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Bank Asset Liquidation and the Propagation of the U.S. Great Depression

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Abstract (100)

We hypothesize that financial disintermediation during and after the Great Depression arose from the slow liquidation of failed-bank deposits. We construct a data series containing the stock of failed national bank deposits for the period 1921-1940. Vector autoregression models show that the stock of failed-bank deposits undergoing liquidation is as important as money stock in terms of explaining output changes over forecast horizons from one to ten years. Failed-bank deposit shocks lasted for about five years and then became transitory. Furthermore, failed-bank deposit shocks had permanent negative effects on money supply and transitory negative effects on prices.
Banking crises may cause severe macroeconomic consequences. However, a framework for convincingly isolating and demonstrating those consequences in real-world economies has proven elusive. Hence the issue of how banking crises are linked to economic performance is of great interest in banking and macroeconomic literature.

Bernanke (1983) formally introduced the idea that banking sector disintermediation could link banking crises and macroeconomic performance. He reported convincing empirical results of a significant relationship between failed bank deposits and industrial output declines during the Great Depression. This so-called credit hypothesis forms the basis for more recent debates regarding the relative importance of credit supply or demand as the source of disintermediation (e.g., see Calomiris and Mason 2002b). However, it is important to realize that the basic credit hypothesis itself still has not been properly tested. While Bernanke tested a rough proxy for the source of disintermediation in his credit hypothesis – a monthly flow of deposits in failed banks – even he hypothesized that the source of disintermediation more accurately lies in the mechanism through which deposits in closed banks are returned to depositors and ultimately the banking system itself through the process of asset liquidation. For this reason, we revisit Bernanke’s original credit channel hypothesis with data and evidence relating to liquidation delays that was not available in his original study.

More specifically, this paper examines bank asset liquidations during the Great Depression and their relation to business cycle persistence. As in Mason (2002), when a bank fails a trustee is charged with selling assets and maximizing creditor returns. Each period, the trustee can sell assets at the current market price or wait another period and incur a positive opportunity cost. In this manner bank failures transform liquid deposits into illiquid investments with uncertain
maturity. The longer it takes to return funds to depositors, the longer funds remain unavailable for investment or consumption. The cycle feeds upon itself as lower investment and consumption are accompanied by lower asset price growth, again prompting the trustee to wait yet another period. Hence longer slower liquidations should be associated with stronger business cycle persistence.

Indeed, this pattern seems evident in the Great Depression. Almost one-third of U.S. banks failed during the Great Depression. Bernanke (1983) argued that disruption of the credit intermediation process due to bank failures and general turmoil in financial markets had significant effects on macroeconomic activity. While Bernanke did not have data adequate to test the relationships in the present paper, he inferred that the duration of credit effects stemming from the bank failures should depend on the how long it would take to revitalize credit channels that intermediate public savings into business investment and rehabilitate insolvent debtors (1983, p. 272).

Below we extend Bernanke’s (1983) analysis by introducing data that more accurately characterizes the duration of credit effects as a process linked to frictions in the intermediation process and rehabilitating insolvent debtors. First, we demonstrate that asset liquidations of nationally chartered banks – those with the highest quality assets – during the Great Depression averaged just over six years and proceeded at a fairly linear rate. As these illiquid “deposits” were returned to depositors in the mid- to late-1930s economic growth improved. Hence we suggest there exists both a logical economic relationship between deposit liquidation and the persistence of the Great Depression, and therefore a high statistical correlation between the two processes.
Next, we formally analyze time series data on the stock of unliquidated deposits in closed national banks during the period 1921-1940. Even casual inspection of the deposit stock series clearly reveals the slow liquidation of bank assets during a period of macroeconomic difficulty. Indeed, contrary to previous literature, this data series suggests that knock-on effects of the banking crises of the Great Depression did not end with the bank holiday of March 1933 but persisted well into the late 1930s.

We employ vector autoregression (i.e., VEC and VAR) models to investigate the explanatory power of the amortized stock of failed national bank deposits during the Depression as a more accurate proxy for the time it takes to rehabilitate insolvent debtors or liquidate their collateral. Forecast error variance (FEV) decompositions indicate that the stock of closed bank deposits is as important as the money stock in terms of explaining output changes over forecast horizons from one to ten years. Impulse response functions show that banking sector shocks measured by the stock variable lasted for about five years. Together these findings suggest that the prolonged banking crisis was a major factor in explaining the persistence of the Great Depression into the late 1930s. Further results show that banking sector shocks had permanent negative effects on money supply and transitory negative effects on prices. Thus, the dynamic effects of banking sector disruptions were cumulative and pervasive during the Depression. We conclude that our results using the stock of closed bank deposits strongly support Bernanke’s inference that the duration of banking sector distress, as measured by the liquidation experience, is important in explaining the persistence of the U.S. Great Depression.

From a policy perspective, our results suggest that deposit insurance can reduce the depth and persistence of severe business downturns by maintaining depositors’ access to funds so that they can be reinvested quickly and efficiently in the financial sector. We also, however, suggest
that it may be important for the deposit insurer (or other entity) to act as an asset management company, mitigating asset price volatility by liquidating bank assets at a controlled, reasonable rate that reduces asset market overhang. This observation constitutes an important, often-overlooked, macroeconomic role for deposit insurance beyond the narrow microeconomic objective of containing potential market failure and contagion in the financial services sector.

Our paper is organized as follows. Section I provides a background discussion of bank failures and liquidations in the Great Depression; Section II provides details on our liquidation series and demonstrates the magnitude of the liquidation problem; Section III describes the econometric methods; Section IV reports the empirical results; and the last section summarizes and concludes.

I. Background on Bank Failures, Suspensions, and Asset Liquidations

A. Receiverships and Voluntary Liquidations versus Suspensions

Literature on bank difficulties during the Great Depression typically makes little distinction between bank receiverships (failure arising from regulatory action) and voluntary liquidations (failure arising from action by the bank itself), and bank suspensions. In all cases, a bank closes and customers lose access to their funds. The cases differ, however, in how long the customer loses access and the balance to which the customer regains access.

Under the bankruptcy law of the period, receivers were not imbued with any responsibility for resuscitating the bank, only managing the liquidation of its assets and appropriately distributing the funds from that liquidation to creditors (Mason 1996). Similarly, trustees responsible for voluntary liquidations were concerned only with the efficient liquidation of the bank and the legally appropriate distribution of the proceeds to creditors.
Suspension, on the other hand, involves no trustees or receivers, nor necessarily any liquidation of bank assets. Rather a suspension merely refers to a period during which customers lose access to their funds. Suspension need not even involve a bank’s temporary closure (though that is usually the case). Some banks might merely prohibit withdrawal of a portion of customer deposits on a temporary basis. Calomiris and Gorton (1991) demonstrate that most bank suspensions of the nineteenth century lasted only a short period, typically a couple of days, after which many banks reopened for normal business. Even in the Great Depression, a substantial number of suspensions did not result in bank failure (as characterized by receivership or voluntary liquidation).

Discussions of bank difficulties during the Great Depression usually do not distinguish bank suspensions and bank failures. That distinction is often lost because of the way the data used for describing bank difficulties were originally reported in the Federal Reserve Bulletin. Footnotes to this widely published series explain that the series contains a mixture of failures (for nationally chartered banks) and suspensions (for state chartered banks).

An inventory of state banking department annual reports suggests why the Federal Reserve may have reported the data in such a fashion. Although all states give the dates of state bank closures (whether because of failure or suspension), only around half give dates of bank failures, per se. Since all failures involve a suspension of customer payments, suspensions may be a useful proxy for failures in states that do not report them. Publishing only suspensions even for those states that did provide failure data was one way to provide a consistent data series on state banking difficulties over the period.

Mixing failures and suspensions, however, overstates the number of bank failures and the amount of deposits in failed banks and therefore misstates the economic importance of failures.
relative to business cycle fluctuations and persistence. The size of the overstatement may be
derived in part from Tables 2 and 3 in Calomiris and Mason (2002a), which shows the difference
between Federal Reserve Member bank failure data and the published failure-suspension data.
According to failure-suspension data, 9.8% of banks holding 6.1% of deposits as of December
31, 1929 failed or suspended in the period January 1, 1930 to December 31, 1932. According to
Calomiris and Mason’s sample of Federal Reserve member banks, only 4.6% of banks with 4.8%
of deposits as of December 31, 1929 failed outright during that same period. These estimates
leave 948 banks with $647 million in deposits that may have suspended without failing during
the period.

Of course, that comparison is much more dramatic in 1933, when 100% of banks
containing 100% of bank deposits suspended for the March Bank Holiday. However, according
to Calomiris and Mason’s (2002a) sample of Federal Reserve member banks only 1.82% of
banks with 2.84% of deposits (as a proportion of banks and deposits existing at December 31,
1929) failed outright during 1933. Given the magnitude of the difference between failure and
suspension in 1933, it is not surprising that the spike in Bernanke’s series introduces
considerable complexity and noise into his analysis (1983, p. 270).

B. The Liquidation Experience

The previous section suggests that mixing bank failures and suspensions overstates the
incidence of economically meaningful bank failure. But why is that overstatement economically
important? Because it may take a long time for bank customers to regain access to their balances
in the event of a failure, while that is not generally the case in suspensions. When customers do
not have access to bank balances, that money cannot be used for savings (outside the present
investment in insolvent bank assets) or consumption expenditures. Worse yet, when a bank was
liquidated, the best assets were usually presented for sale to larger banks in the cities. As the Great Depression progressed and city banks took on more failed-bank assets, the price they offered for additional assets fell dramatically, leading trustees to wait for price recovery. With low interest rates, waiting entailed little opportunity cost (e.g., promoting further delay). Hence, in practice the progress of bank liquidation may slow considerably as trustees search for reasonable asset prices while the crisis deepens.

Mason (2002) demonstrates that even in contemporary periods, bank asset liquidations take just under six years, on average, and progress at a fairly linear rate. Mason suggests that slow liquidations are a direct result of the trustee’s real option on asset values just described. If the trustee believes that asset prices will rise enough in the near future to offset opportunity costs, the trustee may delay liquidating those assets. In the real options liquidation model, expectations of future price movements are a function of past realized volatility and price trajectory (relative to opportunity cost). Mason’s real option model suggests that high asset market volatility and low discount rate – price growth spreads following the market crash of 1929 may have prolonged liquidations of some bank assets.

Anecdotal evidence demonstrates that bank regulators during the Depression understood that liquidation delays created difficulties for banks and their customers. Willis and Chapman (1934) expressed that:

...in bank failures the source of difficulty and losses is not primarily found in lack of assets, but is found in the fact that the resources of depositors are tied up and rendered unavailable for long periods, during which there is a corresponding drag in the process of liquidation (1934, p. 65).

Liquidations during the Depression took longer and resulted in more severe losses than in previous bank failure episodes. Bank supervisors were often caught unprepared for the task of
liquidating massive amounts of bank assets, not only in terms of personnel, but also in terms of legal precedent and market depth. According to Upham and Lamke (1934):

During the last few years, the staffs of the supervisors have been ... heavily taxed with liquidation cases ... (1934, p. 40).

Similarly, in December 1931 the Superintendent of Banks for the State of New York wrote:

One of the greatest problems with which this Department has ever been confronted arose this year from the necessity for releasing funds and credit from closed institutions with all possible speed (1931, p. 9).

According to the Superintendent of Banks for the State of Ohio:

The burden placed upon [the Department], due to the increased number of closings, found the Division prepared in but a limited way for such additional responsibility (1931, p. 30).

The New York Superintendent noted that one additional source of delays was legal frictions that slowed the process of liquidation and disbursement of funds to depositors:

Our State is unaccustomed to bank closings and consequently the means which we have today to meet such conditions are those which have been in existence for decades past. The Banking Law relating to liquidation of closed institutions by the Superintendent as it now stands places legal encumbrances on liquidation procedures which are a deterrent to a prompt distribution of funds to depositors. (1931, p. 9)

Indeed, a brief scan of important cases reported in the Banking Law Journal indicates that many significant bankruptcy law developments took place in New York courts during 1931.

In summary, since the average liquidation time among national banks during the Great Depression was slightly more than six years (at about a straight-line average rate), customers could remain illiquid for quite some time.6 (A more detailed presentation of the length and rate of bank liquidations, along with estimates of the opportunity cost of delay, is provided in the data section.) Furthermore, liquidation times and rates are variables in a potentially endogenous cycle that may, if large enough, be a primary source of business cycle persistence.
C. The Macroeconomic Importance of Liquidations

The above discussion underscores the importance of careful bank liquidation in supporting economic growth. An important effect of slow deposit liquidations in the 1930s arises because, without deposit insurance, deposit balances are unavailable to either consumers or banks during the period of liquidation. This observation is the basis of one of the primary debates about the source of economic effects arising from bank failures during the Great Depression. One side of the debate holds that the primary effect on economic growth arose from decreased consumer demand for goods and services (real effects), which reduced credit demand and instigated a cycle of economic deterioration. The other side holds that banks’ lack of funds reduced credit supply, again propagating a cycle of economic deterioration.

In this paper, we argue that regardless of the channel of knock-on influences that reinforce economic conditions, it is important to revisit the source of the initial shock to credit supply and/or demand. We believe that an important, often-overlooked, contributor to this initial shock is the liquidation technology used to resolve bank failures.

Our approach extends Bernanke’s (1983) original research. It is important to recognize that although he initiated the credit supply/demand debate, Bernanke (1983) really only sought to identify a plausible mechanism that could explain the propagation of the Great Depression beyond Friedman and Schwartz’s (1963) classic account. Without this mechanism, there is no credit supply/demand debate.

Bernanke also wrote in his article that the version of the credit view he tested econometrically was imperfectly specified. Although Bernanke only possessed data that is best described as the flow of deposits in closed banks per month, he surmised that as “…a matter of theory, the duration of the credit effects … depends on the amount of time it takes to 1) establish
new or revive old channels of credit flow after a major disruption and 2) rehabilitate insolvent debtors” (1983, p. 272). The difficult and slow adjustment of these two factors forms the basis of Bernanke’s argument for the persistence of nonmonetary effects. However, lacking relevant data, anecdotal detail and subjective survey reports are the only sources of evidence given for this centrally important assertion.

The present study therefore fills an important gap in the literature. Our data on bank asset liquidations captures many of the effects Bernanke’s failed and suspended bank deposit flow data lacked. Our liquidation data more accurately captures creditor sentiment in the economy, reflecting both the potential for redeposit (the credit supply channel) and/or increased capacity for consumption (the credit demand channel) more accurately than the series used previously.

Thus it is not surprising that our data demonstrate a high correlation between bank liquidation and economic recovery during the Great Depression. Indeed, our data series of national bank liquidations produces a markedly different time series of financial distress than the familiar series of deposits in failed and suspended banks based on the Federal Reserve data and used in Bernanke (1983) and subsequent work. Figure 1 plots our national bank deposits in liquidation (stock) series along with a comparable failed national bank deposit flow series and the familiar failed-suspended bank deposit flow series from Bernanke (1983).

Two differences are apparent among the series in Figure 1. The first is one of magnitude. Our series is a stock of unliquidated deposits from failed banks, whereas the more familiar series are flows of deposits into that unliquidated stock. Because of liquidation delays, the stock grows quite large (compared to the relevant flow of failed national bank deposits) around the trough of the Great Depression and tails off slowly thereafter. Interestingly, this stock does not decrease to pre-Depression levels until around 1939, well after the March 1933 business cycle trough. Hence
the series illustrates a mechanism through which earlier bank failures could have persistently affected macroeconomic performance long beyond their date of failure, a feature lacking in most models of business cycle persistence.

The second difference is one of noise. The familiar flow series contain spikes arising from suspensions and failures in and around the month of the national Bank Holiday on March 3, 1933. As mentioned earlier, relatively few of the banks that were closed for the three-day holiday actually failed and subjected customers to the deposit liquidation process. Furthermore, many of the failures that did subject customers to deposit liquidation happened later in 1933, as regulators recapitalized or closed weak banks prior to membership in the Federal Deposit Insurance Corporation (FDIC) on January 1, 1934. In summary we expect relatively few of the bank deposits in the suspension spikes to have long-lasting effects on economic activity, and many of the failures that we expect to have such effects occurred later in 1933 than previously believed.

It appears, therefore, that the relevant effect Bernanke originally attempted to measure is more one of asset market “seizing” in reaction to persistent high asymmetric information following banking crises. Bank asset liquidation data characterizes that effect more directly than simple failed bank deposit flow data because the liquidation data inherently reflects the runoff in creditor incapacity (for the credit demand hypothesis) and liquidity (for the credit supply hypothesis) that is believed to correlate with economic recovery.

II. Data Description

Our data are hand-gathered from almost 15,000 individual national bank liquidation updates published in the Comptroller of the Currency’s Annual Report. For each individual bank the Annual Report contains the date the liquidation began and ended, amounts of nominal and additional assets, losses on assets, expenses of receiverships, claims proved, dividends paid, and
other data. Records from all 2,375 national banks that failed between 1921 and 1940 were collected. We linearly interpolate the liquidation progress between annual observations and aggregate the individual bank records into a monthly failed national bank deposit stock series (composed of claims proved minus dividends paid at each period) that we analyze and compare to the typical flow series on deposits in banks that closed each month.

Our data series is restricted to national bank liquidations. To check for sample bias we performed a cross-sectional survey of state bank reports to compare state and national bank liquidations. Only about half the states list the state-chartered banks entering receivership during the year in their annual report, and only half again list any indication of the progress of liquidation after receivership. As such, only about one-quarter of the states in the U.S. report any data on the liquidation of state-chartered banks (i.e., most commonly the names of banks in liquidation), and only a handful report useful financial data on the progress of the liquidation comparable to that for national banks. Receiverships in states that reported financial data experienced slower liquidations, on average, than national bank receiverships. Therefore, their inclusion would probably further magnify the business cycle persistence and lending channel effects reported in forthcoming empirical results.9

Table 1 provides details of the liquidation progress of failed national banks by year of failure. The first column in Table 1 shows the number of new receiverships (failures) each year between 1929 and 1939. Although the series begins similar to others describing bank distress during the Great Depression, there is no spike in failures during 1933 and the number remains high into 1934. This time path is reflective of the failure of national banks administered after the bank holiday of March 1933 and, because depositors in many cases only lost access to their
funds upon actual ultimate failure, is more appropriately reflective of the incidence of long-term financial distress upon the broader economy. 10

The second column in Table 1 shows the number of receiverships administered during each year, which grows steadily from 531 in 1929 to 1,649 in 1934. The series does not return to 1929 levels until around 1939, when 536 national bank receiverships are still under administration. The number of receiverships administered provides insight into the fact that bank failures generally took a long time to resolve. A peak of 384 bank failures occurs in 1934 and receiverships administered reaches 1,649 in that year. Although bank failures drop precipitously after that 1934 – to 22 in 1935, 8 in 1936, and 10 in 1937 – receiverships under administration remained high for years thereafter – maintaining levels of 1,582 in 1935, 1,427 in 1936, and 1,223 in 1937.

Even if a failed bank was not fully resolved, substantial amounts of deposits might have already been paid to depositors. In this regard, the remaining columns of Table 1 illustrate average payouts for banks failing each year. Since the present paper is concerned with liquidity and not wealth, these payouts relate to amounts finally paid. For instance, since the average final payout for national banks failing in 1929 was 66.12 cents on the dollar, the table records the $0.6612 aggregate payout for banks failing in 1929 as 100%.

The results in Table 1 indicate that, on average, only about twenty percent of the final amount was paid out in year zero, the year of failure. Another forty percent, on average was paid out in year one, fifteen percent in year two, seven percent in year three, and the remaining portion in the several years following. The standard deviations around these means are also greatest during the first few years of resolution, though this is probably due to a higher average payout percentage in the first three years relative to subsequent periods. The coefficient of
variation for year zero is higher than years one or two, which could be due to the effects of dates of failure within a given year. Banks failing late in the Comptroller’s fiscal year would be expected to report fewer assets liquidated than those failing earlier in the year. The effect of failure timing within the year diminishes as liquidation progresses over the next couple of years, reflected by decreasing coefficients of variation. Coefficients of variation again rise above year zero in later years, possibly due to the greater difficulties associated with selling less liquid assets later in the resolution.

The distribution of liquidation rates is illustrated more generally by the shading in Table 1. Dark shading in Table 1 reflects years where liquidation proceeded at over 10%. Lighter shading reflects years where liquidation proceeded at between 5% and 10%. No shading reflects liquidation rates below 5%. Periods prior to rapid liquidation are shaded at the level associated with the higher liquidation rate, hence 1936, 1938, and 1939 year zero rates are shaded dark.

Years zero and one in Table 1 are shaded dark in every year, indicating high liquidation rates in the first two years are typical, in accordance with the relatively low coefficients of variation for these years. Years two and three in Table 1 are sometimes dark, sometimes light, and sometimes unshaded, indicating more variation in liquidation rates during these years. This explains the higher coefficients of variation on collections in these years. Liquidations in years four through six never exceeded 10%, though out of the eleven years of failures covered in Table 1, six proceeded at the 5% to 10% level in year four, four proceeded at that rate in year five, and two proceeded at that rate in year six. Thus by year six, the standard deviation of the collection rate is falling, but due to low amounts collected in these years, the coefficient of variation is rising.
Table 2 contains information concerning the economic significance of the liquidation rates. Table 2 uses the recovery paths from Table 1 and a variety of discount rate scenarios to estimate present values of the final recoveries and derive a (negative) return that reflects the price of waiting. Table 2 is constructed by using the recovery paths of national banks to determine (upper bound) expected cash flows each future period from the liquidation of estimated total deposits in all (state and national) failed (not suspended) banks, 1929-1939. The resulting cash flow is discounted using rates ranging from risk-free Treasury bills to Moody’s Baa bonds to form present value discounts for the time taken to liquidate failed-bank assets. As discussed above, since time paths for the liquidation of state bank assets are thought to be longer than those for national bank assets our national bank time path should provide a conservative (under)estimate of the present value. The formula for estimating the present values reported in Table 2 is:

\[
NPV_{of\ Recovery} = P_t A + \left( \frac{1}{(1 + r_{t+1})} \right) P_{t+1} A + \left( \frac{1}{(1 + r_{t+2})^2} \right) P_{t+2} A + \ldots + \left( \frac{1}{(1 + r_{t+i})^i} \right) P_{t+i} A
\]

where

\[ P = \text{proportion paid out in the year (from Table 1)}, \]
\[ A = \text{ultimate amount of recovery, and} \]
\[ r = \text{the selected discount rate}. \]

Table 2 shows that average present value discounts on assets in liquidation during the 1930s range from an average of 1\% (using Treasury bill rates) to around 7.25\% (using Moody’s Baa rates). The discounts across years using Treasury bill rates range from 0.05\% to 4.06\%. Using Baa rates, they range from 4.10\% to 11.94\%. Overall, the time spent liquidating banks contributed somewhere in the neighborhood of $100 million to $500 million to direct liquidation costs, which amounts to around 50 basis points of average 1929-1940 GNP.
Based on Table 1, it appears that liquidations of banks failing in the crisis years of 1931 and 1932 are longer and slower than liquidations of banks failing at other times. Interestingly, the highest discounts do not necessarily come from banks failing in those crisis years, but from those failing in years preceding interest rate peaks in the discount rate series, 1931 and 1937. Hence, as in Mason (2002), there appears to exist an interplay between discount rate – growth spreads and asset price volatility that creates high opportunity costs in Table 2 for banks that are the most unliquidated at the discount rate spikes, i.e., recent failures. We believe that the sorts of effects illustrated in Tables 1 and 2 are the root source of illiquidity and uncertainty, and are therefore correlated with macroeconomic recovery.

How does the liquidation experience empirically relate to economic recovery? Consider, for example, the experience of banks that failed in 1933. Table 1 shows that by year five, the collection rate for banks failing in 1933 was 6.90%, for a cumulative total of 85.55%. Since the final recovery national from banks that failed in 1933 was around $0.78 per $1 of deposits prior to failure, the recovery at this point amounted to about $0.67 per $1 of deposits prior to failure (85.55% x $0.78). At this point liquidation rates diminished considerably (to about one percent per year) and creditors would be expected to estimate a low expected present value of additional recoveries. Hence, the liquidation process settles down in 1938, just prior to economic recovery.

A similar pattern can be seen (indicated by the stepped line in Table 1) for banks failing in 1934 and 1932, which together with 1933, encompass the vast majority of national bank failures during the Great Depression. The pattern even holds to a lesser extent for failures occurring in 1931 and 1930, illustrating what – for reasons described above – we believe is an important correlation between liquidation progress and economic recovery.
III. Econometric Methods

In sum, delays in liquidating bank failures resulted in direct effects, including depositor illiquidity, asset market overhang, and money contraction, as well as a number of negative spillover effects, such as deposit disintermediation, declining collateral values for real assets, reduced real asset liquidity, and increased credit restrictions. These events forced banks to increase liquidity and shed risk (Friedman and Schwartz, 1963; Calomiris and Wilson, 1998). Like Bernanke (1983), we believe the depth of the Great Depression was driven in large part by the duration of – and interplay between – money, price, and credit effects. Under this interpretation of events, the initial rapid collapse in expenditures under the Keynesian view was a trigger mechanism that set the stage for the subsequent more complex and potentially damaging transmission process that generated large persistent fluctuations in output during the Depression.

We formally test our conjectures of whether liquidation is an important determinant of this process by modifying Bernanke’s (1983) model of credit disruption and macroeconomic performance. We do so by substituting our series of bank distress created from national bank deposits in liquidation for the common series of failed and suspended bank deposit flows in Bernanke’s (1983) model. Ultimately, we find that the revised series better explains business cycle persistence into the late 1930s.

Figure 1 exhibits our stock series of deposits in failed banks. The skewed distribution reveals that the level of the data series increased rapidly in the period 1931-1934 and then gradually declined until 1940. We interpret this evidence to mean that there was approximately a ten-year period of credit disruption in the banking industry. By contrast, Bernanke’s flow series contained a large spike in March 1933 accompanied by smaller variations in the period 1931-1935, which led him to infer a five-year period of bank credit distress. The difference in the
estimated longevity of the banking crisis can be attributed to the persistence of banking sector
disruption caused by an immense stock of failed bank assets in liquidation, and commensurately
deposits in closed banks, that gradually declined in the period 1935-1940.

Time series modeling has evolved considerably since Bernanke’s (1983) work. For this
reason we adopt a VAR specification instead of Bernanke’s original two-stage regression
approach. Since the influential paper by Sims (1980) on the identifying restrictions of structural
models, the VAR system and its extensions have been used in a large number of macroeconomic
studies for forecasting as well as hypothesis testing. The VAR approach avoids the imposition of
spurious constraints and offers a dynamic framework to examine possible linkages between the
variables under study. Once a VAR model is estimated, it offers estimates of forecast error
variance (FEV) decompositions and impulse response functions for each of the variables. FEVs
indicate the percentage of prediction errors in a given variable attributable to unexpected
movements (or shocks) in other variables as well as to its own shocks. Impulse response
functions show the duration and the manner in which one variable may have responded to
unexpected movements (or shocks) in each of the other variables.

In the present context the FEVs and associated impulse response functions for aggregate
output attributable to prices, money, credit, and own (output) shocks are particularly useful for
investigating how the duration of bank liquidations played a role in the persistence of the Great
Depression. An interesting empirical issue is the relative importance or weights of monetary
versus nonmonetary variables with regard to output declines. While our primary emphasis is on
the duration of bank liquidations, as Bernanke (1983, 268) has pointed out, VAR results for the
monetary variables are also independently of interest to understanding the Depression years more
generally.
We construct a four-variable VAR model of the U.S. economy employing the following variables: (1) index of industrial production as a measure of macroeconomic activity (INP), (2) wholesale price index (WPI) for prices, (3) M1 for money supply (MS1) (4) and the stock of failed national banks’ deposits for credit availability (DCB). These variables are the same as in Bernanke’s 1983 paper, with the exception of the last variable, which we have seen differs markedly from the flow specification of deposits in closed banks. We experimented with other series in the specifications, but these additions and substitutions detracted from the explanatory ability of the model and are not reported here.

Figure 2 illustrates the monthly data series for these variables during the period from January 1921 to December 1940. This period should be sufficiently long to reflect the full dynamism of economic forces that preceded the deep Depression during 1929-1933 and subsequent slow recovery over seven years until 1940.

For the sake of exposition, the Appendix contains a technical description of the VAR methodology, including FEV decompositions, impulse response functions, and associated statistical tests. Three important issues must be addressed in empirical estimation of a VAR model: (1) the order of the VAR (i.e., lag length of the variables), (2) the specification of the VAR in levels or first differences of the variables, and (3) the identification of the estimated model. For the determination of the lag order, we use an asymptotic chi-square test suggested by Sims (1980). The Sims procedure begins by testing a VAR model of order one against a VAR model of order two, then a VAR model of order two against a VAR model of order three, etc…

To determine whether to specify the model in levels or the first differences of the variables, we test the variables for cointegration (i.e., the existence of a set of long-run relationships between the variables in the VAR system) using a test procedure suggested by
Johansen (1989). If the variables are cointegrated, then a VAR model using first differences of the variables is misspecified. In this case the VAR model must be specified as a cointegrated VAR model (i.e., restricted by the cointegrating vectors), which is known as a restricted VAR model or vector error correction (VEC) model. Engle and Granger (1987) have shown that the cointegrating restriction is satisfied asymptotically by a VAR in levels of the variables. Thus, it is appropriate to specify and estimate both unrestricted and restricted VAR models and examine the resultant impulse response functions and variance decompositions.

For the identification of the VAR and VEC models, we rely on the generated impulse response functions from the models. Since the models contain aggregate output and aggregate price variables, they are identified if the response of output to a shock in price is positive (negative) and the response of price to output is negative (positive). The positive response represents the supply side of the economy, and the negative response corresponds to the demand side.

We estimate orthogonalized and nonorthogonalized variance decompositions for industrial production. The orthogonalized decompositions are estimated using Choleski's decomposition of the covariance matrix. It is well known that there are two problems associated with orthogonalized variance decompositions. First, the orthogonalized error variances will not be invariant to the ordering of the variables in the VAR. Second, under orthogonalized error variance decomposition, the decomposed error variances add up to unity by construction. For these reasons, we also use a nonorthogonalized error variance method developed by Pesaran and Shin (1998) known as generalized variance decompositions. The decomposition results from the generalized method are invariant to ordering of the variables in the VAR and the sum of forecast error variances need not sum up to unity.
IV. Empirical Results

Based on the Sims test results in Table 3, a VAR model of order 12 or higher is suggested. A VAR model with 12 monthly lags was estimated and found to be serially correlated using the LaGrange multiplier test. Upon increasing the lag length to 13, the resultant model passed the serial correlation test; hence, a VAR model of order 13 was selected. Using Johansen’s method, we employed the same lag structure and tested for the existence of cointegration among the four variables. Since this method is applicable to time series variables that are integrated of order one (i.e., nonstationary in levels but stationary in first differences), we pretested the four variables using augmented Dickey and Fuller (ADF) unit root tests. As shown in Table 4, the unit root test results indicated that all four variables are integrated of order one. Furthermore, the Johansen's test results shown in Table 5 suggested the existence of two cointegrating vectors. Hence, we estimated a cointegrated VAR model with 13 monthly lags that was restricted with two cointegrating vectors.

To check whether the estimated models are identified, we estimated impulse response functions for the two models over a seven-year period (see Figures 3 and 4). Referring to the restricted VAR (VEC) model, Figure 3.1 shows the responses of the index of industrial production to a one standard deviation shock in prices. The positive response of output to price shocks confirms the supply relation. Also, as shown in Figure 3.4, the negative response of prices to output shocks confirms the demand relation. Comparable impulse response functions are obtained for the unrestricted VAR model, as shown in Figures 4.1 and 4.4. Thus, we infer that the VEC and unrestricted VAR models are identified.

The VEC model impulse response functions in Figure 3 summarize the dynamic relationships between the variables. The responses of output to price and money shocks in
Figures 3.1 and 3.2, respectively, are predictably positive with relatively larger price than money effects. Particularly relevant to the present study, Figure 3.3 shows that a one standard deviation shock in the stock of failed-bank deposits had an immediate and sharp negative effect on the index of industrial production. The duration of the negative effects of a failed-bank deposit shock is about 60 months (or five years), which is likely determined by the time path of the multiple credit effects discussed in the previous section. Moreover, notice that a permanent negative effect is not obtained after 60 months, which we interpret as at least weak evidence that the eventual resolution of closed banks rectified credit channel problems.

Turning to other impulse response functions, Figure 3.9 shows that failed-bank deposits had negative effects on money supply that gradually increased in magnitude over about 30 months and thereafter became permanent. This evidence implies that delayed resolution of closed banks played a major role in money supply contraction during the Depression. As seen in Figure 3.6, prices were also negatively affected by closed bank deposits for about 40 months, but this negative effect was not permanent. Consistent with our historical observations, we infer from this evidence that credit effects can spread out and interact with a wide variety of macroeconomic variables.

Since the impulse response functions for the unrestricted VAR model in Figure 4 are very similar to those for the restricted VAR model in Figure 3, we infer that the impulse response function results are invariant to VEC versus VAR model specification.

Table 6 reports the estimates of the forecast error variance (FEV) decompositions of the four variables in the restricted VAR system based on the Choleski method of orthogonalization of the covariance matrix. The FEVs are estimated over a ten-year forecast horizon. Since the results from the Choleski method can depend on the ordering of the variables, the left panel of
Table 6 reports the range of FEVs obtained from ordering the index of industrial production and deposits of failed banks either first or last in the decomposition process. As shown there, the ordering of the variables does not have a large effect on the FEVs. The right panel of Table 6 summarizes these results by giving the averages of the FEV ranges provided in the left panel.

The average FEVs reported in the right panel of Table 6 indicate that own (output or INP) shocks were important only for a one-year forecast horizon. Over longer forecast horizons the FEVs of prices, money supply, and closed bank deposits played increasingly important roles in explaining variations in output. The percentage of squared prediction error of the index of industrial production attributable to price shocks increases from 26.1% in the first year of the forecast horizon to more than 30 percent in the second year and then gradually increases to over 45 percent by the end of the fifth year. By years six or seven in the forecast horizon the full effects of price changes on output are permanent. The FEV of industrial production attributable to money supply was 13.8% in the first year of the forecast horizon and thereafter reflects a permanent effect over time. By comparison, the stock of failed-bank deposits appears to have a stronger effect than money supply on output over time. Shocks to bank deposits explain more than 30 percent of the squared prediction error of the index of industrial production at the end of the second year of the forecast horizon and thereafter the FEVs reach a permanent level.

The FEV results from the unrestricted VAR model in Table 7 provide further evidence on the interactions between the variables under study and persistence of their respective effects on output. Own shocks on industrial production produce FEVs over the forecast horizon that are similar to those for the VEC model. Also, the FEVs for price shocks are like those discussed above for the VAR model. In the FEVs for money and failed-bank deposits shocks, the money supply appears to have a stronger effect than failed-bank deposits on output. FEVs for money
supply rise from about 17 percent in the first year of the forecast horizon to over 30 percent by the third year. By contrast, FEVs for failed-bank deposits rise from 9% in the first year of the forecast horizon to about 20 percent by the fourth year and then decline to about 17 percent in later years of the forecast horizon.

Tables 8 and 9 report the estimates of generalized FEV decompositions for industrial output from the VEC and VAR models, respectively, using nonorthogonalized error variances that are invariant to ordering of the variables in the VAR system. A comparison of the results from nonorthogonalized errors and the corresponding average results from orthogonalized error variances shows that the two methods produce very similar results. We infer that the results are robust to orthogonalized versus nonorthogonalized VEC and VAR specifications.

In sum, the FEV and impulse response function results for the VEC and unrestricted VAR models are consistent with one another for the most part. The results reveal that bank insolvencies and subsequent liquidation processes negatively affect both the depth and duration of output declines during the Great Depression. Interestingly, shocks in the stock of failed-bank deposits were comparable to money supply shocks in terms of their effects on economic activity. These results strongly favor a hypothesis by which nonmonetary effects originating in the deposit liquidation function augmented monetary effects in causing the magnitude and persistence of the economic collapse during the Great Depression.

V. Summary and Conclusions

Anecdotal accounts and surveys of disintermediation, liquidity, and wealth effects arising from bank failures intuitively suggest that bank failures play a role in long-run business cycle persistence. However, previous empirical work on the credit channel hypothesis has been limited to measuring short-run effects of bank failures, which declined substantially after 1933 and
ceased by 1935. We provide empirical evidence that suggests failed bank liquidations are a promising source of the type of dynamic long-run economic relationship between bank failures and persistence sought by Bernanke (1983) and others.

We examine potential persistence effects arising from the slow liquidation of failed-bank deposits by constructing a data series containing the stock of closed national bank deposits for the period 1921-1940. Casual inspection of our data series indicates that monetary contraction, liquidity effects, and asset market overhang arising from slow liquidation rates correlate well with business cycle persistence following the Great Depression. From this evidence we infer that banking distress during the Depression lasted around ten years, rather than merely five years as previously measured.

The long duration of banking distress, as measured by liquidation time, is by itself a compelling case for the notion that a number of varied effects stemming from the slow liquidation of bank assets worsened and lengthened the economic collapse during the Depression. We formally investigate the relationship between the liquidation of failed banks and the persistence of the Depression using vector autoregression (i.e., VEC and VAR) models. Based on different variable orderings and orthogonal assumptions, we find that changes in prices explained the largest proportion of fluctuations in industrial output. We also find that the stock of failed-bank deposits is as important as money stock in terms of explaining output changes over forecast horizons from one to ten years. Failed-bank deposit shocks lasted for about five years and then became transitory. Furthermore, failed-bank deposit shocks had permanent negative effects on money supply and transitory negative effects on prices. Consistent with recent theories concerning linkages between the financial system and economic growth, we infer that the dynamic effects of banking sector shocks were cumulative and pervasive during the Depression.
Hence it appears that the liquidation function is accompanied by important, and sometimes unrecognized, macroeconomic policy implications.
Footnotes

1 Although a wealth loss certainly occurs in the liquidation, we assume that reasonably accurate expectations of the magnitude of the loss can be formed at the time of failure. From the time of failure the illiquid deposit “investment” may accumulate a positive return as asset values appreciate (see Mason 2002).

2 Lower quality state bank assets would be expected to take longer to liquidate. Comparisons of state and national bank liquidations are discussed at length in the data section.

3 The Resolution Trust Corporation is widely credited for successfully mitigating asset price declines, especially in the real estate sector, and thereby reducing business cycle persistence in the late 1980s and early 1990s in the US. See Klingebiel (1998) for a description of asset management companies used to smooth financial crises in a number of countries. Mason (2002) further addresses the efficiency and profitability of these arrangements in Federal Deposit Insurance Corporation (FDIC) liquidations during the 1990s. Kaufman and Seelig (2000) observe that potential depositor losses in bank failures and associated economic damage can be reduced by timely resolution of failed institutions.

4 Mason 1996 Table 1.5, for instance, illustrates the heterogeneity in state suspension terms just prior to the national bank holiday of March 1933.

5 Proponents of the suspension view will maintain that it does not take outright bank failure to promote disintermediation that can lead to business cycle persistence. While we feel that view is appropriate, the existing failure-suspension series then understates financial distress by omitting suspensions of national banks that closed according to state bank holidays. Neither series includes outflows of deposits from banks that did not fail, yet another meaningful, albeit more commonly used, measure of disintermediation analyzed at length in Calomiris and Mason (2002a and 2002b).

6 There already exists a literature on wealth effects of depositor recoveries (see, for instance, the discussion of wealth effects in Friedman and Schwartz 1963). Average payouts for national banks were about $0.56 per dollar of deposits.

7 See Calomiris and Mason (2002b) for an extensive description of the debate.

8 See Mason 1996 for background on these recapitalization attempts.

9 Two additional points are noteworthy concerning our closed bank deposit data series. First, we take into account the deposits of banks that failed prior to 1920 and were still being liquidated by including them in the amortization process. Because there were not many failed banks during the period leading up to 1920, this data adjustment had little effect on our data series. Second, it is possible that our average 6.14 year receivership duration is biased upward by a number of small banks with illiquid assets. Since the average duration weighted by the size of the bank is 16.09 years, we reject this possibility.

10 Although banks in all states were closed for the three-day holiday in March 1933, even those not immediately certified as sound thereafter usually operated on a limited basis, enabling withdrawals of at least a portion of customer deposits.

11 The FDIC estimated deposits in failed banks annually in an exercise to ascertain probable loss rates it may face providing insurance coverage. This annual series is different from the
suspension and failure series referred to earlier. The source of this data is the *FDIC Annual Report* (1940, p. 66).
References


Technical Appendix: The VAR Methodology

Let $y_t$ be an $(n \times 1)$ vector of time series variables ($t = 1, \ldots, T$). Then a vector autoregression (VAR) of order $p$ is defined as:

$$y_t = \mu + \sum_{i=1}^{p} \Phi_i y_{t-i} + \psi w_t + \varepsilon_t,$$

where $\mu$ is an $n \times 1$ vector of intercepts, $\Phi_i$ are $n \times n$ matrices ($i = 1, \ldots, p$), $w_t$ is a $q \times 1$ vector of deterministic or exogenous variables, and $\varepsilon_t$ is a $n \times 1$ vector of disturbances, such that: $E(\varepsilon_t) = 0$, $E(\varepsilon_t \varepsilon_{t'}') = \Sigma$ for all $t$, with $\Sigma$ an $n \times n$ positive-definite matrix and $E(\varepsilon_t \varepsilon_{t'}') = 0$ for all $t \neq t'$.

Since the VAR model in equation (1A) is basically a multivariate generalization of the univariate autoregressive model (AR), it is possible to write a VAR in vector moving average form. The moving average representation, MA, is written as:

$$y_t = \sum_{j=0}^{\infty} A_j \varepsilon_{t-j} + \sum_{j=0}^{\infty} B_j w_{t-j},$$

where the matrices $A_j$ are given by the following recursive relations:

$$A_j = \Phi_1 A_{j-1} + \Phi_2 A_{j-2} + \ldots + \Phi_p A_{j-p},$$

with $A_0 = I_n$, $A_j = 0$ for $j<0$, and $B_j = A_j \psi$ for $j = 1, 2, \ldots$.

Impulse response analysis. The impulse response function shows the time profile of the response of one variable to a shock in another variable in the VAR system. Since a VAR model is specified and estimated in a reduced form, the original errors, $u_t$ (i.e., the error terms associated with the structural VAR model) must be estimated from the reduced form errors. For this purpose, we use the Choleski factorization, in which a positive definite symmetric matrix is decomposed as the product of two triangular matrixes. Thus, covariance matrix of shocks, $\varepsilon_t$, is decomposed as: $\Sigma = TT'$, where $T$ is lower triangular matrix. Sims employed the Choleski
decomposition and wrote the moving average representation (2A) as:

$$y_t = \sum_{j=0}^{\infty} (A_j T)(T^j \varepsilon_{t-j}) + \sum_{j=0}^{\infty} B_j w_{t-j} = \sum_{j=0}^{\infty} A^*_j u_{t-j} + \sum_{j=0}^{\infty} B_j w_{t-j}, \quad (4A)$$

where $A^*_j = A_j T$, and $u_t = T^j \varepsilon_t$. Orthogonalized impulse response functions are given as:

$$OI_{ij,h} = u_j A_h T u_i$$, where $OI_{ij,H}$ is the response of the $i$th variable to a shock in $j$th variable for the $H$th period in the forecast horizon.

Forecast error variance decomposition analysis. Forecast error variance decompositions provide the percentage of the squared prediction error in one variable attributable to another variable at different forecast horizons. Given the orthogonalized moving-average representation of the VAR model in equation (4A), the forecast error variance (FEV) decomposition for the $i$th variable attributable to the $j$th variable in forecast horizon $H$ is calculated as:

$$OD_{ij,H} = \left( \frac{\sum_{h=0}^{H} (u_i A_h T u_j)^2}{\sum_{h=0}^{H} u_i A_h \Sigma A_h u_i} \right), \quad i,j = 1,2,\ldots,m. \quad (5A)$$
Figure 1

Failed National Bank Deposit Flows and Stocks Compared with Common Failed and Suspended Deposit Flows:
Monthly, January 1921-December 1940

Sources: Comptroller of the Currency, Annual Report, Various Issues, and authors' calculations.
Figure 2
Monthly Data Series for U.S. Industrial Production, Wholesale Price Index, Money Supply (M1), and Deposits of Closed National Banks

2.1. Index of Industrial Production

2.2. Wholesale Price Index

2.3. Money Supply (M1)

2.4 Deposits of Closed Banks
Figure 3

Impulse Response Functions for the VEC Model: Responses of Industrial Production, Wholesale Price Index, Money Supply (M1), and Deposits of Closed National Banks to a One Standard Deviation Shock in These Variables
Figure 4

Impulse Response Functions for the VAR Model: Responses of Industrial Production, Wholesale Price Index, Money Supply (M1), and Deposits of Closed National Banks to a One Standard Deviation Shock in These Variables
<table>
<thead>
<tr>
<th>Year</th>
<th>Number of New Receiverships</th>
<th>Number of Receiverships Administered</th>
<th>Cumulative Collections of Recoverable Amounts at $t$ Years After Failure (Percent):</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>1929</td>
<td>79</td>
<td>531</td>
<td>39.52</td>
</tr>
<tr>
<td>1930</td>
<td>106</td>
<td>530</td>
<td>34.08</td>
</tr>
<tr>
<td>1931</td>
<td>371</td>
<td>812</td>
<td>19.39</td>
</tr>
<tr>
<td>1932</td>
<td>382</td>
<td>1097</td>
<td>25.76</td>
</tr>
<tr>
<td>1933</td>
<td>362</td>
<td>1325</td>
<td>30.97</td>
</tr>
<tr>
<td>1934</td>
<td>384</td>
<td>1649</td>
<td>37.17</td>
</tr>
<tr>
<td>1935</td>
<td>22</td>
<td>1582</td>
<td>30.34</td>
</tr>
<tr>
<td>1936</td>
<td>8</td>
<td>1427</td>
<td>0.20</td>
</tr>
<tr>
<td>1937</td>
<td>10</td>
<td>1223</td>
<td>6.20</td>
</tr>
<tr>
<td>1938</td>
<td>2</td>
<td>885</td>
<td>0.00</td>
</tr>
<tr>
<td>1939</td>
<td>6</td>
<td>526</td>
<td>5.96</td>
</tr>
</tbody>
</table>

Sources: OCC Annual Reports and Author's Calculations. Note: Recoverable Amounts reflect the percent of total claims that were recovered over the entire period of liquidation, which average about $0.56 per dollar of deposits prior to failure for the entire period. Dark shading indicates period over which liquidation proceeds at ten percent per year. Lighter shading indicates progress of five percent per year. Stepped line indicates failure progress at 1938.
### Table 2

Discounted Recoveries from Bank Failures During the Great Depression

<table>
<thead>
<tr>
<th>Year Receiver Appointed</th>
<th>Deposits in Failed Banks ($Millions)</th>
<th>Recoveries of Deposits in Failed Banks (Percent)</th>
<th>Treasury Bills (Notes until 1931)</th>
<th>Long-Term US Gov't Bonds Aaa</th>
<th>Aa</th>
<th>A</th>
<th>Baa</th>
</tr>
</thead>
<tbody>
<tr>
<td>1929</td>
<td>$231</td>
<td>66.67</td>
<td>0.91</td>
<td>2.36</td>
<td>3.08</td>
<td>3.34</td>
<td>3.77</td>
</tr>
<tr>
<td>1930</td>
<td>837</td>
<td>71.68</td>
<td>1.30</td>
<td>3.67</td>
<td>4.51</td>
<td>4.91</td>
<td>5.60</td>
</tr>
<tr>
<td>1931</td>
<td>1,690</td>
<td>76.86</td>
<td>2.73</td>
<td>6.61</td>
<td>7.77</td>
<td>8.39</td>
<td>9.36</td>
</tr>
<tr>
<td>1932</td>
<td>706</td>
<td>76.20</td>
<td>0.48</td>
<td>4.35</td>
<td>5.37</td>
<td>5.86</td>
<td>6.68</td>
</tr>
<tr>
<td>1933</td>
<td>3,597</td>
<td>84.99</td>
<td>0.30</td>
<td>4.46</td>
<td>5.57</td>
<td>5.99</td>
<td>6.78</td>
</tr>
<tr>
<td>1934</td>
<td>37</td>
<td>72.97</td>
<td>0.24</td>
<td>3.11</td>
<td>3.74</td>
<td>4.00</td>
<td>4.55</td>
</tr>
<tr>
<td>1935</td>
<td>14</td>
<td>71.43</td>
<td>0.41</td>
<td>3.80</td>
<td>4.50</td>
<td>4.77</td>
<td>5.41</td>
</tr>
<tr>
<td>1936</td>
<td>28</td>
<td>85.71</td>
<td>0.24</td>
<td>2.28</td>
<td>2.70</td>
<td>2.86</td>
<td>3.30</td>
</tr>
<tr>
<td>1937</td>
<td>34</td>
<td>85.29</td>
<td>4.06</td>
<td>8.09</td>
<td>9.02</td>
<td>9.35</td>
<td>10.19</td>
</tr>
<tr>
<td>1938</td>
<td>59</td>
<td>91.53</td>
<td>0.05</td>
<td>2.74</td>
<td>3.41</td>
<td>3.62</td>
<td>4.30</td>
</tr>
<tr>
<td>1939</td>
<td>159</td>
<td>88.68</td>
<td>0.67</td>
<td>4.06</td>
<td>4.81</td>
<td>5.04</td>
<td>5.60</td>
</tr>
</tbody>
</table>

Table 3

Sims Test Statistics for Selecting the Order of the VAR Model

<table>
<thead>
<tr>
<th>Lag length</th>
<th>$\chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>68.71*</td>
</tr>
<tr>
<td>14</td>
<td>81.33*</td>
</tr>
<tr>
<td>13</td>
<td>94.27*</td>
</tr>
<tr>
<td>12</td>
<td>112.56*</td>
</tr>
<tr>
<td>11</td>
<td>131.61</td>
</tr>
<tr>
<td>10</td>
<td>156.99</td>
</tr>
<tr>
<td>9</td>
<td>178.01</td>
</tr>
<tr>
<td>8</td>
<td>208.61</td>
</tr>
<tr>
<td>7</td>
<td>221.12</td>
</tr>
<tr>
<td>6</td>
<td>245.22</td>
</tr>
<tr>
<td>5</td>
<td>256.12</td>
</tr>
<tr>
<td>4</td>
<td>281.28</td>
</tr>
<tr>
<td>3</td>
<td>308.35</td>
</tr>
<tr>
<td>2</td>
<td>352.66</td>
</tr>
<tr>
<td>1</td>
<td>510.05</td>
</tr>
</tbody>
</table>

*aAn asterisk denotes significance at the five percent level.
<table>
<thead>
<tr>
<th>Variable</th>
<th>With constant</th>
<th>With constant and trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>INP</td>
<td>-1.54</td>
<td>-1.72</td>
</tr>
<tr>
<td>WPI</td>
<td>-1.31</td>
<td>-1.77</td>
</tr>
<tr>
<td>MS1</td>
<td>0.58</td>
<td>-0.28</td>
</tr>
<tr>
<td>DCB</td>
<td>-0.45</td>
<td>-2.18</td>
</tr>
<tr>
<td>ΔINP</td>
<td>-6.72</td>
<td>-6.69</td>
</tr>
<tr>
<td>ΔWPI</td>
<td>-5.83</td>
<td>-5.82</td>
</tr>
<tr>
<td>ΔMS1</td>
<td>-4.34</td>
<td>-4.50</td>
</tr>
<tr>
<td>ΔDCB</td>
<td>-2.98</td>
<td>-3.88</td>
</tr>
<tr>
<td>5% Critical Value</td>
<td>-2.87</td>
<td>3.43</td>
</tr>
</tbody>
</table>

Notes: INP = index of industrial production. WPI = wholesale price index. MS1 = money supply as measured by M1. DCB = stock of failed national banks’ deposits. Δ = first difference of the respective variable.
Table 5

Johansen’s Cointegration Tests$^a$

<table>
<thead>
<tr>
<th>Likelihood Ratio</th>
<th>5 percent critical value</th>
<th>Hypothesized number of cointegrating vector(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>74.22</td>
<td>62.99</td>
<td>None *</td>
</tr>
<tr>
<td>45.05</td>
<td>42.44</td>
<td>At most 1*</td>
</tr>
<tr>
<td>23.20</td>
<td>25.32</td>
<td>At most 2</td>
</tr>
<tr>
<td>4.81</td>
<td>12.25</td>
<td>At most 3</td>
</tr>
</tbody>
</table>

$^a$An asterisk denotes significance at the five percent level.
### Table 6

Forecast Error Variance Decompositions of the Index of Industrial Production
Using the Restricted VAR (VEC) Model

<table>
<thead>
<tr>
<th>Forecast horizon (years)</th>
<th>Percentage of squared prediction error of INP produced by innovations to:</th>
<th>Average percentage of squared prediction error of INP produced by innovations to:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>INP</td>
<td>WPI</td>
</tr>
<tr>
<td>1</td>
<td>41.9-56.6</td>
<td>20.9-31.2</td>
</tr>
<tr>
<td>2</td>
<td>15.5-19.1</td>
<td>33.5-36.0</td>
</tr>
<tr>
<td>3</td>
<td>12.2-13.6</td>
<td>40.2-41.1</td>
</tr>
<tr>
<td>4</td>
<td>11.7-12.3</td>
<td>41.8-43.6</td>
</tr>
<tr>
<td>5</td>
<td>11.8-11.8</td>
<td>45.9-46.1</td>
</tr>
<tr>
<td>6</td>
<td>11.4-11.7</td>
<td>47.1-47.7</td>
</tr>
<tr>
<td>7</td>
<td>11.1-11.4</td>
<td>47.4-48.1</td>
</tr>
<tr>
<td>8</td>
<td>11.1-10.6</td>
<td>46.7-47.5</td>
</tr>
<tr>
<td>9</td>
<td>10.6-10.1</td>
<td>46.0-45.1</td>
</tr>
<tr>
<td>10</td>
<td>9.6-10.0</td>
<td>42.9-43.8</td>
</tr>
</tbody>
</table>

Notes: INP = index of industrial production.  
WPI = wholesale price index.  
MS1 = money supply as measured by M1.  
DCB = stock of closed national banks’ deposits.
### Table 7

Forecast Error Variance Decompositions of the Index of Industrial Production Using the Unrestricted VAR Model

<table>
<thead>
<tr>
<th>Forecast horizon (years)</th>
<th>Percentage of squared prediction error of INP produced by innovations to:</th>
<th>Average percentage of squared prediction error of INP produced by innovations to:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>INP</td>
<td>WPI</td>
</tr>
<tr>
<td>1</td>
<td>45.4-61.4</td>
<td>15.3-26.8</td>
</tr>
<tr>
<td>2</td>
<td>24.4-28.3</td>
<td>26.1-33.4</td>
</tr>
<tr>
<td>3</td>
<td>24.1-25.2</td>
<td>25.7-33.4</td>
</tr>
<tr>
<td>4</td>
<td>23.0-25.3</td>
<td>24.0-32.1</td>
</tr>
<tr>
<td>5</td>
<td>22.6-24.8</td>
<td>23.3-31.2</td>
</tr>
<tr>
<td>6</td>
<td>22.5-24.5</td>
<td>23.0-30.7</td>
</tr>
<tr>
<td>7</td>
<td>22.5-24.4</td>
<td>23.0-30.5</td>
</tr>
<tr>
<td>8</td>
<td>22.3-24.1</td>
<td>22.9-30.1</td>
</tr>
<tr>
<td>9</td>
<td>21.9-23.7</td>
<td>22.5-29.5</td>
</tr>
<tr>
<td>10</td>
<td>21.4-23.1</td>
<td>21.8-28.6</td>
</tr>
</tbody>
</table>

Notes: INP = index of industrial production.
WPI = wholesale price index.
MS1 = money supply as measured by M1.
DCB = stock of closed national banks’ deposits.
Table 8

Nonorthogonalized Forecast Error Variance Decompositions of the Index of Industrial Production Using the Restricted (VEC) Model

<table>
<thead>
<tr>
<th>Forecast horizon (years)</th>
<th>Percentage of squared prediction error of INP produced by innovations to:</th>
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</thead>
<tbody>
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<td>INP</td>
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<tr>
<td>3</td>
<td>13.4</td>
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<tr>
<td>4</td>
<td>12.2</td>
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<tr>
<td>5</td>
<td>11.8</td>
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<tr>
<td>6</td>
<td>11.4</td>
</tr>
<tr>
<td>7</td>
<td>11.0</td>
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<td>8</td>
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</tr>
<tr>
<td>9</td>
<td>10.1</td>
</tr>
<tr>
<td>10</td>
<td>9.6</td>
</tr>
</tbody>
</table>

Notes: INP = index of industrial production.
WPI = wholesale price index.
MS1 = money supply as measured by M1.
DCB = stock of closed national banks’ deposits.
Table 9

Nonorthogonalized Forecast Error Variance Decompositions of the Index of Industrial Production Using the Unrestricted VAR Model

<table>
<thead>
<tr>
<th>Forecast horizon (years)</th>
<th>Percentage of squared prediction error of INP produced by innovations to:</th>
</tr>
</thead>
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<td>INP</td>
</tr>
<tr>
<td>1</td>
<td>56.4</td>
</tr>
<tr>
<td>2</td>
<td>27.7</td>
</tr>
<tr>
<td>3</td>
<td>24.0</td>
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<tr>
<td>4</td>
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<td>22.5</td>
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<td>22.3</td>
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<tr>
<td>9</td>
<td>21.9</td>
</tr>
<tr>
<td>10</td>
<td>21.4</td>
</tr>
</tbody>
</table>

Notes: INP = index of industrial production.
WPI = wholesale price index.
MS1 = money supply as measured by M1.
DCB = stock of closed national banks’ deposits.