LIQUIDITY PREFERENCES OF COMMERCIAL BANKS: THE CANADIAN CASE

by

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ABSTRACT

In conjunction with the recent interest in the liquidity preferences of commercial banks, which is itself part of a new supply theory of money, this thesis investigates the reserve behaviour of Canadian commercial banks from 1920-1939.

Several models of bank reserve behaviour are presented including the one to be tested in this thesis. This model differs from the others in that it will be tested with monthly data on individual banks (and hence can explain differences among banks as to the holding of reserves) whereas the others were tested with annual data for a group of banks or a banking system. Since there was no required reserve in Canada prior to March, 1935, there was also no definition of what constituted reserves. This problem had to be investigated before any reserve ratios could be calculated.

After calculating some reserve ratios, several interesting observations can be made. The hypothesis that Canadian commercial banks adhered to a ten per cent required reserve ratio through a gentlemen's agreement within the Canadian Bankers Association was clearly refuted. Also the

effect of the establishment of the Bank of Canada on reserve holdings was noticed. Furthermore, the evidence cast some doubt on the conclusions of George Morrison in his book, Liquidity Preferences of Commercial Banks.

The model presented previously was then tested both with monthly data for individual banks and with monthly data for the banking system as a whole. The tests using monthly data for the individual banks indicated the need for further refinement of the model although considering the number of observations and the diversity among banks perhaps the R^2 was not that bad. The R^2 was much improved when monthly data for the banking system was used. This is to be expected as aggregations over banks hides much detail which, thus, does not have to be explained.

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CHAPTER ONE

LIQUIDITY PREFERENCES OF COMMERCIAL BANKS: THE CANADIAN CASE

Introduction

In his recent book, Liquidity Preferences of Commercial Banks,[1] George Morrison investigates the reserve behaviour of commercial banks, and after looking at the Canadian banking system, he concludes that it held little or no excess reserves. In this thesis I will examine his finding more fully and on an individual bank basis in order to isolate the determinants of the reserve holdings of individual Canadian commercial banks. Why this interest in the reserve behaviour of commercial banks? This is an important part of a new supply theory of money that is emerging.

Multiplier Analysis

For many years, the theory of the supply of money was largely the theory of the multiplier. This multiplier

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[1] George Morrison, Liquidity Preferences of Commercial Banks, The University of Chicago Press, Chicago, Illinois, 1966.

(the inverse of the required reserve ratio) times any change in bank reserves gave the change in the total money supply. Gradually the multiplier became more sophisticated as certain economists took account of one or all of the following: differing reserve ratios between demand and time deposits, the ratio of currency to the total money supply that people want to hold, the demand for currency by financial intermediaries and the holding of excess reserves by the banks. An early study of this type is Donald Shelby's[2] investigation of the monetary implications of the growth of financial intermediaries. In another study, S.L. Macdonald,[3] looks at the currency ratio and states certain causes of changes in it, such as increased urbanization and improved transportation.

One requirement of the multiplier analysis is that the ratios mentioned be fairly constant over time. If they change often, then the multiplier analysis will be of little use since any prediction made by calculating values for the ratios at a certain time may not be even close to the actual result if the ratios have changed in the meantime. There is

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2 Donald Shelby, "Some Implications of the Growth of Financial Intermediaries," Journal of Finance, Vol. 13: 527-41, (Dec. 1958).

3 S.L. Macdonald, "The Internal Drain and Bank Credit Expansion," Journal of Finance, Vol. 8: 407-21 (Dec. 1953).

some evidence that the ratios are not indeed constant. J. Ahensdorf and S. Kanesathasan[4] conclude that much research is necessary to explain variations in the currency/money ratio, the excess reserve ratio, and the ratio of demand to time deposits.

New Supply Theory of Money

If then we cannot assume that the ratios are constant, it is necessary to investigate them as behavioural relationships in order to find out the determinants of changes in the ratios before we can predict with any certainty what affect a change in bank reserves will have on the money supply. Thus, rather than using the multiplier analysis, economists have begun to formulate a supply theory of money on other bases. One of the first moves in this direction is the study by A.H. Meltzer[5] which rather than using constant ratios uses definitions and equations for the institutional restraints and assumptions about the behaviour of the banks and the public. Karl Brunner and A.H. Meltzer,[6] in a survey article, state

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4 J. Ahensdorf and S. Kanesathasan, "Variations in the Money Multiplier and Their Implications for Central Banking", I.M.F. Staff Papers, Vol. 8: 126 - 45 (Nov. 1960).

5 A.H. Meltzer, "The French Money Supply," Journal of Political Economy, Vol. 67, No. 3: 275- 91 (June, 1959).

6 Karl Brunner and A.H. Meltzer, "Some Further Investigations of Demand and Supply Functions for Money", Journal of Finance, Vol. 19: 240-83 (May, 1964).

that three distinct money supply theories are emerging. One theory, actually more a group of theories, centers on the banks' response to free reserves.[7] Another theory centers on the banks' response to surplus reserves.[8] A third theory is based on some homogeneity properties of demand behaviour and centers on a mutual adjustment of actual and desired allocation ratios.[9] Along with this development of a theory of the supply curve for money, there have been investigations of the properties of this supply curve. R.L. Teigen[10] finds that the money supply is elastic with respect to interest rates and that this elasticity is due mainly to the response of member bank borrowing to interest rate and discount rate changes.

Other economists have concentrated on a certain aspect of a new supply theory of money. An example is the

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7 A. James Meigs, Free Reserves and the Money Supply, The University of Chicago Press, Chicago, Illinois, 1962.

8 Karl Brunner, "A Schema for the Supply Theory of Money", International Economic Review, Vol. 2, No. 1: 79-109, (Jan. 1961).

9 Karl Brunner, "A Case Study of U.S. Monetary Policy: The Inflationary Gold Flows of the Middle Thirties," Schweizerische Keitschrift fuer Volkswirtschaft und Statistik, 1958.

10 R.L. Teigen, "The Demand for and Supply of Money", Readings in National Income and Stabilization Policy, Richard D. Irwin, Inc., Homewood, Illinois, 1965, 44-76.

systematic investigation of the currency ratio by P. Cagan[11] in which he finds that two variables, expected net rate of interest paid on deposits and expected real income per capita have been major determinants of the currency ratio. Interest has also been shown in the part that non-bank financial intermediaries play in the money supply process. Perhaps the greatest interest, however, has been in the actions of the banks themselves and how these actions determine among other things the holding of reserves.

Reserve Behaviour of Banks

F. Brechling and G. Clayton[12] construct a simple theory of bank portfolio behaviour with the rate of interest, level of economic activity, first differences of the rate of interest and the level of exogenously determined liquid assets as determinants of the desired asset ratios. D. Orr and W.G. Mellon[13] bring uncertainty, as to withdrawals from, and additions to, its reserves and cash balances, into the decision making of a bank. With regards to the banking system as a whole, they find that

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11 Phillip Cagan, "The Demand for Currency Relative to the Total Money Supply", Journal of Political Economy, Vol. 66, No. 4, 303-28, (August, 1958).

12 F. Brechling and G. Clayton, "Commercial Banks' Portfolio Behaviour", Economic Journal, Vol. 75, No. 298: 290-316 (June, 1964).

13 D. Orr and W.G. Mellon, "Stochastic Reserve Losses and Expansion of Bank Credit," American Economic Review, Vol. 51, No. 4: 614-23 (Sept. 1961).

uncertainty will increase with the number of banks in the system, and thus, as we increase the number of banks, we also increase the holding of excess reserves against the increasing uncertainty. Thus, the reserve ratio rather than being constant will be a function of uncertainty. R.C. Porter[14] also incorporates uncertainty in the portfolio selection of banks, but in this case uncertainty about future deposit levels, about market values of securities, about loan defaults and about the banks ability to achieve the portfolio it wants. S.M. Goldfeld,[15] again using uncertainty, specifies and estimates equations explaining changes in banks holdings of excess reserves. He uses variables such as the Treasury Bill rate, seasonal dummy variables, changes in demand and time deposits, change in their holdings of loans and changes in potential deposits. J. Tobin,[16] looking not at excess reserves, but at free reserves (excess reserves minus borrowed reserves), states that free reserves will be influenced by the discount rate, the banks' cash preferences

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14 R.C. Porter, "A Model of Bank Portfolio Selection", Yale Economic Essays, Vol. 1, No. 2: 322-59 (Fall, 1961).

15 S.M. Goldfeld, Commercial Bank Behaviour and Economic Activity, North-Holland Publishing Company, Amsterdam, 1966.

16 J. Tobin, "Commercial Banks as Creators of Money", in Banking and Monetary Studies, ed., by Deane Carson, For the Comptroller of the Currency, U.S. Treasury, Richard D. Irwin, 1963.

and expectations of future economic magnitudes and various money market rates. As mentioned at the beginning of this paper, George Morrison[17] also looked at the reserve holdings of commercial banks. For American banks, he finds that they held excess reserves (unlike his findings for Canadian banks) and he set up a model of bank behaviour with the desired cash ratio as a function of the yield on secondary reserve assets, the Federal Reserve discount rate, the spread between yields on bonds of different grade and transitory deposit potential (a measure of uncertainty as to deposit withdrawals). W. Poole[18] using an analysis similar to Morrison's explores more fully the theoretical implications of the model.

Morrison's Results and the Ten Per Cent Reserve Ratio

Because of this current interest in a new supply theory of money and in particular, the part dealing with the banks demand for reserves, in this thesis I will investigate the demand function for reserves of the individual Canadian commercial banks. As already stated, Morrison in his study found that the Canadian banking system held little or no excess reserves. His method of calculation was to subtract

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17 George Morrison, Liquidity Preferences of Commercial Banks, University of Chicago Press, Chicago, Illinois, 1966.

18 W. Poole, "Commercial Bank Reserve Management in a Stochastic Model: Implications for Monetary Policy", Journal of Finance, Vol. 23, No. 5: 769-79 (Dec. 1968).

ten per cent of total Canadian deposit liabilities from the actual reserve holdings of the system. Since there was no required reserve ratio in Canada until 1935, where did this ten per cent ratio come from?

There was an idea prevalent at the time, and still prevailing, that the banks adhered to a ten per cent reserve ratio through an understanding within the Canadian Bankers Association. Was this ratio as strongly adhered to as it was believed? The first mention of a ten percent reserve was by B.E. Walker, Esq., before the Congress of Bankers and Financiers at Chicago, June 23, 1893.

> "With us no reserves are actually required by law. The cash reserve in gold and legal tenders has averaged for some years about tenper cent."[19]

On the other hand, George Hague states:

> "The only thing that can be truly said about this matter (the holding of reserves) is, as has been said in this article, that opinions differ. It is well known to those whose acquaintance with the subject is practical, that what is a strong reserve to one bank would be a weak reserve to another, what would be a strong reserve at one time would be a weak reserve at another."[20]

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19 B.E. Walker, Esq., "Paper read before the Congress of Bankers and Financiers, Chicago, June 23, 1893, The Journal of The Canadian Bankers Association ,Vol. 1, Part 1, Sept. 1893, p. 24.

20 George Hague, "Bank Reserves", The Journal of the Canadian Bankers Association, Vol. 1, part 2, Dec. 1893, p. 110.

A little later in Interviews on the Banking and Currency Systems of Canada,

> "Mr. Coulson, a Canadian Banker, declared that there was an understanding among members of the Bankers' Association that they were to maintain in cash an amount equal to fifteen per cent--he probably meant of deposits, though this was not made clear."[21]

B.E. Walker, now Sir Edmund Walker again makes mention of the reserve ratio maintained by Canadian commercial banks in testimony given in 1923.

> "Well, we keep about from ten per cent to twelve per cent in actual cash, twenty to thirty per cent in quick loans, and forty to fifty per cent reasonably quickly got at."[22]

Mention is also made by James Holladay of the reserves maintained by Canadian Banks.

> "From 1908 to 1924, with one exception, the cash in hand averaged over ten per cent of net liabilities to the public (net liabilities equals total liabilities to the public minus notes of other banks, cheques, of other banks, and loans to other banks in Canada) but since the latter date it has declined gradually."[23]

Finally, Mr. Graham F. Towers makes mention of the reserve ratio of the Canadian banks before the Standing Committee on Banking and Commerce in 1939.

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21 Interviews on the Banking and Currency System of Canada, Senate Document No. 584, 61st Congress, 2nd Session, Washington Government Printing Office, 1910, Quotation from Benjamin Haggott Breckhart, "The Banking System of Canada" reprinted from Foreign Bankingsystems, H. Holt and Co., New York, 1929, p. 430.

22 Benjamin Haggott Beckhart, "The Banking System of Canada", reprinted from Foreign Banking Systems, H. Holt and Co., New York, 1929, p. 435.

23 James Holladay, The Canadian Banking System, Bankers Publishing Company, New York, 1938, p. 83.

> "If someone were to ask me why the chartered banks try to maintain a ten per cent cash reserve instead of a five per cent or a fifteen per cent, or some other figure, I could only reply that the working experience of many years has indicated that ten per cent is a reasonable ratio which provides sufficient cash to cover any immediate demands, but is not so high as to constitute an unnecessary burden in the form of non-earning assetts."[24]

Although there is agreement that Canadian banks held reserves, there is no definite statement that it was ten per cent exactly. All the statements seem to be of the form, "from ten to twelve per cent", "averaged about ten per cent", "try to maintain ten per cent".

Conclusions

What relationship does this finding have to Morrison's results? Morrison found, by determining excess reserves to be any reserves held above ten per cent, that the Canadian banking system held little or no excess reserves. In effect he found that the Canadian banking system, for some reason, held almost a constant ten per cent reserve (since when he subtracted ten per cent of Canadian deposit liabilities from actual reserves, the difference, either negative or positive, was small). Thus, Morrison's results support the hypothesis that

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24 Minutes of Proceedings and Evidence respecting the Bank of Canada of the Standing Committee on Banking and Commerce, No. 1, 1939, Kings Printer, Ottawa, 1939, p. 11.

Canadian commercial banks did adhere to a ten per cent reserve policy and seem to indicate that the agreed upon ten per cent reserve was above the range of changes in reserve holdings that the banking system might make in response to a liquidity preference function, since the systems' actual reserve ratio seldom if ever went above ten per cent.

How then can I test any model I may construct to explain bank reserve holdings if their reserve holdings remain constant at ten per cent? There are, however, some reasons for continuing. Since there was no legal reserve requirement there was thus no legal definition of what constitutes reserves. Therefore, Morrison's results may depend on what he decided to include in reserves. For example, if he leaves out of reserves some asset with which the banks make most of their desired changes in reserves, then his resulting reserve ratio would have much more stability than it should. Also his data are for the Canadian banking system as a whole. The individual banks may have varying reserve ratios with changes in their ratios offsetting each other leaving the system ratio fairly constant. Finally, his data are an annual average of month-end figures. This annual average may hide considerable variation over a given year.

There does seem to be then some reason for constructing a liquidity preference function (demand function for reserves) for Canadian banks and testing it with monthly data.

CHAPTER TWO

A MODEL OF BANK RESERVE BEHAVIOUR

Introduction

Why does a bank hold reserves? Is it only because it is forced to by law or is there some other, perhaps economic reason for doing so? In this chapter, I will first of all investigate possible reasons for a bank's holding reserves. Then after looking at two studies which investigated a banks demand for reserves, I will present my own empirical model, to be tested in this paper, with an explanation of the variables contained therin.

Why a demand for Reserves?

A bank must be ready at all times to allow its depositors to withdraw immediately part or all of the money entrusted to the bank. If the bank fails to meet a demand for withdrawal of funds, it will probably cease operations as a bank* Many of the withdrawals may be re-deposited very quickly in the same bank or may be offset by completely new deposits. Also if it was necessary to give notice of withdrawal the banks could plan to have some of its earning assets mature at such a time as they could be converted into currency

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* The Bank Act states that "any suspension by the bank of payment of any of its liabilities as they accrue, in Bank of Canada notes (Dominion notes before the establishment of the Bank of Canada) if it continues for ninety days consecutively, or at intervals within twelve consecutive months, constitutes the bank insolvent" Canada, An Act Respecting Banks and Banking, Queen's Printer, Ottawa, 1954.
However, before the bank became legally insolvent, any inability to meet a withdrawal demand would result in a loss of public confidence and a possible run on the bank.

acceptable to the withdrawer. Inasmuch as the above situations do not hold, that is withdrawals are not so quickly re-deposited in the same bank, new deposits do not offset withdrawals or a withdrawer does not have to give notice, it will be necessary for a bank to hold some of its assets in the form of non-interest earning, highly liquid assets called reserves.

If held as cash, these reserves do not earn interest and there is a cost to holding them in the form of the opportunity cost foregone by holding these reserves rather than securities or loans. Thus, as interest rates on loans and securities rise a bank would tend to reduce its reserve holdings because of the rising opportunity cost of them. Likewise if rates are falling or if the chance of a capital loss from holding these other assets is rising the opportunity cost of holding reserves will fall and thus the amount of reserves held may rise.

Banks may have other means of meeting sudden withdrawals than simply relying on their own resources. That is they may be able to borrow either from other commercial banks or a central bank. Why not then attempt to minimize reserve holdings and borrow when necessary to meet withdrawals? There is, however, also a cost to borrowing.

Thus, not only is there a cost to holding too many reserves, there is also a cost to not holding enough. How then does a bank decide how much cash reserves to hold? Does it simply adjust its reserve holdings either downward, if the cost of meeting a deficiency (borrowing) falls while the opportunity cost rises or upwards if they move in the opposite direction?

Banks are probably able to form a subjective probability distribution of possible net cash flows. This means first of all that net cash flows are not constant. The bank never knows exactly how much of a cash flow will occur at any given time but it also means that they do form a distribution of possible net cash flows and this subjective distribution changes over time as certain variables change. Thus, they will use this subjective probability of possible net cash flows along with the penalty cost of a cash deficiency and the opportunity cost of holding reserves when deciding how much of reserves they will hold. For example, after deciding on a certain range of net cash flows,which may occur, they would then look at the cost of erring on either side of the expected net cash flow. That is, if they hold a little more than the expected net cash flow this will have a certain opportunity cost. If this opportunity cost is low they may decide to have this extra margin of safety. Likewise if they hold less than the expected net cash flow this also will have a cost, namely

the cost of meeting a cash deficiency. If this cost is low they may be willing to take the chance.

In the long run, a bank's holding of reserves may also be affected by economies of scale. As a bank grows in size, the absolute amount of reserves held will rise but the reserve ratio may fall. These economies of scale would occur because of greater speed in processing bank business (that may result as the bank grows) thus reducing the amount of cash needed to handle a given amount of business. They may also result from greater sophistication (likewise resulting from larger bank size) in predicting withdrawals, allowing the bank to hold a lesser percentage of its deposit liabilities as reserves. If the bank, while growing in size, is also growing relative to its competitors or if the number of banks in the system is declining then the chance of a withdrawal being re-deposited in the same bank increases and thus the reserve ratio may fall. Finally, the larger the bank, the less it need worry about indivisibility of its assets. In other words, a smaller bank would have to hold a greater percentage of its assets as reserves because with its smaller portfolio it would not be able to operate as close to any given percentage as would a large bank.

Morrison's model

An attempt to incorporate most of the above points in a theoretical model of a banks' demand for reserves was

made by George Morrison in his book, Liquidity Preferences of Commercial Banks.[25] He begins by constructing an expected loss function for the demand for reserves. It is assumed that a bank will attempt to minimize its expected loss during a certain time period by an appropriate allocation of its assets between cash reserves and loans.[26] In making this allocation the bank is faced with certain variables such as:

1. the return per dollar of loans, composed of an interest component (y) and an expected capital gain or loss component (g) which possesses some probability density ($\emptyset(g)$).
2. an expected change in cash reserves expressed as a proportion (v) of initial deposits with (v) possessing a probability density f(v).
3. a penalty cost of meeting a cash deficiency (n).

Letting p be cash as a ratio to initial deposits the expected loss function is written as follows:

$$E\,[L(p)] = yP + P\int_{-1}^{\infty} g\emptyset(g)\,dg + \int_{c}^{-p} n(-v-P)f(v)\,dv.$$

From this can be derived a demand equation for reserves as a function of the above terms and also (k), the range of the

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25 Chicago, University of Chicago Press, 1966, pp. 8-11.

26 It is assumed that the bank has only a choice between cash reserves and loans. The term loans represents in an undefined way the whole spectrum of assets other than reserves which are open to a bank. If the choice between all assets was incorporated explicitly into the model, it would become a problem in portfolio selection, another field again, which would unnecessarily complicate matters when our interest is simply in the bankers cash reserve behaviour.

distribution of expected cash flows.[27]

$$P = k\left(\frac{1}{2} - \frac{(\bar{y} + \bar{g})}{n}\right) - \bar{v}$$

If this demand equation is differentiated with respect to P we find that the model predicts a direct relationship between the demand for cash reserves and the penalty cost of a cash deficiency (n) and an inverse relationship between the demand for cash reserves and the interest rate on loans (y), the expected capital gain or loss on loans $\overline{(g)}$ and the expected cash inflow ($\bar{v}$) and a changing relationship between the demand for cash reserves and the range of the distribution of expected cash flows (k). A model similar to the above was then tested empirically using American data.

Thus, Morrison asserts that there exists a bank demand for cash reserves, irrespective of any reserves that the bank might be required to hold by law. Since he was dealing with aggregate data in the form of groups of banks, economies of scale with regards to reserve holdings was of no relevance to him. Also because of the use of aggregate data the aggregation problem is present but its effect is unknown.

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[27] Morrison, Op. cit., p. 10, the demand equation is derived from the expected loss function.

Goldfeld's model.

Stephen Goldfeld,[28] as part of a larger study of commercial bank portfolio behaviour, tests empirically two bank demand equations, one for excess reserves and another for borrowings from the Federal Reserve, the two together forming free reserves. The demand for excess reserves he has as a function of the Treasury bill rate, a lagged value of excess reserves, seasonal dummy variables, various constraint variables such as deposit flows of various types, a variable incorporating changes in the average reserve requirement of each class of bank and a dummy variable to take account of a structural shift which took place after the Federal Reserve-Treasury Accord of 1951. Separately he tests empirically the demand for borrowings from the Federal Reserve as a function of the difference between the discount rate and the Treasury bill rate, seasonal dummy variables and the same constraint variables as in the demand for excess reserves equation.

The above separation of free reserves into excess reserves and borrowed reserves with a separate demand equation for each is a step forward in the analysis of the American banking situation and it could be applied to the Canadian banking system also if instead of excess reserves we use total reserves (since there were no required reserves, excess reserves is meaningless) and instead of borrowing from a

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28 Stephen Goldfeld, Commercial Bank Behaviour and Economic Activity, Amsterdam, North-Holland, 1966, pp 4-53.

central bank we use bank borrowing under the Finance Act. However, in this study I will not include an analysis of bank borrowing under the Finance Act but will focus only on banks' cash reserve behaviour.[29] Because of the large number of American banks, Goldfeld, like Morrison, used aggregate data to test his demand equations with the resultant unknown biases because of aggregation and also the inability to test the effect of differences among banks on the holding of reserves.

The Model to be tested

Because of one of the characteristics of the Canadian banking system, namely the small number of banks, I will investigate the reserve behaviour of the banks on an individual basis and thus, unlike the two previous studies may be able to determine the effect of differences between banks on the holding of reserves. The aggregation problem, which results from using aggregate data for a group of banks or a whole banking system to test a model of individual bank reserve behaviour will also be alleviated. By the use of monthly data the problem of aggregation over time periods will likewise be reduced. It would only be eliminated if the banks planning

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29 Canadian commercial bank borrowing under the Finance Act has been investigated by Eric Sven Kerr, The Determinants of Bank Borrowing under the Finance Act 1914 - 1934, Erik Sven Kerr, M.A. Thesis, U.B.C., 1967.

period were one month and if the data were monthly average figures, neither of which is the case here.[30]

The actual model I will test to explain the reserve holding behaviour of individual Canadian commercial banks is the following:

$$p = f(n, r, y, O, c, h, I, G, S)$$

where n is the rate of interest on borrowing under the Finance Act

r is the New York call loan rate

y is imports

c is railroad carloadings

O is interest rate on long term Ontario Government bonds

h is a ratio of demand to total deposits

I is a ratio of interbank to total deposits

G is a ratio of this month's deposits to last month's.

S is a bank size variable.

The above model uses the empirical counterparts of several of the variables from Morrison's theoretical model presented earlier. Several other variables are added because of my use of individual bank data. Also one variable, expected capital gains or losses on loans, is not included in my empirical model because with the lack of interest rate data in Canada for

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30 H. Theil, Linear Aggregation of Economic Relations, Amsterdam, North-Holland, 1954, and R.G.D. Allen, Mathematical Economics, London, Macmillan, 1957, pp. 694-719. Either of these books can be referred to for more on the aggregation problem.

the period under study it will be impossible to measure it.[31]

In any country wherethere is a central bank, the penalty cost of a cash deficiency is indicated by the central bank discount rate (the rate that banks pay on borrowings from the central bank). In Canada, no such central bank existed during most of the period under study. However, the Canadian banks did have a source of borrowed funds in the form of borrowings under the Finance Act. Originally established as a wartime measure to ensure bank's liquidity it was continued after the war in gradually changing form. The provision of importance to us here concerns the advancing of Dominion notes to the charteredbanks upon the pledge of approved securities deposited with the Minister of Finance. This part of the Act was renewed under the Finance Act of 1923 and continued until the establishment of the Bank of Canada in 1935. Therefore, as the penalty cost of a cash deficiency (n) for the banks, I will use the rate of interest charged on bank borrowing under the Finance Act, until 1935, after which it is the discount rate of the Bank of Canada. This penalty cost of borrowing should have a direct relationship with bank's reserve holdings.

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31 Expected capital gains or losses are measured by the spread between long term and short term interest rates.

Information on interest rates in Canada during the period under study is very scarce. A long term interest rate series on Ontario Government bonds is available (and will be tested) but since the bank's trade-off would be between cash reserves and very short term securities, a short term interest rate would probably be a better determinant of cash reserve behaviour. There is no Canadian short term interest rate available for the period under study. Given the fact that the Canadian banks played an important role in the New York money market and indeed used it as the primary place for adjusting their liquidity positions, the relevant short term rate for the Canadian commercial banks would be the New York call loan rate. The theoretical model states that the relationship between reserves held and the loan rate (under which the security rate is included as explained in footnote 26) will be inverse.

This lack of interest rate information also applies to the loan situation. In this case I use, rather than interest rates, some variables to indicate the demand for loans which I postulate will also have an inverse relationship with reserve holdings. This allows me to get around the lack of interest rate data but also it is good for the following reason. There was and still is a belief prevalent

among Canadian bankers (and produced probably by their vulnerability to public opinion because of their small numbers) that the main purpose of the Canadian banks is to make loans. Because of this they may respond more to the actual demand for loans rather than to the profit motive in the form of interest earned on loans when deciding to grant more or less loans and thus draw down or build up their reserves. Also in most instances, the two will move together. That is when the demand for loans is high thus encouraging banks to make loans and draw down their reserves, the interest rate on loans will also be high, making it profitable for the banks to grant loans. If at any time the demand for loans and the interest rate on loans do not move together in the same direction it will be the demand for loans which governs the banks granting of loans and thus their holding of reserves. I would argue then that a variable representing the demand for loans will be a better determinant of the banks reserve holdings than the interest rate on loans and further that there will be an inverse relationship between the demand for loans and the banks holdings of reserves.

A good variable to represent the demand for loans would be some measure of the level of economic activity such as gross national product or industrial production. The

reason is that when the level of economic activity is high, so also will be the demand for loans as people revise upward their consumption patterns and businesses increase capital expenditures, both groups financing part of this expenditure through loans. However, again we encounter the problem of lack of data for the period under study. Since the level of imports is tied very closely to gross national product or industrial production, [32] I would postulate that the level of imports would be a good proxy for the demand for loans, the movements in both being closely related.

The demand for loans would also vary seasonally. Of particular importance in Canada is the large part that commercial banks play in the financing of agriculture and in particular crop movements. Since agriculture was such a large sector of the Canadian economy during the period under study, crop movements would probably have a great influence on the demand for loans and thus the holding of reserves. Crop movements will be represented in the model by railroad carloadings.

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32 As gross national product and thus incomes increase, consumption also increases and since for Canada a large part of our consumption consists of foreign made goods or foreign supplied services, imports also will increase correspondingly. Likewise as industrial production increases much of the new capital equipment used in production is imported.

Not only will the demand for loans affect the banks desire for reserves, decreasing it during times of high demand for loans and vice versa, but the demand for loans will also affect the cash drains on a bank. When people take out a loan they are not likely to leave it sitting idly in the bank. Also some people will withdraw their own funds from the bank to meet the needs which prompted the increased demand for loans. The amount of withdrawals[33] from a bank will then increase as the demand for loans increases. To the extent

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33 The banks could meet this cash drain by issuing their own notes which were not part of cash reserves. However, any notes in circulation above the amount of a banks unimpaired paid-up capital had to be matched by a deposit of gold or Dominion notes in the Central Gold Reserves. Since most banks usually had

that banks can predict such drains they may be able to meet them without drawing down their reserves. This may be done by planning in their securities portfolio for certain issues to come due at the same time the cash will be needed. To the extent that they fail to predict exactly, then their reserves may fall even lower than the low level desired by the banks because of the increased demand for loans.

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33 (Continued)

notes in circulation above the amount (as witnessed by a statement made by Sir Edmund Walker, that " the bank is using its full circulation against capital" [34]) any withdrawal of funds by depositors would affect cash reserves.

34 H.P. Willis and B.H. Beckhart, ed., Foreign Banking Systems, New York, Henry Holt, p. 386.

In summary then, the demand for loans will be a better determinant of reserve behaviour than interest rates on loans and the demand for loans will be represented in my model by the level of imports, and railroad carloadings. Increased withdrawals from the banks, as a result of the increased demand for loans, will increase the tendency for the banks reserve ratio to fall. The relationship then between the demand for loans and the holding of reserves will be inverse.

According to Morrison's theoretical model, the demand for reserves will be affected by the expected cash flow and the range of the distribution of possible cash flows. In other words the banks form an idea about the distribution of possible cash flows. This theoretical distribution will be affected by such things as the percentage of a banks' deposits which are demand deposits, the percentage of a banks' deposits which are interbank deposits and the ratio of this months' deposits to last.

The greater the percentage of a bank's deposits which are demand deposits the greater the chance of a sudden withdrawal taking place which must be met immediately. An increase in the percentage of demand deposits would increase the expectation of a cash drain and thus also increase the reserves held. If a bank has a large amount of interbank deposits and thus acts as a bankers bank, the expectation of a

cash drain probably increases and also the range of the distribution increases. In other words the size of the withdrawal may be much larger than with an ordinary deposit.[36] Finally if a banks deposits have jumped tremendously from one month to the next because of large new deposits, the bank may at first expect a sudden large withdrawal until it becomes accustomed to the new higher level of deposits and then makes the necessary adjustments in its portfolio. Also it takes time for the bank to carry out the desired changes and working with monthly data we have to allow for this lag in response. Thus, we would expect that if a bank had experienced a sharp increase or decrease in deposits, its reserves would also show an increase or decrease.

As mentioned previously in this chapter, I will be using data for the individual Canadian commercial banks. Some of the variables already presented, such as percentage

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36 Also if a bank acts as a fiscal agent for a senior level of government such as the Federal Government this may affect the banks reserve holdings perhaps because of some greater variability of such government deposits. The Bank of Montreal was such a fiscal agent for the Federal Government for most of the period under study. Account must be taken of this when testing the model.

of deposits which are demand deposits and the percentage which are interbank deposits, will reflect differences among individual banks. However, one further difference should be included. This is the difference in size among banks. A size variable will be included to see if there is any evidence of economies to scale in banking with regards to the holding of reserves.

That then is the model but before actually testing it, it will be necessary to investigate the concept and measurement of reserve ratios.

CHAPTER THREE

THE CONCEPT AND MEASUREMENT OF RESERVE RATIOS

In this chapter I consider some of the conceptual and data problems involved in calculating Canadian commercial bank reserve ratios.

The Concept of a Reserve Ratio

Since there was no required reserve ratio in Canada prior to 1935, [37] there was no official concept of reserves. Such a requirement was first introduced in 1935, after which banks were required to hold five per cent of their Canadian deposit liabilities in the form of vault cash or deposits with the Bank of Canada.[38] Most studies of reserve behaviour focus on the bank's holdings of excess reserves, that

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37 Banks were, however, required after 1891 to make a deposit (contribution) to the Bank Circulation Redemption Fund and could after 1913 make deposits in the Central Gold Reserve. The Bank Circulation Redemption Fund was set up to guarantee the redemption of bank notes of failed banks and each bank was required to contribute according to a set formula. The Central Gold Reserve was mentioned in the previous chapter, footnote 33. For more information on the above consult H.P. Willis and B.H. Beckhart, ed., Foreign Banking Systems, New York, Henry Holt, pp. 380-81; 385-87 and R. Craig McIvor, Canadian Monetary, Banking and Fiscal Development, Toronto, Macmillan, 1958, pp. 77 and 84.

38 Bank of Canada Act, 1934, Section 27 (1).

is reserves in excess of required reserve holdings. Since these are not relevant concepts in the Canadian case before 1935, in this thesis I will estimate the demand for reserve holdings of the banks rather than "excess reserves". To do this it is necessary to determine what exactly should be considered as reserves.

The Contemporary View

What did the Canadian banker himself consider as reserves? B.H. Beckhart [39] states that the Canadian banker would include: cash on hand, deposits with banks in foreign countries, call loans in New York and London, and Securities and Commercial paper. Another statement of what constitutes reserves appears in the Report of the 1933 Royal Commission on Banking and Currency.

> "The general practice of the CAnadian banks is to classify their reserves in two categories: (1) cash assets and (2) quickly realizable assets, also called secondary reserves. . . The"cash assets" include (a) gold and subsidiary coin, (b) Dominion notes, (c) United States and other foreign currencies, (d) notes of other banks, (e) cheques on other banks, (f) balances due by banks and banking correspondents elsewherethan in Canada, (g) balances due by other banks in Canada."[40]

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39 Willis and Beckhart, Op. cit., p. 430.

40 Report of the Royal Commission on Banking and CUrrency in Canada, Ottawa, Kings Printer, 1933, p. 32.

It would seem that there was no agreement as to what assets constitute reserves. It will be necessary to define what we mean by reserves and then by looking at the banks' balances sheets determine which assets will be considered as reserves.

Definition of Reserves from Economic Theory

In the previous chapter we looked at why banks held reserves. But what exactly are reserves? The ultimate test of whether an asset can be included in reserves is it liquidity. Since the purpose of reserves is to be available to meet any unforeseen withdrawals they must be in a form readily acceptable to bank depositors or easily converted into such a form in a short time period and with little or no risk of capital loss. Within the category of reserves we have some assets more liquid than others, starting at one end of a spectrum with cash reserves and advancing along to other assets which are fairly liquid but may perhaps earn some interest. As we move along the spectrum away from cash reserves into secondary reserves the liquidity becomes less and the interest return greater. At some point the assets stop being considered as part of reserves and are considered as part of the banks' securities portfolio. In this thesis I will only be considering cash reserves[41] --that is, the most liquid end of the reserve spectrum. This is partly just a

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[41] What exactly is included in cash reserves will be shown in the next section.

matter of choice as to where exactly to draw the line. Also secondary reserves were not included because of certain features they had during this time period in Canada. Secondary reserves are those assets which do earn some interest but yet still can be converted into cash reserves with little cost or rish of loss. In order for so-called secondary reserve assets to actually be considered as part of reserves it is necessary that there be, in the case of securities, a well-established market for such assets in order that theymay be quickly sold with little cost involved in making the actual sale. Also this market is necessary in order to lessen the risk of capital loss when having to dispose of such assets before maturity. Thus any Canadian short term securities would have to be excluded because there was no established market for them at this time. What about foreign short term securities? There was an established market for them in New York and thus the actual cost of carrying out buying and selling operations would be low but their liquidity was impaired by the risk of a future adverse movement of the foreign exchange rate. Another typical asset included as secondary reserves is call loans. Call loans in CAnada at this time however were not subject to immediate call as they are nowadays. Call loans in New York were subject to call but again their liquidity was impaired by the rish of a future adverse movement of the foreign exchange rate.

In this thesis I will be considering as reserves only cash reserves.

The Banks' Balance Sheet

Which of the Canadian commercial banks' assets could be included in cash reserves? "Gold and subsidiary coin" and "Dominion notes" are the most liquid of the banks' assets since they are readily acceptable in their present form by any of the banks depositors. "Notes of other banks", "cheques on other banks" and "deposits with other Canadian banks" were also extremely liquid because they can be converted into gold or Dominion notes simply by making presentation at the other bank or banks involved or in the case of notes of other banks, used directly to meet withdrawals if necessary. The three preceding types of assets are included in cash reserves because I am calculating the reserve ratios of each individual bank. If the reserve ratio of the whole banking system is calculated the above three factors would not be included since these items are assets of one bank in the system while being liabilities of another and thus would cancel out when a reserve ratio was calculated for the system. Another extremely liquid asset is "Government and bank notes other than Canadian", since these can be used to purchase gold and/or Dominion notes from other Canadian or foreign banks very quickly and with little or no loss. "Deposits with and sums due from foreign banks and banking correspondents", are also fairly liquid since they can be transferred within a short

time to meet any deposit withdrawals. "Deposits with the Bank of Canada" (after 1935) constitute part of the official definition of reserves and so they are included also. "Deposits in the Central Gold Reserve", are a border line case. Canadian commercial banks had the privilege up until 1935 (when it began to be curtailed) of issuing their own bank notes. Any note issue beyond an amount equal to the issuing banks paid up capital had to be matched by a deposit in the Central Gold Reserve. Ideally only "free" Central Gold Reserve Deposits (i.e., Deposits in excess of reserves against covered bank note circulation) should be included in reserves against deposits, but monthly data on such deposits are not available on an individual bank basis. Also if, as I do in this study, one includes notes in circulation as a liability of the bank against which it must hold reserves, then it is legitimate to include deposits in the Central Gold REserve in reserves.

We have now looked at what could be included in cash reserves but there is also the problem of what could be included in the denominator of a reserve ratio. In other words, against what are the reserves being held? Again until 1935, when it became Canadian deposit liabilities, there was no official definition. One possible definition could be all deposit liabilities of the bank. Other possible definitions involve varying combinations of Canadian deposit liabilities,

foreign deposit liabilities and notes in circulation.

The above then are possible items which could be included when calculating a reserve ratio. Because of the lack of any clear cut definition it will be necessary to calculate several reserve ratios by varying the items included in the numerator and denominator. Table I below gives all the possible "cash" and"deposit and note" items to be included.

TABLE ONE

RESERVE ASSETS

1. Gold and subsidiary coin
2. Dominion notes (after 1935 notes of the Bank of Canada)
3. Notes of other banks
4. Cheques on other banks
5. Deposits made with and balances due from the other banks in Canada.
6. Due from banks and banking correspondents in the United Kingdom
7. Due from banks and banking correspondents elsewhere than in Canada and the United Kingdom
8. Deposits with the Bank of Canada (after 1935)
9. Government and Bank notes other than Canadian (also called U.S. and other foreign currencies)
10. Deposits in the CEntral Gold Reserve.

LIABILITIES

10. Balances due to Dominion Government after deducting advances for credit, pay-lists, etc.,

11. Balances due to Provincial Governments

12. Deposits by the public payable on demand in Canada

13. Deposits by the public payable after notice or on a fixed day in Canada

14. Deposits elsewhere than in Canada

15. Deposits made by and balances due to other banks in Canada

16. Due to banks and banking correspondents in the United Kingdom

17. Due to banks and banking correspondents elsewhere than in Canada and the United Kingdom

19. Notes in circulation

The Reserve Ratios

What will be included in the ratios to be calculated? The numbers appearing below are those representing the different types of assets and liabilities in Table One.

A. Comprehensive Ratio : $\frac{1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 18}{10 + 11 + 12 + 13 + 14 + 15 + 16 + 17 + 19}$

B. Domestic Ratio : $\frac{1 + 2 + 3 + 4 + 5 + 8 + 18}{10 + 11 + 12 + 13 + 15 + 19}$

C. Foreign Ratio : $\frac{6 + 7 + 9}{14 + 16 + 17}$

D. Cash Ratio (including notes as liabilities): $\frac{1 + 2 + 3 + 8 + 9}{10 + 11 + 12 + 13 + 15 + 19}$

E. Cash Ratio (excluding notes as liabilities): $\frac{1 + 2 + 3 + 8 + 9}{10 + 11 + 12 + 13 + 15}$

F. Similar to Morrison's Ratio: $\frac{1 + 2 + 3 + 4 + 5 + 7 + 8}{10 + 11 + 12 + 13 + 14 + 16 + 17}$

G. Ratios for the banking system as a whole are similar to the above except that 3, 4, and 5 are dropped from the numerator wherever they appear and 15 is dropped from the denominator wherever it appears.

The Comprehensive Ratio is simply the sum of all the assets I have defined as cash reserves over the sum of all the deposit and note liabilities for each bank. The Domestic Ratio as it implies is limited to domestic assets and liabilities and similarly for the Foreign Ratio. Then there are the two Cash Ratios including and excluding notes as liabilities. These two ratios include only the most liquid of cash reserves in the numerator and only Canadian deposit liabilities (as well as notes in circulation in the one instance) in the denominator. Also there is a ratio similar to the one calculated by George Morrison[42] when he determined that the Canadian banking system adhered fairly closely to a ten percent

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42. George Morrison, Liquidity Preferences of Commercial Banks, University of Chcago Press, Chicago, 1966, p.70-71.

reserve. It is only similar and not exactly the same because Morrison was looking at the system as a whole and I am looking at each individual bank. Also, Morrison includes in reserves free Central Gold Reserve Deposits, but as mentioned previously, these figures are not available for each bank by month and the task of calculating them would be prodigious. Therefore, I have assumed that they will be small. I also calculate all the above ratios for the Canadian banking system as a whole. The only difference between the ratios for the system and those for the individual banks is a dropping of all Canadian interbank assets and liabilities for the reason given previously.

Source and limitations of the data

The data to calculate the reserve ratios appears in the official monthly returns of the commercial banks to the Minister of Finance which are published as supplements to the Canada Gazette.[43]

The major limitation of the data is the fact that they are month-end figures rather than monthly averages. That is, the figures represent the situation on the last day of each month rather than the average of each day of

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43 Canada Gazette, 1920 - 1939, Kings Printer, Ottawa.

the month. This practice probably results in the commercial banks engaging in window dressing. Generally this is an attempt by banks to make their size and/or financial position appear bigger and better than it is. This may be used to influence the public in favour of patronizing the bank in question and/or to convince the Finance Department of the solvency of the bank. For example, there is often some doubt as to the actual value of some of a banks assets and the bank will place a higher value on that asset than may be justified. Also, the banks may arrange their portfolios in a certain way on the day the return is filed and then follow a completely different policy on the remaining days of the month.

The banks own action aside, economic conditions which influence reserve holdings may on the day the returns are filed be very different from conditions prevalent throughout the rest of the month. Thus one may get a very distorted picture since the last day of the month figures may be very different from the average conditions during the month.

What effect would the above limitations have on the data? If window dressing is indeed important this would bias the results in favour of greater liquidity than

actually existed (since a bank's main worry is to convince the public that it is solvent it would most probably window dress in favour of greater liquidity). This would produce higher reserve ratios than actually existed: I will have to assume that window dressing is small. The most probable assumption about the economic conditions affecting the holding of reserves mustbe that they are random and thus that the actual situation on the last day of each month will differ randomly from the average conditions of the month. This will cause a reduction in R^2 of, it is to be hoped, not too great an extent.[44]

The above data limitations should be kept in mind when interpreting the results later in this thesis.

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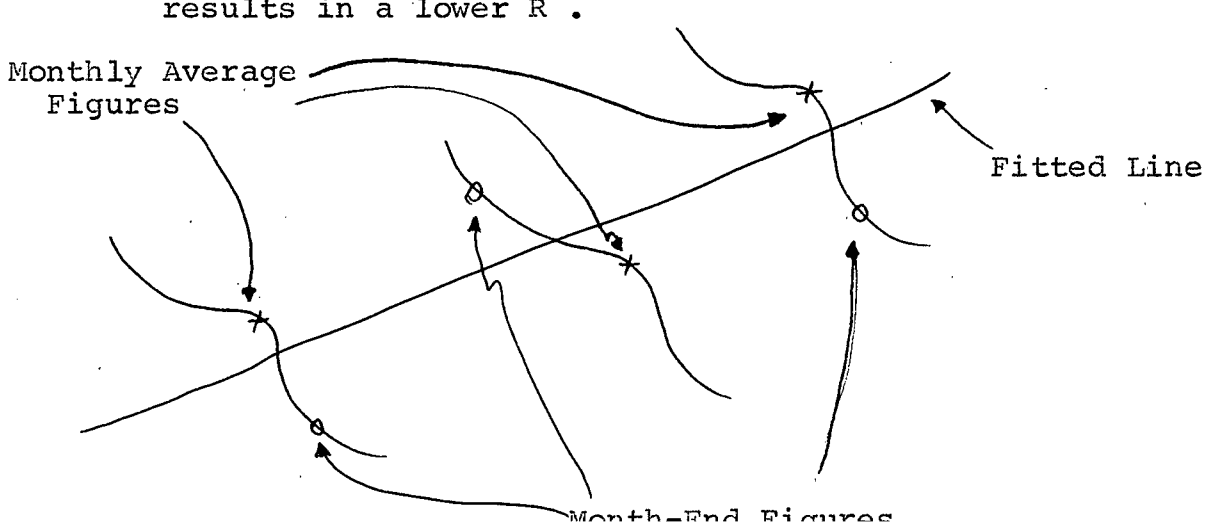
[44] If we assume that the economic conditions which affect the holding of reserves are random and operate such as to cause the daily actual holding of reserves to be normally distributed in a given month then if monthly average figures were used the observations would cluster around a line fitted to the data while if data from the last day of the month is used these observations may be anywhere in the normal distribution for each month and thus these observations would not lie as close to a line fitted to them as the monthly average observations did to the line fitted to them. This results in a lower R^2.



CHAPTER FOUR

THE RESERVE RATIOS: OBSERVATIONS AND CONCLUSIONS

Introduction

The results from calculating the reserve ratios which were presented in the last chapter will be analyzed here and some conclusions drawn which are pertinent to this thesis. As well as refuting the hypothesis of a ten per cent reserve requirement being adhered to in Canada, some other interesting findings are presented.

The Ratios

Of the six ratios calculated, five of them, Ratios A, B, D, E, and F can be represented by just the two Ratios A and E since the others follow closely movements in either of these two. Ratio C (the Foreign Ratio) exhibited tremendous swings and was of such a magnitude that it was clearly not the reserve ratio I sought. Ratios A and E, graphed for each bank, appear in the Appendix. Ratios A, B, D, and E are given for the Bank of Montreal and Molson's Bank to show how movements in the ratios do follow either Ratio A or E. Of the two ratios, A and E, the Cash Ratio (E), seems to be

the one which people meant when they talked of Canadian banks holding ten per cent reserves, since it comes closest to this ten per cent level. Therefore, the following observations will be on this Cash Ratio (E).

Annual Peaks

The first thing to notice is the occurence of regular annual peaks in the reserve ratios of most of the banks. The size of these peaks and the month in which they occur differ among banks and they coincide exactly with the year end of each bank.[45] Thus, the banks do indulge in window dressing with regards to their own annual reports. That is, on the month which happens to be their year end, most banks increase their holdings of cash reserves in order to convince the public, and in particular the shareholders, of their liquidity. In Chapter Three, while discussing the problem of using month end data, it was mentioned that banks may window dress the month end figures by increasing the amount of cash reserves they held on the last day of each month and then holding less for the rest of the month. The evidence of window dressing with regards to the annual reports thus reinforces the caution mentioned

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45 Account will have to be taken of this when the model is tested.

in Chapter Three of the possible bias upwards in the results.

Variation in the Reserve Ratios of Individual Banks

These peaks aside there is still considerable variation in the reserve ratio of each bank. Part of this variation, it must be remembered is a result of the use of month end figures rather than monthly averages.[46] The remainder of the variation is a result of the bank altering its reserve holdings in response to changes in certain variables. Hopefully, this will be explained by the model.

Differences Among Banks

There is also a marked difference among banks as to the amount of reserves they hold as shown by the mean of Cash Ratio E for each bank given in Table II. Surprisingly it seems that the larger banks held greater cash reserves than the smaller banks. Looking only at the banks which existed throughout the whole period, (see Appendix) two of the three largest banks, the Bank

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46 See footnote 44.

of Montreal and the Royal Bank of Canada, seldom went below ten per cent reserves while the third, the Canadian Bank of Commerce, seldom went below eight per cent. On the other hand the smallest bank which existed throughout this whole period, the Banque Provinciale du Canada held around three per cent reserves before March, 1935. Middle-sized banks held reserves between these extremes. Looking at banks which did not exist through the whole period (generally much smaller banks) we find some even lower holdings of reserves. The Weyburn Security Bank for example held only two per cent cash reserves for a while.

Decline in Reserves over Time

Observing all of the banks during this period we find a decline in reserve holdings over time, continuing, for some banks until 1929-30 and for others until March, 1935. The Standard Bank held twelve per cent until the beginning of 1922, then ten per cent until the beginning of 1925, seven per cent until the middle of 1926 and finally six per cent until the ceasing of operations in October, 1928.[47] The

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47 Remember that when I speak of the banks holding six or seven per cent, I mean disregarding the annual peaks and the oscillations which are considerable for some banks.

TABLE II

MEAN OF THE CASH RATIO (E)

FOR EACH BANK

BANK	MEAN (%)
Bank of Montreal	15.47
Bank of Nova Scotia	14.43
Bank of Toronto	9.67
Molson's Bank	7.99
Banque Nationale	6.20
Mercantile Bank	7.61
Banque Provinciale	5.08
Union Bank	10.36
Canadian Bank of Commerce	10.20
Royal Bank of Canada	15.95
Dominion Bank	9.25
Bank of Hamilton	8.69
Standard Bank	9.48
Banque Canadienne Nationale (formerly Banque d'Hochelaga)	6.31
Imperial Bank of Canada	88.82
Home Bank	10.67
Sterling Bank	7.84
Weyburn Bank	4.37
Barclay's Bank	8.31

Dominion Bank held ten per cent until the middle of 1925, then nine per cent until the end of 1928, seven per cent until the end of 1929, and six per cent until March, 1935.

Effect of the Depression

The above downward trend in reserves began, for some banks, to turn up with the beginning of the Great Depression. This rise in reserve holdings of Canadian banks as a result of the Depression is in contrast to Morrison's[48] finding of almost constant ten per cent reserve holdings. Thus, this throws some doubt on his use of this finding to prove that it was bank failures that caused American banks to increase their holdings of reserves.[49] The rise in reserve holdings of Canadian banks, perhaps is explained by a fall in interest rates. Even so, as long as reserves did rise, this still damages Morrison's argument because interest rates were low in both Canada and the U.S.A. Thus, perhaps the low interest rates also explain the increased reserve holdings of

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[48] George Morrison, Liquidity Preferences of Commercial Banks, Chicago, University of Chicago Press, 1966.

[49] His reasoning was that if it was bank failures which caused banks to increase reserves then there should be no increase in reserves by Canadian banks because there were no bank failures during the Great Depression.

American banks. No, says Morrison, because interest rates fell in both countries while reserve holdings increased in the U.S.A. but remained the same in Canada (according to Morrison's evidence). Thus, Morrison says there must be some other reason for the increased reserve holdings in the U.S.A., the shock effect of bank failures.

Effect of the Establishment of the Bank of CAnada

Why did the reserve holdings of some banks turn up, and rather sharply in some cases, after March, 1935? This was the date of the establishment of the Bank of Canada at which time required reserves were instituted and this had a tremendous effect on most banks. For those banks which were holding very small amounts of reserves there was a marked increased in reserve holdings and all banks began to hold closer to ten per cent reserves (even though the required reserve was only five per cent), than they had before. For example, the Banque Provinciale which had oscillated around three per cent suddenly jumped to ten per cent after the establishment of the Bank of Canada. Similarly the Imperial Bank moved from five per cent to eight per cent after March, 1935.

Conclusions

The evidence presented disproves the hypothesis of ten per cent reserves being maintained by the Canadian banks because the reserves vary over time and also between banks. Although previously in this chapter I found evidence of window dressing by the banks, it is probably safe to assume that all banks would window dress to some extent and that even if some did so more than others the great difference among banks as to their holdings of cash reserves could not be explained by differences in window dressing alone.

It is easy enough to see why such a belief, as the ten per cent reserves being held, would prevail. In all previous studies it was concluded that Canadian banks held ten per cent reserves by using annual data for the whole Canadian banking system. The greater constancy and at a level closer to ten per cent of the system ratio compared to any individual bank can be observed from the graphs. If, in addition, the ratio was aggregated over time (annual averages were used) I am sure it would show even greater constancy. Or, if the banks reserve ratios were calculated from each banks annual report, again you will get results much closer to ten per cent because of the banks tendency to window dress during the month of their year-end.

There is also some evidence that Canadian banks increased their holding of reserves during the Great Depression. This throws some doubt on Morrison's results as explained previously.

Finally, the belief that the establishment of the Bank of Canada had little effect on the reserve holdings of Canadian commercial banks was also refuted.

We will proceed now to explain by the model presented in Chapter Two, the changes in reserves and the differences among banks as to reserve holdings.

CHAPTER FIVE

THE TESTING OF THE MODEL

Introduction

The model of bank cash reserve behaviour presented in Chapter Two is here tested by multiple regression analysis using monthly data for the individual banks and then monthly data for the Canadian banking system. Some observations are made on the regression results and it is concluded that the model works fairly well when tested for the Canadian banking system but that for the individual banks the results are not nearly as good.

The Model

I will repeat here the model to be tested that was first presented in Chapter Two.

$$p = f(n, r, Y, O, C, h, I, G, S)$$

where

- p is the cash reserve ratio (Ratio E).
- n is the rate of interest on borrowing under the Finance Act.
- r is the New York call loan rate.
- Y is imports.
- O is the interest rate on long term Ontario Government bonds (as an index number).

C is railroad carloadings.

h is a ratio of demand to total deposits.

I is a ratio of interbank to total deposits.

G is a ratio of this months deposits to last.

S is a bank size variable (total deposits).

Further three dummy variables were included.

D_1 is a dummy variable to take account of the Bank of Montreal acting as fiscal agent for the Federal Government.

= 1 from January, 1920 to February, 1935 for the Bank of Montreal.

= 0 elsewhere.

D_2 is a dummy variable to take account of the increase in cash reserves because of window dressing in the banks annual report.

= 1 in the month which is year-end.

= 0 elsewhere.

D_3 is a dummy variable to take account of the shift up in reserve holdings with the establishment of the Bank of Canada in March, 1935.

= 1 for each month for each bank after March, 1935.

= 0 elsewhere.

This model was then tested using the Cash Ratio (E) as the dependent variable and combinations of the above variables n, r, Y, etc., as the independent variables. It was stested using monthly data for each individual bank and also using monthly data for the banking system as a whole.

Tests on Individual Bank Data

The model was first used to determine whether a long term or short term interest rate effected banks cash reserve behaviour most (Table III, equations 1 and 2). With the short term rate (r) included, the model has a slightly better R^2 than with the long term rate (O) but more important the short term rate is significant at the five per cent level while the long term rate is not. Thus, as was mentioned in Chapter Two, the short term rate is a better determinant of bank cash reserve behaviour than the long term rate.

Then the dummy variables were added, one at a time, and with the inclusion of each extra dummy variable the R^2 improved, (Table III, equations 3, 4, and 5).

In the last and best equation (highest R^2) (Table III, equation 5) all the independent variables except G (this month's deposits over last) are significant at the five per cent level.

SOURCE FOR TABLE III (Continued)

r --Survey of Current Business, United States Department of Commerce, Bureau of Foreign and Domestic Commerce, Washington.

C --Twelve Years of the Economic Statistics of Canada, op, cit., pp. 16-17 and

--Monthly Review of Business Statistics, Dominion Bureau of Statistics, Ottawa, King's Printer.

h, I, G, S --calculated from data in Canada Gazette, Volumes 1920-1939, Ottawa, King's Printer.

D_1, D_3 --Page 53of this Chapter.

D_2 --Annual Reports of the different banks.

The signs of the coefficients are as expected in all cases but three. The sign of h (demand deposits over total deposits) is negative, contrary to what was expected. No explanation could be found for this. Also the sign of S (total deposits) is positive, again contrary to what was expected. However, in this case we found in Chapter Four that the larger banks held greater reserves than smaller banks and thus the positive coefficient is in agreement with this. Finally the sign of r (the New York call loan rate) is positive, again contrary to expectations. No explanation could be found for this either. The very small coefficients for imports (Y), carloadings (C), and total deposits (S) is a result of the magnitude of the data used, which is all measured in thousands compared to the dependent variable E which is measured as a decimal (.09 being nine per cent).

Even though the best R^2 obtained was only .3778 this does not mean that the model is useless. Because of the large number of observations (2882) and the great diversity among banks the low R^2 is understandable. It will be seen that the performance of the model is much improved when we aggregate over banks and test the model with data for the whole Canadian banking system.

Tests on Canadian Banking System Data

Again as in the tests on the individual bank data, using r instead of O increases the R^2 slightly. Also r is more significant than O, although at this stage both are highly insignificant. (Table IV, equations 1 and 2).

Likewise the R^2 of these equations improves as we add further dummy variables (Table IV equations 3 and 4) finally we achieve a fairly respectable R^2 of .6606. In the final equation all but two of the independent variables are significant at the five per cent level. C (carloadings) and G (this months deposits over last) are insignificant. All but two of the coefficients have the signs expected. I (interbank deposits over total deposits) has a negative coefficient whereas it was expected to be positive and r (New York call loan rate) has a positive sign whereas it was expected to be negative. Again no explanation could be found for this.

Unlike with individual bank data, S (total deposits) now has the sign expected (negative). This is because of a general downward trend in cash reserve holdings over time. For the individual bank data this is offset by the larger reserve holdings of large banks compared to small

banks but looking at the whole banking system we get only the one effect, a decline over time of cash reserves while total deposits increase.

Conclusions

Using the aggregated data for the Canadian banking system we get a much higher R^2 than with the individual bank data. However, that we can predict better group behaviour than individual behaviour does not mean we should foresake the study of individual behaviour to concentrate on group behaviour. As shown in this thesis the model presented can shed some light on individual bank behaviour and with further refinement it is hoped it could shed much more.

TABLE III

REGRESSIONS ON INDIVIDUAL BANK DATA (Number of observations = 2882)

				INDEPENDENT VARIAB LES									
Dep. Var.	Constant	n	Y	O	r	C	H	I	G	S	D_1	D_2	D_3	R^2
1. E	0.0616	+0.757-02	-0.356-07	+0.147-03		-0.112-03	-0.04	+0.021	+0.457-02	+0.121-06				.3156
	(0.9458-02)	(0.1466-02)	(0.426-07)	(0.8-04)		(0.19-04)	(0.011)	(0.77-02)	(0.68-02)	(0.34-08)				(.0392)
2. E	0.0738	+0.822-02	-0.1-06		+0.125-02	-0.116-03	-.0415	+.0219	+0.5732-02	+0.12-06				.3157
	(0.8249-02)	(0.1162-02)	(0.53-07)		(0.63-03)	(0.1868-04)	(.0110)	(0.77-02)	(0.69-02)	(0.34-08)				(.0392)
3. E	0.0785	+0.717-02	-0.785-07		+0.109-02	-0.118-03	-0.037	+0.02	+0.48-02	+0.107-06	+0.025			.3285
	(0.8197-02)	(0.116-02)	(0.524-07)		(0.625-03)	(0.185-04)	(0.01)	(0.769-02)	(0.687-02)	(0.385-08)	(0.343-02)			(.0389)
4. E	0.0782	+0.723-02	-0.666-07		+0.104-02	-0.124-03	-0.036	+0.021	+0.509-02	+0.11-06	+0.026	+0.751-02		.3301
	(0.819-02)	(0.116-02)	(0.525-07)		(0.624-03)	(0.187-04)	(0.011)	(0.768-02)	(0.686-02)	(0.385-08)	(0.343-02)	(0.288-02)		(.0388)
5. E	0.0175	+0.0199	-0.3443-06		+0.3311-02	-0.859-04	-0.0422	+0.028	+0.85-02	+0.121-06		+0.563-02	+0.447	.3778
	(0.855-02)	(0.131-02)	(0.5271-07)		(0.614-03)	(0.18-04)	(.011)	(.074-02)	(0.66-02)	(0.324-08)		(0.266-02)	(0.277-02)	(.0374)

SOURCE:

Cash Ratio E Graphs in Appendix.

n --Report of the Royal Commission on Banking and Currency in Canada, Ottawa, King's Printer, 1933, p. 41. and Bank of Canada Annual Reports, 1935, 1936, 1937, 1938, and 1939, Ottawa, Bank of Canada.

Y --Trade of Canada, Department of Trade and Commerce, Dominion Bureau of Statistics, Ottawa, King's Printer.

O -- Prices and Price Indexes, Dominion Bureau of Statistics, Ottawa, King's Printer, 1913-1929; 1913-1939 and Twelve Years of the Economic Statistics of Canada, supplement to the Monthly Review of Business Statistics, Nov. 1931, Dominion Bureau of Statistics, Ottawa, King's Printer, pp. 14-15.

TABLE IV

REGRESSIONS ON CANADIAN BANKING SYSTEM DATA (Number of Observations = 240)

				INDEPENDENT VARIABLES									
Dep. Var.	Constant	n	Y	O	r	C	h	I	G	S	D_2	D_3	R^2
1.	0.0595	+0.368-02	-0.1744-06	-0.182-04		-0.417-04	+.48	-.8827	-.0124	-0.706-08			.4848
E	(0.0210)	(0.161-02)	(0.572-07)	(0.919-04)		(0.2198-04)	(.0512)	(.1299)	(0.9109-02)	(0.4591-08)			(.0119)
2.	0.0598	+0.2935-02	-0.2012-06		+0.5346-03	-0.3824-04	+0.4744	-0.9066	-0.0123	-0.6304-08			.4861
E	(0.0190)	(0.148-02)	(0.6543-07)		(0.6785-03)	(0.2153-04)	(0.0516)	(0.1311)	(0.9087-02)	(0.4217-08)			(.0119)
3.	0.1015	+0.458-02	-0.2078-06		+0.1546-02	-0.1392-04	+0.3938	-0.4266	-0.5377-02	-0.3062-07		+0.0247	.5797
E	(0.0181)	(0.1362-02)	(0.5931-07)		(0.631-03)	(0.198-04)	(0.0481)	(0.1365)	(0.8293-02)	(0.5114-08)		(0.3445-02)	(.0108)
4.	0.1046	+0.4588-02	-0.1937-06		+0.181-02	-0.2403-04	+0.3648	-0.3846	+0.4064-02	-0.3385-07	+0.0169	+0.0269	.6606
E	(0.0163)	(0.123-02)	(0.535-07)		(0.5693-03)	(0.1789-04)	(0.0435)	(0.1230)	(0.7577-02)	(0.4627-08)	(0.3117-02)	(0.2281-02)	(0.9695-02)

SOURCE:

Same as Table III.

CHAPTER SIX

CONCLUSIONS

After setting out to study the reserve behaviour of Canadian Commercial Banks it was first necessary to build a model of bank reserve behaviour. This was done after presenting two other models which differed from mine in that they were meant to be tested using aggregate data (data for a group of banks or a banking system), whereas mine was constructed to be tested using individual bank data.

Before testing the model it was necessary to study the concept and measurement of reserves in the Canadian context because there was no required reserve ratio and no official definition of reserves during the period under study. However, there was a generally prevalent idea that the Canadian commercial banks did adhere to a ten per cent reserve through a gentlemen's agreement within the Canadian Bankers Association.

Arriving at some possible reserve ratios, these were calculated using monthly data for the individual banks. It was decided that the Cash Ratio (E) was the one people meant when they referred to the banks holding ten per cent reserves. After graphing this ratio for each bank it was

seen that all the banks did not adhere to the ten per cent reserve nor did any one bank consistently. Some evidence was found refuting George Morrison's claim that Canadian banks did not experience an increase in reserves during the Great Depression.

The model presented earlier in the thesis was then tested with individual bank data and data for the whole Canadian banking system. Although the R^2 for the model tested with individual bank data was not very high most of the variables were significant and had the expected sign. Tested with data for the whole banking system the R^2 was much higher because of some detail being hidden by aggregation. It is hoped that with further refinement the model could be made to better predict individual bank behaviour.

By using disaggregated data (which was possible because of the small number of Canadian banks) much interesting detail was revealed which otherwise is lost in aggregation. Some misconceptions were also cleared up which result from conclusions being made about individual bank behaviour by studying data for a whole banking system.

APPENDIX

Graphs of Reserve Ratios of Canadian Banks

Fig 2

RESERVE RATIOS - BANK OF MONTREAL

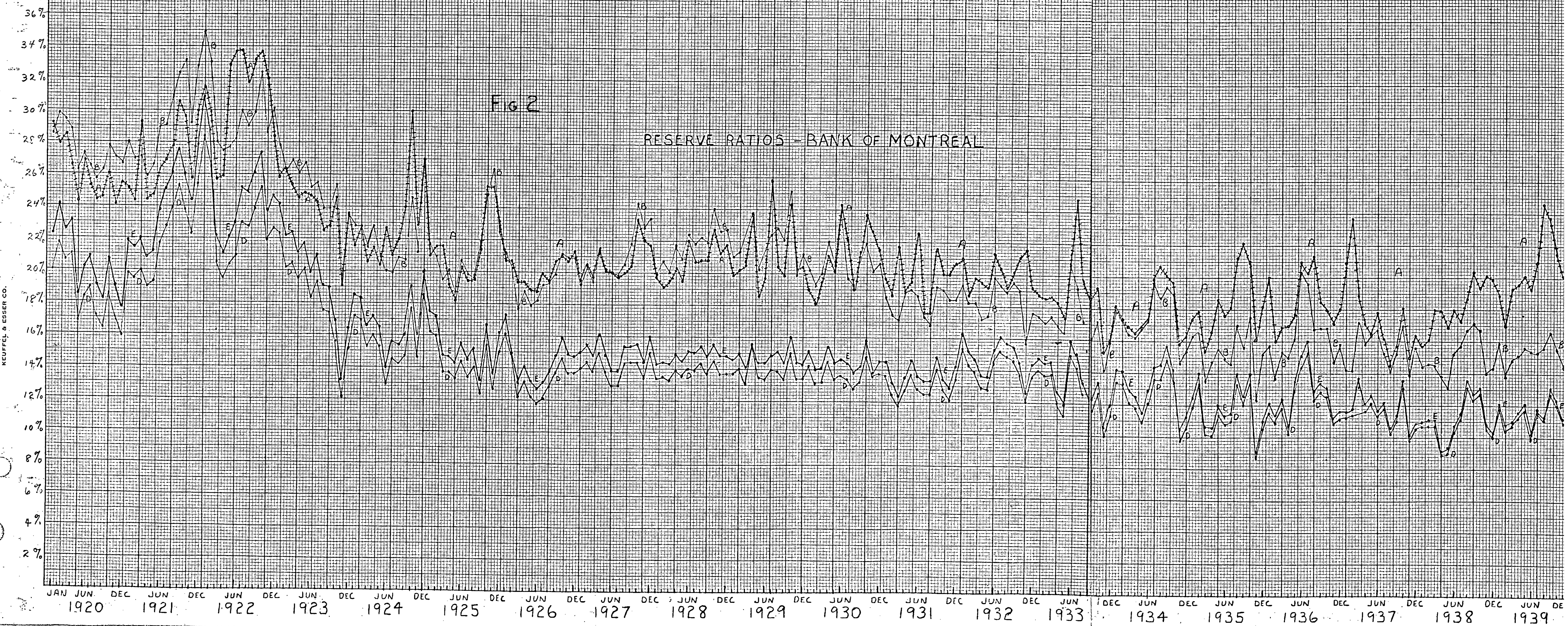
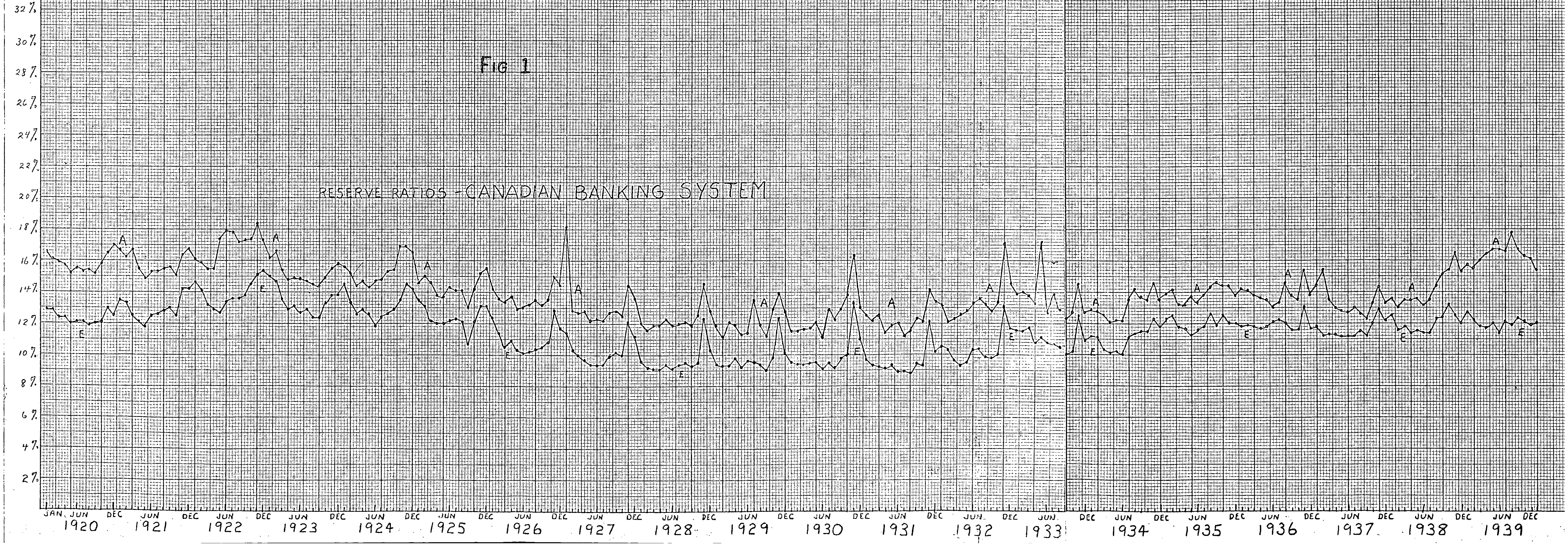


FIG 1


RESERVE RATIOS - CANADIAN BANKING SYSTEM
32%
30%
28%
26%
24%
22%
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
A
E
JAN JUN DEC
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939

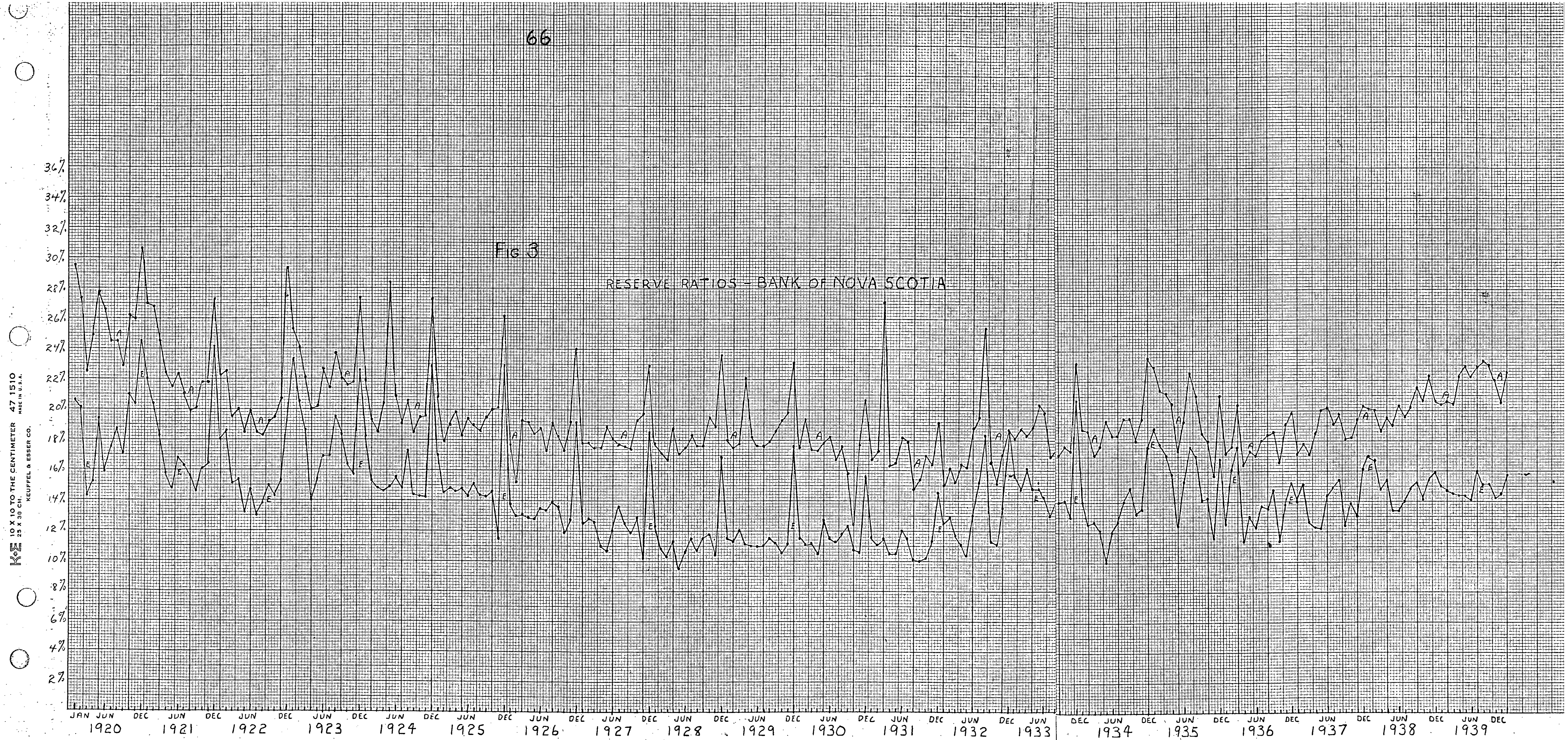
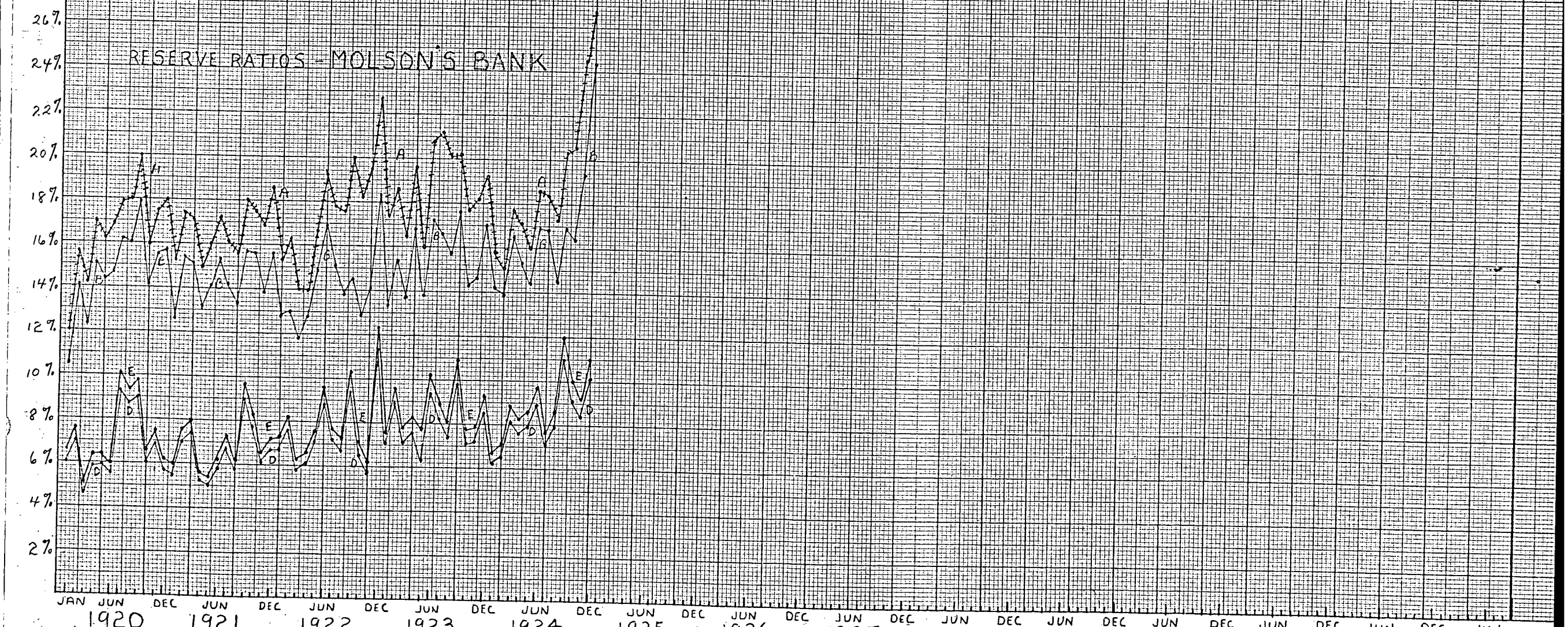


Fig 3

RESERVE RATIOS - BANK OF NOVA SCOTIA

Fig 4


RESERVE RATIOS - MOLSON'S BANK
36%
34%
32%
30%
28%
26%
24%
22%
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
JAN JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN
1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933

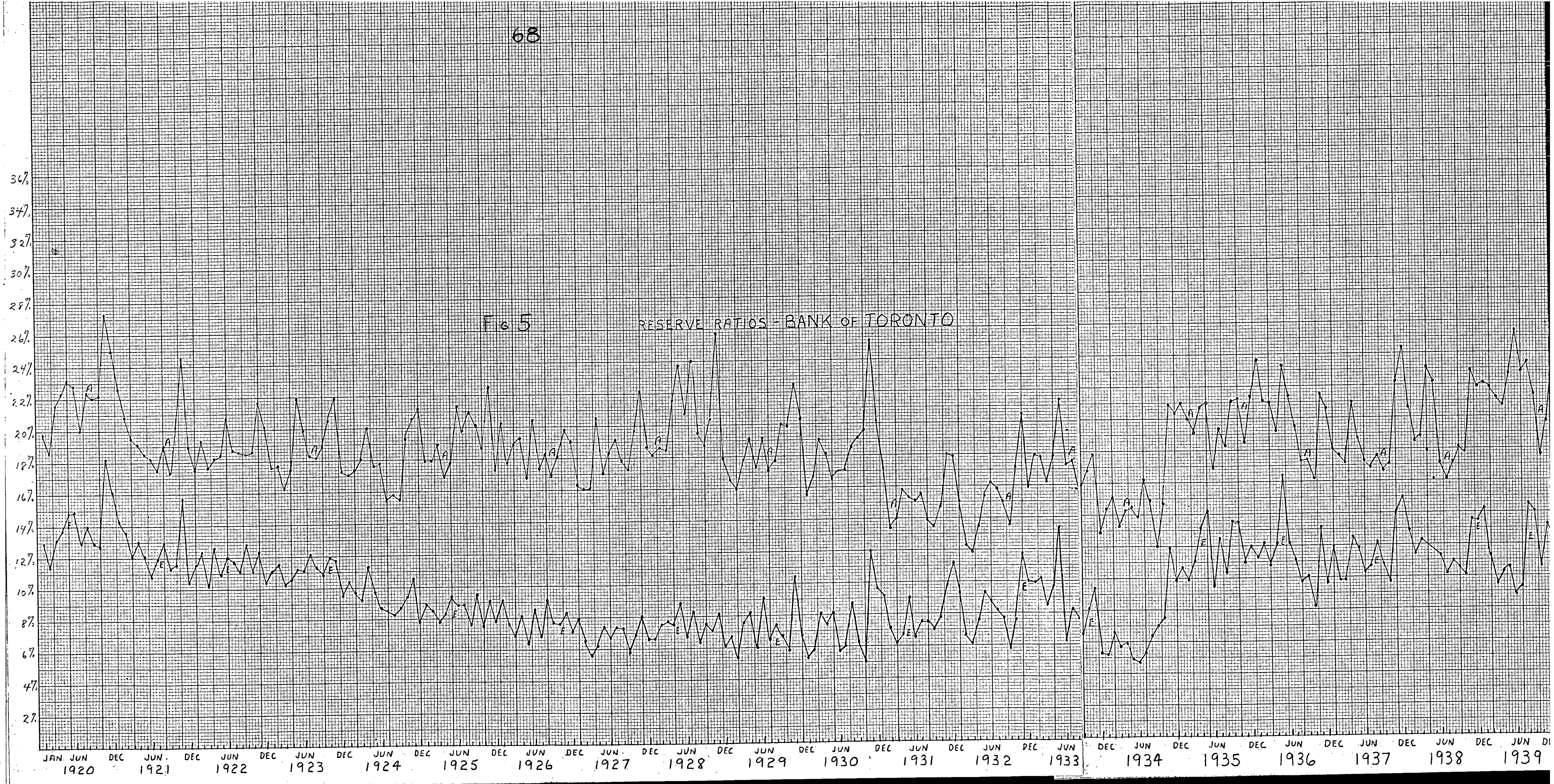


Fig 5
RESERVE RATIOS - BANK OF TORONTO
36%
34%
32%
30%
28%
26%
24%
22%
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
A
E
JAN JUN DEC
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939

FIG 6

RESERVE RATIOS - BANQUE PROVINCIALE DU CANADA

JAN 1920 JUN DEC 1921 JUN DEC 1922 JUN DEC 1923 JUN DEC 1924 JUN DEC 1925 JUN DEC 1926 JUN DEC 1927 JUN DEC 1928 JUN DEC 1929 JUN DEC 1930 JUN DEC 1931 JUN DEC 1932 JUN DEC 1933 JUN DEC 1934 JUN DEC 1935 JUN DEC 1936 JUN DEC 1937 JUN DEC 1938 JUN DEC 1939

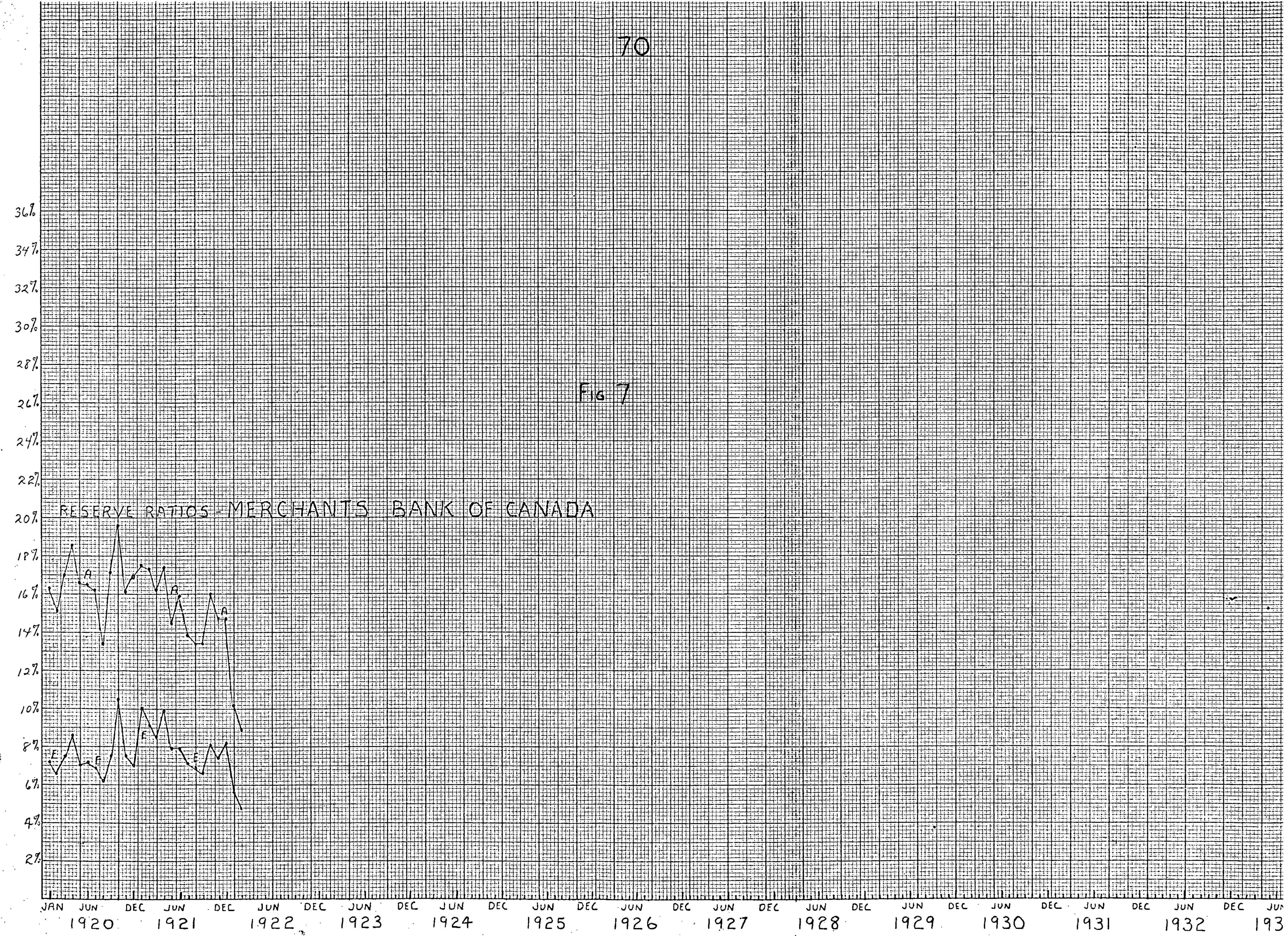
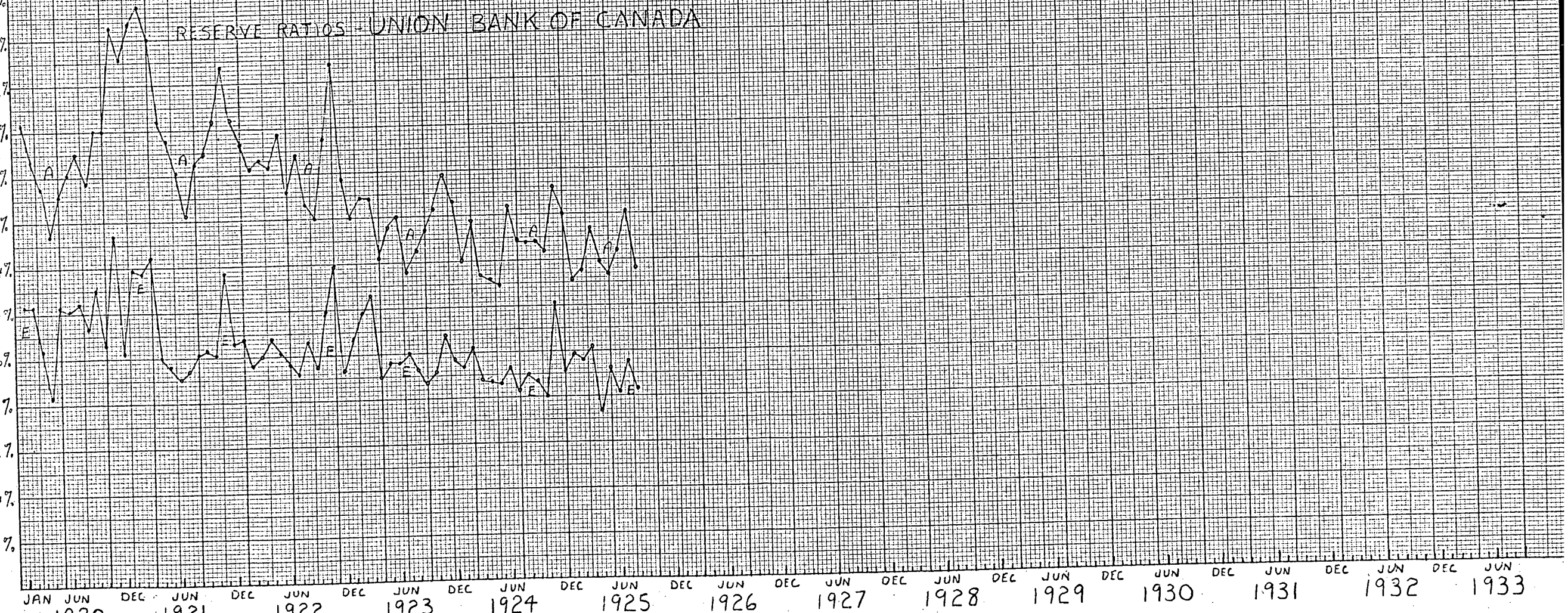


Fig 7

FIG 8

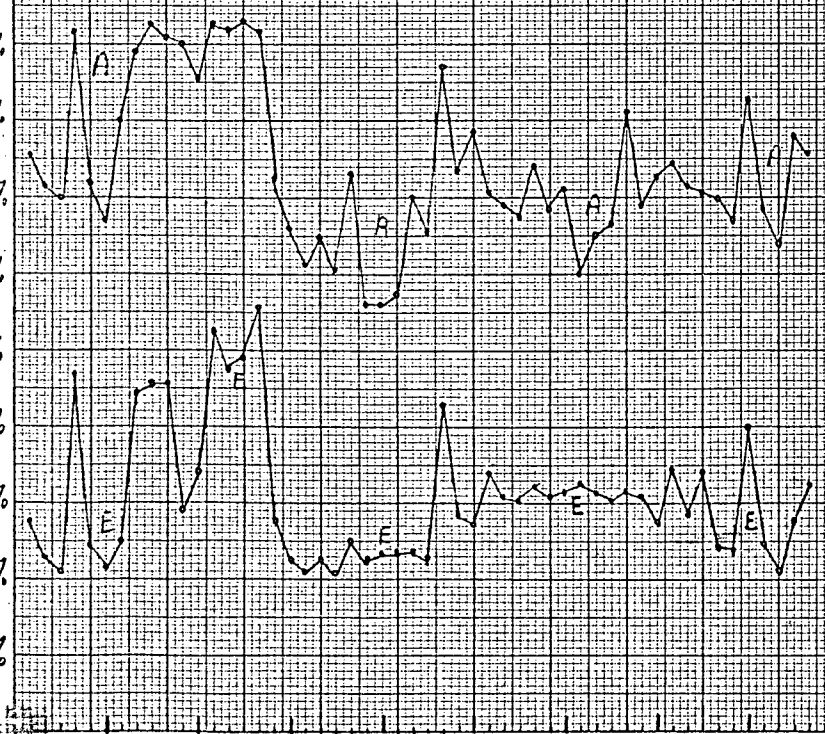
RESERVE RATIOS - UNION BANK OF CANADA



36%
34%
32%
30%
28%
26%
24%
22%
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%

Fig 9

RESERVE RATIOS - BANQUE NATIONALE



JAN JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN

1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933

Fig 10

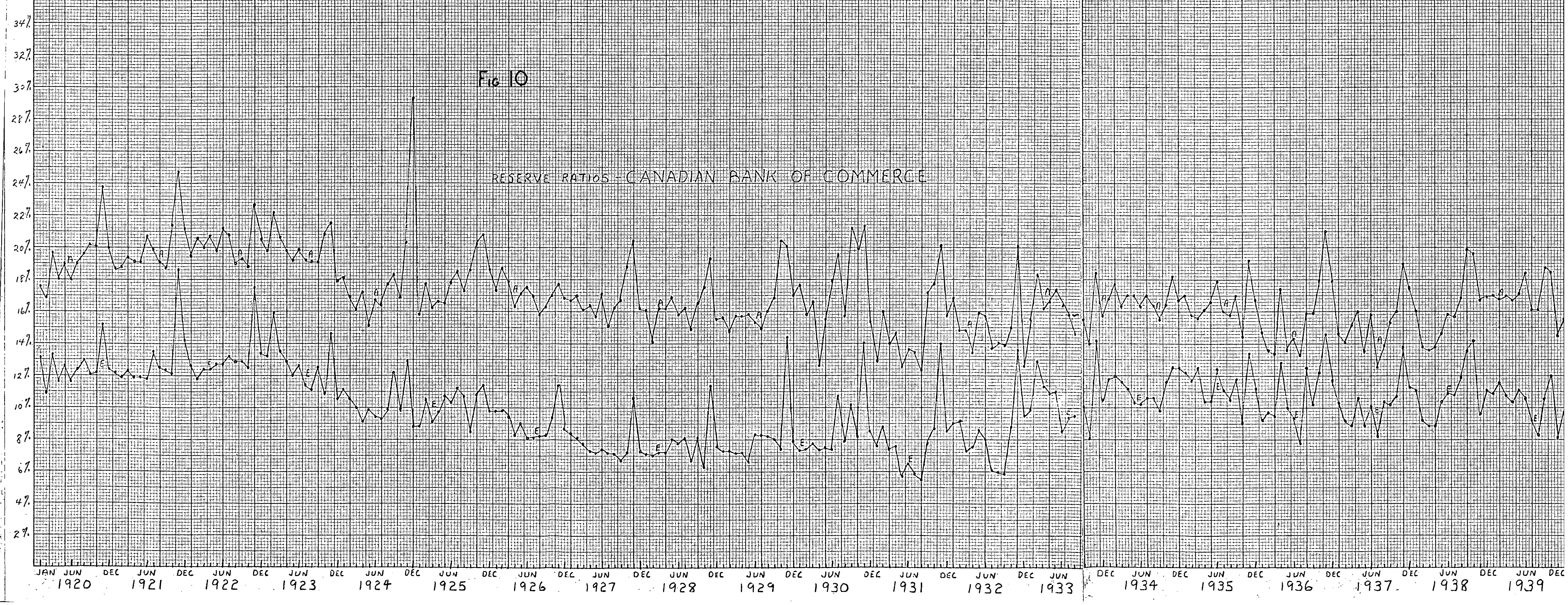

RESERVE RATIOS - CANADIAN BANK OF COMMERCE
36%
34%
32%
30%
28%
26%
24%
22%
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
JAN JUN DEC
1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939
A
E

Fig 11

RESERVE RATIOS - ROYAL BANK OF CANADA

Fig 12

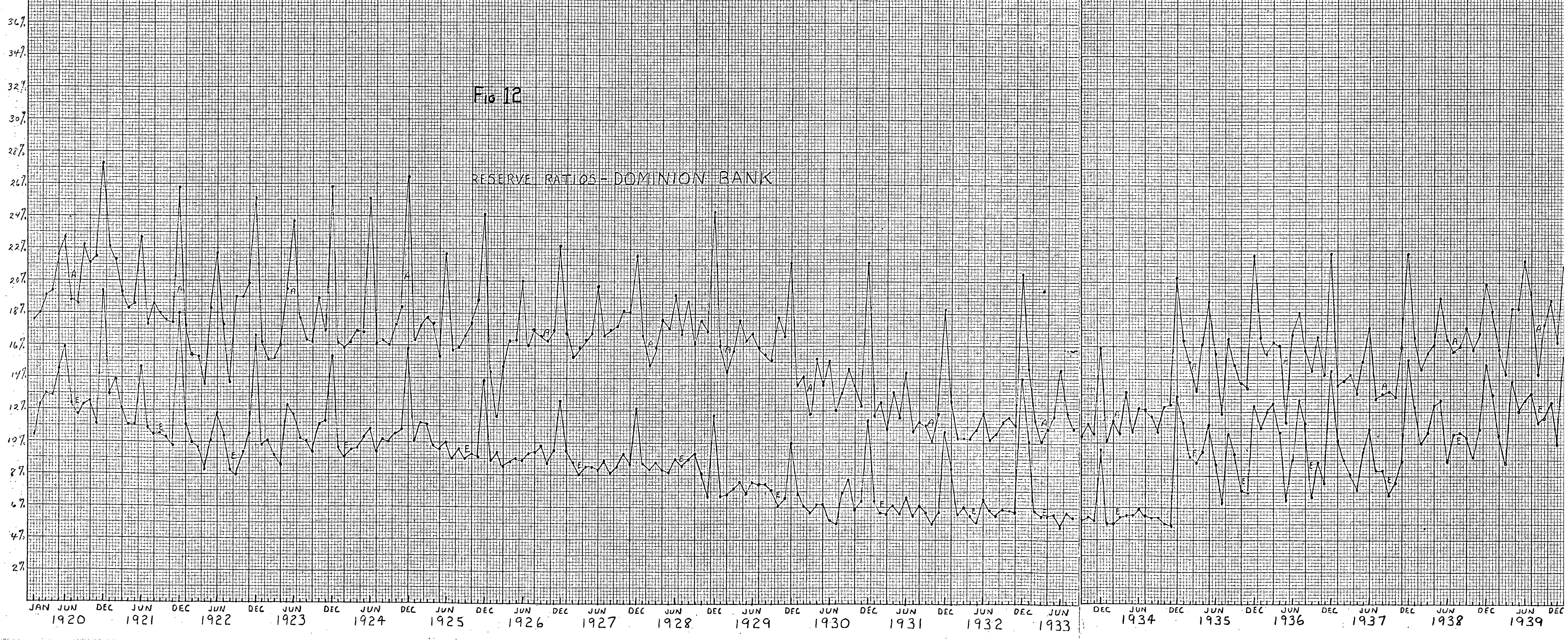

RESERVE RATIOS - DOMINION BANK
36%
34%
32%
30%
28%
26%
24%
22%
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
A
E
JAN JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN
1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933
DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC
1934 1935 1936 1937 1938 1939

Fig 13

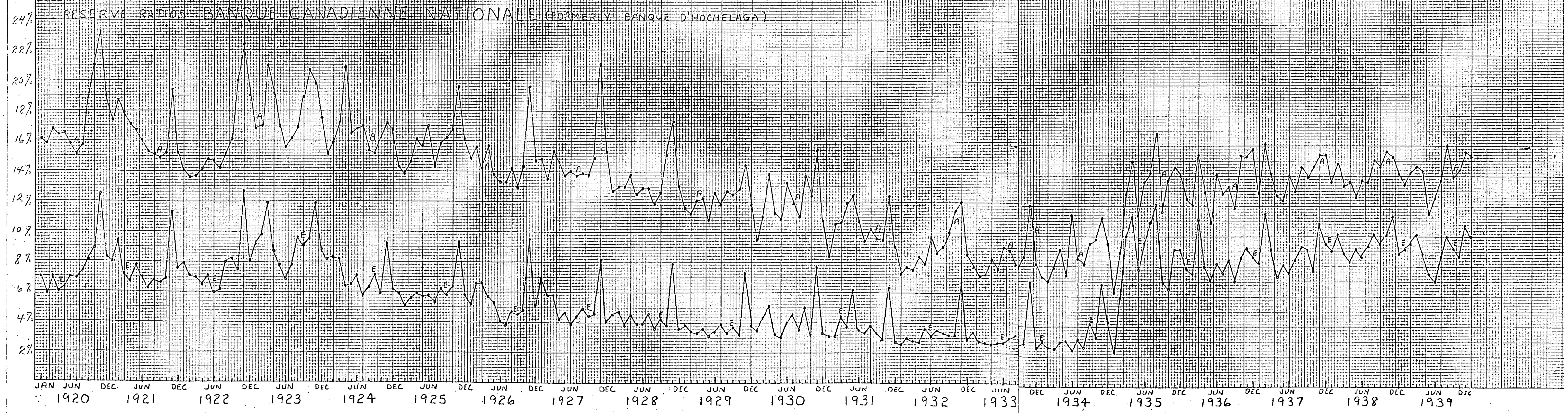
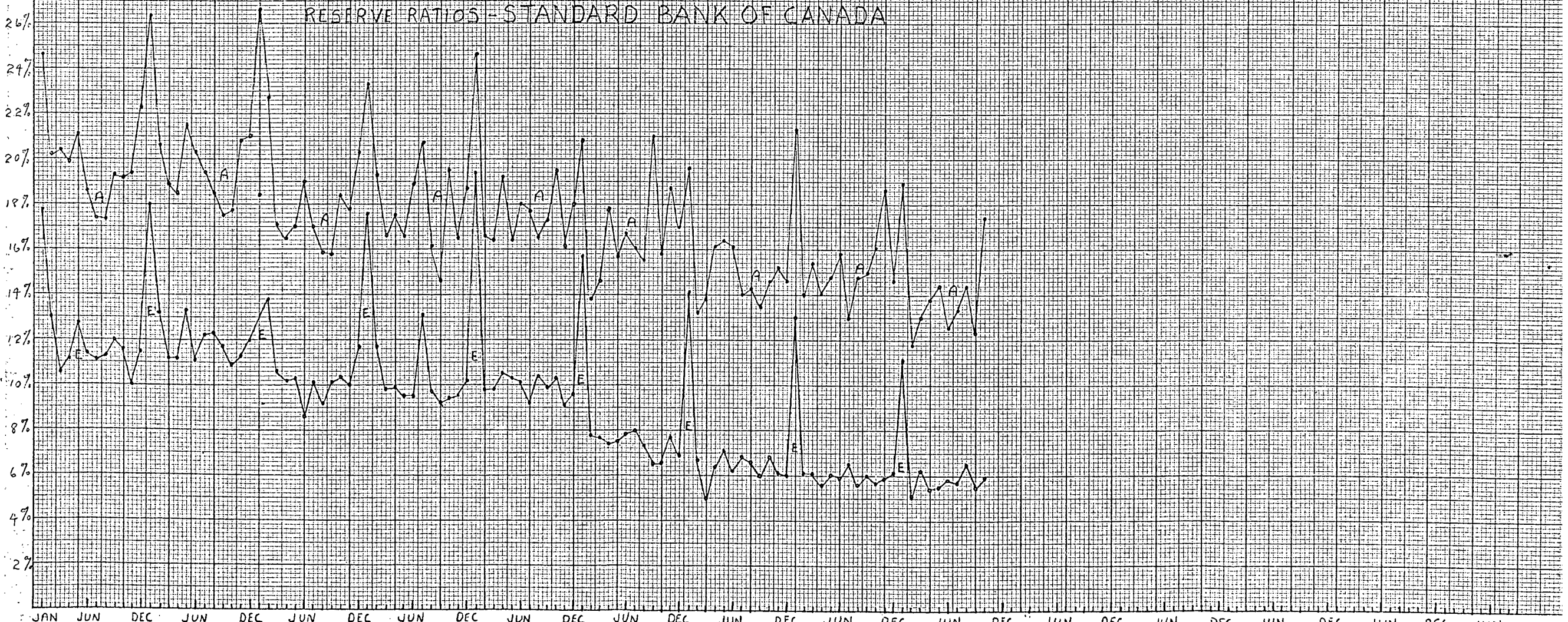

RESERVE RATIOS - BANQUE CANADIENNE NATIONALE (FORMERLY BANQUE D'HOCHELAGA)
36%
34%
32%
30%
28%
26%
24%
22%
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
A
E
JAN JUN DEC
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939

FIG 15

RESERVE RATIOS - STANDARD BANK OF CANADA



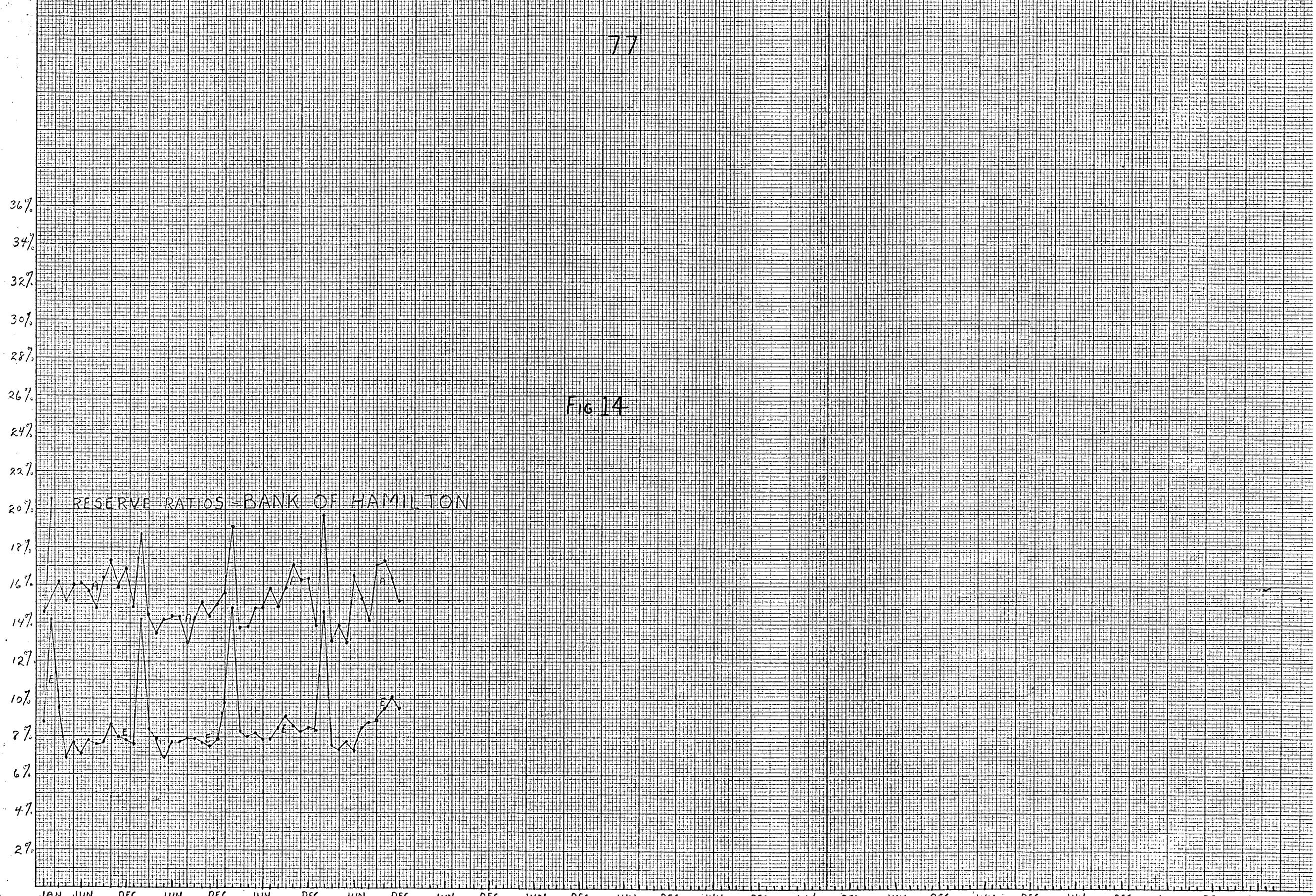

RESERVE RATIOS - BANK OF HAMILTON
36%
34%
32%
30%
28%
26%
24%
22%
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
JAN JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN
1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933

Fig 14

Fig 16

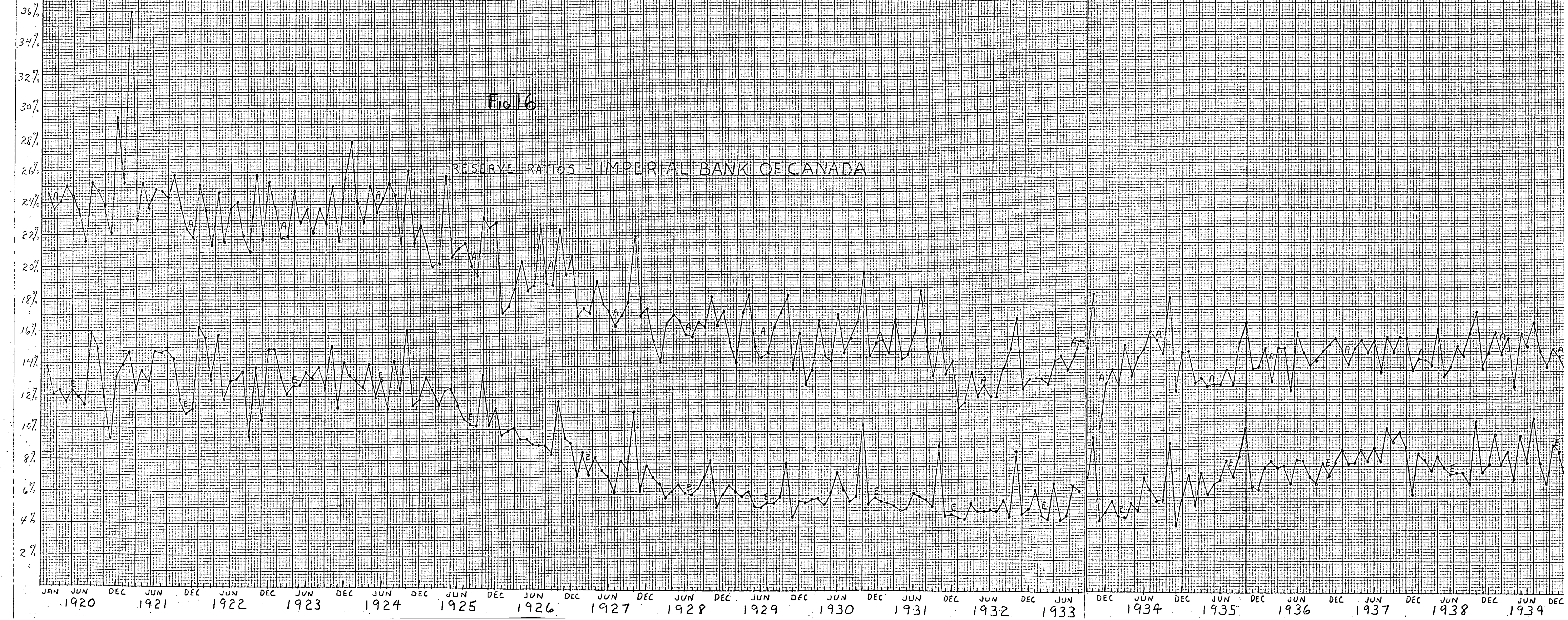

RESERVE RATIOS - IMPERIAL BANK OF CANADA
36%
34%
32%
30%
28%
26%
24%
22%
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
A
E
JAN JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN
1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933
DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC
1934 1935 1936 1937 1938 1939

FIG 17

RESERVE RATIOS - HOME BANK OF CANADA

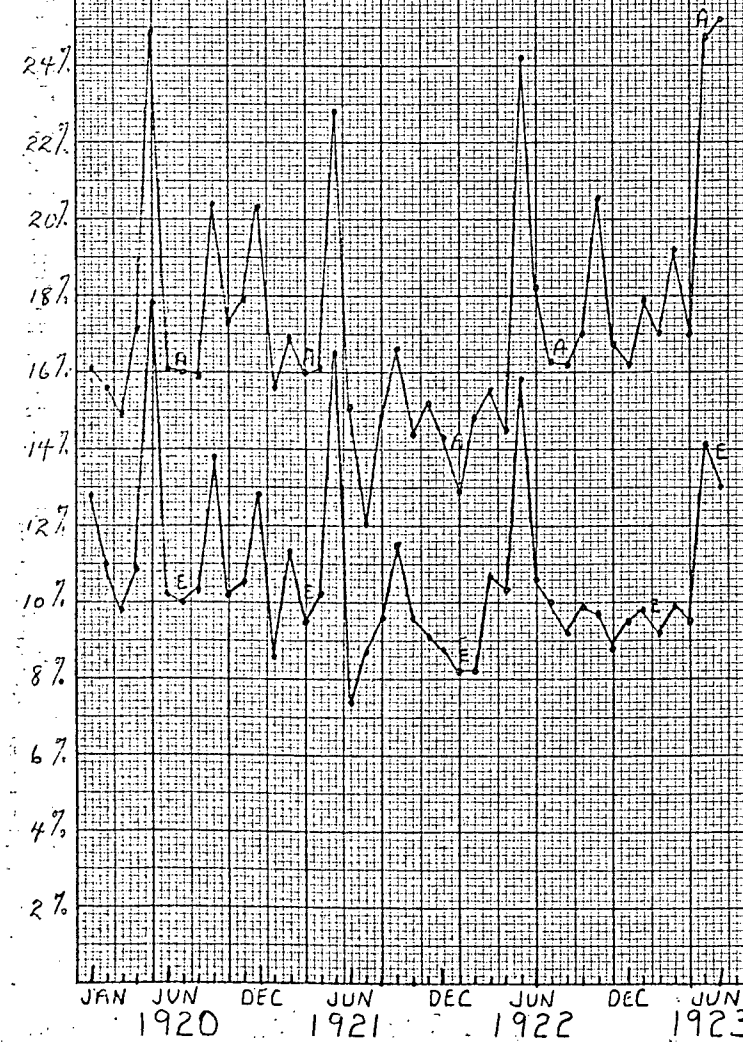


Fig 19

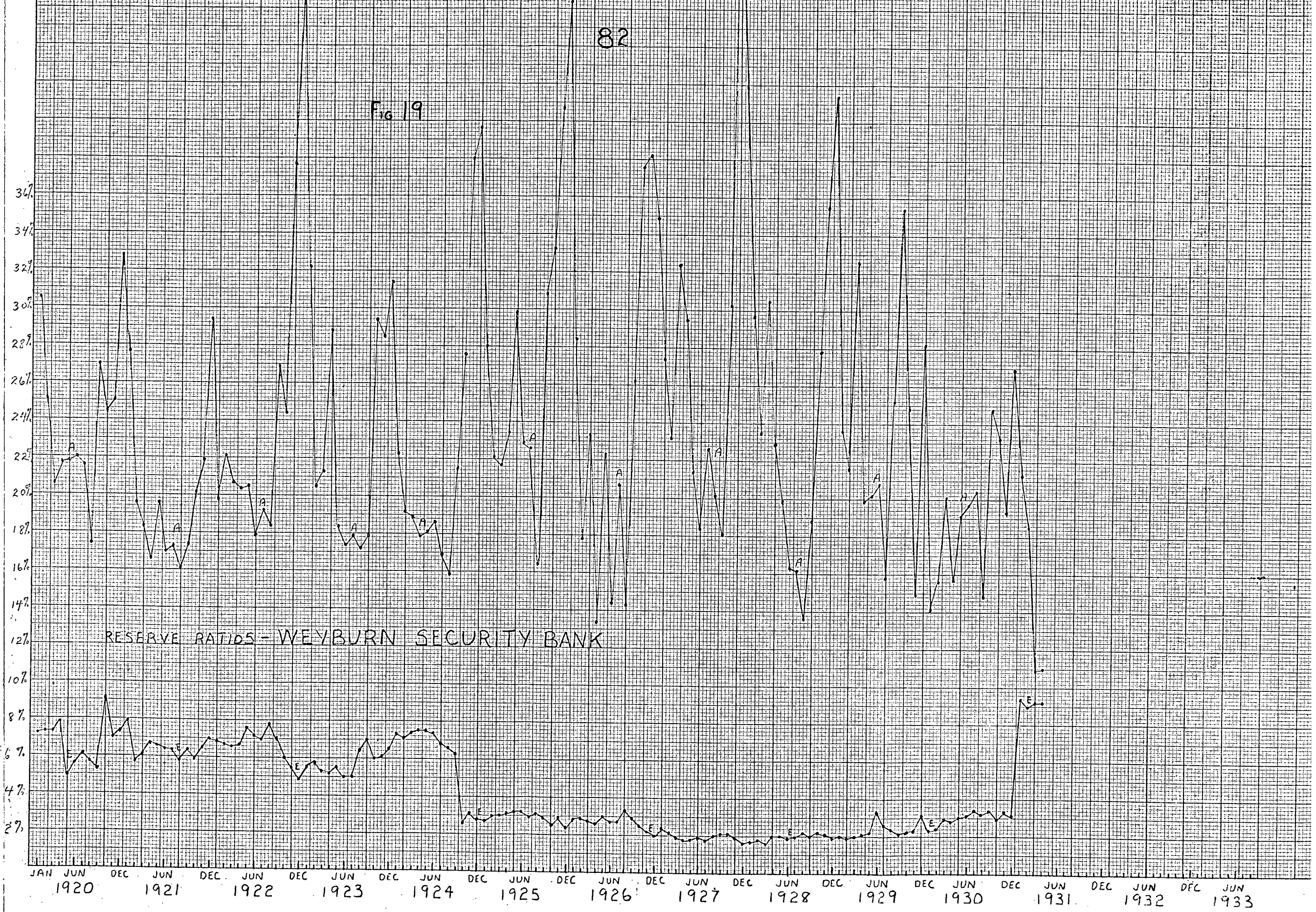
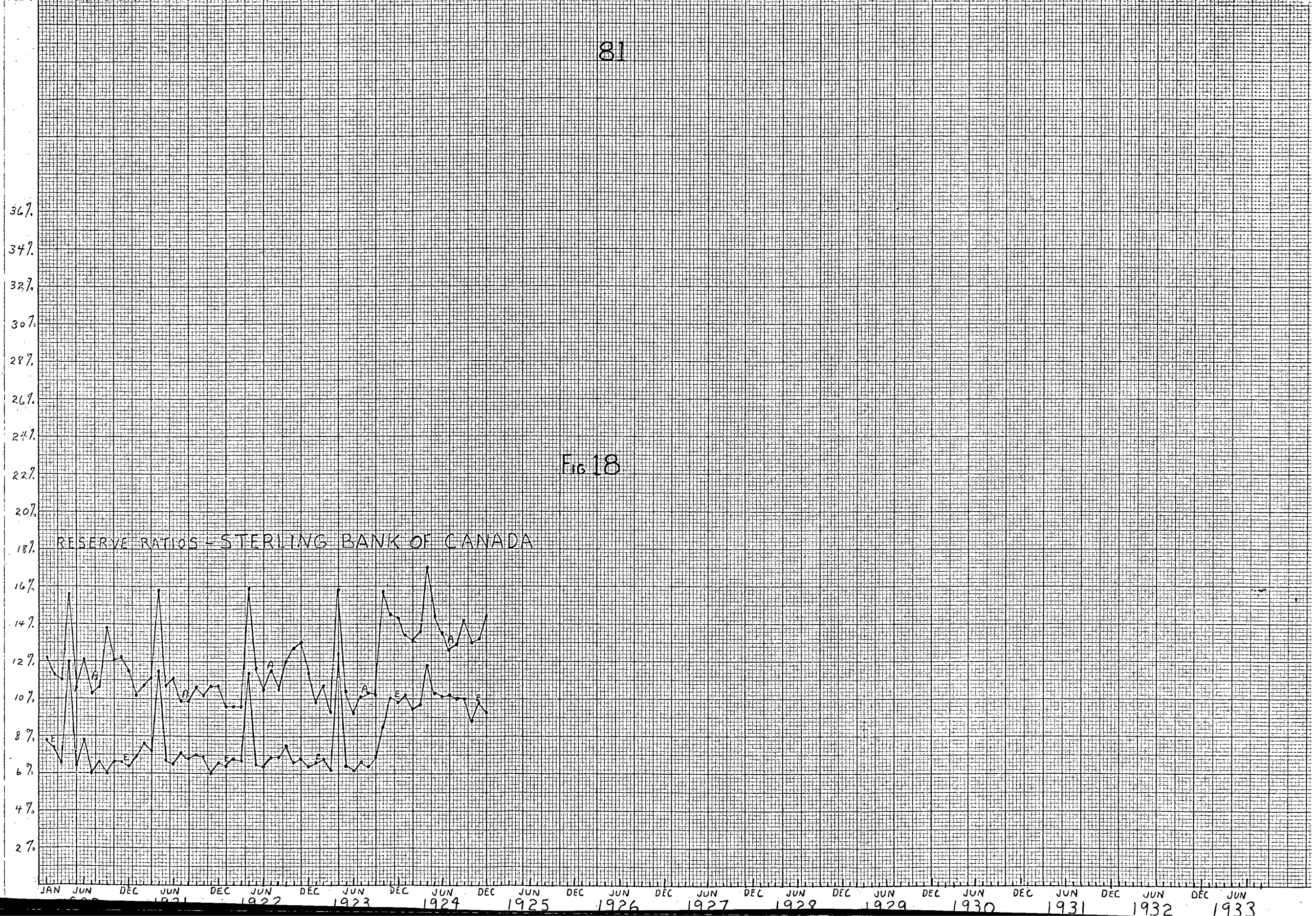

36%
34%
32%
30%
28%
26%
24%
22%
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
RESERVE RATIOS - WEYBURN SECURITY BANK
JAN JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN DEC JUN
1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933

Fig 18


RESERVE RATIOS - STERLING BANK OF CANADA
36%
34%
32%
30%
28%
26%
24%
22%
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
JAN
JUN
DEC
JUN
DEC
JUN
DEC
JUN
DEC
JUN
DEC
JUN
DEC
JUN
DEC
JUN
DEC
JUN
DEC
JUN
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DEC
JUN
DEC
JUN
DEC
JUN
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933

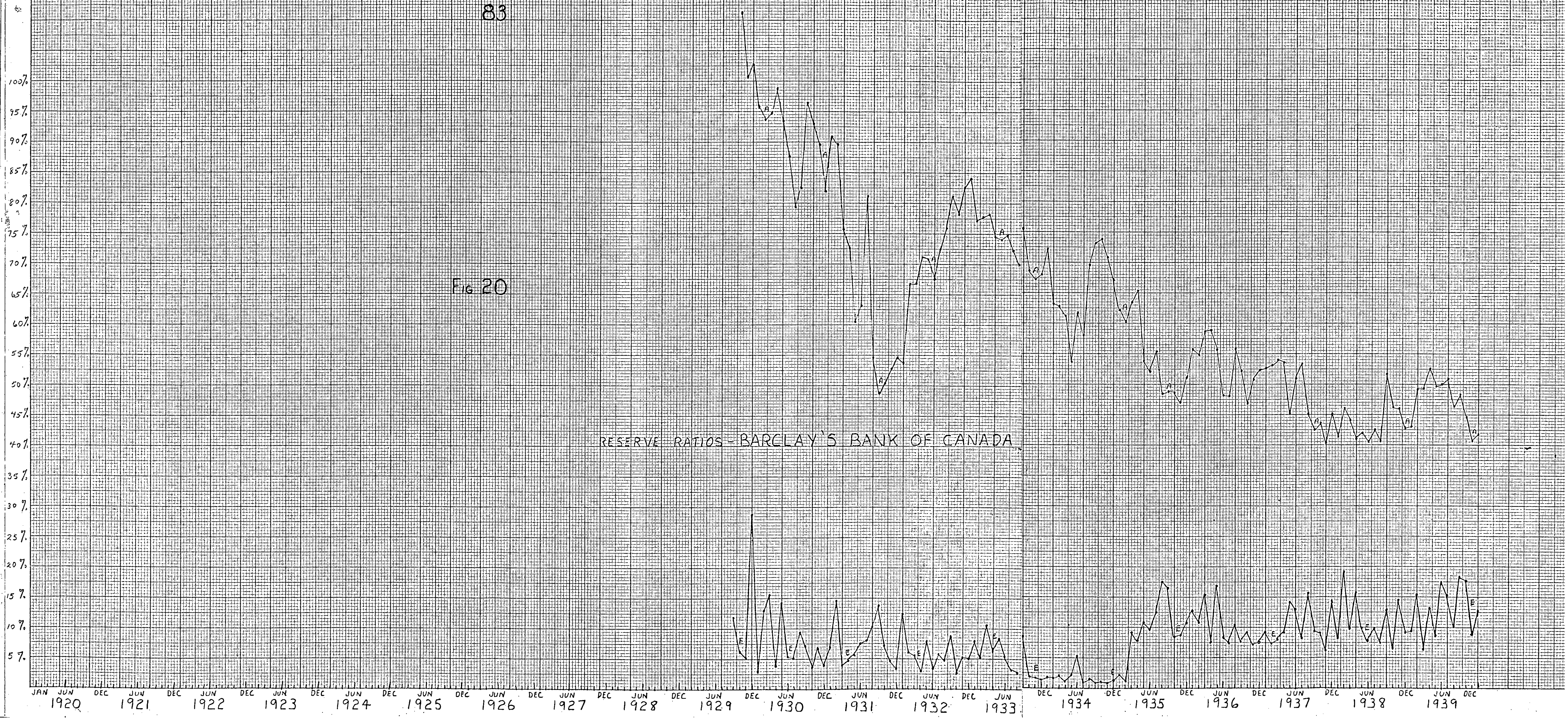

Fig 20

RESERVE RATIOS - BARCLAY'S BANK OF CANADA

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