# THE NONMONETARY EFFECTS OF FINANCIAL FACTORS DURING THE INTERWAR PERIOD

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*This paper employs vector autoregressions to estimate the nonmonetary effects of financial sector shocks on output and prices during the interwar period. Variance decompositions indicate that the nonmonetary financial proxies have significant and important effects. Impulse response functions indicate that most of the significant shocks to our financial crisis proxies have negative effects on output and prices. Focusing on the depressed conditions of the 1930s, historical decompositions indicate that the nonmonetary financial crisis variables are generally more important than the monetary base in explaining macro behavior. Our findings thus support theoretical models emphasizing the important nonmonetary effects of financial variables.*

## I. INTRODUCTION

In *A Monetary History of the United States*, Friedman and Schwartz [1963] attributed the enormous decline in real output and prices during the Great Depression of 1929–1933 to an unprecedented fall in the supply of money. While there is much support today for the view that money played an important role in this episode, many economists feel that this variable alone does not provide a sufficiently complete explanation of the link between the chaotic conditions in the U.S. financial sector and aggregate output and prices. Bernanke [1983] contended in an influential paper that financial shocks had important nonmonetary effects on aggregate economic activity in addition to their effects via the supply of money. Rather than consider the 1929-33 episode "outside of its context," Bernanke widened his sample to include the entire interwar period, which he defined as January 1919-December 1941.

The major purpose of this paper is to present empirical evidence on the importance of the nonmonetary effects of financial factors in explaining fluctuations in real output and prices during the interwar period. We define the interwar period as August 1922-June 1938. By omitting from our sample a few years immediately following World War I and immediately preceding World War II, we avoid the potential problems connected with war-related government expenditures and autonomous gold flows discussed in Joines [1985]. Our interwar period corresponds closely to the four peacetime cycles identified by Firestone [1960].

The theoretical literature on the nonmonetary effects of financial factors focuses on two related, but distinct aspects.[1] First, studies by Bernanke and Blinder [1988], Williamson [1987a; 1987b], Bernanke and Gertler [1987], and Scheinkman and Weiss [1986] demonstrate that the efficiency with which banks perform their intermediation function is an indepen-

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1. See Gertler [1988] for a more thorough review of this literature.



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dently important determinant of the level of real economic activity. Second, Bernanke and Gertler [1989; 1990], Gertler and Hubbard [1988], and Calomiris and Hubbard [1990] focus on the effects of shocks to borrowers' net worth positions on aggregate economic activity. This approach suggests that exogenous shocks to borrowers' net worth may be a source of economic fluctuations. Therefore, for example, to the extent that a deflation is unanticipated, it is likely to erode borrowers' net worth, and thereby adversely affect aggregate economic activity. Beginning with Fisher [1933], this deflation story has played an important role in studies such as Bernanke [1983], Hamilton [1987], and Bernanke and James [1990] that attempt to explain the Great Depression.

In evaluating the effects of financial sector shocks during the Great Depression, Bernanke [1983] argued that in addition to the traditional monetary effects of adverse shocks to financial intermediation stressed by Friedman and Schwartz [1963], these shocks increased the cost of credit intermediation which in turn led to credit contraction, rejection of otherwise profitable projects, and subsequent falls in output. To test this hypothesis, Bernanke included the deposits of failing banks and the liabilities of failing businesses (as joint proxies for the cost of credit intermediation) in a Barro [1977]—type output equation that also included unanticipated money. Both the deposits of failing banks and liabilities of failing businesses were found to be significant. Moreover, dynamic simulations of the path of output for the period between mid-1930 and March 1933 accounted for substantially more of the actual decrease in output than was captured when only unanticipated money was included in the output equation. In place of the joint proxies, Bernanke also used the yield differential between Baa corporate and long-term U.S. government bonds as a proxy for credit intermediation costs. In all cases, entry of the credit cost proxies significantly increased the percentage of the decline in output that was captured.[2] In addition to the foregoing evidence, Calomiris and Hubbard [1989] employ a "structural" vector autoregression model to show that proxies for the financial factors discussed above were important determinants of the level of real aggregate activity in the U.S. from 1894-1909.[3]

To examine the importance of the nonmonetary effects of financial factors in the interwar period, we construct and estimate vector autoregressive (VAR) models from which we calculate variance decompositions, impulse response functions, and historical decompositions. Due to contemporaneous feedback from the economy to the money supply during this period, the monetary base is used as the monetary policy variable and the separate and combined effects of the base and the proxies for the nonmonetary effects of financial factors are estimated.

In section II, we outline the empirical model used, while section III is devoted to a discussion of the empirical procedures and results. Our conclusions are summarized in section IV.

## II. MODEL SPECIFICATION

The nonmonetary effects of financial factors are examined by estimating and analyzing seven- and eight-variable VAR models. Monthly data are used. We em-

2. Haubrich [1990] employed the empirical methodology in Bernanke [1983] to investigate the nonmonetary role of financial crisis during the Great Depression in Canada. His results indicate that the decline in bank operations in Canada failed to significantly explain output fluctuations. Moreover, unlike the debt crisis in the U.S., a measure of the deterioration of borrowers' net worth in Canada had little impact on output.

3. It should be noted that Fazzari and Athey [1987], Fazzari, Hubbard, and Petersen [1988], and Gertler and Hubbard [1988] all present cross sectional evidence supportive of the view that borrowers' balance sheet characteristics strongly influence the level of investment and, thereby, aggregate economic activity.

ployed the reduced-form VAR methodology for the following reasons. First, the VAR technique is not subject to the simultaneity problems that frequently characterize single-equation reduced forms. Second, as noted by Fischer [1981] and Genberg, Salemi, and Swoboda [1987], since very few constraints are placed on the way in which the system's variables interact, VARs are well-suited to an examination of the channels through which a variable operates.[4] Since our purpose is to understand the nonmonetary channels through which financial factors may affect the macroeconomy, our use of the VAR technique is appropriate.

As noted above, we specify and estimate seven- and eight-variable VAR models. These models share six variables: output, the price level, the interest rate, the monetary base, the money supply, and government spending. Although many studies of this period include the money supply as the monetary policy variable, contemporaneous feedback from the state of the economy to the money multiplier during this period renders this questionable. For this reason, the monetary base is included as the monetary policy variable. Simultaneous inclusion of the base and the money supply means that shocks to the money supply should be interpreted as shocks to the base multiplier.[5] The models differ in their choice of proxies for the nonmonetary effects of financial crisis. Following Bernanke [1983], the eight-variable model adds two variables: the real value of the deposits of failed banks and the real value of the liabilities of failed commercial businesses. Again, following Bernanke [1983] and Mishkin [1990], the seven-variable model replaces the real deposits of failed banks and the real liabilities of failed businesses with the yield differential between Baa corporate bonds and long-term U.S. government bonds as a single proxy for the nonmonetary effects of financial crisis. The real deposits of failed banks are intended to measure the nonmonetary effect of financial crisis on the efficiency with which the banking system is able to perform its intermediation function, while the real liabilities of failed businesses capture the effect of deterioration in borrowers' net worth positions. The yield differential is thought to capture both types of shocks. However, as noted by Bernanke [1983], some of the change in the yield differential may reflect pure anticipations of future output declines. Therefore, while we would be reluctant to use only this measure, we feel it does provide a useful check on the sensitivity of our results to alternative measures of the nonmonetary effects of financial factors.

The empirical counterparts to the model variables are as follows. The yield differential (*DIF*) is calculated as the difference (in percentage points) between the yields on Baa corporate and long-term U.S. government bonds. The interest rate (*CPRATE*) is the four- to six-month yield on prime commercial paper. All of the foregoing variables are from *Banking and Monetary Statistics 1914–1941* (Board of Governors of the Federal Reserve System, 1943). The price level measure (*WPI*) is the wholesale price index and comes from the 1933, 1938, and 1943 editions of the *Statistical Abstract of the United States*. Output is measured by the industrial production index (*IP*) with 1977 as the base year. Data for *IP* are taken from the 1985 revision of *Industrial Production* (Board of Governors

4. Cooley and LeRoy [1985], Leamer [1985], and Eichenbaum [1985] have discussed limitations of VARs.

5. The systems were also estimated with the first difference of the reserve requirements on demand and time deposits as deterministic variables in each equation in the system. Because these requirements were changed relatively infrequently compared to the other variables in the system, they were entered as deterministic variables rather than as system variables. The results were essentially identical to the ones reported below, and a likelihood ratio test indicated that the null hypothesis that the coefficients on the reserve requirement variables in each equation jointly equalled zero could not be rejected.

of the Federal Reserve, 1985). Money (*M2*) is Friedman and Schwartz's [1963] measure of *M2* and is taken from their Table A-1, as is the monetary base (*BASE*). Government expenditures (*EXP*) include purchases of goods and services and the small amount of transfer payments in our sample. Separate series on purchases and transfer payments were unavailable. *EXP* is measured in billions of dollars and is taken from Firestone's [1960] Table A-3, and is deflated by *WPI*. The real value of the deposits of failed banks (*DEPFAIL*) is measured in millions of dollars and its nominal counterpart comes from various issues of the *Federal Reserve Bulletin*. The real value of the liabilities of failed commercial businesses (*LIABFAIL*) is measured in millions of dollars and its nominal version comes from various issues of the *Survey of Current Business*. In both cases, real values were obtained by deflating the nominal series with *WPI*.

Prior to specification and estimation of the VAR, augmented Dickey-Fuller tests were employed to check for first-order unit roots. These tests suggested that first differences of the logs of *IP*, *WPI*, *M2*, and *EXP* and first differences of the levels of *CPRATE*, *DIF*, *DEPFAIL*, and *LIABFAIL* should be used in specifying and estimating the models. However, based upon the arguments of Engle and Granger [1987], cointegration tests were also performed, and , on balance, the presence of cointegrating vectors was rejected.[6] As a consequence, the systems were estimated with the differenced variables.

Following Lutkepohl [1982], Akaike's AIC criterion is used to determine the lag length of the VAR model.[7] Use of the AIC criterion suggested a lag of twelve months for both the seven-variable and eight-variable systems for the estimation period 1922:8–1938:6. Q-statistics indicated the absence of any serial correlation in the residuals of the models.

## III. EMPIRICAL RESULTS

As indicated above, the nonmonetary effects of financial sector shocks are analyzed through computation of variance decompositions, impulse response functions and historical decompositions which, in turn, are based on the moving average representation of the VAR model and capture both direct and indirect effects. The variance decompositions show the percent of the forecast error variance for each variable that may be attributed to its own innovations and to fluctuations in the other variables in the system. Therefore, the variance decomposition for *IP* indicates the percent of the forecast error variance in *IP* accounted for by the proxy (or proxies) for financial crisis and by other variables in the system. This suggests that if *DEPFAIL* is an important determinant of movements in *IP*, it should explain a significant portion of the forecast

6. The lag length for the unit root and cointegration tests was determined using the criterion suggested by Schwert [1987]. Cointegration tests of the sort suggested by Engle and Yoo [1987] were performed. However, since Hansen [1990] pointed out that the power of this test, as well as the test proposed by Johansen [1988], falls substantially as the size of the system increases, Hansen's two-stage test was also employed. The power of Hansen's test is said to be unaffected by the size of the system.

Cointegration tests on the money, output, and prices subset of the systems were also performed as were tests on the monetary base, output, and prices subset. No evidence of cointegration was found among these subsets of variables.

Details of the unit root and cointegration tests are available on request.

7. The lag length chosen is the one that minimizes

$$AIC(k) = \ln \det \sum_k + (2d^2k)/T$$

where $k = i, \ldots, m$ and $d$ = number of variables in the system, $m$ = maximum lag length considered (set to twelve months),

$\det \sum_k$ = determinant of $\sum_k$, and

$\sum_k$ = estimated residual variance-covariance matrix

for lag $k$.

error variance in *IP*. Moreover, Sims [1982] has suggested that variance decompositions give an indication of the strength of Granger-causal relations that may exist between variables. Therefore, if *DEPFAIL* explains a large and significant portion of the forecast error variance of *IP*, this could be interpreted as a strong Granger-causal relation.

The impulse response functions are appropriately viewed as measuring the predictable response elicited by a one-standard-deviation shock to one of the system's variables on the other variables in the system. Since the impulse response functions measure how the future path of these variables is altered in response to the shock, they can be viewed as a type of dynamic multiplier that conveys information about the size and direction of the elicited effect.

While variance decompositions and impulse response functions are often reported without standard errors or confidence intervals, Runkle [1987] has argued that this is equivalent to reporting regression coefficients without *t*-statistics. Therefore, in order to provide some indication of the precision of estimation, a Monte Carlo integration procedure similar to that described in Doan and Litterman [1986] was employed to estimate standard errors for the variance decompositions and impulse response functions. Five hundred draws were employed in the Monte Carlo procedure. For the variance decompositions, the estimates of the proportion of forecast error variance explained by each variable are judged to be significant if the estimate is at least twice the estimated standard error. For the impulse response functions, a two-standard-deviation band is constructed around the point estimate. If this band includes zero, the effect is considered insignificant.

Historical decompositions are used to assess the impact of the financial crisis variables on the macroeconomy over several subperiods of our sample. As noted by Burbidge and Harrison [1985], the historical decomposition assigns credit for the difference between what can be called the base projection for a series and the actual series to the shocks to the system's variables. The extent to which a series that adds the shocks to a particular variable(s) to the base projection is closer to the actual series than is the base projection alone is a measure of the importance of that variable or that set of variables.[8]

Since the equations of the VAR contain only lagged values of the system's variables, any contemporaneous relations among the variables are reflected in the correlation of residuals across equations. In this paper, the Choleski decomposition is used to orthogonalize the variance-co-

8. Like the variance decompositions and impulse response functions, the historical decompositions are based upon the moving average representation of the VAR. This moving average representation can be written as

$$X_t = \sum_{i=0}^{\infty} M_i \mu_{t-i}$$

where $X_t$ = a column vector of the variables in the system, $\mu_{t-i}$ = column vector of shocks to the elements of $X$ in period $t-i$, $M_i$ = matrix of impulse response weights conformable to the dimensions of $X$ and $\mu$. Consider a base period which runs from observation 1 to observation $T$. The value of $X$ in periods subsequent to $T$ may be written as

$$X_{T+j} = \sum_{i=j}^{\infty} M_i \mu_{T+j-i} + \sum_{i=0}^{j-1} M_i \mu_{T+j-i}$$

where

$$\sum_{i=j}^{\infty} M_i \mu_{T+j-i} = \text{base projection}$$

or forecast of $X_{T+j}$ based only on information available at time $T$, and

$$\sum_{i=0}^{j-1} M_i \mu_{T+j-i} = \text{the part of } X \text{ accounted}$$

for by shocks since $T$. The elements of the second term are used to determine the extent to which addition of the shocks to a particular variable(s) to the base projection generates a series that is closer to the actual series ($X_{T+j}$) than is the base projection alone (first term).

variance matrix. In this approach, the variables are ordered in a particular fashion. When a variable higher in the order changes, variables lower in the order are assumed to change. The extent of the change depends upon the covariance of the variables higher in the order with those lower in the order. The ordering chosen reflects institutional and theoretical concerns and a desire to provide a conservative test of the effect of nonmonetary financial factors on the macroeconomy.

The ordering of primary interest for the seven-variable model is *EXP, BASE, IP, WPI, CPRATE, M2, DIF*. In the eight-variable model, *LIABFAIL* and *DEPFAIL* replace *DIF*. In both models the nonmonetary financial factors are placed last. This is consistent with the set of structural models in which there is contemporaneous feedback from the other model variables to the nonmonetary financial variables. For example, it is possible that a negative shock to output would increase both bank and business failures in the current period. Ordering these variables last also provides the most conservative test of the effects of the nonmonetary financial variables; since all contemporaneous correlation between these variables and the other variables is credited to the other variables, the nonmonetary financial variables are placed in the least favorable position. We also note that the effect of the nonmonetary financial variables on the other variables does not depend upon the order in which these variables precede the nonmonetary financial variables. That is, when the nonmonetary financial variables are ordered last, the effect of these variables on , for example, *IP* is the same whether *IP* is ordered first or just before the nonmonetary financial variables.

In the ordering described above, *LIABFAIL* is placed before *DEPFAIL*; this allows bankruptcies of commercial businesses to contemporaneously affect the real value of deposits of failed banks since commercial business bankruptcies can be expected to contribute to the failure of banks.[9] It is also assumed that, while government spending decisions may respond to prior movements in the other variables in the system, these spending decisions are independent of the current values of the other variables in the system. Thus, *EXP* is placed first. *BASE* is placed second based upon the assumption that the monetary authority responds to movements in output, prices, and the interest rate only with a lag; this is a common assumption in the macro literature. The sensitivity of the results to this assumption is, however, checked. *CPRATE* is placed after the fiscal and monetary policy variables as well as after output and price based upon efficient markets considerations that shocks to these variables contemporaneously alter the interest rate. *M2* is placed after *CPRATE*. Recall that shocks to *M2* should be interpreted as shocks to the base multiplier since *BASE* is explicitly included in the system. Placement of *M2* in this position allows the multiplier to respond to current movements in output, prices, or the interest rate.

The sensitivity of the results to alternative orderings in which the monetary and nonmonetary financial variables were rearranged was checked. The alternative orderings were: (1) *EXP, IP, WPI, CPRATE, LIABFAIL, DEPFAIL, BASE, M2*; (2) *EXP, IP, WPI, CPRATE, BASE, M2, LIABFAIL, DEPFAIL*; and (3) *EXP, BASE, IP, WPI, CPRATE, LIABFAIL, DEPFAIL, M2*. Similar orderings for the seven-variable system with *DIF* replacing *LIABFAIL* and *DEPFAIL* were also considered. The first alternative ordering allows a contemporaneous response of the monetary base and the base multiplier to all the other variables in the system; the nonmonetary financial variables still respond contempo-

9. Ordering *DEPFAIL* before *LIABFAIL* had no appreciable effect on the results.

raneously to expenditures, output, the price level, and the interest rate. The second ordering differs from the preferred ordering only by allowing the monetary base to respond contemporaneously to government spending, output, prices, and the interest rate. The final alternative ordering differs from the preferred ordering only by placing *M2* last. The variance decomposition results from these alternative orderings were essentially identical to those for the preferred ordering. In all cases, the results were within one standard deviation of those for the preferred ordering.

An alternative approach to the Choleski decomposition is the structural VAR model approach of Bernanke [1986]. In this approach the researcher commits himself to a particular structural model and employs the residuals from the VAR model in the estimation of the structural model. In this way the contemporaneous correlation across the VAR model residuals is purged, and the residuals of the structural model are interpreted as fundamental shocks. The structural approach is not employed in this paper, however. As noted by Bernanke and Blinder [1989], the results of this approach are generally sensitive to the specification employed and to the restrictions imposed to identify the model. This is a particular problem since there is no general agreement on the most appropriate structural macro model. The Choleski decomposition used here is consistent with the class of structural models in which there is contemporaneous feedback from the macroeconomy to the nonmonetary financial variables.

The variance decompositions for *IP* and *WPI* in both the eight- and seven-variable models are presented in Table I. The estimated standard errors are shown in parentheses below the point estimates. A * indicates the point estimate is at least twice the standard error. Variance decompositions at horizons of six, twelve, twenty-four, thirty-six, and forty-eight months are shown in order to convey a sense of the dynamics of the system. Only the individual and joint effects of *LIABFAIL*, *DEPFAIL*, and *BASE* (eight-variable system) and *DIF* and *BASE* (seven-variable system) on *IP* and *WPI* are shown in order to focus on the point of central interest to this paper and to conserve space.

We observe in the eight-variable model that both *LIABFAIL* and *DEPFAIL* have significant effects on *IP* and *WPI*. Jointly, these variables explain 14-18 percent of the variation in *IP* at horizons of twenty-four months or longer and 16-18 percent of the variation in *WPI* at horizons of twelve months or longer. (See the column labeled SUM1.) *BASE* also has significant effects on *IP* and *WPI*. The effects of *BASE* on *IP* are stronger than are the individual effects of *LIABFAIL* and *DEPFAIL* but weaker than their joint effects at longer horizons. The effects of *BASE* on *WPI* are weaker than are the effects of *LIABFAIL* and about half the size of the combined effects of *LIABFAIL* and *DEPFAIL*. When the joint effects of the nonmonetary financial crisis variables are added to the effects of *BASE*, the three variables combined explain 21-30 percent of the variation in *IP* and 23-28 percent of the variation in *WPI* at horizons of twelve months and longer. (See the column labeled SUM2.)

When *DIF*, our alternative nonmonetary financial crisis variable, is used, it also has significant effects on *IP* and *WPI*. These effects are somewhat larger for *IP* and roughly equivalent for *WPI* as compared to the combined effects of *LIABFAIL* and *DEPFAIL* in the eight-variable system. The effects of *BASE* are smaller, however, in the seven-variable system, and surprisingly we do not find significant effects of *BASE* on *WPI*. Jointly, *DIF* and *BASE* account for 27-28 percent of the variation in *IP* and 22-24 percent of the variation in *WPI* at horizons of twelve months and longer. (See the column labeled SUM3.)

The impulse response functions for *IP* and *WPI* for shocks to *LIABFAIL* and

**TABLE I**
Variance Decompositions[a]

| Variable | Horizon | Explained by Shocks to | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | *LIABFAIL* | *DEPFAIL* | *BASE* | *SUM1* | *SUM2* | *DIF* | *BASE* | *SUM3* |
| *IP* | 6 | 2.8 | 2.0 | 13.2* | 4.8 | 18.0 | 5.4 | 10.2* | 15.6 |
| | | (2.21) | (1.81) | (4.34) | | | (2.96) | (4.21) | |
| | 12 | 4.1 | 5.2* | 11.4* | 9.3 | 20.7 | 19.2* | 7.7* | 26.9 |
| | | (2.84) | (2.44) | (3.54) | | | (5.43) | (3.65) | |
| | 24 | 6.1* | 8.1* | 11.7* | 14.2 | 25.9 | 19.8* | 7.4* | 27.2 |
| | | (2.78) | (3.08) | (3.68) | | | (4.48) | (3.56) | |
| | 36 | 5.8* | 11.1* | 11.8* | 16.9 | 28.7 | 20.2* | 7.7 | 27.9 |
| | | (2.78) | (3.88) | (3.69) | | | (4.69) | (3.88) | |
| | 48 | 5.8* | 11.8* | 12.2* | 17.6 | 29.8 | 20.2* | 7.6 | 27.8 |
| | | (2.94) | (4.22) | (3.80) | | | (4.79) | (4.05) | |
| *WPI* | 6 | 5.5 | 4.0 | 3.8 | 9.5 | 13.3 | 3.1 | 3.5 | 6.6 |
| | | (3.51) | (2.42) | (2.40) | | | (2.12) | (2.73) | |
| | 12 | 12.1* | 3.7 | 7.1 | 15.8 | 22.9 | 17.2* | 4.5 | 21.7 |
| | | (5.26) | (2.19) | (3.66) | | | (5.30) | (3.27) | |
| | 24 | 11.3* | 5.8* | 9.3* | 17.1 | 26.4 | 16.7* | 6.9 | 23.6 |
| | | (4.49) | (2.34) | (3.94) | | | (4.71) | (4.54) | |
| | 36 | 11.2* | 6.5* | 9.6* | 17.7 | 27.3 | 16.2* | 7.6 | 23.8 |
| | | (4.26) | (2.56) | (3.95) | | | (4.73) | (5.01) | |
| | 48 | 11.3* | 6.7* | 9.7* | 18.0 | 27.7 | 16.3* | 7.5 | 23.8 |
| | | (4.31) | (2.77) | (4.01) | | | (4.81) | (5.20) | |

[a]Numbers in parentheses are standard errors. A * indicates that the point estimate is at least twice its standard error. SUM1 = *LIABFAIL* + *DEPFAIL*. SUM2 = SUM1 + *BASE*. SUM3 = *DIF* + *BASE*.

*DEPFAIL* are presented in Figure 1. We observe that the only significant effects of *LIABFAIL* on *IP* and *WPI* are negative, whereas the results for *DEPFAIL* are mixed. The impulse response functions for *IP* and *WPI* for shocks to *DIF* are shown in Figure 2. With only one exception (month four for *WPI*), the significant effects for *IP* and *WPI* are negative and occur at several different horizons for both variables.

The variance decompositions and impulse response functions provide us with estimates of the "average" effect of the financial crisis variables over our entire sample. Historical decompositions are calculated for several subperiods of interest and allow us to determine the effects of the nonmonetary financial crisis variables within a particular subset of the entire sample. Table II reports historical decompositions for both the eight-variable and seven-variable systems for two of these subperiods—1929:9-1938:6 and 1929:9-1933:3. The first subperiod begins in the month following the cyclical peak of August 1929 and includes the Great Depression and the subsequent recovery and ends with the recession of 1937-38. The second subperiod focuses exclusively on the Great Depression. While historical decompositions are also calculated for two similar subperiods beginning in 1929:11 to reflect the public's frequent association of the stock market crash with the start of the Great Depression, these results are virtually identical to those for 1929:9-1938:6 and 1929:9-1933:3 and are not shown. The root-mean-squared errors for the base projection for each subperiod are presented, as are the root-mean-squared errors for the base projections plus the contribution of the shock to the nonmonetary financial crisis proxies. The ratios of the root-mean-squared errors for the base projection plus the contribution of financial crisis variables to the root-mean-squared error for the base projection are in parentheses.

We observe that in the first subperiod the addition of shocks to *LIABFAIL* and *DEPFAIL* to the base projection reduces the base projection's root-mean-squared error for each variable. When shocks to both variables are simultaneously added to the base projections for *IP* and *WPI*, the base projection's root-mean-squared errors for these variables fall by 18 percent and 12 percent, respectively. (See the column labeled BPLD.) The effects of adding shocks to *BASE* to the base projections are smaller. While none of these effects are large, the base projection's root-mean-squared errors for *IP* fall by 29 percent and for *WPI* fall by 22 percent when shocks to all three financial variables—*LIABFAIL, DEPFAIL,* and *BASE*—are simultaneously added to the base projections. The effects for all three financial variables combined on *IP* are weaker in the shorter subperiod while the effects on *WPI* are roughly similar.

In general, results in the seven-variable model are reasonably consistent with those in the eight-variable model for both subperiods. When shocks to *DIF* and *BASE* are simultaneously added to the base projections, the base projection's root-mean-squared errors for *IP* and *WPI* fall by 24 percent and 20 percent, respectively, in 1929:9-1938:6 and by 20 percent and 24 percent, respectively, in 1929:9-1933:3.

## IV. CONCLUSIONS

This paper employs vector autoregressions to estimate the nonmonetary effects of financial factors on output and prices during the interwar period. An eight-variable model is estimated in which the real value of the deposits of failed banks and the real value of the liabilities of failed commercial businesses are used as joint proxies for the nonmonetary effects of financial crisis. As an alternative, a seven-variable model is estimated in which the yield differential between Baa corporate bonds and long-term U.S. government bonds is used as a single proxy.

**FIGURE 1**

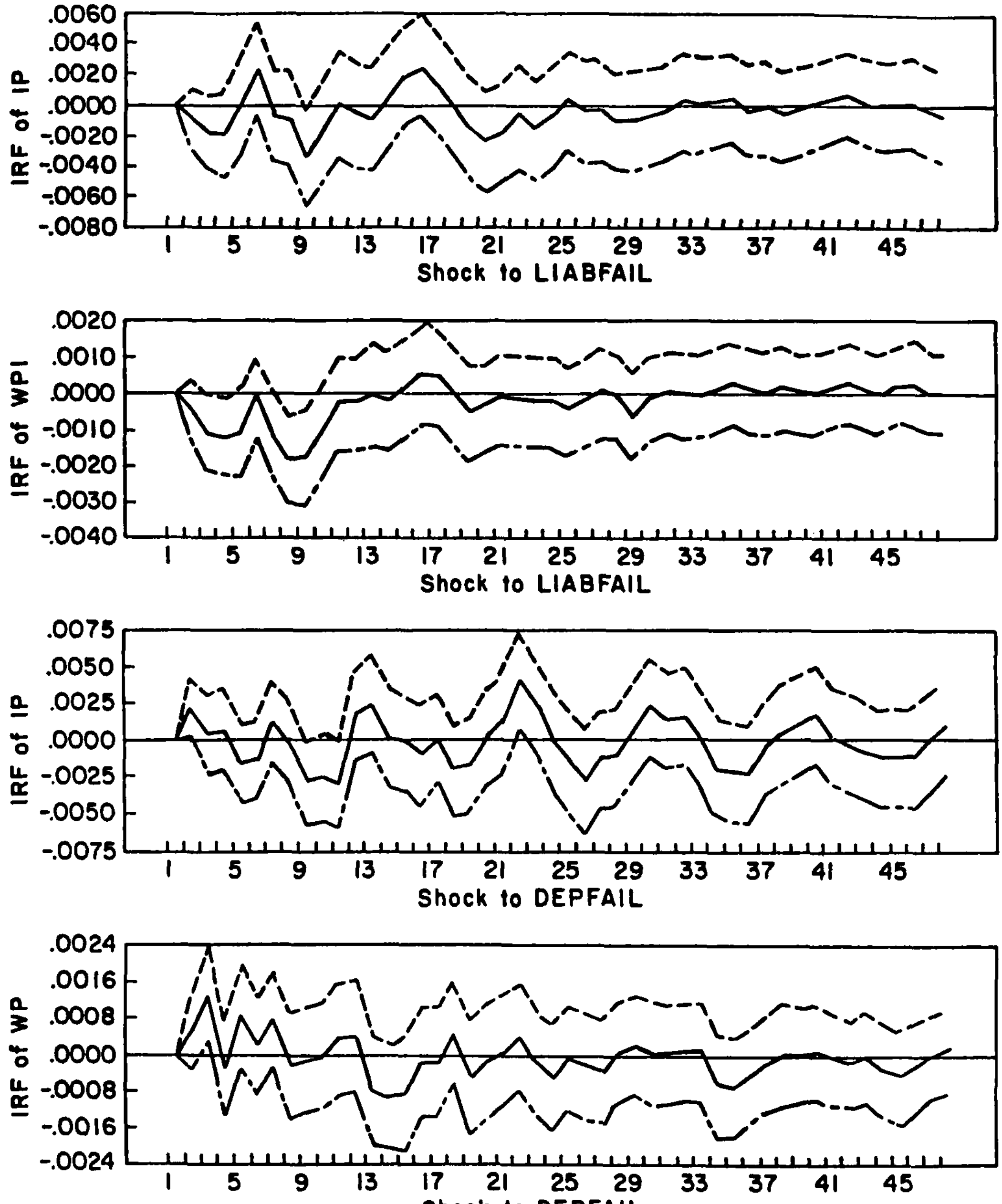

.0060
.0040
.0020
.0000
-.0020
-.0040
-.0060
-.0080
IRF of IP
1 5 9 13 17 21 25 29 33 37 41 45
Shock to LIABFAIL
.0020
.0010
.0000
-.0010
-.0020
-.0030
-.0040
IRF of WPI
1 5 9 13 17 21 25 29 33 37 41 45
Shock to LIABFAIL
.0075
.0050
.0025
.0000
-.0025
-.0050
-.0075
IRF of IP
1 5 9 13 17 21 25 29 33 37 41 45
Shock to DEPFAIL
.0024
.0016
.0008
.0000
-.0008
-.0016
-.0024
IRF of WP
1 5 9 13 17 21 25 29 33 37 41 45
Shock to DEPFAIL

TABLE II
Historical Decompositions[a]

A. Eight-Variable Model

Sample: 1929:9–1938:6

| Variable | BP | BPLIABFAIL | BPDEPFAIL | BPBASE | BPLD | BPLDBASE |
|---|---|---|---|---|---|---|
| *IP* | .0399 | .0383<br>(.96) | .0345<br>(.86) | .0351<br>(.88) | .0329<br>(.82) | .0282<br>(.71) |
| *WPI* | .0132 | .0121<br>(.92) | .0127<br>(.97) | .0121<br>(.92) | .0116<br>(.88) | .0102<br>(.78) |

Sample: 1929:9–1933:3

| Variable | BP | BPLIABFAIL | BPDEPFAIL | BPBASE | BPLD | BPLDBASE |
|---|---|---|---|---|---|---|
| *IP* | .0284 | .0283<br>(.997) | .0261<br>(.92) | .0263<br>(.93) | .0257<br>(.90) | .0232<br>(.82) |
| *WPI* | .0120 | .0108<br>(.90) | .0119<br>(.99) | .0108<br>(.90) | .0105<br>(.87) | .0092<br>(.76) |

B. Seven-Variable Model

Sample: 1929:9–1938:6

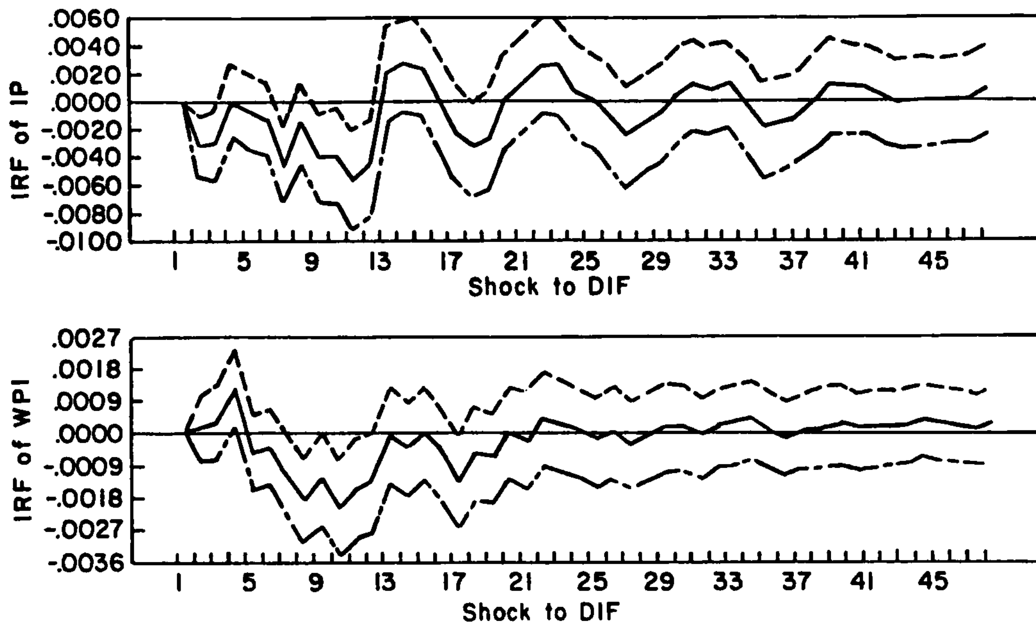
| Variable | BP | BPDIF | BPBASE | BPDIFBASE |
|---|---|---|---|---|
| *IP* | .0410 | .0326<br>(.80) | .0394<br>(.96) | .0310<br>(.76) |
| *WPI* | .0132 | .0111<br>(.84) | .0125<br>(.95) | .0105<br>(.80) |

Sample: 1929:9–1933:3

| Variable | BP | BPDIF | BPBASE | BPDIFBASE |
|---|---|---|---|---|
| *IP* | .0318 | .0282<br>(.89) | .0291<br>(.91) | .0253<br>(.80) |
| *WPI* | .0121 | .0107<br>(.89) | .0106<br>(.88) | .0091<br>(.76) |

[a]The results in the column labelled BP are the root-mean-squared errors (RMSEs) for the base projection for the period indicated. BPLIABFAIL, BPDEPFAIL, and BPBASE are the RMSEs for BP plus the contribution of shocks to *LIABFAIL*, *DEPFAIL*, and *BASE*, respectively. BPLD is the RMSE for BP plus shocks to both *LIABFAIL* and *DEPFAIL*. BPDIF is the RMSE for BP plus shocks to *DIF* and BPDIFBASE is the RMSE for BP plus shocks to both DIF and BASE. The numbers in parentheses are the ratios of the RMSEs for the individual shocks to the RMSEs for the BPs.

FIGURE 2




In all cases, these proxies are placed last in the orderings and provide the most conservative test of the nonmonetary effects of financial factors.

In both models, variance decompositions indicate that the nonmonetary financial proxies have significant and important effects on output and prices. Combined with the smaller effects of the monetary base, the joint effects are substantial. Impulse response functions for the nonmonetary financial variables are also computed. Most of the significant effects of shocks to these variables on output and prices are negative. Finally, historical decompositions are calculated and allow a determination of the effects of the nonmonetary financial crisis variables within subsets of the entire sample that focus on the depressed conditions of the 1930s. In these subperiods the nonmonetary financial crisis variables are generally more important than the monetary base in explaining macro behavior.

Rather than focusing narrowly on the monetary base, our results point to an important role for the nonmonetary effects of financial factors in explaining aggregate economic activity in the periods under consideration. Our empirical findings are thus consistent with those theoretical models that emphasize the important nonmonetary effects of financial variables. In particular, our results support those of Bernanke [1983] who used a single-equation reduced form to show an important role for nonmonetary financial factors during the Great Depression. Unlike Bernanke, we employ vector autoregression models that are not subject to the simultaneity problems that are frequently associated with single-equation reduced forms.

## REFERENCES

Barro, R. J. "Unanticipated Money Growth and Unemployment in the United States." *American Economic Review*, March 1977, 101-15.

Bernanke, B. S. "Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression." *American Economic Review*, June 1983, 257-76.

_____. "Alternative Explanations of the Money-Income Correlation." *Carnegie-Rochester Conference Series on Public Policy*, Autumn 1986, 49-99.

Bernanke, B. S., and A. S. Blinder. "Credit, Money, and Aggregate Demand." *American Economic Review*, May 1988, 435-39.

_____. "The Federal Funds Rate and the Channels of Monetary Transmission." Federal Reserve Bank of Philadelphia Working Paper No. 89-10, February 1989.

Bernanke, B. S., and M. Gertler. "Banking and Macroeconomic Equilibrium," in *New Approaches to Monetary Economics*, edited by W. A. Barnett and K. Singleton. New York: Cambridge University Press, 1987, 89-111.

_____. "Agency Costs, Net Worth, and Business Fluctuations." *American Economic Review*, March 1989, 14-31.

_____. "Financial Fragility and Economic Performance." *Quarterly Journal of Economics*, February 1990, 87-114.

Bernanke, B. S., and H. James. "The Gold Standard, Deflation, and Financial Crisis in the Great Depression: An International Comparison." National Bureau of Economic Research Working Paper No. 3488, October 1990.

Burbidge, J., and A. Harrison. "A Historical Decomposition of the Great Depression to Determine the Role of Money." *Journal of Monetary Economics*, July 1985, 45-54.

Calomiris, C. W., and R. G. Hubbard. "Price Flexibility, Credit Availability, and Economic Fluctuations: Evidence From the United States, 1894-1909." *Quarterly Journal of Economics*, August 1989, 429-52.

_____. "Firm Heterogeneity, Internal Finance, and 'Credit Rationing'." *Economic Journal*, March 1990, 90-104.

Cooley, T. F., and S. F. LeRoy. "Atheoretical Macroeconomics: A Critique." *Journal of Monetary Economics*, November 1985, 283-308.

Doan, R., and R. Litterman. *User's Manual RATS Version 2.0.* Minneapolis: VAR Econometrics, 1986.

Eichenbaum, M. "Vector Autoregressions for Causal Inference? A Comment." *Carnegie-Rochester Conference Series on Public Policy*, Spring 1985, 305-18.

Engle, R. F., and C. W. J. Granger. "Co-Integration and Error Correction: Representation, Estimation, and Testing." *Econometrica*, March 1987, 251-76.

Engle, R. F., and B. S. Yoo. "Forecasting and Testing in Co-integrated Systems." *Journal of Econometrics*, May 1987, 143-59.

Fazzari, S., and M. J. Athey. "Asymmetric Information, Financing Constraints, and Investment." *Review of Economics and Statistics*, November 1987, 481-87.

Fazzari, S., R. G. Hubbard, and B. C. Petersen. "Financing Constraints and Corporate Investment." *Brookings Papers on Economic Activity* 1, 1988, 141-95.

Firestone, J. M. *Federal Receipts and Expenditures During Business Cycles, 1879-1958.* Princeton: Princeton University Press, 1960.

Fischer, S. "Relative Shocks, Relative Price Variability, and Inflation." *Brookings Papers on Economic Activity* 2, 1981, 381-431.

Fisher, I. "The Debt Deflation Theory of Great Depressions." *Econometrica*, October 1933, 337-57.

Friedman, M., and A. J. Schwartz. *A Monetary History of the United States, 1867-1960.* Princeton: Princeton University Press, 1963.

Genberg, H., M. K. Salemi, and A. Swoboda. "The Relative Importance of Foreign and Domestic Disturbances for Aggregate Fluctuations in the Open Economy: Switzerland, 1964-1981." *Journal of Monetary Economics*, January 1987, 45-67.

Gertler, M. "Financial Structure and Aggregate Economic Activity: An Overview." *Journal of Money, Credit and Banking*, August 1988, part II, 559-88.

Gertler, M., and R. G. Hubbard. "Financial Factors in Business Fluctuations." in *Financial Market Volatility*. Kansas City: Federal Reserve Bank of Kansas City, 1988, 33-71.

Hamilton, J. D. "Monetary Factors in the Great Depression." *Journal of Monetary Economics*, March 1987, 145-69.

Hansen, B. E. "A Powerful, Simple Test for Cointegration Using Cochrane-Orcutt." University of Rochester Working Paper No. 230, May 1990.

Haubrich, J. G. "Nonmonetary Effects of Financial Crises: Lessons From the Great Depression in Canada." *Journal of Monetary Economics*, March 1990, 223-52.

Johansen, S. "Statistical Analysis of Cointegrating Vectors." *Journal of Economic Dynamics and Control*, September 1988, 231-54.

Joines, D. H. "Deficits and Money Growth in the United States: 1872-1983." *Journal of Monetary Economics*, November 1985, 329-51.

Leamer, E. E. "Vector Autoregressions for Causal Inference?" *Carnegie-Rochester Conference Series on Public Policy*, Spring 1985, 255-303.

Lutkepohl, H. "Non-Causality Due to Omitted Variables." *Journal of Econometrics*, August 1982, 367-78.

Mishkin, F. S. "Asymmetric Information and Financial Crises: A Historical Perspective." Working Paper, Columbia University, May 1990.

Runkle, D. E. "Vector Autoregressions and Reality." *Journal of Business and Economic Statistics*, October 1987, 437-42.

Scheinkman, J., and L. Weiss. "Borrowing Constraints and Aggregate Economic Activity." *Econometrica*, January 1986, 23-45.

Schwert, G. W. "Effects of Model Specification on Tests for Unit Roots in Macroeconomic Data." *Journal of Monetary Economics*, July 1987, 73-103.

Sims, C. A. "Policy Analysis with Econometric Models." *Brookings Papers on Economic Activity* 1, 1982, 107-52.

Williamson, S. D. "Financial Intermediation, Business Failures, and Real Business Cycles." *Journal of Political Economy*, December 1987a, 1196-1216.

_____. "Recent Developments in Modeling Financial Intermediation." Federal Reserve Bank of Minneapolis *Quarterly Review*, Summer 1987b, 19-29.