.2)	.13 (4.0)	356.99 (4.0)	-232.06 (2.8)		3.18 (2.9)	.79	1.56	.6
4.	17.73 (.3)	73.44 (2.5)	169.45 (7.8)	64.18 (1.9)	-.03 (.7)	-59.65 (1.4)	.04 (Y_t) (1.4)	283.91 (2.8)	-207.85 (2.2)			.71	1.25	.7

Notation:

PS = personal savings deposits.

Q_i (i=1, 2, 3) = seasonal dummies.

r_{TR} = average rate on Trust Company term certificates.

r_{PS} = rate on personal savings deposits.

Y_P = 'permanent' income = $\frac{1}{\sum_{i=0}^{7} .9^i} \sum_{i=0}^{7} .9^i \, Y_{t-i}$

Y_t = GNP (current dollars).

E = 'extrapolative' expectations variable $r_{10} - \frac{1}{\sum_{i=1}^{8} .35^i} \sum_{i=1}^{8} .35^i \, r_{10t-i}$

N = 'normal' expectations variable $r_{10} - \frac{1}{\sum_{i=1}^{8} .75^i} \sum_{i=1}^{8} .75^i \, r_{10t-i}$

A = average term to maturity of Canada debt held by the general public.

σ^2_H = four quarter moving variance of a 1-year holding period yield.

r_{10} = average yield on Canada bonds with more than 10 years to maturity.

between these two variables. Secondly, as in equations 4-6 of Table 14, I approximate movements in all relevant deposit interest rates by movements in two rates, namely, the rate on personal savings deposits and the rate on trust company term certificates used above. The interest rate expectations variables (E, N) are formed from the long-term Canada bond rate (r_{10}) and are differentials between the current rate and weighted moving averages of past rates. A positive sign is expected on the variable E (extrapolative expectations) since investors expecting capital losses on bonds will shift to fixed price claims and, conversely, a negative sign on N (regressive expectations).

This formulation of the demand for personal savings deposits does much better than the equations reported in Table 14. The coefficients are all highly significant with the expected signs, note especially the significance of the coefficients on the interest rate expectations variables. The coefficient of multiple determination is considerably higher and the Durbin-Watson statistic is better. It does appear, however, that significant serial correlation would still be found in the residuals were the lagged dependent variable not included. The reaction coefficient remains low with only about 15-20 per cent of the total adjustment taking place in the current period.

Examination of equations 2 and 3 in Table 15 reveals that either average term to maturity or the variance in holding-period yields improves the fit of the equation. The Chow test results, reported in Table 16 below, indicate that the average term to maturity variable (which does better in terms of 't' values than the variance of holding period yields) does not produce coefficients which are significantly different during the sub-periods 1965-60 and 1961-65.

TABLE 16

CHOW TEST-2

(Accept hypothesis that $\beta=\beta_1=\beta_2$ if $F_c < F_{.05}$, where β, β_1, β_2 = coefficients generated from sample periods 1955-65, 1955-60 and 1961-65, respectively)

	Computed F (F_c)	Critical F ($F_{.05}$)	DF
Equation 1 (Table 15)	1.59	2.27	(9, 26)
Equation 2 (Table 15)	.64	2.26	(10, 24)
Equation 3 (Table 15)	.73	2.26	(10, 24)

The results in Table 15 offer support for the hypothesis that
we
wealth (or a proxy for it) is the relevant scale variable in a demand equation for personal savings deposits. Equation 4 shows the result of substituting current for 'permanent' income - its coefficient is small and insignificant at the five per cent level contrasting with the highly significant coefficient on permanent income (Y_p) in equation 1.

Finally, I report the results of estimating directly (by the Almon method) the lag reflecting interest rate expectations. The best equation from my experiments is given below.[15]

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[15] The notation is as in Table 15.

$$\Delta PS = \underset{(2.2)}{129.01} + \underset{(3.7)}{65.33Q_1} + \underset{(10.5)}{183.75Q_2} + \underset{(5.9)}{103.90Q_3} - \underset{(2.8)}{100.67}(r_{TR} - r_{PS})$$

$$+ \underset{(4.1)}{4.38\sigma^2_{Ht-1}} + \underset{(4.8)}{.19Yp} + \underset{(3.0)}{143.56r_{10t}} + \sum_{i=1}^{9} b_i r_{10t-i} - \underset{(3.6)}{.24PS_{t-1}}$$

$$\bar{R}^2 = .83$$
$$\%\ \text{Error} = .5$$
$$DW = 1.59$$

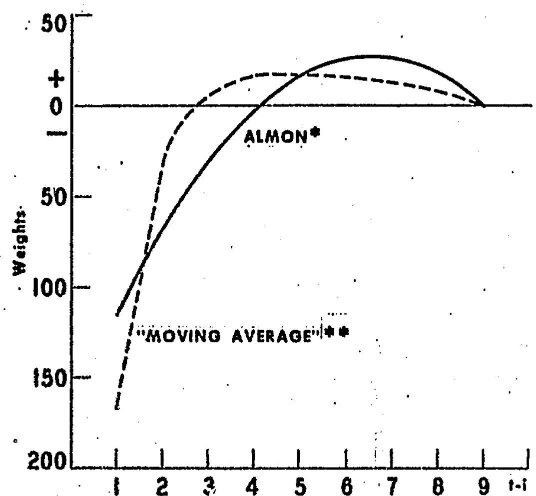
The b_i' represent the lag coefficients on the long-term interest rate (constrained to lie on a second degree polynomial with nine quarter lag). They are plotted in Chart 5. Seven of the eight coefficients are significant at the five per cent level. The lag distribution has the expected shape and is consistent with the hypothesis that the formation of expectations is predominantly extrapolative. Further, the coefficient on the current value of the long-term rate is significantly different from zero at the five per cent level and has the expected (positive) sign.

The overall fit of the equation is slightly better than that obtained in equation 3 of Table 15 where rate expectations were accounted for by weighted moving averages of past interest rates.

It is interesting to compare the shape of the distributed lag on long-term interest rates obtained by two different methods; both lag distributions are shown in Chart 5. Both curves imply strong elements of extrapolation in the formation of expectations but the 'Almon' curve indicates that the horizon from which extrapolation occurs extends slightly longer into the past than is indicated by the distribution obtained from the 'moving average' variables.

Chart 5

LAG WEIGHTS ON $r10_{t-i}$



* Almon weights from equation in text
** "Moving Average" weights from Equation 3, Table 15

The elasticities of demand for personal savings deposits with respect to 'permanent' income and current interest rates (calculated at the sample means of the variables) are shown in Table 17. The interest elasticity is calculated with respect to the differential between rates on competing deposits and the personal savings rate.

TABLE 17

ELASTICITY OF DEMAND FOR
PERSONAL SAVINGS DEPOSITS*

	Short-Run	Steady-State
With respect to:		
$r_{TR}-r_{PS}$	.026	.111
Y_p	.231	.980

*Calculated from the equation in the text above.

The interest elasticity implies that a 50 basis point rise in the interest differential (from the sample mean) would result in a decline of some $49 million in personal savings deposits in the short-run and about $210 million in the long-run. I find that in equilibrium, personal savings deposits are approximately proportional to 'permanent' income.

Non-Personal Term and Notice Deposits:

The introductory paragraphs to this chapter noted that this class of deposits has grown rapidly in the period since 1960, and that the reason for this is that prior to 1960 the banks did not attempt to influence the amount of term deposits by varying the supply conditions under which these deposits were accepted.

The Porter Commission notes[16] that

> At the end of 1953, the rate on balances of $100,000 or more was raised from 1/2 per cent to 1.5 per cent, where it remained until late 1955, while Treasury Bill rates varied from just below 1 per cent to 2.5 per cent. From December 1955 until 1960, the banks set their rate on these large balances just below current rates on Treasury Bills. Since the beginning of 1961, they have paid rates on deposit receipts with a term from 30 days to a year which have frequently exceeded the Treasury Bill rate and have lowered the minimum size of deposits on which these rates will be paid to $25,000. These steps have enabled them to attract an impressive volume of funds and to hold an increasing share of the market in short-term investments.

Therefore, I have estimated a supply equation for non-personal term deposits for the sample period 1961-65 using the interest rate on non-personal term deposits as dependent variable. The hypothesis is

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[16]Porter Report, p. 118.

that the banks' supply curve of deposits is perfectly elastic at their desired rate. The amount of deposits outstanding at any point in time is demand-determined.

I consider first the demand determinants of non-personal term deposits. These deposits are held largely by corporations and governments as part of their stocks of liquid assets. Therefore, standard portfolio theory would make holdings of this asset a function of the stock of liquid assets, current short-term interest rates (own and competing) and expectations about movements in long rates in the short-run, and the expected variance of return on long rates. I have used the stock adjustment model on a set of independent variables designed to represent the factors noted above. The results are shown in equation 1 of Table 18.

Clearly, this formulation does not work well; the coefficient on the lagged dependent variable is insignificant and has the wrong sign. The explanatory power of the equation is very low and the Durbin-Watson statistic indicates significant serial correlation in the residuals. Since quarterly balance sheet data are not available for Canada, I have been forced to use GNP as the scale variable; in this equation its coefficient is not significantly different from zero. The fact that neither the lagged dependent variable nor income is significant is probably due to multicollinearity. The simple correlation coefficient between these two variables is .89. The coefficient on the differential between the short Government

TABLE 18

NON-PERSONAL TERM AND NOTICE DEPOSITS
(Dependent Variable: ΔNPT)

No.	Constant	Q_1	Q_2	Q_3	NPT_{-1}	Y_t	$r_{0-3}-r_{NPT}$	$r_{SW}-r_{NPT}$	E	N	r_{10t}	r_{10t-i}	r_{SW}	r_{NPT}	$\bar{R}^2$	DW	% Error
1.	- 25.82 (.2)	35.50 (1.1)	70.14 (2.3)	30.46 (.8)	.03 (.5)	.01 (.3)	-73.84 (2.0)		10.90 (.1)	- 89.61 (.9)					.39	1.16	7.8
2.	- 49.34 (.5)	27.80 (1.0)	62.42 (2.5)	26.50 (.9)	.09 (1.3)	.01 (.4)	-67.26 (2.2)	-238.43 (3.8)	71.99 (.7)	-119.65 (.5)					.56	1.41	6.7
3.	-337.86 (2.7)	98.22 (2.8)	77.26 (3.0)	-30.61 (.8)	-.05 (.6)	.07 (2.5)					-259.13 (3.9)	i=1 -2.5 (.1) 2 12.6 (.7) 3 23.6 (2.2) 4 30.3 (4.0) 5 32.7 (3.8) 6 30.9 (3.3) 7 24.8 (2.9) 8 14.5 (2.6)	-41.23 (3.9)	71.56 (3.1)	.55	1.40	6.7
									σ^2_{H-1}								
4.	-349.68 (2.7)	96.54 (2.7)	76.51 (2.9)	-29.35 (.8)	-.05 (.6)	.07 (2.4)			-.75 (.5)		-249.57 (3.5)	i=1 -4.1 (.1) 2 11.6 (.6) 3 22.9 (2.1) 4 30.0 (3.9) 5 32.6 (3.8) 6 31.0 (3.2) 7 25.0 (2.9) 8 14.7 (2.6)	-42.40 (3.9)	70.60 (3.0)	.54	1.38	6.8

TABLE 18 (Cont'd)

No.	Constant	Q_1	Q_2	Q_3	NPT_{-1}	Y_t	$r_{0-3}-r_{NPT}$	$r_{SW}-r_{NPT}$	E	A	r_{10t}	r_{10t-i}	r_{SW}	r_{NPT}	$\bar{R}^2$	DW	% Error
5.	-311.78	93.51	82.10	-19.48	-.04	.07				1.69	-380.37	i=1 38.4 (1.1)	-38.16	102.52	.60	1.54	6.4
	(2.7)	(2.8)	(3.4)	(.5)	(.5)	(2.5)				(2.3)	(4.6)	2 37.8 (1.8)	(3.8)	(4.0)			
												3 36.0 (3.1)					
												4 33.0 (4.5)					
												5 28.8 (3.5)					
												6 23.4 (2.5)					
												7 16.8 (1.9)					
												8 9.0 (1.6)					

Notation:

A = average term to maturity of Canada debt held by the general public.

C_H^2 = four quarter moving variance of a one-year holding period yield.

NPT = non-personal term deposits.

Q_i (i=1, 2, 3) = seasonal dummies.

Y = GNP (current dollars).

r_{0-3} = average yield on Canada bonds with less than 3 years to maturity.

r_{NPT} = rate on non-personal term deposits.

r_{SW} = rate on 'swap' deposits (from 1962-65 only).

E = 'extrapolative' expectations variable $r_{10} - \frac{1}{\sum_{i=1}^{8} .35^i} \sum_{i=1}^{8} .35^i r_{10t-i}$

N = 'normal' expectations variable $r_{10} - \frac{1}{\sum_{i=1}^{8} .75^i} \sum_{i=1}^{8} .75^i r_{10t-i}$

r_{10} = yield on Canada bonds with more than 10 years to maturity.

bond rate and the deposit rate enters significantly in the expected (negative) direction. The expectational variables (E, N) have the expected signs but neither of the coefficients is significantly different from zero.

Shortly after the banks became active competitors in the Canadian money market by seeking Canadian dollar funds they introduced a similar instrument denominated in foreign currency known as 'swapped' deposits. Undoubtedly high short-term interest rates abroad, particularly in Europe, had something to do with the introduction of these deposits, but since (until very recently) the banks have paid common, agreed, rates on their Canadian dollar notice deposits[17] it seems probable that part of the motivation for introducing 'swapped' deposits was to evade the agreement on common interest rates. The Porter Report notes that "the banks compete very aggressively with each other, and with other channels of international investment, for these swapped deposits on an interest rate basis."[18] Shearer supports this view, noting that

> The range of competition is not simply inter-bank and 'other channels of international investment.' It includes the full range of investment media in the Canadian money market, including those offered by other institutions such as trust companies. In interviews, treasurers of

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[17]See Porter Report, p. 138.

[18]Ibid., p. 138. It should be noted that holders of these swapped deposits incur no exchange risk. The Porter Report notes (p. 138) that: "The banks purchase a customer's Canadian dollars for foreign exchange, normally U.S. dollars, under an agreement to reverse the transaction at a fixed date in the future. In the interim the customer carries his foreign currency balance on deposit at the bank, earning a return formally made up of interest on the time deposit and the profit or loss on the foreign currency 'swap.' In effect, he is earning a combined rate of return on his Canadian dollars."

companies holding swapped deposits generally indicated that they did not consider them to be international investments.[19]

Hence, it seems quite possible that the introduction of swapped deposits affected the demand function for non-personal term deposits. This hypothesis is supported by equation 2 in Table 18. The equation uses the same set of independent variables as equation 1 with the exception that the differential between the rates on swapped deposits and non-personal term deposits is added. This variable enters with the expected negative sign and a highly significant, and large, coefficient. The coefficient of multiple determination improves somewhat (from .39 to .56) and serial correlation in the residuals is reduced. However, the coefficients on the interest expectations variables remain below the 10 per cent level of significance. Each of the risk variables was tried in these equations; neither was significant.

In an attempt to improve the specification of the expectations variables I estimate the equation using the Almon technique to determine the distributed lag on long-term interest rates. The results are shown in equation 3 of Table 18. This equation is estimated without the short Canada bond rate; when it was included, its coefficient was insignificant and the lag weights on the long term rate were insignificant. Coefficients on the

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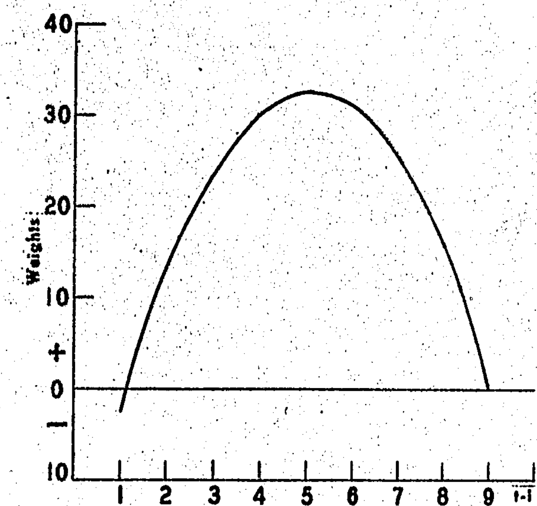
[19] R.A. Shearer, "The Foreign Currency Business of Canadian Chartered Banks," pp. 344-345. It is interesting to note that these deposits are, in theory, a vehicle for removing liabilities from the deposit base used in calculating required reserves, since required reserves are calculated relative to Canadian dollar liabilities. Shearer notes that, "In discussions with bankers hints were dropped that a significant volume of 'phony swaps' were created in 1960 or 1961 but that the Bank of Canada moved quickly to discourage the practice." (p. 345.)

other short-term interest rates (r_{SW} and r_{NPT}) are estimated separately in this equation. The best results are obtained using a second degree polynomial fitted over eight quarters (with the weight at t-9 constrained to zero).

The overall fit of the equation remains mediocre with the coefficient of determination remaining low (.55) and the Durbin-Watson statistic (1.40) indicating significant serial correlation in the residuals. Qualitatively, this equation is reasonably good with all coefficients, except that on the lagged stock, significant at the five per cent level. The signs are in accord with those expected. The negative sign on the current long-term rate (r_{10t}) is consistent with the observed lag distribution containing all positive weights. The lag weights are plotted in Chart 6; the weights on r_{10t-3} through t-8 are significant at the five per cent level. The positive distribution with the expected, inverted U, shape indicates that expectations on the demand side of this market are predominantly regressive.

Finally, I test for the influence of changes in risk on non-personal term deposits by adding, to equation 3, the average term to maturity and variance of yield variables. The results are shown in equations 4 and 5. The variance of holding-period yields enters with the wrong sign and with a coefficient which is not significantly different from zero. The equation is improved, however, by addition of the

Chart 6
LAG WEIGHTS ON $r10_{t-i}$*

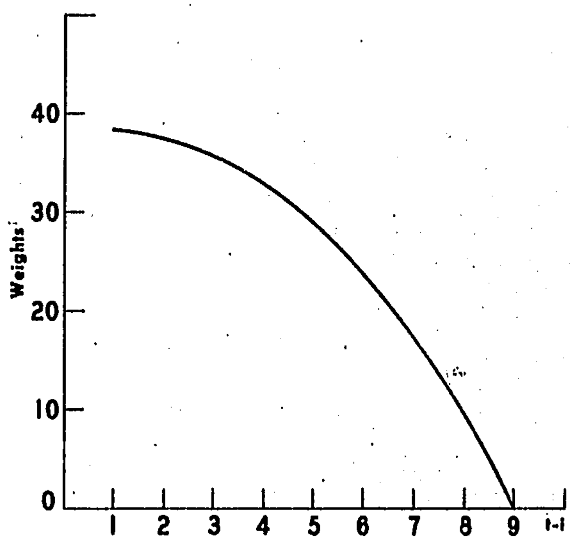


*From Equation 3, Table 18

average term to maturity variable (equation 5) which exerts a significant influence in the expected (positive) direction. Both the coefficient of determination and the Durbin-Watson statistic are somewhat larger, though the latter statistic still indicates that serial correlation in the residuals is significant. The pattern of lag weights on the long-term interest rate from this equation is shown in Chart 7. It indicates, more strongly than Chart 6, that extrapolation of the current trend of interest rates plays little part in the formation of rate expectations on the demand side of this market.

Chart 7

LAG WEIGHTS ON $r10_{t-i}$*



*From Equation 5, Table 18

Chow test results (reported in Table 19) indicate that none of equations 3 to 5 yield coefficients for which the hypothesis of stability can be accepted over the sub-periods 1955-60 and 1961-65. This is true even at the 1 per cent level of significance.

TABLE 19

CHOW TEST-3

(Accept hypothesis that $\beta=\beta_1=\beta_2$ if $F_c < F_{.01}$, where β, β_1, β_2 = coefficients generated from sample periods 1955-65, 1955-60, and 1961-65, respectively)

	Computed F (F_c)	Critical F ($F_{.01}$)	DF
Equation 3 (Table 18)	4.24	3.18	(11, 22)
Equation 4 (" ")	4.20	3.23	(12, 20)
Equation 5 (" ")	3.62	3.23	(12, 20)

Though the Chow test has been used thus far to test for instability associated with the average term to maturity variable, it is clear that the significant difference found in the coefficients of these equations (over the periods 1955-60 and 1961-65) is attributable to the marked structural shift on the supply side of the non-personal term deposit market. Therefore, little confidence can be placed in the coefficients of any of these equations. It can be said, however, that the results of my experiments suggest that the hypotheses tried would yield an acceptable set of coefficients if they were tested on data generated solely in the post-1961 period.[20]

The results obtained for the supply side of the market for non-personal term deposits are shown in Table 20. These equations are estimated over the period since 1961-(to 1965) when the banks actively began to solicit large blocks of short-term funds. The term to maturity of these deposits varies from a few days to upwards of one year. No information is available on the actual maturity distribution. Interest rates are available for each maturity range; but there are no data on the average rate for all non-personal term deposits. Therefore, I was forced to choose a 'representative' maturity and rate. The rate chosen is that paid on deposits of 90-179 days to maturity.[21]

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[20] I did not attempt to estimate these equations over the period since 1961 because the number of observations available was small relative to the number of independent variables.

[21] Casual enquiry revealed that it is thought that most of the deposits are in this maturity range.

TABLE 20

INTEREST RATE ON NON-PERSONAL TERM AND NOTICE DEPOSITS
(Dependent Variable: Δr_{NPT})

No.	Constant	r_{NPT-1}	r_{TB}	r_{FIN}	r_L	ELA/TBA	$\bar{R}^2$	DW	% Error
1.	-.001 (0.0)	-.67 (8.6)	.68 (6.6)		.03 (.1)		.85	.80	3.9
2.	-3.87 (1.8)	-.75 (8.6)		.49 (6.0)	.84 (2.0)		.83	1.81	4.1
3.	2.66 (2.2)	-.77 (9.2)	.53 (5.4)			-6.09 (2.1)	.88	1.46	3.4
4.	2.73 (1.5)	-.79 (7.4)		.44 (3.4)		-5.75 (1.3)	.81	1.72	4.4

Notation:

r_{NPT} = interest rate on non-personal term deposits (90-179 days).

r_{TB} = 3-month Treasury Bill rate.

r_{FIN} = interest rate on 90-day finance company paper.

r_L = chartered bank prime loan rate.

ELA/TBA = chartered banks' ratio of earning liquid assets to total assets.

The hypothesis tested is that the rate on term deposits is determined largely by two factors. First, the non-personal term deposit rate should be positively related to yields on other financial instruments of similar quality which compete for the funds of the non-financial sector of the economy. Second, the rate should also be positively related to the rate of return currently obtainable on the banks' asset portfolio.

To represent alternative yields obtainable by non-bank investors, I try the three-month Treasury Bill rate and the rate on finance company paper with 90 days to maturity. As proxies for the rate of return on bank assets the prime loan rate and the ratio of earning liquid assets to total assets are used. The idea in the latter case is that the rate of return available to the banks is negatively related to the ratio of low yielding, liquid assets in the portfolio. Therefore, this variable should enter the equation with a negative sign.[22] The results in Table 19 indicate that these variables do quite well in explaining the term deposit rate. Equations 2 and 3 do better than equations 1 and 4. In these equations all variables are significant at the 10 per cent level.[23] Either of these equations is reasonably satisfactory. The choice is not clear-cut because, though the coefficient of determination is higher in equation 3, the Durbin-Watson statistic is better in equation 2. The reaction coefficients indicate that

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[22] This formulation neglects any influence which expected capital gains on earning liquid assets may have on this interest rate. Given the evidence of Chapter 4 this may be important. Due to the small sample size involved here I have not attempted to test this hypothesis.

[23] A 't' value of 2.1 is required for significance at the five per

most of the discrepancy (75-80 per cent) between actual and desired rates is eliminated in the current quarter, a reasonable result. These results strongly confirm the hypothesis that the banks act quickly to meet competitive short-term rates, given the profitability of their own asset portfolio.

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cent level, the value on the bank loan rate (r_L) in equation 2 is just below this. But for this variable all are significant at the five per cent level.

CHAPTER 6

CONCLUSIONS

In this thesis I have attempted to develop equations which explain chartered bank demand for the main components of their earning asset portfolio and equations which determine the quantities of the components of bank liabilities.

I concentrated on explaining the components of earning assets because the results of a survey and critique of the literature, in Chapter 2, led to the conclusion that, given the nature of the legal reserve constraints in Canada, the demand equation for excess reserves is not identifiable in a model which aggregates over all banks.

Chapter 3 outlined the theory of portfolio selection as applied to analyzing the determinants of the distribution of liquid assets in investors' portfolios between 'money' and 'bonds.' The theory postulates that the critical variables determining the distribution are the expected return and the associated variance of return, as a proxy for risk, of the portfolio. One of the major aims of this study was to examine the influence of risk and expected future bond prices on the public's demand for chartered bank liabilities and on bank demand for earning assets. The influence of these variables, and especially of expected interest rates, has been recognized in empirical work on the term structure of interest rates, but little research has been done to date in testing their influence directly in demand functions for financial assets.[1]

Following the theoretical discussion of Chapter 3, I proceeded to develop variables, for use in the subsequent empirical analysis, which serve as proxies for risk and expected interest rates. The discussion of risk (on Canada bonds) concluded that large changes in risk resulted from the Conversion Loan of 1958, which increased substantially the average term to maturity of the public debt, and from changes in the proximate monetary policy targets pursued by the central bank over the sample period. Consideration of the desirable qualities of a variable designed to capture these effects, and an examination of the variable used heretofore (average term to maturity of Canada debt in the hands of the general public) led me to conjecture that a new variable (variance of a holding-period yield) would better capture both of the effects. Therefore, in relevant equations I tested for the influence of each of these variables. Where the former variable proved to be best in terms of 't' values, I used a second statistical test to check whether the average term to maturity variable had induced instability in the coefficients of the relation over two subperiods (1955-60 and 1961-65). This was deemed desirable because casual examination of some of the

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[1]So far as I know, the only previous Canadian study to test directly for the influence of rate expectations in demand equations for financial assets is Shapiro, "The Canadian Monetary Sector: An Econometric Analysis." Shapiro tested only for the presence of the notion of a 'normal' rate in demand equations for personal savings deposits and bank business loan authorizations.

evidence revealed that, while the 'liquidity preference' curve of the public had shifted back to its pre-1958 position by 1961, the average term to maturity variable was still relatively high in the period since 1961. Hypotheses tested with respect to the formation of interest rate expectations were that expectations are generated by investors from present and past experience partly by assuming that recent trends of rates will continue and partly by assuming that rates will return to some longer-run, 'normal', level. It was demonstrated that these hypotheses imply a U-shape distributed lag response pattern of the demand for financial assets to the level of interest rates (represented by the long-term rate). If the data are consistent with the hypotheses, the distributed lag should have a U shape in the case of demand functions for Canada bonds and an inverted U shape in cases of demand functions for substitutes for bonds, such as interest-earning bank deposits.

The equation estimates, contained in Chapters 4 and 5, indicate that both expectations and risk are important contributors to the explanation of the banks' demand for earning assets and of the public's demand for bank deposits. With respect to the risk variables, the evidence was that they contribute significantly to the explanation of demand for all of these financial assets. In the deposit demand equations the average term to maturity variable performed best and did not induce significant instability in the relations over the two subperiods. In the equation representing bank demand for earning liquid assets the opposite was true, the variance variable performed considerably better than did the average term to maturity. This result is intuitively plausible since the banks' holdings of Canada bonds are of relatively short term to maturity. Therefore, they should be relatively immune from the risk effects of a lengthening of the average term to maturity, but they should be affected by shifts in the variance of bond yields in general.

The evidence was, in all cases, that interest rate expectations are formed partly by extrapolating recent trends in rates and partly on the basis of a notion about the 'normal' rate. The equations representing bank demand for earning liquid assets and business loan authorizations suggested that the formation of rate expectations by banks is predominantly regressive. It should be noted, however, that the influence of expectations on loan authorizations was relatively weak and very sensitive to the specification of the equation. Regressive expectations were also dominant on the demand side of the market for non-personal term deposits. This behaviour contrasts with that observed in the demand equation for personal savings deposits where expectations were found to be a result primarily of extrapolation of recent trends in interest rates.[2]

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[2]This evidence is broadly consistent with the results obtained from using these hypotheses to explain the term structure of interest rates. See H.T. Shapiro, "Distributed Lags, Interest Rate Expectations, and the Impact of Monetary Policy: An Econometric Analysis of a Canadian Experience," American Economic Review, Papers and Proceedings, 57, (May, 1967), pp. 455-460. The main difference between Shapiro's results and mine is that he used a sixteen quarter lag and I have used a lag of eight quarters. I found that the quality of my estimates generally deteriorated when longer lags were used.

The evidence suggests, therefore, that these simple hypotheses about the formation of expectations are reasonable approximations to reality. No doubt they are capable of being refined and improved. For example, it seems probable to me that expectations are based to a considerable extent on the current economic outlook, and future research might be directed towards modifying the results obtained here to take account of factors of this nature. I believe, however, that I have made a reasonable start in incorporating expectations of capital gains in equations explaining financial behaviour. The results indicate that expectational factors are important and should be taken account of in future econometric analysis of financial activity.

In order to summarize and test the reliability of the equations developed and estimated in Chapters 4 and 5, I list the best equations here and compare the actual values of the dependent variables during 1966 with the values predicted by these equations. 1966 probably provides a fairly good test of the reliability of the equations, since monetary policy varied appreciably over the course of the year. Interest rates rose during the early part of 1966, reached a peak in August, and generally declined during the remainder of the year.[3]

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[3]See Bank of Canada, Annual Report of the Governor to the Minister of Finance, Ottawa, 1966.

The best results of my attempts to explain bank demand for earning assets are as follows:[4]

1) $$\Delta ELA - \underset{(1.4)}{678.10} + \underset{(5.6)}{56.98}C_R - \underset{(5.5)}{20.69}C_R . r_{0-3} - \underset{(1.8)}{5.46}\sigma_H^2$$

$$- \underset{(1.2)}{70.19}\Delta r_B + \underset{(1.5)}{333.65}r_{10t} + \sum_{i=1}^{8} b_i r_{10-i} - \underset{(2.0)}{.19}ELA_{-1}$$

$$- \underset{(1.1)}{75.91}Q_1 - \underset{(3.7)}{247.94}Q_2 - \underset{(3.1)}{191.98}Q_3$$

$\bar{R}^2 = .76$, D.W. = 1.58, % Error = 3.5.
(Equation 7, Table 4, p. 74.)

2) $$\Delta TA = \underset{(3.3)}{1798.99} + \underset{(3.1)}{331.64}r_L - \underset{(.5)}{.07}(TA-L_B)_{-1} + \underset{(1.9)}{.13}ELA_{-1}$$

$$+ \underset{(1.9)}{.11}TBA - \underset{(4.0)}{244.06}r_{10t} + \sum_{i=1}^{8} b_i r_{10-i} - \underset{(1.1)}{.12}TA_{-1}$$

$\bar{R}^2 = .73$, D.W. = 1.98, % Error = .9.
(Equation 4, Table 5, p. 88.)

3) $$Lp = - \underset{(8.9)}{2510.58} + \underset{(8.9)}{3.42}CD + \sum_{i=0}^{6} c_i ELA_{-i} + \underset{(4.4)}{463.23}Q_1$$

$$- \underset{(1.6)}{135.00}Q_2 + \underset{(5.0)}{488.96}Q_3$$

$\sum_{i=0}^{6} c_i = .34$; $\bar{R}^2 = .92$, D.W. = 1.66, % Error = 12.0.
(Equation 3, Table 6, p. 96.)

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[4]Figures in parentheses below the coefficients are 't' values. The source of each equation is given, in parentheses, below the summary test statistics.

The main inadequacy of the earning liquid assets equation is that the short-term interest rate variable enters, significantly, with the wrong sign. Isolation of the expected, positive, effect of the short-term interest rate is particularly difficult in this case because there is a strong simple correlation (in the opposite direction) between this rate and earning liquid assets. The equation predicts changes in earning liquid assets reasonably well over 1966, however, as is shown in Table 21. But for the third quarter, the errors are no greater than the standard error of estimate of $125 million. In the third quarter the equation underestimates the change,

TABLE 21

CHANGE IN EARNING LIQUID ASSETS
$ mill., SEE = $125 mill.

	Actual	Predicted	Actual-Predicted
1966 1Q	+151	+ 99	+ 52
2Q	-138	-132	- 6
3Q	+155	- 50	+205
4Q	+242	+117	+125

and, in fact, shows a reduction in earning liquid assets when the actual change was positive and large.

The difficulties I encountered in explaining bank demand for business loan assets are reflected in the generally bad results obtained where this equation is used to generate estimates of the dependent variable for 1966. The results are shown in Table 22. The estimated values for the change in authorizations remain large throughout the year while, in fact, the growth of authorizations was virtually zero during the second

TABLE 22

CHANGE IN BUSINESS LOAN AUTHORIZATIONS
$ mill., SEE = $50 mill.

	Actual	Predicted	Actual-Predicted
1966 1Q	+153	+275	-122
2Q	+ 9	+273	-264
3Q	+ 13	+266	-253
4Q	+166	+353	-187

and third quarters. I think the problem with this equation is the strong upward trend in authorizations over the sample period, which I attempted to account for by including a scale variable (total bank assets) in the set of independent variables of the equation. It appears that there was little variance in the authorizations series, apart from trend, during the sample period.

Table 23 reports the results of extrapolating the personal loan equation through 1966. In this equation the dependent variable is the stock

TABLE 23

PERSONAL LOANS
$ mill., SEE = $173 mill.

	Actual	Predicted	Actual-Predicted
1966 1Q	2,801	2,622	+179
2Q	2,885	2,389	+497
3Q	2,948	2,636	+312
4Q	2,985	3,008	- 23

of loans outstanding. The equation estimates the stock reasonably well in the first and fourth quarters but does very badly in the second and third. I think the variability in the accuracy of the estimates reflects the fact that the lagged stock is not included among the set of explanatory variables, so that the equation does not benefit from its stabilizing effect. When this variable was tried in the equation its coefficient was greater than one, implying a negative speed of adjustment, a nonsense result. Again the difficulty derives from the bias induced in the coefficients by the strong trend in the dependent variable during the sample period.

The results obtained in Chapter 5, where I developed equations explaining the components of bank liabilities, are generally much better than those obtained for bank assets. The best results are contained in the following set of equations:[5]

$$4)\quad \Delta DD = \underset{(4.9)}{564.92} + \underset{(5.3)}{.10Y} - \underset{(7.5)}{98.19r_{0-3}} + \underset{(2.9)}{3.75\sigma^2_{H(-1)}} - \underset{(4.0)}{.30DD_{-1}} - \underset{(4.2)}{143.07Q_1}$$

$$- \underset{(2.7)}{67.62Q_2} - \underset{(4.0)}{134.62Q_3}$$

$\bar{R}^2 = .83$, D.W. = 2.00, % Error = 1.5.
(Equation 3, Table 9, p. 106.)

$$5)\quad \Delta PS = \underset{(2.2)}{129.01} - \underset{(2.8)}{100.67(r_{TR} - r_{PS})} + \underset{(4.1)}{4.38\sigma^2_{H(-1)}} + \underset{(4.8)}{.19YP} + \underset{(3.0)}{143.56r_{10t}}$$

$$+ \sum_{i=1}^{8} b_i r_{10-i} - \underset{(3.6)}{.24PS_{-1}} + \underset{(3.7)}{65.33Q_1} + \underset{(10.5)}{183.75Q_2} + \underset{(5.9)}{103.90Q_3}$$

$\bar{R}^2 = .83$, D.W. = 1.59, % Error = .5.
(Equation in text, p. 121.)

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[5]Equations 4) and 5) contain σ^2_H as the risk variable. These equations produced better estimates of the dependent variables for 1966 than did those containing A.

6) $\Delta NPT = -311.78 + .07Y + 1.69A - 38.16r_{SW} + 102.52r_{NPT} - 380.37r_{10t}$
$\quad\quad\quad\quad\quad\quad (2.7) \quad (2.5) \quad (2.3) \quad (3.8) \quad (4.0) \quad (4.6)$

$+ \sum_{i=1}^{8} b_i r_{10-i} - .04NPT_{-1} + 93.51Q_1 + 82.10Q_2 - 19.48Q_3$
$\quad\quad\quad\quad\quad\quad (.5) \quad (2.8) \quad (3.4) \quad (.5)$

$\bar{R}^2 = .60$, D.W. = 1.54, % Error = 6.4.
(Equation 5, Table 18, p. 126.)

7) $\Delta r_{NPT} = 2.66 + .53r_{TB} - 6.09ELA/TBA - .77r_{NPT-1}$
$\quad\quad\quad (2.2) \quad (5.4) \quad (2.1) \quad (9.2)$

$\bar{R}^2 = .88$, D.W. = 1.46, % Error = 3.4.
(Equation 3, Table 20, p. 133.)

The equations representing the public's demand for demand and personal savings deposits are of a high statistical quality, with all coefficients being highly significant and having the theoretically expected signs.

The actual changes in demand deposits in 1966 and the estimates generated from equation (4) above are shown in Table 24. The errors are well within the standard error of estimate in the first two quarters of 1966, but the equation underestimates the changes by rather large amounts in the

TABLE 24

CHANGE IN DEMAND DEPOSITS
\$ mill., SEE = \$53 mill.

	Actual	Predicted	Actual-Predicted
1966 1Q	- 96	-135	+ 39
2Q	+106	+ 72	+ 34
3Q	+139	- 27	+166
4Q	+261	+101	+160

last two quarters. The banks began to require loan customers to hold compensating balances in mid-1966[6] and it is probable that the large errors are a result of the build-up in these balances.

The personal savings deposit equation predicts the 1966 changes very well, as can be seen in Table 25. The equation consistently over-estimates the actual change but all errors are smaller than the standard

TABLE 25

CHANGE IN PERSONAL SAVINGS DEPOSITS
$ mill., SEE = $40 mill.

	Actual	Predicted	Actual-Predicted
1966 1Q	+117	+130	-13
2Q	+229	+257	-28
3Q	+166	+203	-37
4Q	+ 59	+ 73	-14

error of estimate. The non-personal term deposit equation does not fare so well, as is indicated by Table 26. The error in the first quarter is particularly large. The actual and predicted changes in non-personal

TABLE 26

CHANGE IN NON-PERSONAL TERM
AND NOTICE DEPOSITS
$ mill., SEE = $56 mill.

	Actual	Predicted	Actual-Predicted
1966 1Q	- 77	+ 89	-166
2Q	+148	+159	- 11
3Q	+116	+ 44	+ 72
4Q	+ 9	+ 67	- 58

[6] See p. 82, note 10, above.

term deposits are of approximately the same magnitude but of opposite sign. In view of the mediocre fit of this equation, however, the results for the other quarters are not bad.

Finally, Table 27 shows the actual and estimated changes in the interest rate paid on non-personal term deposits. As would be expected from the fit of the equation, the estimated changes are extremely close

TABLE 27

CHANGE IN INTEREST RATE ON NON-PERSONAL TERM AND NOTICE DEPOSITS
Percentage points, SEE = .130 percentage points

	Actual	Predicted	Actual-Predicted
1966 1Q	+.200	+.174	+.026
2Q	+.250	+.263	-.013
3Q	.000	+.038	-.038
4Q	.000	+.034	-.034

to those which actually occurred. The largest error is about 4 basis points in the third quarter, compared with a standard error of estimate of 13 basis points.

In general, the equations explaining supply and demand for bank liabilities generate quite acceptable estimates of their dependent variables, as the statistical quality of the results would lead one to expect. The equations which purport to explain bank demand for earning assets do less well. This is especially true of the loan authorizations and personal loan equations. In these cases I feel that many of the difficulties have to do more with the quality of the sample observations on the dependent variables than with the techniques and independent variables used.

The equations developed in this thesis will be affected to some extent by the recent changes in the Bank Act. The main changes in the Act were the removal of the interest rate ceiling on bank loans, the introduction of a differential reserve requirement for demand and time deposits, and removal of the prohibition on conventional mortgage lending.[7] The removal of the ceiling on loan rates should mean that variation in the set of terms on which loans are granted will be reflected to a greater extent than previously in changes of the lending rate. Moreover, the removal of the loan rate ceiling, combined with the introduction of the differential reserve requirement, should result in increased competition for time deposits by the banks through variation of the interest rates paid on these deposits.[8]

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[7]On the Bank Act changes see: H.H. Binhammer, "Canada's Revised Banking Legislation," The National Banking Review, 4, (June, 1967), pp. 493-501; G.L. Reuber, "Recent Revisions in Canada's Banking Legislation - I," Bankers' Magazine, 204, (December, 1967), and "Recent Revisions in Canada's Banking Legislation - II," Bankers' Magazine, 205, (January, 1968).

[8]In fact, the banks began to compete more aggressively for deposits as soon as the Act came into force. The Governor of the Bank of Canada has noted that,

> "the chartered banks, operating aggressively under the terms of the new Bank Act, attracted a somewhat increased share of the flow of savings at the expense of competing institutions. They introduced non-chequable savings accounts bearing a 4 1/2 per cent interest return (later raised to 5 per cent) and other new types of fixed-term deposits with life insurance or other novel features."

Bank of Canada, Annual Report of the Governor to the Minister of Finance, Ottawa, 1967, p. 50.

These effects will probably change the coefficients on interest rates in particular equations, e.g. the demand equation for personal savings deposits. I will be surprised, however, if they require the set of explanatory variables in existing equations to be changed. The one change in the Act which will probably require the addition of explanatory variables is the introduction of the differential reserve requirement. It is quite possible that, as a result of this innovation, the banks' desired distribution of total assets will be affected by the distribution of their liabilities between time and demand deposits. For example, an increase in the relative size of demand deposits (which now carry a reserve requirement of 12 per cent) may lead a bank to increase the proportion of liquid assets in its portfolio. If this is true a new variable representing the distribution of deposits will have to be added to the earning liquid assets and loan-supply equations.

For the most part, the equations developed in this thesis should be capable of being used (with appropriate adjustment for changes such as those noted above) within a complete econometric model of the economy to help to analyze, for instance, the links in the chain connecting monetary policy with economic activity.

APPENDIX A

A NOTE ON DATA SOURCES

All data on assets and liabilities of chartered banks were obtained from the Bank of Canada Statistical Summary Supplement. Where available, the "Average of Wednesdays" data were used and the monthly numbers averaged over quarters. Where only quarter-end data were available, the observation for period t is an average of the values at quarter-ends t and t-1.

Interest rate series on Canada Treasury Bills and bonds, and on chartered bank liabilities are either published in the Bank of Canada Statistical Summary or are available from the Research Department of the Bank. The average interest rate on 1 and 5 year Trust Company term certificates was constructed from data contained in Table V, Appendix E, of the Appendix Volume to the Report of the Royal Commission on Banking and Finance. Data for the period subsequent to that covered by the Porter Report (i.e. for the period since 1963) were obtained from the Research Department of the Bank of Canada.

A set of 'synthetic' interest rate series was required in order to examine the variance-term to maturity relationship (in Chapter 3) and to construct the variance of holding-period yield variable. I needed time series of yields on bonds with constant term to maturity over time. Since the term to maturity of a given bond issue declines continuously over time, the only way of standardizing for term to maturity is to construct yield-curves for each point in time and to read the yield values (for a given term to maturity) from the time series of yield curves. This procedure was used to construct 'representative yield' series for the years 1958-1965. Prior to 1958 the Bank of Canada published similar data (called "Theoretical Bond Yields") in the Statistical Summary.

To construct the one-year holding-period yields, I used the following method (the description uses, as an example, the calculation of a holding-period yield on a 'representative' bond, with five years to maturity at the time of purchase):

1) Using tables of bond values[1] I find the value of a bond (P_{5t}) corresponding to the 'representative yield' on a 5 year bond at time t, assuming a 4 per cent coupon.

2) I assume that the bond is sold one year later, at time t+1, when the term to maturity is 4 years. Therefore, I find the value of a bond (P_{4t+1}) corresponding to the 'representative yield' on a 4 year bond at time t+1 (again assuming a 4 per cent coupon).

3) Since bond value tables relate prices and yields to maturity (i.e. they assume that bonds are held until redeemed at par by the issuer), I normalize on the selling price (by taking the ratio of the purchase price to

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[1] Investors Bond Values Table, (Boston: Financial Publishing Company, 1962).

the selling price, P_{5t}/P_{4t+1}) in order to use the bond tables to find the one-year yield (which is the holding-period yield, r_H) on a bond purchased at the price P_{5t}/P_{4t+1} and sold at par ($100).

Data on GNP and expenditure on consumer durable goods were obtained from the National Accounts, Income and Expenditure (Catalogue No. 13-001 Quarterly) published by the Dominion Bureau of Statistics.

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