The Role of the Federal Reserve as "Lender of Last Resort" and the Seasonal Fluctuation of Interest Rates

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THE EFFECT OF THE FOUNDING OF THE FEDERAL RESERVE SYSTEM in 1914 on the seasonal fluctuation of interest rates has recently become an issue in the debate over the effectiveness of monetary policy. The traditional view, espoused recently by Jeffrey Miron (1986), is that during its early years the Federal Reserve System used open market operations to reduce the seasonal fluctuation of interest rates. Miron argues that by supplying reserves to the banking system when they were most needed, the Fed's policy also reduced the number of bank failures and financial panics. Thus, seasonal (anticipated) money growth has real effects.

Truman Clark (1986) casts doubt on the traditional view. He finds that seasonal fluctuation of interest rates fell in some other countries at about the same time as in the United States. He attributes the change in the behavior of interest rates to factors other than the founding of the Fed such as the breakdown of the gold standard at the beginning of World War I. In response, Robert Barsky et al. (1988) present evidence that a later breakdown in the gold standard (the end of the Bretton Woods system) did not affect the seasonal pattern of interest rates and conclude that the creation of the Fed was the critical factor.

We develop in this paper an alternative model that indicates a potential role for the Fed in reducing the seasonal fluctuation of interest rates but does not require short-term activist monetary policy. The model emphasizes the Fed's role as a "lender of

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last resort" instead of its role in conducting open market operations. The creation of the Fed reduces the seasonality of interest rates because its lending policy reduces the seasonality of bank deposits. Bank deposits become less seasonal because creation of the Fed reduces the seasonality of the expected availability of emergency credit to banks, which causes a reduction in the seasonality of the probability of bank failure and financial panic. The effects can result from a policy set in place when the Fed was created and never altered again.

Our major point is that even if the creation of the Fed did cause a reduction in the seasonality of interest rates (assumed to be real interest rates), that does not *necessarily* imply that seasonal money growth was the cause.[1] We therefore concentrate on the potential role of the Fed, ignoring the international issues raised by Clark. We find all of the available evidence to be consistent with the lender-of-last-resort model, and some of the evidence appears to be inconsistent with the open market operations model.

1. A GENERAL MODEL OF THE POTENTIAL EFFECTS OF THE FED ON THE INTEREST RATE

In this section we extend Miron's model to create a general model in which the open market operations (OMO) and lender-of-last-resort (LLR) models are special cases. The general model contains simplifying but unrealistic assumptions that do not essentially alter the results.

Each bank takes the interest rate as given and is risk-neutral, maximizing expected profit by choosing its planned supply of loans and planned reserves before it experiences any unanticipated withdrawals. If there is no lender of last resort, a bank's expected costs depend on two basic factors: (1) costs rise as the variance of withdrawals rises and (2) costs decline as the ratio of planned reserves to expected deposits rises. If reserves turn out to be inadequate because of unanticipated withdrawals, then a bank must respond by liquidating loans to replenish reserves, which imposes costs in the form of capital losses and excess brokerage fees. A sufficiently large unanticipated withdrawal causes a bank to restrict or suspend payments to depositors and possibly to fail.

We specify that the LLR (either public or private) is willing to provide a bank with some maximum amount of emergency credit with probability x ($0 \leq x \leq 1$). The expected availability of emergency credit from the LLR is the maximum amount of emergency credit offered by the LLR multiplied by the probability (x) that a bank receives its emergency request. An "emergency" occurs when unanticipated withdrawals exceed planned reserves, implying that all borrowing from the LLR is unplanned. Each bank is small enough that a large request for credit on its part has a negligible impact on the ability of the LLR to lend. We assume for simplicity that the interest (discount) rate on the borrowing is zero.

[1]Robert Shiller (1980) finds the evidence regarding the effect of the creation of the Fed on the seasonality of real interest rates to be inconclusive. Marvin Goodfriend (1988) develops a model in which the Fed's creation affects nominal interest rates through inflation expectations rather than the real rate.

The bank's expected profit function is

$$\pi = iL - (s^2/2)\{[(R + C)/D] - 1\}^2 , \tag{1}$$

where π is expected profit, i is the interest rate on loans, L is the planned quantity of loans, s^2 is the variance of withdrawals, R is planned reserves, C is the expected availability of emergency credit, D is expected deposits, and $(R + C)/D \leq 1$ by assumption. Equation (1) differs from Miron's profit function in its inclusion of C, which reduces bank costs by supplementing planned reserves.

A less fundamental difference between our model and Miron's emerges in the way we model open market operations. In our model, an open market purchase of bonds by the Fed increases the bank's ability to make loans and also increases expected deposits through the deposit expansion multiplier. In Miron's model, there is no explicit statement that an anticipated open market operation affects expected deposits. Our approach does not change any of his major conclusions but does imply that the seasonality of deposits is affected by a seasonal open market operation. We feel this captures the spirit of his model and also makes his model consistent with the evidence provided below that end-of-the-year reductions in deposits disappeared after creation of the Fed.

The existence of a lender of last resort also affects expected deposits. Depositors choose their planned level of deposits at the beginning of the period based on their expectations for the period. They seek to maximize the expected rate of return from investing in bank deposits and all other assets. The demand for bank deposits is positively related to the deposit interest rate (assumed to be zero for simplicity) and negatively related to the probability of a bank restricting payments to depositors. The probability of restriction is negatively related to the expected availability of emergency loans from the LLR to the bank. Thus, C and D are positively related.

The bank maximizes expected profit subject to the constraints,

$$R + L = D , \tag{2}$$

and

$$D = G + \lambda F + \gamma C, \ \lambda, \gamma > 0 , \tag{3}$$

where G is the component of expected deposits that is independent of either open market operations or lender-of-last-resort activity, F is the size of the open market purchase (negative for an open market sale), and λ and γ are parameters. The resulting loan supply curve is

$$L^s = C + [(G + \lambda F + \gamma C)^2/s^2]i . \tag{4}$$

An expansionary open market operation of the amount F increases the supply of loans (for a given interest rate) by reducing the slope of the supply curve.[2] An

[2]In Miron's model the loan supply curve shifts to the right.

increase in the expected availability of emergency credit of the amount C has a direct effect of shifting the loan supply curve to the right and an indirect effect (through increased expected deposits) of reducing the slope of the loan supply curve. For convenience, we assume that (4) represents the market supply of loans (implying that λ is the deposit expansion multiplier).

The market demand for loans is related to the real interest rate $(i - p^*)$, the price level (P), and an exogenous component (Y):

$$L^d = P[Y - \beta(i - p^*)] , \tag{5}$$

where p^* is expected inflation and β is a parameter. We assume as Miron did that the price level is constant (equal to one) and the expected inflation rate is zero, so there is no distinction between the nominal and the real interest rate.

The equilibrium interest rate is also determined before the bank experiences any unanticipated withdrawals and is based on equating the demand and the planned supply of loans:

$$i = (Y - C)s^2/[\beta s^2 + (G + \lambda F + \gamma C)^2] . \tag{6}$$

Ceteris paribus, an increase in loan demand (Y) or the variance of withdrawals (s^2) causes the interest rate to rise. An increase in the exogenous component of expected deposits (G), the size of the open market operation (F), or the expected availability of emergency credit from the Fed (C) causes the interest rate to fall.

The solutions for the quantity of loans, reserves, and the loan-reserve ratio are

$$L = [\beta s^2 C + Y(G + \lambda F + \gamma C)^2]/[\beta s^2 + (G + \lambda F + \gamma C)^2] , \tag{7}$$

$$\begin{aligned} R = \{&\beta s^2[G + \lambda F + (\gamma - 1)C]^2 + (G + \lambda F + \gamma C)^3 \\ &- Y(G + \lambda F + \gamma C)^2\}/[\beta s^2 + (G + \lambda F + \gamma C)^2] , \end{aligned} \tag{8}$$

$$\begin{aligned} L/R = [&\beta s^2 + Y(G + \lambda F + \gamma C)^2]/\{\beta s^2[G + \lambda F + (\gamma - 1)C]^2 \\ &+ (G + \lambda F + \gamma C)^3 - Y(G + \lambda F + \gamma C)^2\} . \end{aligned} \tag{9}$$

An increase in F increases both L and R, and reduces L/R. An increase in C also increases L, but the direction of its effect on R and L/R depends on the magnitude of γ, the response of D to a change in C. The larger is γ the more likely that an increase in C increases R and reduces L/R. Seasonal fluctuation of any of the rightside variables in (6) through (9) would affect the seasonal fluctuation of the interest rate, loans, reserves, and the loan-reserve ratio.

2. SEASONALITY AND THE DISTINCTION BETWEEN THE OMO AND LLR MODELS

The OMO and LLR models are special cases of the general model in which $C = 0$ and $F = 0$, respectively. They are similar in that increases in both C and F increase the total quantity of bank deposits and reduce the interest rate. In fact, C and F enter the model in essentially the same way. *The two models have different implications, however, for Federal Reserve credit and the effectiveness of seasonal monetary policy.* The primary implication that emerges from the OMO model is that increases in Federal Reserve credit and money growth during the autumn season are required to reduce the seasonality of the interest rate. The LLR model, however, implies that the existence of the Fed can reduce the seasonal fluctuation of the interest rate without increases in Federal Reserve credit and money growth during autumn. In the rest of this section, we elaborate the distinctions between the two models.

In the OMO model, prior to creation of the Fed, $F = 0$ and seasonal (autumn) increases in i result from seasonal increases in Y or s^2 or seasonal reductions in G. The Fed could eliminate the autumn increase in i by purchasing a sufficiently large quantity of government securities, which would also reduce the seasonal fluctuation of loans, reserves, and the loan-reserve ratio. Every year in which a seasonal increase in the interest rate does not occur must be a year in which a seasonal increase in Fed credit does occur. According to Miron, such a policy would reduce the seasonal fluctuation of the probability of bank failure and financial panic, which tended in pre-Fed times to be higher during the autumn. Therefore, seasonal changes in Fed credit and money growth have real effects.

In the LLR model, prior to creation of the Fed, the existence of private lenders of last resort causes C to fluctuate seasonally. A private LLR emerges when a large bank provides lines of credit to other banks or when several banks form a central clearinghouse to provide lender-of-last-resort services. Private clearinghouses solicited members for contributions that could be used for emergency loans (Sprague 1910 and Timberlake 1984).[3] Banks knew, however, that a private LLR could run short of funds to lend if a large number of banks requested emergency loans as would happen during a financial panic. The expected availability of emergency credit (C) tended to decrease during autumn (when a financial panic was more likely), thereby exacerbating the effects of seasonality of Y, s^2, or G on the seasonality of i.[4]

After the creation of the Fed, the probability of a bank receiving its request for emergency credit would not necessarily decrease in autumn. Banks expect that emergency credit will be more freely extended during the critical autumn months than in the past. The Fed's willingness to lend to banks at all times of the year reduces the seasonal fluctuation of the probability of bank failure and financial panic. The policy also reduces the seasonal fluctuation of interest rates, deposits, loans, and reserves. If the reduction in the seasonality of deposits is sufficiently large, then the seasonality of the loan-reserve ratio also decreases.

[3]The Aldrich-Vreeland Act of 1908 expanded the emergency powers of clearinghouses. Milton Friedman and Anna Schwartz (1963, p. 172) contend that the Act provided an effective means of preventing financial panics. Fabio Canova (1987) finds evidence that the seasonal patterns changed for some interest rates but not others in the early 1900s, possibly around 1908. An attempt to discover the determinants of interest rates during the pre-Fed period is beyond the scope of this paper.

[4]The cost of acquiring emergency credit also could rise but, according to Richard Timberlake (1984), emergency loans provided by clearinghouses during the pre-Fed period tended to have a constant interest rate (6 percent for New York City clearinghouses).

In assessing the implications of the LLR model for Federal Reserve credit, it is important to realize that the interest rate is determined at the beginning of the period before any emergencies occur or any Fed credit is extended. If an emergency occurs, a bank requests a loan and if the Fed honors the request the level of Fed credit increases. If the Fed does not honor the request, the bank seeks another source of credit or liquidates loans (and it may fail), and the level of Fed credit does not change. If no emergency occurs, a bank does not request a loan and the level of Fed credit does not change.

Emergencies are unanticipated but could still be more likely in the autumn. For example, if loan demand (Y) increases in autumn, then the interest rate is higher and the reserve-deposit ratio is lower [see equation (8)] and requests for emergency credit from the Fed are more likely.[5] While Fed credit would experience greater increases on average during the autumn, in some years the autumn demand for borrowing from the Fed and the addition to Fed credit are large because unanticipated withdrawals are large, and in others they are small (conceivably zero) because unanticipated withdrawals are small. Yet the Fed's actions as lender of last resort reduce the seasonality of i equally in either case because the seasonality of the expected availability of emergency credit, not the seasonality of actual emergency credit, determines the interest rate. Unlike the OMO model, a reduction in interest rate seasonality does not require anticipated seasonal money growth.

One way to summarize the major difference between the two models is that the OMO model implies that Fed credit is exogenous and the LLR model implies that Fed credit is endogenous. In the OMO model it is not crucial that the Fed purchase securities to inject reserves into the banking system. Direct loans would serve as well. The crucial element is that the Fed sets the quantity of credit to banks. The Fed supplies more credit by buying more securities, or extending more loans, when it anticipates seasonal fluctuations in Y, G, or s^2. In the LLR model it is not crucial that the Fed use discount loans to provide emergency credit to banks. Purchases of securities would serve as well. The crucial element is that, after announcing a policy for C, the Fed allows banks to determine the quantity of credit (except for its occasional denial of requests for credit). The Fed allows banks to request a certain amount of credit based on unanticipated withdrawals and then decides whether to grant the request.

We could also extend the LLR model to allow banks to borrow from the Fed for the purpose of relending funds in the market. An increase in the interest rate (relative to the discount rate) would then stimulate bank borrowing. Compared to the OMO model, the LLR model reverses the direction of causality and changes the sign (from negative to positive) of the relationship between the seasonality of the interest rate and the seasonality of Fed credit.[6]

[5]A bank's request for borrowing is the maximum of zero and $W - E(W) - R$, where $W - E(W)$ is the volume of unanticipated withdrawals. We assume that the Fed does not completely smooth the interest rate by increasing C to offset the increase in Y.

[6]David Wheelock (1990) argues that banks during this period did plan to borrow from the Fed whenever the conditions made it profitable.

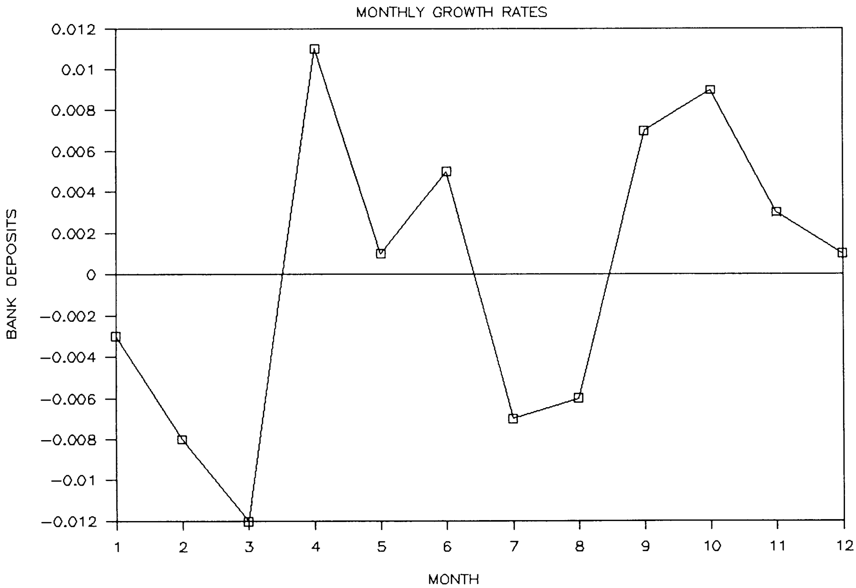

FIG. 1. Bank Deposits, 1922–28: Monthly Growth Rates

3. EVIDENCE

The lender-of-last-resort and open market operations models have several conclusions in common. Both models imply that the creation of the Fed could have reduced the seasonality of interest rates, loans, reserves, and the loan-reserve ratio. Miron provides evidence that supports reduced seasonality for each of these variables. Each model also implies that creation of the Fed could have reduced the seasonality of bank deposits. One difference between the models, however, is that the OMO model implies an unambiguous decline in the seasonality of the loan-reserve ratio while the LLR model requires a substantial reduction in the seasonality of deposits to induce a reduction in the loan-reserve ratio.

We know from evidence provided by Miron that prior to creation of the Fed, deposits tended to decrease during the fall months. We show in Figure 1 the seasonal pattern of demand deposits for 1922–28, the same post-Fed period analyzed by Miron. The figure was constructed by taking the coefficients from a regression of monthly first differences of the log of demand deposits on twelve seasonal dummies (with no intercept) and then subtracting the mean value of the coefficients.[7] Unlike the pre-Fed period, demand deposits near the end of the year were not unusually low. If anything, they tended to be higher than average during the last four months

[7]We use first differences throughout to assure stationarity of the series. None of the results reported in this paper are affected by using detrended levels instead of first differences.

of the year.[8] The finding lends some credence to the notion that the creation of the Fed altered the seasonal pattern of bank deposits sufficiently to reduce the seasonality of the loan-to-reserve ratio.

Furthermore, we know from evidence provided by Miron (though he does not make the point) that reductions in expected deposits were the *primary* factor in seasonality of the interest rate during the pre-Fed period. Miron shows in his figure 6 that the quantity of loans tended to decrease during the fall prior to creation of the Fed, which rules out increases in Y, loan demand, as the primary factor since $\partial L/\partial Y > 0$ (from equation 7). He also shows in his figure 5 that the ratio of loans to reserves tended to increase during the fall, which rules out increases in s^2, the variance of unanticipated withdrawals, as the primary factor since $\partial(L/R)/\partial s^2 < 0$ [from equation (9)]. Therefore, reductions in either G or C, both of which imply a reduction in expected bank deposits, were the primary factor since $\partial L/\partial G > 0$, $\partial L/\partial C > 0$, $\partial(L/R)/\partial G < 0$, and $\partial(L/R)/\partial C < 0$.[9]

The next two subsections examine more of the evidence in order to highlight differences in the two models. In general, all of the evidence is consistent with the LLR model and some of its appears to be inconsistent with the OMO model. Specifically, we find the following.

1. There are periods after creation of the Fed when neither Federal Reserve credit nor interest rates exhibit much evidence of seasonality.
2. Fed credit appears to exhibit greater seasonality whenever interest rates exhibit greater seasonality.
3. When Fed credit does fluctuate seasonally, it reflects seasonality of discount loans and bankers' acceptances but not Fed holdings of government securities.

A. The Seasonality of Federal Reserve Credit and Interest Rates

The LLR model is consistent with but does not require seasonal fluctuation of Fed credit and implies a positive correlation between the interest rate and Fed credit, if there is nonemergency borrowing from the Fed. In contrast, the OMO model requires seasonal fluctuation of Fed credit to reduce or eliminate the seasonal fluctuation of interest rates. Miron's major piece of evidence supporting the OMO model is that during 1922–28 Federal Reserve credit tended to rise significantly late in the year as interest rates did prior to the creation of the Fed. Miron chooses 1922 because weekly data are available beginning in that year. We show using monthly data from the period 1915–40 that many other years show little, if any, tendency for Fed credit to rise late in the year, and that Fed credit tends to exhibit the greatest seasonality when the seasonality of interest rates is most pronounced.

Table 1 presents the results of testing for seasonality in both Fed credit and the

[8]Using the same tests for seasonality described below, the end-of-the-year increase in deposits is not statistically significant.

[9]According to Miron, end-of-the-year reductions in the reserve-deposit ratio occurred prior to creation of the Fed. Reductions in expected deposits cause reductions in R/D if $D^2 > \beta s^2$.

TABLE 1

Tests for Seasonality in the Monthly Growth Rate of Fed Credit and the Monthly Change in the Call Rate

Period	Fed credit F	Fed credit Q	Call rate F	Call rate Q
1890–1914	—	—	5.13 (0.0001)	20.47*
1915–1940	5.39 (0.0001)	65.42*	2.31 (0.01)	11.84*
1915–1921	0.66 (0.77)	2.12	1.89 (0.05)	4.23
1918–1921	0.77 (0.67)	1.11	1.90 (0.07)	1.83
1922–1928	23.01 (0.0001)	69.80*	3.56 (0.0005)	11.58*
1929–1933	1.92 (0.06)	2.26	1.20 (0.31)	0.00
1934–1940	1.20 (0.30)	0.39	0.77 (0.67)	0.00

Data source: Board of Governors (1943).
Notes: Significance level is in parentheses. *Exceeds 0.05 critical value.

call rate of interest over various subperiods between 1890 and 1940.[10] The F-statistics are computed by regressing the first difference of the log of Fed credit and the first difference of the call rate on a set of twelve monthly dummies (with no intercept) and then testing whether the last eleven dummy coefficients jointly differ from the first. For the Q-statistics, we estimate the first three (positive) annual autocorrelation coefficients of the first difference of the log of Fed credit and the call rate and then multiply the number of months in the sample period by the sum of the squared values of the coefficients.

The summary statistics for the two long periods, 1890–1914 and 1915–1940, indicate less seasonality of interest rates for the latter period, though seasonality is statistically significant for both periods. Breaking the data into subperiods, however, is more revealing. During the period 1915–21, the seasonality of the call rate is less pronounced than in the period before creation of the Fed, 1890–1914. During the same period, however, both Table 1 and Figure 2 suggest that Federal Reserve credit is not significantly higher during the fall (see also Clark 1986). Miron (p. 133) claims that before 1918 "the problems of financing World War I constrained its [the Fed's] ability to conduct discretionary open market operations." When we exclude the war years and focus on the period 1918–21, however, there still is no evidence of significant seasonality of Fed credit, but this may be due in part to the small sample size. A closer examination of the data reveals only one year, 1919, in which the growth of Fed credit is much higher for the last part of the year than for the rest of the year. That is also the only year in which the call rate of interest is much higher late in the year.

For the period 1922–28, monthly Fed credit displays significant seasonality

[10]For Federal Reserve credit, we use end-of-the-month data in the table. Similar results appear when we use averages of daily figures.

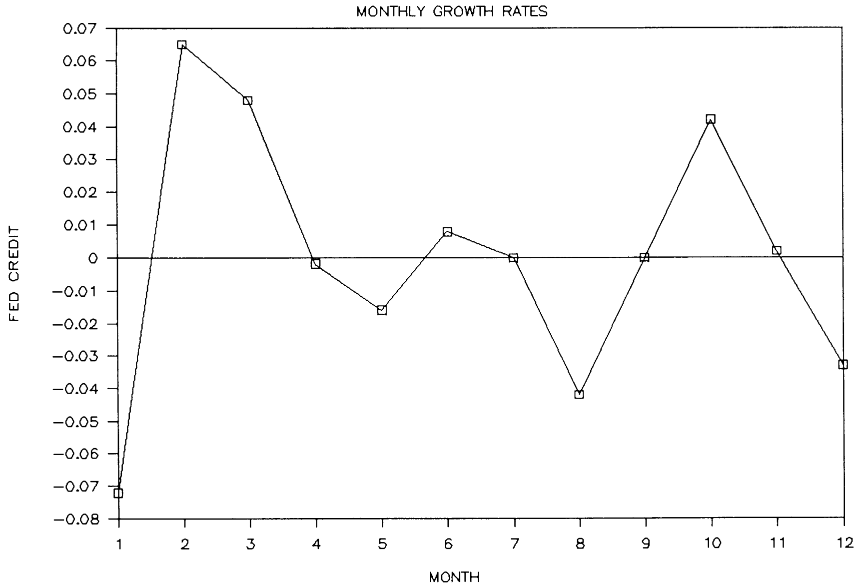

FIG. 2. Fed Credit, 1915–21: Monthly Growth Rates

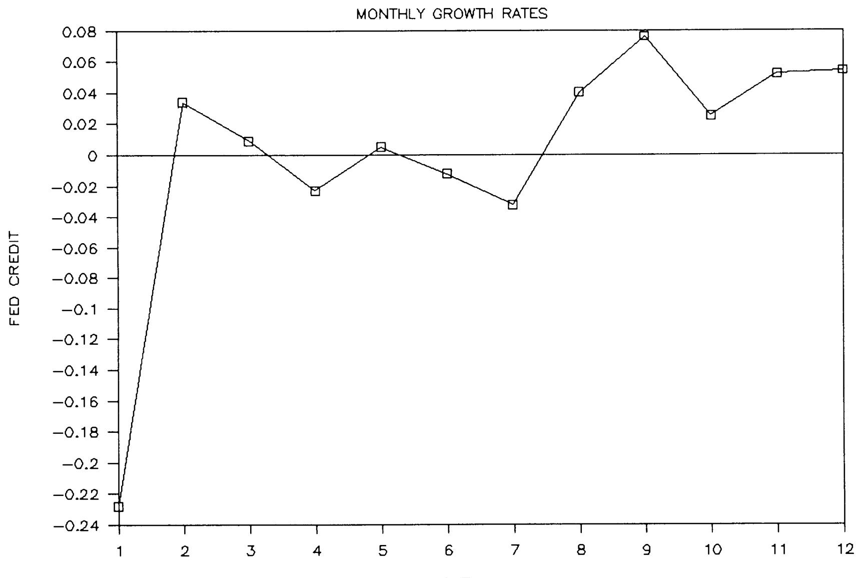

FIG. 3. Fed Credit, 1922–28: Monthly Growth Rates

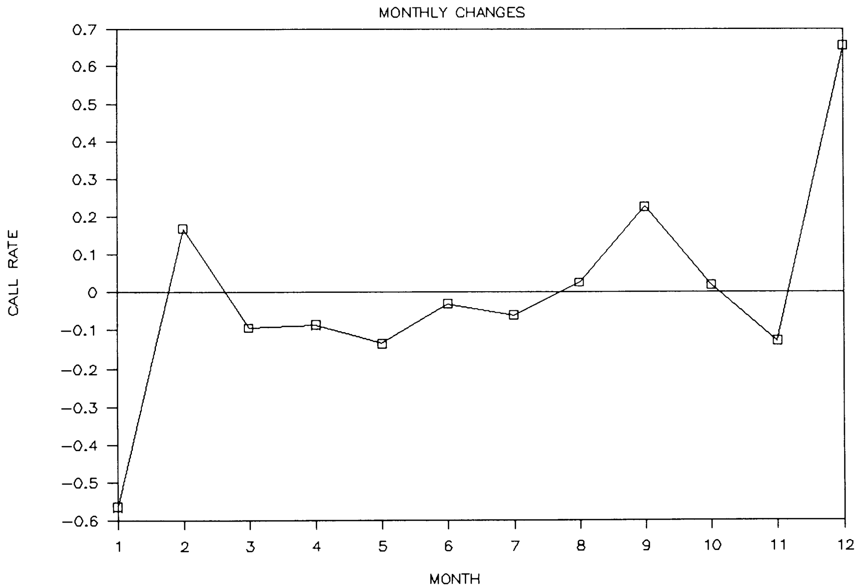

FIG. 4. Call Rate, 1922–28: Monthly Changes

which confirms Miron's results for weekly data. Seasonality of the call rate, however, is greater than during the 1915–21 period. Figures 3 and 4 indicate that the seasonal patterns in Fed credit and the call rate from 1922–28 are similar: both tend to be higher during the fall. A plot of the monthly first differences of each variable (not shown) indicates that those years with a particularly large increase in Fed credit during the fall (for instance, 1924 and 1927) also tend to be years with particularly large fall increases in the call rate. More formally, we compare the difference between the mean growth rate of Fed credit during the last five months of each year and the mean growth rate for the entire year with a similar measure of seasonality for the call rate. The correlation coefficient is 0.75 (significant at the 0.05 level).[11]

Turning to the early part of the Great Depression, Figure 5 shows Fed credit growth rates near the end of the year to be somewhat higher than the rest of the year, and Table 1 shows the seasonal pattern to be close to statistical significance for the years 1929–33. But Miron emphasizes that the standard deviation and the amplitude of the seasonal cycle in Fed credit decreased in moving from the 1920s to the 1930s, suggesting that the Fed was responsible for the financial panics of the 1930s. Table 1 and Figure 6 show, however, that the reduced seasonal fluctuation of Fed credit did not increase the seasonal fluctuation of interest rates as implied by the OMO model. Friedman and Schwartz's (1963, p. 318–19) explanation of the Fed's role in the re-

[11]For the period 1922–28, the correlation coefficient between the first differences of the call rate and Fed credit is .44.

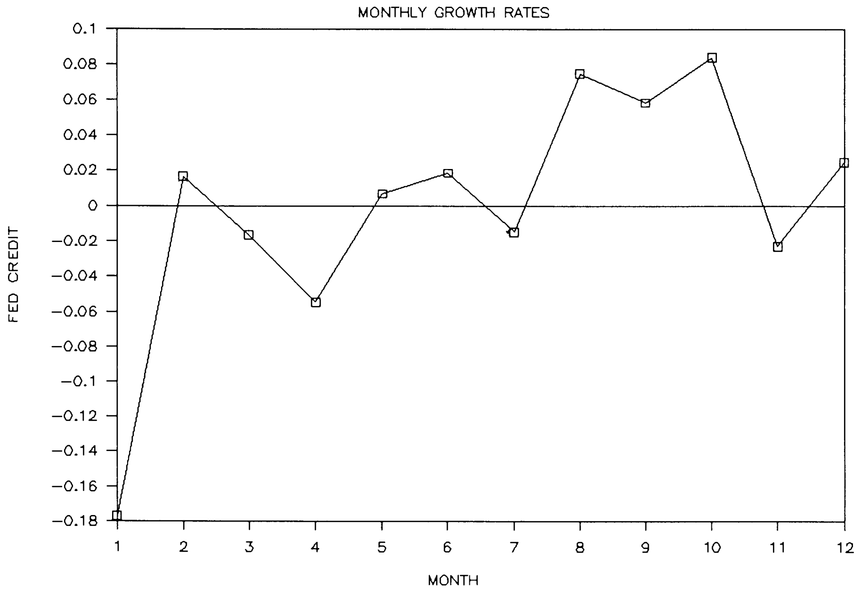

FIG. 5. Fed Credit, 1929–33: Monthly Growth Rates

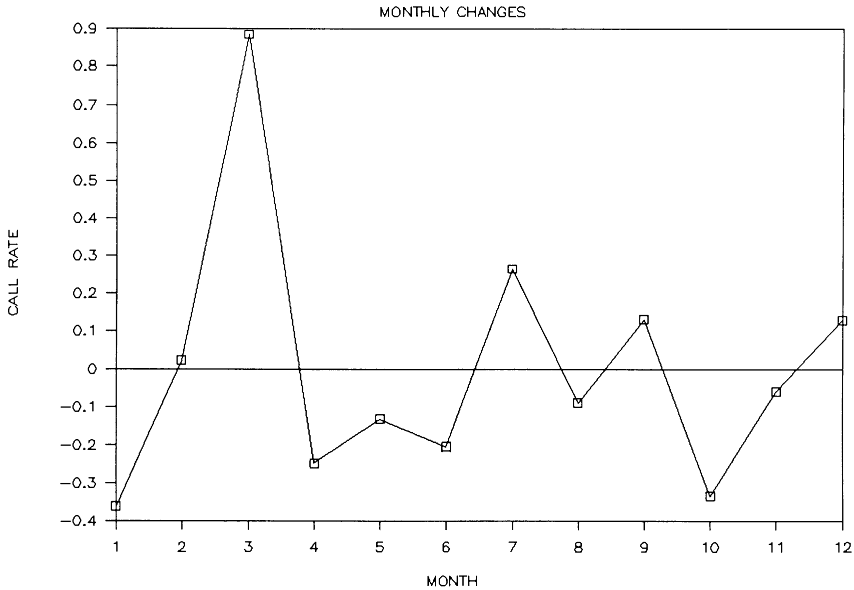

FIG. 6. Call Rate, 1929–33: Monthly Changes

emergence of financial panics during the early years of the Great Depression is that the general availability of loans from the Fed declined. In the LLR model this need not have resulted in greater seasonality of interest rates.

By 1934, the Fed's credibility as a lender of last resort had declined to the point that deposit insurance was considered necessary to prevent financial panics. The LLR model can be revised to apply to this period because deposit insurance performed the function that banks had expected the Fed to perform in its role as a lender of last resort prior to the Great Depression. The advent of deposit insurance meant a very low probability of financial panic and of course little or no seasonal fluctuation in the probability of a financial panic. This would imply continued low levels of seasonal fluctuation of both interest rates and Federal Reserve credit.

The evidence shows that interest rates did not display significant seasonal fluctuation during the period 1934–40 (see Table 1), and were in fact remarkably steady. Except for the period April 20, 1935, to May 16, 1936, the call rate equaled 1.00 percent each week.[12] Furthermore, after passage of the Gold Reserve Act of 1934, the Fed adopted a passive strategy toward open market operations. Summarizing the 1934 to mid-1939 period, Friedman and Schwartz (p. 513) conclude that the "use of open market operations to influence the volume of Federal Reserve credit outstanding from day to day, week to week, and month to month ceased to be a continuous activity of the System."[13] Table 1 and Figure 7 confirm that Fed credit did not display significant seasonal fluctuation over the period 1934–40.[14] Note in particular the small amplitude of the series relative to the other subperiods. The spike in the series in month 9 is primarily the result of a one-time increase in Fed credit in September of 1939.

To summarize, the absence of seasonal fluctuation of interest rates during the three subperiods 1915–1921, 1929–1933, and 1934–1940 does not appear to result from a policy of discretionary open market operations because Fed credit was clearly not seasonal during 1915–21 and 1934–40 and was less seasonal in 1929–33 than in 1922–28. In fact, the period of greatest seasonal fluctuation of Fed credit, 1922–28, was also the period of greatest seasonal fluctuation of interest rates.

B. The Components of Federal Reserve Credit

In hopes of shedding light on the issue of whether Fed credit was exogenous or endogenous, we examine in Table 2 the seasonal patterns in monthly data for the components of Federal Reserve credit over the period 1915–28. Both bankers' acceptances purchased by the Fed (columns 2 and 3) and discount loans (columns 4 and 5) displayed significant seasonality during the period 1922–28 but not during

[12]Other interest rates also varied little over the 1934–1940 period.

[13]Friedman and Schwartz (p. 512) point out that "from January 1934 through March 1937, government securities held at month's end fluctuated within a range of $17 million; on successive Wednesdays, within a $4 million range; and was exactly equal to $2,430 million in 133 out of 170 weeks."

[14]While the Treasury took over some of the monetary powers of the Fed, additional tests (not reported) indicate that the broader aggregate, high-powered money, also did not increase near the end of the year during the 1934–40 period.

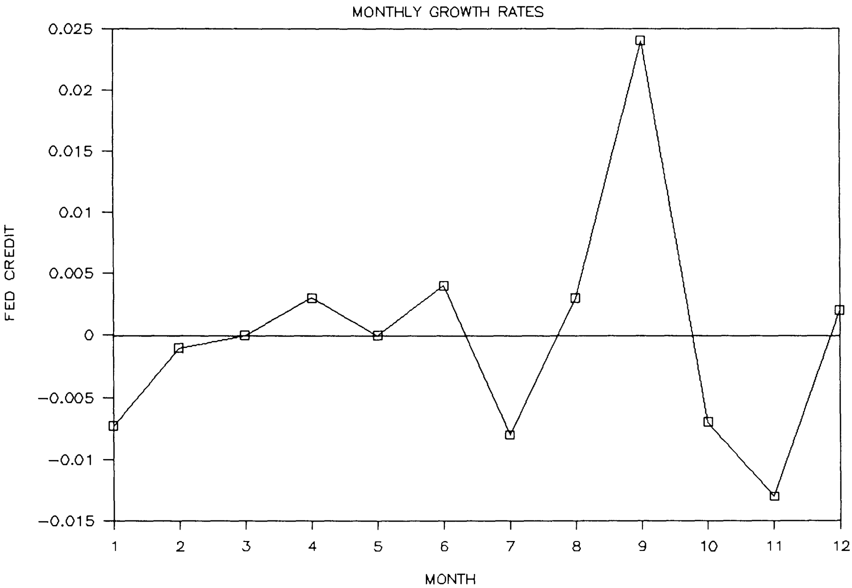

FIG. 7. Fed Credit, 1934–40: Monthly Growth Rates

the period 1915–21. Fed holdings of government securities (columns 6 and 7), on the other hand, were not close to displaying significant seasonality in either subperiod, especially 1922–28. Figures 8 and 9 show that the monthly growth rates of both discount loans and the quantity of acceptances purchased by the Fed tended to rise late in the year during the period 1922–28, which explains why Fed credit tended to rise late in the year during the same period as shown in Figure 3. We find similar patterns for weekly data.

Bankers' acceptances during the early 1900s originated in the private sector as bills of exchange that often were drawn to finance the wintertime movement,

TABLE 2

TESTS FOR SEASONALITY IN THE MONTHLY GROWTH RATES OF THE COMPONENTS OF FED CREDIT

Period	Bankers' acceptances F	Bankers' acceptances Q	Discount loans F	Discount loans Q	Open market securities F	Open market securities Q
1915–28	3.73 (0.0001)	27.61*	2.21 (0.02)	1.99	1.49 (0.14)	1.30
1915–21	0.73 (0.71)	0.25	0.83 (0.61)	0.00	1.33 (0.22)	1.00
1918–21	1.18 (0.33)	0.01	0.84 (0.60)	0.07	1.27 (0.28)	0.06
1922–28	5.80 (0.0001)	19.06*	2.90 (0.003)	6.53**	0.86 (0.58)	0.00

Data source: Board of Governors (1943).
NOTES: Significance level is in parentheses. *Exceeds 0.05 critical value. **Exceeds 0.10 critical value.

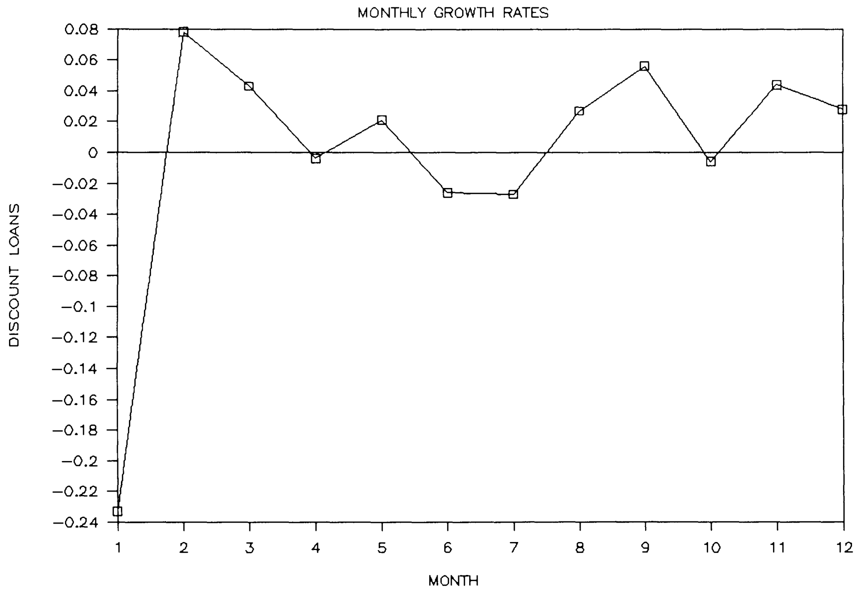

FIG. 8. Discount Loans, 1922–28: Monthly Growth Rates

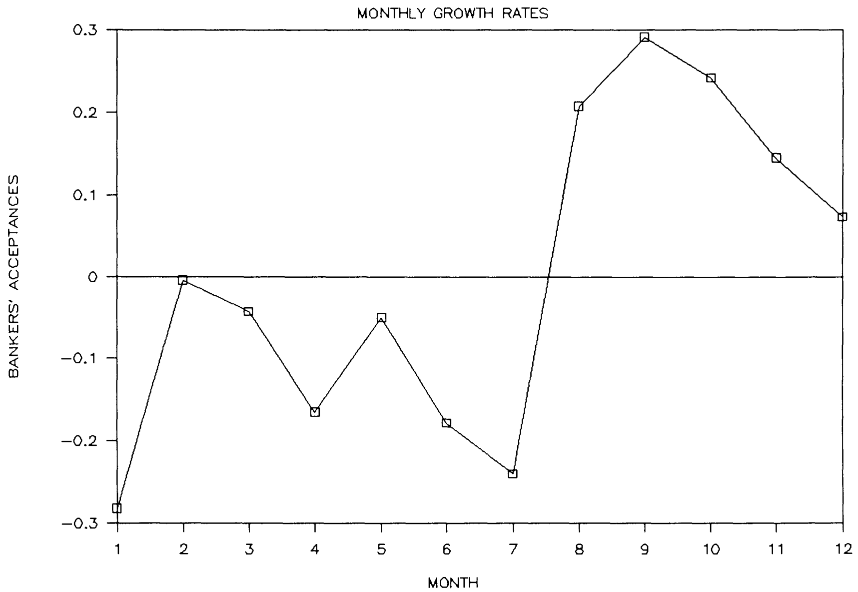

FIG. 9. Bankers' Acceptances, 1922–28: Monthly Growth Rates

storage, and exportation of agricultural products (see Burgess 1946). While acceptances bought by Federal Reserve Banks were a significant source of Fed credit in the 1920s, they declined in importance in the 1930s. The nature of the Federal Reserve's acceptance policy is indicated by the summary statement provided in the Board of Governors' *Banking and Monetary Statistics, 1914–1941:*

> Federal Reserve practice in the purchase of acceptances differs somewhat from the usual practice in the purchase of Government securities, where the Federal Reserve officials take the initiative in making the purchase. In the case of acceptances the Federal Reserve officials establish a rate at which they will buy all bills offered, and the initiative is, therefore, taken by the seller—usually a member bank or a dealer—although the Federal Reserve authorities may encourage offerings by lowering or raising the buying rate. Thus, as a factor of Federal Reserve Bank credit, acceptances purchased from member banks resemble discounts of eligible paper or secured advances to member banks. (1943, p. 326)[15]

The similarity between the Federal Reserve's acceptance and discount policies can be documented by examining movements in the Federal Reserve Bank of New York's discount rate and acceptance buying rate from 1919–1928 (Table 117, *Banking and Monetary Statistics, 1914–1941,* 1943, pp. 439–41 and 443–44). Both the discount and acceptance buying rates were constant for the first ten months of 1919, with the discount rate adjusted up on November 3 and the acceptance rate on November 4. The two rates also were constant for a long period spanning 1920 and 1921—from June 1920 to April 1921 for the discount rate and from September 1920 to June 1921 for the acceptance rate. While the acceptance buying rate, unlike the discount rate, changed frequently during the first ten months of 1922, both rates changed only once (April 1923 for the acceptance rate and February 1923 for the discount rate) during the eighteen-month span from November 1922 to April 1924. The buying rate was constant from late June to November 1924, it changed three times in 1925, and was constant from August 1926 to July 1927 and the last halves of 1927 and 1928. Similarly, the discount rate was constant from August 1924 to January 1925, it changed one time in 1925, and was constant from August 1926 to July 1927 and the last halves of 1927 and 1928. Since the market rate (as opposed to the Fed's buying rate) on bankers' acceptances changed daily, the evidence indicates that the 1920s' acceptance policy was analogous to the 1920s' discount policy. With both policies, the Fed allowed the demand for Fed credit by banks to determine the amount of Fed credit extended.

4. CONCLUSION

The model presented in this paper implies that the Federal Reserve's role as a lender of last resort may explain why the seasonal fluctuation of interest rates

[15]Also, in his detailed study of the early 1900s security market, Benjamin Beckhart (1932, p. 448) notes that Fed purchases of bankers' acceptances "are not to be looked upon as a phase of the open market operations of the system, but rather of their discount operations . . . with the Reserve banks occupying a passive role, buying at the rates fixed and never selling the bills purchased in the market."

appeared to decline around 1914. Unlike earlier providers of emergency credit to banks, the Fed was not likely to run short of funds to lend during financial panics. Because panics in pre-Fed times were more likely to occur during the autumn than in other seasons, the probability of a bank receiving an emergency loan fluctuated seasonally. The creation of the Fed reduced the seasonal fluctuation of the probability of receiving an emergency loan and the probability of a financial panic. It thereby reduced the seasonal fluctuation of bank deposits and the interest rate as well.

According to the model, the interest rate depends on the expectations of banks and depositors. The Federal Reserve affects the interest rate because banks and depositors expect the Fed to provide credit to banks during emergencies. Whether or not the Fed actually provides the emergency credit does not influence the interest rate. For the creation of the Fed to reduce the seasonality of interest rates, it is not necessary that the Fed actively expand bank reserves during times of seasonal interest rate pressures. In other words, it is not necessary that seasonal changes in money growth have real effects as in the open market operations model.

We are not able to conclude that the creation of the Fed in 1914 necessarily caused a reduction in the seasonality of interest rates. The control of markets during World War I, the suspension of the gold standard, or other concurrent developments may have been important determinants of the seasonality of interest rates. If the creation of the Fed did reduce interest rate seasonality, however, the evidence is consistent with the hypothesis that it did so through its role as lender of last resort.

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