1973

Money
C

DEPARTMENT OF ECONOMICS
UNIVERSITY OF CALIFORNIA, DAVIS

WORKING PAPER SERIES

THE EXPLANATION OF EXCESS RESERVES IN THE 1930'S
A CROSS SECTION STUDY

by

Thomas Mayer

Working Paper Series
No. 22

February 1973

Department of Economics
University of California
Davis, California

The Explanation of Excess Reserves in the 1930's

A Cross Section Study

Thomas Mayer*

Until fairly recently the commonly accepted view of monetary policy during the Great Depression was that easy money was tried and found wanting. A prime piece of evidence cited to support this view is the great volume of excess reserves after 1933. An eased Federal Reserve policy appeared as merely pushing on a piece of string. As E. A. Goldenweiser (1951, p. 175), a former Director of the Federal Reserve Board's Division of Research and Statistics, put it: "the Federal Reserve did all it could through easy credit conditions from 1933 to 1936 to help arrest the depression.... However, monetary policy was not able to reverse the trend."

This prevailing interpretation of the 1930's, which for want of a better term, I will call the Keynesian explanation, was radically challenged in 1963 by Friedman and Schwartz (F-S) who argued that monetary policy was tight rather than easy; that the severity of the Great Depression is a monument to the strength, and not to the weakness, of monetary policy. In their view the so-called excess reserves of banks were excess only in a legal, and not in an economic, sense. Having seen that the government was unable or unwilling to stop bank failures in the period 1930-1933 banks wanted to protect themselves by holding a large cushion of extra reserves.

---

* Professor of Economics, University of California, Davis. I am indebted for very capable research assistance and programming to Thomas Bible and John Snider.

The explanation of the high excess reserve holdings is crucial for the interpretation of the 1930's. If banks did hold these reserves only because they feared runs then the Federal Reserve is to blame for not creating more reserves. On the other hand, if these excess reserves were held because of an inadequate demand for bank loans, then the F-S analysis is clearly wrong.

THE TEST

This paper presents a test of these two opposing views of excess reserves. Unlike many previous tests it is based, not on time series data, but on cross section data. Specifically, I am looking at differences in the excess reserves of member banks in various Federal Reserve Districts. Table 1, which gives excess reserves as a percent of total reserves, shows that these differences were substantial. For country banks in 1934 the highest excess reserve ratio (Chicago District) was 182 percent of the lowest ratio (Philadelphia District). For Reserve City banks, even if one excludes New York which had an abnormally low ratio, the corresponding figure is 248 percent.[1] Presumably the strength of whatever factors caused banks to accumulate excess reserves differed among various Districts.[2] Hence, an explanation of the difference in the excess reserve ratios should tell us why banks kept substantial excess reserves at all. Using data on Federal Reserve Districts means, of course, working with a very small sample, and not

---

1. Throughout this paper I am using the term "reserve city banks" in its strict sense, i.e. excluding "central reserve city banks."

2. But another possibility, discussed briefly below, is that differences in excess reserves resulted from differences in the willingness of various Federal Reserve banks to grant discounts and advances.

surprisingly many coefficients are therefore not significant. But, as will be shown below, for country banks enough coefficients are significant so that meaningful results emerge.[1] Admittedly, with such a small sample the assumption of normalcy made in the significance tests may not be valid.

The main problem in using these data to test the two rival theories is to find measurable variables which fairly represent these two theories. The strategic variable for the Keynesian theory, the supply of earning assets to banks, is not, of course, directly observable. But since the securities market is largely national rather than regional it is only, or almost only, the supply of loans which in the Keynesian view can account for differences in the excess reserve ratios in various Federal Reserve Districts. And while the demand for loans is also not directly observable, it is presumably correlated with income. To be sure, the correlation is not perfect. Differences in the industrial structure of various Districts may cause differences in the amount of bank loans per dollar of income. However, this problem is ameliorated by the fact that I am looking at changes, rather than levels, of income. Hence, instead of assuming that the volume of bank loans per dollar of income is the same in all Districts, I am merely assuming that this relationship either did not change over the period covered, or else changed in the same proportion in the various Districts.

Another problem is created by the fact that bank loans need not originate in the District in which they generate income. A large firm may borrow working capital from a bank outside its own District. And for plant and equipment loans the situation is even worse since investment raises income where the

---

1. Unfortunately, it is not possible to switch to a larger sample by working with state data rather than with Federal Reserve District data because excess reserves for this period cannot be calculated on a state basis.

capital goods are produced. In the case of equipment, this may well be a different District than the one the lending bank is located in. However, since term loans, and hence loans for fixed equipment, were much less prominent in the 1930's than they are now, this difficulty is probably not of great importance.

But, all in all, the fact that large firms can readily borrow outside their Districts, and that therefore large banks which are patronized by large firms can lend more readily outside their Districts than small banks can, suggests that the District's income change is a much better measure of loan demand for country banks than for reserve city banks. Hence, one would expect the income change variables to show up more strongly in regressions for country banks than for reserve city banks.

An additional difficulty which arises is that banks may have treated income changes as a measure of the risk of bank failures.[1] If so, then my income variable belongs to the F-S theory rather than the Keynesian hypothesis. But while this consideration cannot be dismissed completely, it is greatly weakened by the fact that the correlation between income changes and bank failures is very low in these data so that banks had little justification for using income changes as a proxy for bank failures. Moreover, bank failures resulted primarily from runs on banks, and runs are not closely connected to income changes. To be sure, banks may have used income change

---

1. I am indebted for this point to Mr. Robert Carter.

as a measure of the soundness of the assets offered to them, but such a use of income change as a risk measure fits the Keynesian rather than the F-S hypothesis in the sense that it focuses on the absence of "sound" borrowers. (Admittedly, however, it does not provide any evidence supporting the Keynesian view that money was easy.) It is therefore probably legitimate to treat income changes as a Keynesian rather than a F-S variable. However, the possibility that income change may, in small part, also be a proxy for bank failure suggests that if the income variable does perform slightly better than the F-S variable I used, one should not attach any importance to such a slight superiority.

Another problem that arises is that excess reserves are not uniquely related to the bank's loan opportunities. A bank faced with a low demand for loans need not hold excess reserves, but can buy securities instead. One might therefore argue that irrespective of the loan demand in their Districts banks should hold the same excess reserve ratios. But this argument is not convincing. Banks have a choice between four types of assets -- loans, securities, excess reserves, and miscellaneous assets. Given declining marginal productivities for each of these assets, one would expect a bank which faces a falling off of its loan demand to increase its holding of all other assets. To be sure, the cross elasticity between loans and securities may be much higher than the cross elasticity between loans and excess reserves so that a decline in loan demand may cause virtually no increase in excess reserves. This may, but need not, be the case. The proper procedure is therefore not to make an a priori judgment about cross elasticities but to include an income variable in the regression and to see what happens.

The income variables I used represent the change rather than the level of income. My Keynesian theory therefore implies that if income fell (rose) more in District A than in District B then the excess reserve ratio was higher (lower) in District A than in District B.[1] There are two such income change variables. One is the change in income from the previous year, the other is the income decline since 1929.

Federal Reserve District lines do not follow state lines but in many cases include parts of states in two Districts. Hence, I had to estimate income in various Districts. To do so I took personal income in each state,[2] and divided the split states between Districts in proportion to a measure of retail sales in 1933 for each county.[3] Presumably, this rather crude procedure created some error, and hence results in some bias against the Keynesian explanation.

For the Friedman-Schwartz explanation the danger of bank runs is the obvious, but unmeasurable, variable. I substituted past failures for it. The assumption that banks looked at previous bank failures in their Districts in assessing their own chances of failure is, of course, only a make-shift one. As in the case of the Keynesian theory, the procedure used is more plausible

---

1. Juxtaposing the first difference of income and the level of excess reserves is legitimate because the normal level of excess reserves is trivial compared to what it was in 1934-1936. Hence, the level of excess reserves is essentially the same as the first difference of excess reserves.

2. See U.S. Department of Commerce, p. 140.

3. The specific measure of county income I used was "comparative retail sales possibilities" given in Rand-McNally Commercial Atlas and Marketing Guide.

for country banks than for reserve city banks. The specific failure variables I used are: (1) bank suspensions in 1933 as a percent of all District banks, (2) suspended banks 1930-1933 as a percent of all banks in 1933, (3) deposits in suspended banks in 1933 as a percent of all bank deposits, and (4) deposits in suspended banks cumulative 1930-1933 as a percent of total bank deposits in 1933.[1] The use of four failure variables and only two income variables is, of course, open to the objection that this biases the results against the Keynesian theory. But this objection is not valid, because all of these failure variables may be worse representations of the F-S explanation than the two income variables are of the Keynesian theory. Indeed, one might argue that if it takes four variables to represent the former fairly, then, since most of my tests use only a single failure variable, my tests are biased against the F-S position. (However, as discussed below, I did run one regression using all four failure variables.)

The basic assumption that the excess reserves of country banks, and to a lesser extent of city banks, were affected by income changes and bank failures within the bank's own District is, of course, open to challenge. Hence, if it should turn out that either of the two variables is not significant in explaining differences in excess reserves this cannot be treated as a convincing disconfirmation of either the Keynesian or F-S explanation. On

---

1. The data come from Board of Governors, Federal Reserve System, (1943, pp. 690-910), (1933 and 1935, pp. 207, 208, 209, 214, 216 and 176, 177); Member Bank Call Reports (June 1930-1933, p. 8).

the other hand, if the income or failure variables do explain excess reserve holdings then my procedure of using income change and past failures within the District is vindicated, particularly if the regressions explain a substantial part of the variance in excess reserves.

In addition to the variables just discussed the regressions also include structural variables to take account of differences among banks in various Districts. For country banks these structural variables are the ratio of time deposits to total deposits and the average size of banks as measured by deposits. For reserve city banks there is also a third variable, the ratio of interbank deposits to total deposits. Originally I included these structural variables only to hold them constant, and hence to isolate the effect of the income and failures variables. But as is discussed below, these structural variables can be interpreted on the basis of the two rival explanations.

The variables listed above were used in regressions explaining the excess reserve ratio (i.e. excess reserves as a percent of total reserves). I ran separate regressions for country banks and for reserve city banks for each of the three years 1934-1936, as well as pooled regressions for all the years jointly. (These pooled regressions included dummy variables for the years.) Since even in the case of country banks the New York District might be unusual, there are separate regressions including and excluding the New York District. For reserve city banks, the New York District was clearly unusual. Its excess reserve ratio was so much below the average that its inclusion in the regressions would give it an inordinate influence on the coefficients. In the individual year regressions I therefore excluded the New York District.

RESULTS

Before comparing the income and failure variables, one has to select the best variable of each of these two sets. I therefore regressed the excess reserve ratio on each of six variables mentioned above, as well as on the following combinations of variables: (1) the two income variables, (2) failures 1933 and failures 1930-1933, (3) failures 1933 and deposits in suspended banks 1933, (4) failures 1930-1933 and deposits in suspended banks 1930-1933. Fortunately, the results of these regressions were clear-cut. For country banks income change since 1929 was clearly superior to income change over the previous year. In fact, in many cases the one year income change variable had the wrong sign.[1] On the other hand, for reserve city banks, the one year income change variable is superior. While the one year income change variable has the wrong sign in only one regression (1935), income change since 1929 has the wrong sign in every regression.[2] The best representative of the Keynesian theory is therefore income change since 1929 for country banks, and the one year income change for reserve city banks. The use of different variables for country banks and for reserve city banks is, of course, open to challenge, but, it does not really matter, because, as discussed below, neither variable performed adequately for reserve city banks. For the F-S hypothesis the percent of banks failing in 1933 was clearly the best variable for both country and reserve city banks.

---

1. Since, according to the Keynesian hypothesis, the pile-up of excess reserves is explained by the decline in income reducing loan demand, the regression coefficient of excess reserves on income change should be negative. By hindsight it is easy to see why the one year income change coefficient has the wrong sign. Suppose that the demand for a District's exports increases. This raises its income and also generates an inflow of reserves. Insofar as banks do not adjust fully to this reserve inflow within a year a positive correlation between income change and excess reserves results. For income change since 1929 banks had a long enough time to adjust to reserve inflows so that this distortion is less serious.

2. Fortunately, all of these coefficients with the wrong sign are less than one standard error.

Having decided which variables to use as the representatives of the two rival hypotheses, the obvious next step is to regress the excess reserve ratio on each of them. The results of this are shown in Table 2. This Table gives the coefficients of determination (corrected for degrees of freedom), the t values, and the beta coefficients. The latter are used instead of the regression coefficients. Since regression coefficients depend upon the units in which the variables are expressed -- quite arbitrary units in this case -- they cannot tell us which variable is the more important. The beta coefficients, on the other hand, are free of units and measure the effect of "equally likely" changes in the independent variables upon the dependent variable.[1] They are therefore an excellent measure of the relative importance of income change (denoted by Y in Table 2) and failures (F) in explaining the excess reserve ratio.

For country banks in the majority of cases $\bar{R}^2$ is quite satisfactory for a cross-section test. Looking first at the regressions including New York for 1934, the two variables perform about equally well, except perhaps on the beta coefficient criterion where income is a little bit better. For 1935, on the other hand, failures do better, but neither regression has a high $\bar{R}^2$ and the t value of the failure coefficient misses significance (though not by very much) even at the 10 percent level. For 1936 income is superior to failures. In the regressions for all three years pooled the $\bar{R}^2$ is about the same in the two regressions, but the income regression has a considerably higher beta coefficient. The exclusion

---

1. The beta coefficient is equal to the regression coefficient multiplied by the ratio of the standard deviation of the independent variable to the standard deviation of the dependent variable. See Arthur Goldberger, pp. 197-198.

of New York does little to change these results. The only noticeable difference is that in the pooled regressions the failure variable has a somewhat higher $\bar{R}^2$ and also a higher $\underline{t}$ value than does the income variable. But since both variables are significant at the 1 percent level this difference in $\underline{t}$ values has little meaning.[1]

The story is quite different for reserve city banks. Here both the income and failure regressions have, with one exception, quite low $\bar{R}^2$'s, and only one of the $\underline{t}$ values is significant. It is not surprising that neither hypothesis explains the excess reserves of city banks well. As pointed out above, for reserve city banks the income and the failure variables are not as good measures for the two hypotheses as is the case for country banks. Their lack of success in explaining excess reserves of reserve city banks therefore does not indicate that reserve city banks had other motives than did country banks in accumulating excess reserves. It is more plausibly interpreted as an indication that these banks tended to lend to firms outside their Districts, and that they did not treat bank failure in their own Districts as indicators of their own need for reserves.[2]

Having looked at separate regressions for each of the two failure variables the obvious next step is to put the two variables into the same regression to see if either one can "kick-out" the other. As Table 3 shows

---

1. In calculating the significance levels for the pooled regressions I treated the three annual observations for each District as independent observations. Actually these successive observations are probably not fully independent.

2. The bank failure figure I used refers to all banks in the District. Since it was predominantly small banks which failed, reserve city banks (which tended to be much larger than country banks) had little reason to consider the failure rate of banks in their own District as an indication of their own risk of failure.

this does not occur. On the contrary, the two variables coexist peacefully. This is not surprising since their intercorrelation is low.[1] The verdict on their relative performance is similar to what it was in Table 2. Including New York, the two t values are nearly the same in 1934. In 1935 the failure variable has the higher t value, but since even that t value is below unity, this superiority is hardly impressive. On the other hand, in 1936, as well as for all the years pooled, the income variable has the higher t value. On the beta value criterion the income variable is superior except in 1935, a year, however, in which both t values are so low that the performance of both variables may well be due to sampling error.

Excluding New York again changes the story very little. However, in the pooled regressions the t value of the failure variable exceeds that of the income variable. But the more meaningful beta coefficient is again higher for income than for failures.

The overall picture which emerges from Tables 2 and 3 is therefore that both income change and previous bank failures were responsible for the high level of excess reserves. And the importance of these two factors is approximately equal. While the income variable is slightly superior, it is too slight a superiority to be really meaningful given the crudity

---

1. The correlation coefficient (not corrected for degrees of freedom) between the income and failure variables for country banks (including New York) is -.298 for 1934, -.296 for 1935, -.230 for 1936 and -.153 for the pooled data.

of my measures.[1]

In addition to the income and failure variables the regressions include structural variables. These are (1) the ratio of time deposits to total deposits, (2) bank size, and (3) for city banks, interbank deposits as a percent of total deposits. Although these variables were originally introduced merely to isolate the effect of the income and failure variables, it turns out that they are directly related to the hypotheses being tested. Consider first bank size. The Keynesian interpretation suggests that the excess reserve ratio should be negatively related to bank size. The larger banks enjoy economies of scale in security purchases, and hence they are less discouraged from investing by low interest rates. The F-S hypothesis has the same implication here. Since large banks had experienced a lower failure rate than small banks, large banks had less of an incentive to keep excess reserves.

The time deposit ratio creates a more complex problem. It fits well into the F-S hypothesis.[2] If banks are worried about runs, then the relative size of the reserves they <u>want</u> to hold against their demand deposits and time deposits may well differ from the relative size of the legally

---

1. It might be objected that this conclusion is biased against the F-S hypothesis since it is based on a comparison of one failure variable -- i.e. one-fourth of the failure variables -- with one of the two income variables -- i.e. half the income variables. I therefore ran another regression for the pooled country banks including all the failure variables. Despite the inclusion of all the failure variables the income variable was significant at the 10 percent level. The t values and betas (in that order) for different variables are: income change since 1929, -1.68, -.499; failures in 1933, 1.06, .454; cumulative failures 1930-1933, -.59, -.278; deposits in suspended banks, -.05, -.024; cumulative deposits in suspended banks 1930-1933, .19, .101.

2. This is particularly so in George Morrison's version of the F-S approach since Morrison argued in detail that banks treated their reserve influx as only temporary.

required reserve ratios. Hence, they may hold different ratios of excess reserves against these two types of deposits. However, since it is not possible to tell a priori whether banks felt that the legal reserve ratio was less adequate for demand deposits or for time deposits, one cannot predict what the sign of the coefficient should be, or even that it should be significant.

The Keynesian hypothesis implies that the time deposit variable per se should not be significant. If banks hold excess reserves only because of a lack of investment outlets, then the composition of their deposits should not affect their excess reserve ratio. Hence a significant coefficient for the time deposit ratio seems to disconfirm the liquidity trap. But the problem is more complex. The supply of loan opportunities was probably greater for banks with a high time deposit ratio. Such banks were presumably oriented more towards consumer banking than were banks with a low time deposit ratio, and the demand for bank credit by consumers appears to have grown relative to demand for bank loans by business. While unfortunately complete data on consumer loans of banks are not available for this period, the limited available data show that consumer loans of banks, while still very small, were rising rapidly -- in sharp contrast to total bank loans.[1] What is much more important is that the much bigger real estate loans of banks rose relative to other bank loans in the early and mid 1930's. Hence, the statistical significance of the time deposit

---

1. See Rolf Nugent, p. 26; and John Chapman and Associates, p. 31.

ratio can be explained by the Keynesian hypothesis as a result of banks with a high time deposit ratio experiencing greater loan demand than other banks.[1]

The final structural variable, the interbank deposit ratio, fits into the F-S hypothesis in a way similar to the time deposit ratio. It would fit into the Keynesian theory only if it should turn out that banks with a high ratio of interbank deposits experienced a relatively greater loan demand than did other banks. But there is no evidence that this was actually the case. Presumably any bank holding a significant volume of interbank deposits was largely a business oriented bank rather than a consumer oriented bank. (In a ranked regression of real estate loans as a percent of total loans on the interbank / deposit ratio for city banks in 1934, the correlation coefficient was significantly negative, at the 5 percent level, rather than positive. Hence, a significant coefficient for the interbank deposit ratio furnishes some, though perhaps not very strong, evidence against the liquidity trap.

Table 4 shows the results for bank size and the time deposit ratio. (Since these were always joined in the regressions by either the income variable, the failure variable, or by both of them, Table 4 shows three sets of regressions.) The size variable generally has the sign predicted by both hypotheses, but it is usually not significant. The time deposit ratio, on the other hand, does much better. It is significant much more frequently, despite the fact that I am using a two tailed test. Finally, the interbank deposit ratio, shown in Table 5, is significant for 1934 and for the pooled data.

---

1. For 1934 I ran ranked correlation / of real estate loans as a percent of total loans against the time deposit ratio. The correlation coefficient was positive and significant for both country banks (5 percent level) and city banks, excluding New York (10 percent level).

These results for the structural variables support the F-S, rather than the Keynesian, hypothesis. The common implications of both hypotheses with respect to bank size and the time deposit ratio are confirmed. In addition, the data strongly support the significance of the interbank deposits ratio which fits into the F-S hypothesis but not into the Keynesian hypothesis.

Thus, the structural variables -- unlike the comparison of the income and failure variables -- support the F-S hypothesis and reject the Keynesian hypothesis. What accounts for this difference? It is that the strictness of the Keynesian hypothesis differs in the two tests. In the first test the Keynesian hypothesis asserts merely that the demand for loans played a role in determining excess reserve holdings. It does not assert that only the demand for loans mattered. In the second test the Keynesian hypothesis can be interpreted in two different ways. A weak version -- a version which asserts that demand for loans mattered, but does not imply the existence of a bank liquidity trap -- is not disconfirmed by the significance of the interbank deposit ratio. On the other hand, a strict version which asserts the existence of a liquidity trap, is disconfirmed. Since the results of the first test supported the weak version of the Keynesian hypothesis, and -- due to the importance of the failure variable -- rejected the strong version, there is no disagreement between the two tests.

DIRECTION OF CAUSATION

Having found significant correlations for the variables suggested by both the F-S and the Keynesian explanations the next step is to investigate the direction of causation; is the excess reserve ratio the cause, or the effect, of the other variables?

There may be some reverse causation for the size variable. The higher the excess reserve ratio which banks wish to hold, the lower will be deposits in the District, and hence the lower will be the average size of banks which is measured by deposits. But bank size is a variable which, in any case, does not allow one to discriminate between the two hypotheses, so that this reverse causation is uninteresting. For the time deposit ratio reverse causation cannot explain the above findings because it operated in the wrong direction. Suppose that banks decide to raise their excess reserves. As they make fewer loans, demand deposits in the District fall, presumably more than time deposits do, and hence the time deposit ratio rises. Thus reverse causation implies a positive relation between the excess reserve ratio and the time deposit ratio whereas the observed relationship is negative. This suggests that the coefficient of the time deposit ratio may be downward biased. In case of the interbank deposit ratio it is hard to see what would generate reverse causation.

For the income variable the danger of reverse causation is also not large because it is the change in income since 1929. Since excess reserves did not rise significantly until 1933, and did not reach their subsequent substantial level until 1934, excess reserves had only a limited chance to affect the income variable, particularly in the regressions for 1934. In addition, for country banks in 1934, one can test the extent to which excess reserves took advantage of even this limited chance by regressing the increase in income 1933-1934 on the income change 1932-1933 and on the excess reserve ratio in 1934. What this regression does is to assume that the factors, other than excess reserves, which caused income to change from 1932 to 1933 were also operative in the 1933-1934 income change, and then

to see if the addition of the excess reserve ratio in 1934 helps to explain the 1933-1934 income change. And this regression shows that excess reserves in 1934 do not account for the income change. The reserve ratio had a trivial t value with a wrong sign.[1]

For bank failures the reverse causation effect is in the direction actually found. If banks decide to raise their excess reserve ratio this causes a contraction of bank deposits and, like a currency drain, may cause some banks to fail. But, the failure variable used is bank failures in 1933, and at that time excess reserves were still fairly moderate. In 1933 excess reserves of country member banks averaged only about $100 million more than they did in 1929, which represents only about 1-1/4 percent of all country bank deposits. Hence, the reverse causation effect appears to be rather small.[2]

This still leaves one causation problem, the interrelation of the income and failure variables. One could certainly argue that bank failures are not the proper exogenous variable, that instead, they merely reflect the drop in income, so that the fundamental cause of high excess reserves is wholly Keynesian. But the correlation (within the same year) between the income variable (income change since 1929) and the failure variable (percent of banks failing in 1933) is so low in these data that the income variable "explains" generally less than 10 percent of the failure variable.

---

1. $\bar{R}^2$ was .831. There may appear to be a danger of infinite regress in this argument since the 1932-1933 income change could itself depend upon the excess reserve ratio. But this is not a real danger because excess reserves were quite small until March 1933, and compared to 1934, were low for the rest of the year too.

2. It may seem that there is an additional effect: the higher the excess reserve holdings of a bank, the lower its chance of failure. But my failure variable relates to 1933.

DISCOUNT WINDOW ADMINISTRATION

One variable which should have been included, but due to a lack of adequate data could not be, is the administration of the discount window at various Federal Reserve Banks. Clark Warburton (p. 320) has argued that as bank failures became common the Federal Reserve Banks were very reluctant to grant discount and advances. Such an experience would give banks an incentive to hold excess reserves. Insofar as this policy was uniform in various Districts this would not matter for my test, but it is certainly possible that the degree of reluctance to lend varied among Federal Reserve Banks. Unfortunately, no adequate data on this are available. Only data on actual borrowings from the Federal Reserve Banks are published, and they are an extremely poor measure of Federal Reserve tightness. If borrowings in a District are low this need not indicate an unwillingness of the Federal Reserve to lend, but my just as easily indicate a lack of demand. In fact, one could well argue that a high volume of borrowing is likely to be a sign that a Federal Reserve Bank was unusually tight rather than easy. If a certain Federal Reserve Bank made a particularly large volume of loans to its member banks it may very well have felt reluctant to lend more, and hence may have been tighter than other Federal Reserve Banks which had a smaller loan volume outstanding. Thus, the volume of Federal Reserve Bank loans to member banks can hardly be treated as a reliable proxy for the tightness of Federal Reserve Banks, and

hence as an indicator of the utility of excess reserves to banks.[1]

Nonetheless, for what it is worth, I regressed the excess reserve ratio of country banks in 1934 on borrowings from the Federal Reserve in 1930-1933 as a percent of total reserves.[2] The $\bar{R}^2$ was trivial, 0.06, and the t value of the regression coefficient just missed significance at the 10 percent level.[3] In any case, even if the willingness of Federal Reserve banks to lend would turn out to be a significant factor, this would reinforce, rather than contradict, one of the results reached above, the (partial) validity of the F-S explanation. However, if Federal Reserve bank tightness would be a significant factor it could conceivably "kick-out" the income variable, thus rejecting the other above conclusion, the (partial) validity of the Keynesian interpretation. In the absence of a good measure of Federal Reserve Bank tightness it is not possible to reject this possibility completely. However, when I added the income variable to the regression just discussed, the t value of the borrowings coefficient became trivial (0.2), thus suggesting that income is not just a proxy for borrowing from the Federal Reserve. Admittedly, a better measure of Federal Reserve Bank tightness might give a different result; this possibility cannot be evaluated.

---

1. The ratio of loans applied for to loans granted would be a much better variable, but no data on loan applications have been published. Such data may, however, be available in the archives of Federal Reserve Banks. But even if such data should be available they would be open to the criticism that the Federal Reserve may simply discourage banks from applying for loans instead of turning down loan applications actually made. (Cf. Charles Whittlesey, pp. 210-211.)

2. I used borrowings 1930-1933 rather than borrowings in 1934 since borrowings in 1934 were quite small. Using the experience of banks 1930-1933 to explain their excess reserve holdings in 1934 is in line with the F-S analysis. Since borrowings are such a poor measure I did not experiment with other possible variants such as using borrowings only in 1933.

3. The lowness of $\bar{R}^2$ compared to the t value is due to the correction of $\bar{R}^2$ for degrees of freedom.

OTHER PRIMARY RESERVES

All of the above has dealt with the excess reserves problem as usually formulated. But it is not at all clear that the volume of excess reserves which member banks held at the Federal Reserve is the relevant variable. Banks can protect against runs by holding not only excess reserves, but also by holding vault cash and interbank deposits. Similarly, in the Keynesian interpretation, banks unable to buy earning assets may hold their surplus cash assets as either vault cash or as interbank deposits instead of as excess reserves. It is therefore worth seeing whether both hypotheses are able to explain what may be called "voluntary primary reserves," that is primary reserves (vault cash, reserves with the Federal Reserve and interbank deposits) minus required reserves.[1]

But neither the income variable nor the failure variable does well in regressions using voluntary reserves. Neither is significant with the correct sign. This does not mean that these regressions were unsuccessful and fail to explain voluntary primary reserves. As Table 6 shows, their $\bar{R}^2$'s are very high for a cross section test. But the explanatory power of these regressions comes from the structural variables. Since voluntary reserves are so well explained by the structural variables and since the sample is

---

1. However, to explain the decline in the money stock excess reserves are more relevant than voluntary reserves. If a bank increases its deposits in other banks it provides these banks with the means of raising their deposits.

very small it is not surprising that the income and failure variables performed so poorly.[1] And since the structural variables which dominate these regressions are consistent with both hypotheses neither one is damaged by these results for voluntary primary reserves.

CONCLUSION

Thus the results obtained by analyzing the distribution of excess reserves between Federal Reserve Districts show that neither the F-S explanation nor the Keynesian explanation are fully valid. Rather, both hypotheses are needed to explain the excess reserve ratio. More specifically, both explanations turned out to be of roughly equal importance. Admittedly, this more specific result depends upon the relative accuracy of the proxies used for each hypothesis. And both of these proxies are far from ideal. But since the coefficients of determination which were obtained for country banks with these proxies are usually high, it is unlikely that the use of better proxy variables would change this overall result very much and reestablish a monistic explanation of excess reserves.

But as far as policy implications are concerned the results are not "in between." They support Friedman and Schwartz. This is so because they strongly reject the extreme Keynesian idea of an absolute liquidity trap for banks. The significance of the failure variables, and to a lesser

---

1. And further, the (insignificant) incorrect sign of the failure variable can be explained by the plausible possibility that in Districts with high bank failures country banks were sometimes reluctant to entrust reserves to their city correspondents.

extent of the interbank deposit ratio, implies that had the Federal Reserve provided banks with additional reserves then deposits would have expanded. The Federal Reserve's conception at that time that excess reserves showed the impotence of an expansionary policy is therefore invalid.

It is worth noting that these results are not as far removed from either hypothesis as may appear at first. Thus Friedman and Schwartz allowed for the fact that some part of the increase in excess reserves was due to a shortage of earning assets available to banks, writing (pp. 453, 457):

> No doubt changes in the demand for loans and in the supply of investments, and the large increase in available reserves produced by the gold inflows...played a role in the shifts in asset composition.... The increased fraction of bank assets held in the form of cash assets, unlike the increased fraction held in short term investments, can be partly explained by supply considerations .... Rates of interest in general fell, which made cash assets more attractive compared to other assets.... Moreover, the shift in preferences depressed particulary the yields on short-term highly liquid assets, fostering still more the shift into cash.

To accomodate the results shown above this has to be changed only to the extent of allowing a larger role for the availability to banks of earning assets than F-S did. They followed the first sentence just quoted by writing (p. 453) "However, the major factor was not those but rather a shift in the liquidity preferences of commercial banks..." The evidence here cited suggests that both factors were of very roughly equal importance.

Although the liquidity trap notion is rejected by the above regressions the conflict with a more moderate Keynesian interpretation is also not so great. Thus Goldenweiser, who was cited above as claiming that the Federal Reserve did all it could to arrest the depression, also wrote (1949, p. 34):

> ...member banks had as much as $5 billion in excess of reserve requirements, but with depressed business conditions and a vivid memory of the banking troubles in 1930-1932, they were very reluctant to lend or to invest additional funds. At the same time the business community itself was cautious and potential borrowers with good credit standing were curtailing their operations.... (italics added)

This passage is also not so very far removed from the conclusions reached here.[1]

---

1. But Peter Frost in his important and thorough study of excess reserves comes to a somewhat different conclusion since he does not accept the F-S interpretation. (And an essentially similar thing applies to George Horwich's study of excess reserves.) This clearly conflicts with the results reached here. However, this conflict occurs only with respect to Frost's rejection of the F-S hypothesis; there is no conflict with Frost's general explanation of excess reserves by a wealth maximizing model. Brunner and Meltzer's rejection of the liquidity trap for banks is, of course, supported by the above results.

TABLE 1

EXCESS RESERVES AS PERCENT OF TOTAL RESERVES

	Country Banks			Reserve City Banks		
	1934	1935	1936	1934	1935	1936
Boston	41.1%	45.5%	40.8%	58.3%	60.2%	49.2%
New York	36.3	45.9	46.7	5.7	10.9	16.4
Philadelphia	34.0	37.4	40.3	41.1	46.1	45.6
Cleveland	45.9	49.5	48.0	45.3	50.7	47.2
Richmond	40.6	46.1	44.5	53.1	54.8	51.6
Atlanta	45.2	50.1	48.3	23.5	29.4	24.9
Chicago	61.9	61.2	59.2	39.7	49.8	45.7
St. Louis	48.3	52.8	49.2	50.2	51.6	40.7
Minneapolis	53.0	60.5	54.8	37.5	49.5	39.8
Kansas City	54.4	59.3	58.5	44.4	48.1	40.4
Dallas	58.1	60.6	61.2	52.6	41.5	34.9
San Francisco	36.3	39.1	37.3	29.1	33.8	31.9
Unweighted Mean	46.3	50.7	49.1	40.0	43.9	39.0

Source: Based on Board of Governors, Federal Reserve System, Banking and Monetary Statistics, pp. 928-939.

TABLE 2

RESULTS OF INCOME AND BANK FAILURES REGRESSIONS

	$\bar{R}^2$		t		Beta	
	Y	F	Y	F	Y	F
Including New York						
Country Banks						
1934	.593	.592	-2.30[b/]	2.28[b/]	-.511	.458
1935	.260	.346	- .54	1.17	-.141	.296
1936	.622	.366	-2.66[b/]	1.01	-.501	.251
Pooled	.567	.537	-3.22[a/]	2.75[a/]	-.650	.331
Reserve City Banks						
Pooled	.330	.334	.14	.39	.036	.067
Excluding New York						
Country Banks						
1934	.543	.534	-2.28[b/]	2.23[b/]	-.580	.500
1935	.234	.377	- .40	1.34	-.112	.348
1936	.640	.504	-2.30[b/]	1.41	-.453	.325
Pooled	.544	.573	-2.79[a/]	3.21[a/]	-.620	.386
Reserve City Banks						
1934	.647	.180	-3.10[b/]	-.86	-.740	-.280
1935	.000	.048	.39	.69	.133	.296
1936	.000	.000	-.63	.33	-.237	.154
Pooled	.303	.296	-.56	-.19	-.086	-.029

Note: Y is decline in income since 1929 for country banks and income change since previous year for reserve city banks; F is number of bank failures in 1933 as percent of all banks; -- denotes not computed. Other variables included in the regressions are the time deposit ratio, bank size and dummy variables for the years in the pooled regressions and for city banks, also the interbank deposit ratio.

a/ t significant at 1% level one tailed test.

b/ t significant at 5% level one tailed test.

TABLE 3

RESULTS OF "KICK-OUT" TEST

COUNTRY BANKS

	$\bar{R}^2$	t		Beta	
		Y	F	Y	F
		Including New York			
1934	.709	-2.06[b/]	2.04[b/]	-.402	.359
1935	.257	- .23	.98	-.063	.277
1936	.603	-2.40[b/]	.79	-.472	.157
Pooled	.622	-2.79[a/]	2.31[b/]	-.542	.256
		Excluding New York			
1934	.650	-1.82[c/]	1.78[c/]	-.434	.369
1935	.273	.03	1.17	.007	.351
1936	.648	-1.96[b/]	1.08	-.395	.219
Pooled	.624	-2.11[b/]	2.58[a/]	-.451	.308

a/ t significant at 1 percent level, one tailed test.

b/ t significant at 5 percent level, one tailed test.

c/ t significant at 10 percent level, one tailed test.

Note: For definition of Y and F and for other variables included in regressions, see note to Table 2.

TABLE 4

IMPORTANCE OF BANK SIZE AND TIME DEPOSIT RATIO

	Income Variable in Regressions				Failure Variable in Regressions			
	t		Beta		t		Beta	
	Size	Time Deposit Ratio	Size	Time Deposit Ratio	Size	Time Deposit Ratio	Size	Time Deposit Ratio
Country Banks -- Including New York								
1934	-.36	-2.25[f]	-.092	-.513	-1.17	-2.46[e]	-.271	-.577
1935	-1.12	-1.40	-.340	-.429	- .93	-1.71	-.273	-.508
1936	-1.23	-2.40[e]	-.270	-.527	-1.03	-1.76	-.295	-.514
Pooled	-1.88[b]	-.357[d]	-.253	-.471	-1.97[b]	-3.72[d]	-.272	-.521
Country Banks -- Excluding New York								
1934	.01	-2.15[f]	.004	-.520	-1.21	-2.38[e]	-.596	-.293
1935	-1.18	-1.35	-.418	-.367	-1.25	-1.78	-.349	-.517
1936	-1.46[c]	-2.34[f]	-.320	-.503	-1.68[c]	-2.05[f]	-.418	-.529
Pooled	-.183[b]	-3.42[d]	-.258	-.463	-3.65[a]	-3.98[d]	-.345	-.537
Reserve City Banks -- Excluding New York[g]								
1934	-1.39	-3.13	-.338	-.749	- .10	-2.47[e]	-.034	-.924
1935	.49	-1.77	.232	-.770	.75	-1.20	.402	-.583
1936	- .24	-1.46	-.117	-.644	.02	-1.35	.010	-.656
Pooled	.01	-3.88[d]	.002	-.747[d]	.06	-3.73[d]	.013	-.772

a/ t significant at 1 percent level, one tailed test
b/ t significant at 5 percent level, one tailed test.
c/ t significant at 10 percent level, one tailed test.
d/ t significant at 1 percent level, two tailed test.
e/ t significant at 5 percent level, two tailed test.
f/ t significant at 10 percent level, two tailed test.
g/ income variable used, is one year income change.

Note: For definition of Income and Failure variables, see note to Table 2. -- denotes not computed.

TABLE 4

IMPORTANCE OF BANK SIZE AND TIME DEPOSIT RATIO

(continued)

	Both Variables in Regressions			
	t		Beta	
	Size	Time Deposit Ratio	Size	Time Deposit Ratio
	Country Banks -- Including New York			
1934	-.31	-3.05[e/]	-.067	-.607
1935	-.88	-1.60	-.276	-.507
1936	-1.03	-2.46[e/]	-.237	-.570
Pooled	-1.64[c/]	-4.28[d/]	-.208	-.541
	Country Banks -- Excluding New York			
1934	-.20	-2.83[e/]	-.049	-.613
1935	-1.15	-1.66	-.350	-.517
1936	-1.46[c/]	-2.56[e/]	-.317	-.560
Pooled	-2.05[b/]	-4.29[d/]	-.263	-.545
	Reserve City Banks -- Excluding New York[g/]			
1934	--	--	--	--
1935	--	--	--	--
1936	--	--	--	--
Pooled	--	--	--	--

a/ t significant at 1 percent level, one tailed test.
b/ t significant at 5 percent level, one tailed test.
c/ t significant at 10 percent level, one tailed test.
d/ t significant at 1 percent level, two tailed test.
e/ t significant at 5 percent level, two tailed test.
f/ t significant at 10 percent level, two tailed test.
g/ income variable used is one year income change.

Note: For definition of Income and Failure variables, see note to Table 2. -- denotes not computed.

TABLE 5

IMPORTANCE OF INTERBANK DEPOSITS

RESERVE CITY BANKS[a/]

	t Variable in Regressions:		Beta Variable in Regressions:	
	Y'	F	Y'	F
1934	-3.21[b/]	-1.51	-.947	-.666
1935	- .47	.18	-.281	.140
1936	-1.28	-.59	-.746	-.493
Pooled	-2.04[c/]	-1.69	-.492	-.506

a/ Excluding New York

b/ t significant at 5 percent level, two tailed test.

c/ t significant at 10 percent level, two tailed test.

Note: Y' is one year income change. For definition of F and for other variables in regressions see note to Table 2.

TABLE 6

IMPORTANCE OF BANK SIZE AND TIME DEPOSIT RATIO

FOR VOLUNTARY PRIMARY RESERVES

COUNTRY BANKS[a/]

	t		Beta		$\bar{R}^2$
	Size	Time Dep. Ratio	Size	Time Dep. Ratio	
		Including Income Variable			
1934	-3.33	-4.69	-.517	-.624	.861
1935	-4.98	-5.60	-.529	-.595	.910
1936	-5.80	-8.47	-.474	-.678	.950
Pooled	-1.88[b/]	-3.57	-.253	-.471	.922
		Including Failure Variable			
1934	-3.60	-4.76	-.475	-.650	.861
1935	-3.76	-4.30	-.507	-.599	.856
1936	-6.21	-8.53	-.465	-.660	.956
Pooled	-1.97[c/]	-3.72	-.272	-.521	.912

a/ Including New York.

b/ t significant at 10 percent level, one tailed test.

c/ t significant at 5 percent level, one tailed test.

Note: With exceptions indicated in footnotes all coefficients are significant at the one percent level (single tailed test for size; two tailed test for time deposit ratio). For definitions of income and failure variables, see note to Table 2.

REFERENCES

Karl Brunner and Allan Meltzer, "Liquidity Traps for Money, Bank Credit and Interest Rates," Journal of Political Economy, Vol. 76, January/February 1968, pp. 1-37.

John Chapman and Associates, Commercial Banking and Consumer Installment Credit (New York, National Bureau of Economic Research, 1940).

Milton Friedman and Anna Schwartz, A Monetary History of the United States (New York, National Bureau of Economic Research, 1963).

Peter Frost, "Bank's Demand for Excess Reserves," Journal of Political Economy, Vol. 79, July/August 1971, pp. 805-825.

Arthur Goldberger, Econometric Theory (New York, John Wiley, 1964).

Emanuel Goldenweiser, American Monetary Policy (McGraw Hill Book Co., 1951).

----------, Monetary Management (McGraw Hill Book Co., 1949).

George Horwich, "Effective Reserves, Credit and Causality in the Banking System of the Thirties," in Deane Carson (ed.), Banking and Monetary Studies (Homewood, Ill., Richard D. Irwin, 1963), pp. 80-100.

George Morrison, Liquidity Preference of Commercial Banks (Chicago, University of Chicago, 1966).

Rolph Nugent, "The Growth of Personal Lending," Banking, Vol. 30, December 1937.

Rand-McNally & Co., Rand-McNally Commercial Atlas and Marketing Guide (Chicago, Rand-McNally & Co., 1940).

Clark Warburton, Depression, Inflation and Monetary Policy (Baltimore, Johns Hopkins University Press, n.d.).

Charles Whittlesey, "Credit Policy at the Discount Window," Quarterly Journal of Economics, Vol. LXXII, May 1959, pp. 207-216.

U.S. Board of Governors, Federal Reserve System, Annual Reports, 1933 and 1935 (Washington, D.C., 1934, 1936).

----------, Banking and Monetary Statistics (Washington, D.C., 1943).

----------, Member Bank Call Reports, June 1930-1933 (Washington, D.C., 1930-1933).

U.S. Department of Commerce, Personal Income by States since 1929 (Washington, D.C., 1956).

WORKING PAPER SERIES

Department of Economics
University of California, Davis

1. "Some Tests of the Permanent Income Theory," by Thomas Mayer, February 1970.

2. "Externalities and Generalizations of the Negishi-Kemp Proposition," by Henry Wan, Jr., April 1970.

3. "Technology Diffusion, Substitution and X-efficiency," by T. Y. Shen, April 1970.

4. "The Aggressive Firm, Market Structure, and Economic Welfare," by Victor P. Goldberg, August 1970.

5. "Land Use Conflict and Public Policy," by Victor Goldberg, October 1970.

6. "The Minmax Representation of the Small Country Economy," by Leon L. Wegge, November 1970.

7. "A Note on Long Run Market Power and Substitute Competition," by Victor P. Goldberg, December 1970.

8. "Mechanization, Industrialization, and Technical Change in Rural West Pakistan," Hiromitsu Kaneda, January 1971.

9. "A Study of the Cost Behavior of Credit Unions," by Thomas F. Cargill and C. Daniel Vencill, March 1971.

10. "Options for Recreation and Transportation," by Kenneth D. Goldin, September 1971.

11. "Small-Scale, Agriculturally Related Industry in the Punjab," by Hiromitsu Kaneda and Frank C. Child, September 1971.

12. "Potential Entrants Discourage Entry: Comment," by Victor Goldberg and Sharon Moirao, October 1971.

13. "Investment Constraints and New York City Mutual Savings Bank Financing of Ante-Bellum Development," by Alan Olmstead, February 1972.

14. "The Emergency Employment Act of 1971. Experience in the State of California (excepting Los Angeles & San Diego). Second Interim Report, May 1972," by Martin P. Oettinger and C. Daniel Vencill, May 1972.

15. "The Permanent Income Theory and the Burden of General Consumption Taxes," by Thomas Mayer, May 1972.

16. "The Role of Central Bank Policy in the Industrial Growth of Germany, 1870 - 1914," by Martin P. Oettinger, May 1972.

17. "The Money Illusion in the Speculative Demand for Money," by Thomas Mayer, June 1972.

18. "A Model of International Migration," by Barry Douglas, July 1972.

19. "P- and PN-Matrices, Minkowski- and Metzler-Matrices, and Generalizations of the Stolper-Samuelson and Samuelson-Rybczynski Theorems," by Yasuo Uekawa (Kobe University of Commerce and University of New South Wales), Murray C. Kemp (University of New South Wales), and Leon Wegge, August 1972.

20. "The Concept of General Equilibrium in a Market Economy with Imperfectly Competitive Producers," Richard R. Cornwall, October 1972.

21. "Variable Interest Rate Mortgages and Household Risk," by Thomas Mayer, November 1972.

22. "The Explanation of Excess Reserves in the 1930's. A Cross Section Study," by Thomas Mayer, February 1973.