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The Texas Credit Crunch:

Fact or Fiction?

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Total inflation-adjusted loans extended by commercial banks in Texas peaked at more than \$107 billion in the first quarter of 1986 and then declined 46 percent by the first quarter of 1990. The sharp curtailment in lending activity at Texas banks has given rise to increasing concerns that economic activity in the state is being squeezed by a lack of credit. In this scenario, banks are alleged to be unwilling or unable to extend loans with which to finance worthwhile investment projects. Banks may be unwilling to extend new loans, either as part of a retrenchment from overly aggressive lending practices of the past or in response to increased regulatory scrutiny. If bank capital falls below regulatory standards, banks may be unable to extend additional loans because of regulatory restrictions. While these supply-side effects may be at work in the decline in lending activity at Texas banks, it is also possible that demand-side factors are playing a role. In particular, Texas bankers may be facing a lack of credit-worthy borrowers, in which case the decline in lending would be an appropriate response.

Whether the Texas economy has suffered from a credit crunch is a difficult question to answer empirically. In fact,

economists often differ on the precise meaning of the term *credit crunch*. The approach taken here is to examine whether, and to what extent, banking conditions and economic activity in Texas are related. We can expect that the deterioration in economic activity precipitated by falling oil prices adversely affected the banking sector in Texas. Our interpretation of a credit crunch centers on whether the decline in the Texas banking sector exerted a "feedback" effect on real economic activity in the state. If so, it would be evident that credit availability from Texas banks, or the lack thereof, affected economic activity in the state.

Our statistical tests indicate that economic activity had a strong influence on banking-sector output. We find little evidence, however, that banking-sector activity in Texas has affected the overall economy of the state. Before examining these results, we first offer some background on possible links between the financial system and economic activity. Then, the statistical techniques used are described, and the results are interpreted. Finally, some policy implications arising from these results are offered.

Background

There has been a resurgence of interest among economists regarding the link between financial structure and the performance of the economy. The economic upheaval of the Great Depression generated much interest in the role financial factors play in influencing movements in economic activity. However, the Keynesian revolution that swept the economics profession after the depression, while recognizing the importance of financial factors, examined the role of *money* in its theory of liquidity preference, as opposed to the broader measure of *credit*. Even so, traditional Keynesians attached little importance to money in explaining movements in real output. In contrast, the work of Friedman and Schwartz, along with the resurgence of monetarism, further empha-

sized the importance of money as the only financial aggregate in macroeconomic analysis.¹

A movement toward a reconsideration of the role of financial structure in influencing real economic activity began with the work of Gurley and Shaw (1955), who emphasized the broader measure of credit as opposed to the more narrowly defined money aggregate. Credit emerges as a key variable behind movements in output, especially in more advanced economies. This expanded role of credit is due, in part, to the existence of close money substitutes in more advanced economies. In short, what economists call the “transmission mechanism” of monetary policy—or the manner in which monetary policy affects the real economy—is different in the Gurley–Shaw hypothesis. Credit supply, rather than the money supply, is the principal channel of monetary policy.

In a related vein, Bernanke (1983) stresses that credit contributed to the economic collapse suffered during the Great Depression. Building on the framework established by Friedman and Schwartz, Bernanke argues that monetary factors alone are insufficient to explain the sharp decline in output during the depression. The financial shocks suffered during the 1930s reduced the *quality* of financial intermediation services offered. According to Bernanke, the real service performed by the banking system is the differentiation between good borrowers and bad borrowers. Thus, the “cost of credit intermediation”—or the cost of channeling funds from savers and lenders to good borrowers—is increased when bank failures become widespread, as in the Great Depression. As evidence for the important role of credit, Bernanke first estimates national output as a function of only monetary variables over the period 1919–41. He then shows that

adding proxy variables for the general financial crisis (including real deposits of failed banks, liabilities of failed businesses, and yield differentials between safe securities and risky securities) significantly improves the results over those from equations that include only monetary variables.

Bernanke’s evidence is consistent with the proposition that the financial collapse of the 1930s exerted a negative effect on real economic activity, independent of any effect arising from a decline in the money supply. Evidence about the Canadian experience during the Great Depression suggests that a key element contributing to a downturn in economic activity is bank *failure*, rather than just financial-sector weakness. Canada’s branch-banking system proved immune to runs and panics during the early 1930s. The banking sector, however, did shrink significantly in Canada: loans and deposits declined, bank stock prices dropped, and the number of branches diminished. In an environment where the banking sector was severely weakened but where widespread failures did not occur, Haubrich (1990) finds no evidence that the cost of credit intermediation had a major impact on the course of economic activity. In Canada, then, a shrinkage of the banking system did not significantly influence Canadian economic activity, suggesting that without outright *failures*, the cost of credit intermediation has few macroeconomic effects. Failures become important by increasing the real cost of transferring funds from lenders (savers) to borrowers (investors).

Bernanke and Gertler (1987) develop a model that stresses the importance of bank capital. The net worth of the banking system determines the amount of risky projects financed by banks, which, in turn, affects investment and output. They also stress that monetary policy operates primarily through its effects on bank credit, in contrast to the traditional Keynesian and monetarist interpretations. Samolyk (1989) demonstrates how, given geographically segmented banking

¹ Friedman and Schwartz (1963). See Gertler (1988) for a summary of the role of financial factors in affecting aggregate economic activity.

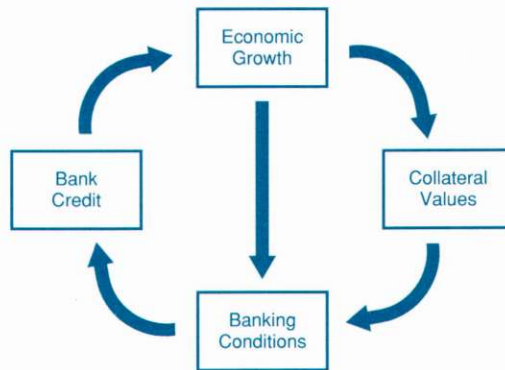
markets, local banking conditions affect real investment and output in a particular region. Again, bank capital is a critical feature. Economic shocks to a particular region, such as a sharp and unanticipated decline in oil prices, can reduce bank capital. The regional banking system can then become capital-constrained, which leads to underinvestment in risky projects.

The Texas banking and economic environment of the past decade offers a unique setting to investigate for the effects of financial conditions on economic activity. The regional economic shock suffered in the Southwest and the associated effects on banks' capital positions fulfill the general criteria of the Bernanke-Gertler and Samolyk approaches. In Texas, bank equity capital, adjusted for inflation, fell 40 percent from its peak in the fourth quarter of 1985 to the first quarter of 1990. If there are no close substitutes for bank loans, then the decline in bank capital and the associated reduction in bank lending may have adversely affected economic activity in the state. The next section describes the empirical methodology used to analyze the effect of financial structure in Texas on economic activity in the state.²

Cross Correlations and Lead-Lag Relationships

Our approach focuses on certain linkages implied by the various theories that posit a link between the nonfinancial and financial sectors of the economy. Chart 1 shows the possible linkages between the banking sector and economic activity implied by the existence of a credit crunch. A shock to real economic activity can have a significant negative effect on the overall health of the banking system—either directly by affecting bank earnings, and thus banking conditions generally, or indirectly through a decline in collateral values, which affects the quality of bank loans and (ultimately) bank profitability. This decline in the financial condition of banks can affect banks' ability to extend credit, which, in

Chart 1
Linkages Between Banking and Economic Activity

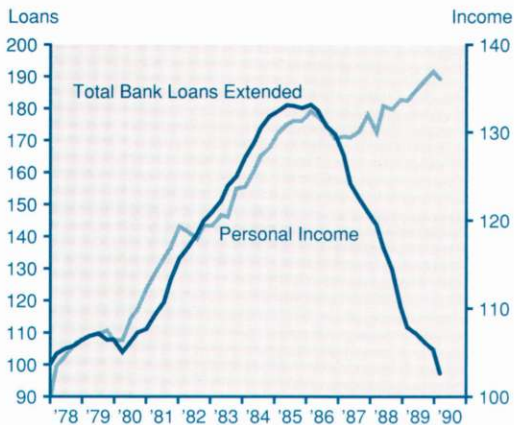


turn, may further influence economic growth. Any causal connection between bank performance and economic activity is difficult to isolate, though, particularly at the regional level. Even if banks in a particular region are weak, it might be possible to break or circumvent this linkage if creditworthy borrowers are able to negotiate loans with stronger financial institutions, including nonbank financial institutions, that are located outside the region. Thus, a downturn in regional banking conditions will not necessarily have a significant independent effect on economic activity that causes further deterioration in a regional economy. But the broader the market area that is affected by the financial deterioration, the more ineffective this potential release valve becomes.

A direct test of the effect of financial structure on economic activity presents formidable econometric difficulties. Chart 2 shows movements in a measure of banking activity—bank credit, or total loans extended

² Another view of the role of financial factors in output fluctuations is found in the real business-cycle framework. With this approach, financial structure is largely irrelevant. See Plosser (1989) for a summary of the related literature.

Chart 2
Bank Credit and Personal Income, 1978–90
 (Adjusted for Inflation, 1978:1 = 100)



SOURCES: Consolidated Reports of Condition and Income; Federal Reserve Bank of Dallas Research Department

by Texas banks, adjusted for inflation.³ Also included in Chart 2 is a measure of economic activity, personal income in Texas, also adjusted for inflation. These two variables moved fairly closely together in the first half of the decade but separated significantly in subsequent years.

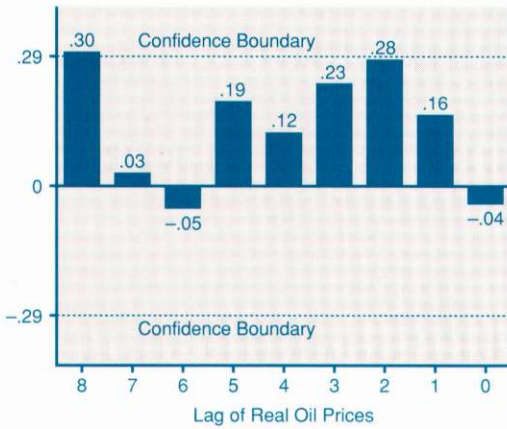
One measure of the degree of association between two variables is the contemporaneous correlation coefficient. If two series are positively and perfectly correlated, then the contemporaneous correlation coefficient is equal to 1. If there is no correlation between two variables, their correlation coefficient equals zero. The correlation coefficient between the two series shown in Chart 2 equals 0.54, indicating a fairly high degree of association between real (inflation-adjusted) loans and real income in Texas. However, in attempting to discover what, if any, effect the decline in lending by Texas banks exerted on the Texas economy, we

must look behind the simple correlation coefficient between the two series. This measure tells us nothing about how the two series might actually be related. It is possible for two time series that are not related to show a high spurious correlation if each series is highly correlated with its own past values. Moreover, the contemporaneous correlation between two series sheds little light on the direction of their association. In our case, we can expect a fairly strong linkage running from economic activity to banking conditions. What is of interest is whether banking conditions then exert any feedback effect on economic activity in the state.

One approach to gauging the direction of the association between two variables is to estimate their temporal ordering. A variety of methods have been used in this regard, but the most intuitive is simply to calculate the cross-correlation function between “shocks” in the relevant variables. The cross-correlation function includes not only the contemporaneous correlation but also the correlations between each variable and *lags* of the other variable. Because the cross-correlation function measures the strength of a relationship between two variables at different lags, it can indicate the *direction* of any association. For example, if current measures of banking conditions exhibit large cross correlations with lagged measures of economic activity, then we may say that economic conditions would be a leading indicator of banking activity or that economic conditions are a predictor of banking conditions. Similarly, a strong correlation between current economic output and lagged measures of banking-sector activity would indicate that current levels of economic activity are related to past values of bank performance. If this is the case, some evidence exists that banking-sector conditions in Texas affected economic activity in the state, so there is a feedback effect from banking to economic activity. In addition, by examining the cross-correlation function of *shocks* in the time series, as opposed to the variables

³ The results reported here are for loans at domestic offices of Texas banks. Qualitatively identical results are obtained when loans at both domestic and foreign offices of Texas banks are used.

Chart 3
Relationship Between Oil Prices
and Real Personal Income



themselves, the spurious correlation that can arise between two variables is avoided. For additional discussion on the techniques used to estimate the cross-correlation functions, see the Appendix.⁴

We used the following variables in our analysis of the effect of credit availability on economic activity in Texas: real oil prices; real loans extended by Texas commercial banks; and two different measures of economic activity, real personal income in Texas and Texas nonagricultural employment. Our time period runs from the first quarter of 1978 to the first quarter of 1990. We anticipate positive correlations between our variables. Oil prices and measures of economic activity should move together, as should economic activity and lending activity at Texas banks.

The first cross correlations calculated are those between past movements in oil prices and real personal income in Texas, as shown in Chart 3. The dotted lines in the chart indicate the approximate 95-percent confidence interval. That is, if a particular correlation coefficient lies within these lines, it is not different from zero in a statistical sense. From Chart 3, the correlation of oil prices lagged two quarters with current real income is almost significantly different from zero, and the correlation for

oil prices lagged eight quarters is significant. Note that negative correlations are not expected between oil prices and real income and that the lagged correlations that are negative are not statistically significant. If we wish to detect the direction of the relationship between oil prices and real income, we need to know whether past values of oil prices, *as a group*, are significantly correlated with current real income in Texas. The test statistic used to evaluate the statistical significance of the cross correlations as a group is the so-called Q statistic.⁵

We examine eight lagged correlations, implying that after two years, the cross correlations between the series are insignificant. When the cross correlations between lagged values of oil prices and

⁴ Cross correlations are used mainly for pedagogical purposes to highlight more easily the concepts involved in our approach. More formal statistical techniques exist to detect lead-lag relationships, or what economists call Granger causality. Gunther, Lown, and Robinson (1991) estimate a four-variable vector autoregressive model of the Texas economy to examine the issue of feedback effects from banking to economic activity. Their model has the following variables: oil prices; various measures of U.S. economic activity; various measures of Texas banking-sector activity—namely, loans and equity; and various measures of economic activity in Texas. Preliminary calculations of the impulse response functions and variance decompositions indicate the same qualitative results obtained in the analysis here. There is some limited evidence, though, that shocks to bank equity may play a small role in explaining movements in economic activity in Texas.

⁵ The Q statistic is defined as

$$Q(K) = n(n+2) \sum_{k=1}^K \frac{1}{n-k} r_{xy}^2(k),$$

where r_{xy} is the sample cross-correlation coefficient, k represents the lag of the cross correlation, n represents the number of data points used in the calculation of r_{xy} , and the chosen value of K is such that it can be assumed that the $r_{xy}(k)$'s for $k > K$ are negligible. This test statistic is approximately distributed as chi-square with K degrees of freedom. For a layman's guide to the techniques used here, see Vandaele (1983), chap. 11.

current economic activity—as measured by real income—are calculated, the value of the Q statistic equals 27.24. This indicates that, as a group, the first eight cross correlations of lagged values of oil with current income are significantly different from zero. Thus, as expected, oil prices can be considered a leading indicator of economic activity (as measured by real income) in Texas.

We next compare real income and real loans. The cross correlations of real loans and lagged personal income are found in Chart 4. Again, we expect lagged personal income to be positively correlated with bank lending, and the negative correlations in Chart 4 are not statistically significant. When the cross correlations between lagged values of real personal income in Texas and current real loans are calculated, the eight lagged cross correlations, as a group, are significantly different from zero. The Q statistic equals 19.65. However, the correlations of lagged values of bank lending with current economic activity are *not* significantly different from zero, as indicated by a Q statistic of 6.36. Chart 5 shows these cross correlations. A summary of these findings appears in Table 1.

Cross correlations calculated using Texas nonagricultural employment in place of

Chart 4
Relationship Between Personal Income and Real Bank Loans

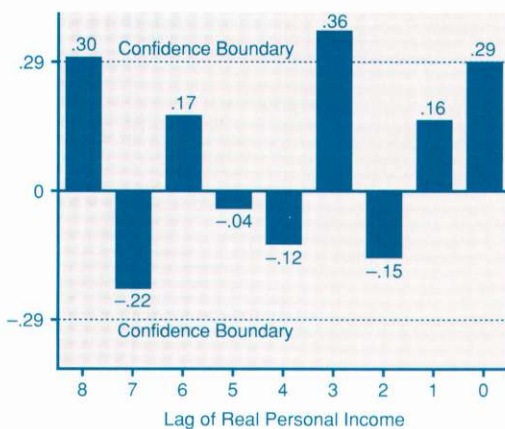
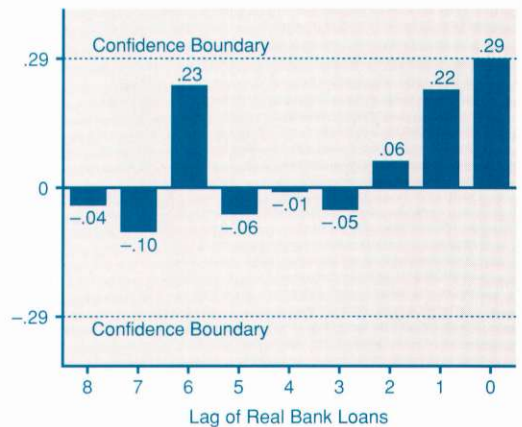


Chart 5
Relationship Between Bank Loans and Real Personal Income



real personal income are shown in Charts 6 through 8. When employment is used as a measure of economic activity, the same qualitative results are obtained. A summary of the significance of these cross correlations appears in Table 2. These results suggest that economic conditions in Texas can be viewed as a leading indicator of banking conditions in the state. There is no evidence, however, that lending by Texas banks exerted any feedback effect on economic activity.

Interpretation and Policy Implications

Our results suggest that the upheaval suffered in the Texas banking sector had little effect on overall economic activity in the state. While we find evidence that economic events affected the banking sector, we can find little evidence that lending activity by Texas banks exerted any influence on overall economic activity. One possible explanation for these results is that capital apparently flows fairly well across regions. If Texas banks were either unable or unwilling to extend viable loans, then perhaps banks and other financial institutions outside the state fulfilled this function.

It has also been argued that banks are becoming less important in financing

Table 1
Significance of Cross Correlations Using Texas Real Personal Income

Variable	Q statistic
OIL \Rightarrow RPICTX	27.24*
RPICTX \Rightarrow RLOANS	19.65*
RLOANS \Rightarrow RPICTX	6.36

Definitions of variables

- OIL = inflation-adjusted oil prices.
- RPICTX = real personal income in Texas.
- RLOANS = real loans extended by Texas commercial banks.

* Statistical significance at the 5-percent level.

economic activity as corporations increasingly make use of more direct financial intermediation through credit market instruments, such as commercial paper. Savers are also finding it easier and, presumably, more attractive to bypass banks, as witnessed by the strong growth of money market mutual funds over the past decade. Hence, the unique role of bank lending in affecting output may have been reduced.

A trend away from the more traditional use of banks in the financial intermediation process would not appear to be as attractive an option for small businesses, however. Smaller entities lack access to national

money markets in the form of commercial paper. At the same time, information costs regarding lender quality would increase, making it more difficult for financial institutions outside a particular region to extend credit to small enterprises. It could easily be the case that many small businesses were adversely affected by the decline in lending activity at Texas banks, but this effect was obscured by aggregate state data.

Finally, it must be acknowledged that the swift interventions and resolutions by the various regulatory agencies, while not without serious unintended consequences, were successful in averting any widespread

Table 2
Significance of Cross Correlations Using Texas Nonagricultural Employment

Variable	Q statistic
OIL \Rightarrow EMPLOYMENT	17.61*
EMPLOYMENT \Rightarrow RLOANS	13.56†
RLOANS \Rightarrow EMPLOYMENT	6.43

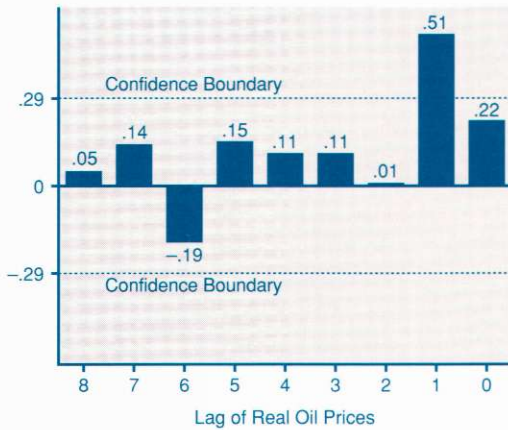
Definitions of variables

- OIL = inflation-adjusted oil prices.
- EMPLOYMENT = total Texas nonagricultural employment.
- RLOANS = real loans extended by Texas commercial banks.

* Statistical significance at the 5-percent level.

† Statistical significance at the 10-percent level.

Chart 6
Relationship Between Oil Prices
and Employment



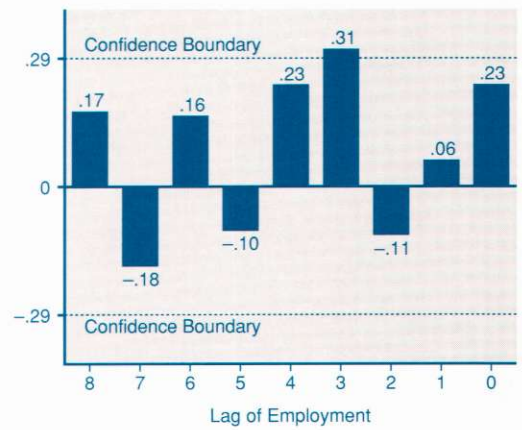
financial panic in the state—unlike what occurred during the financial collapse in the Great Depression. These actions also could explain the lack of any effect of bank credit availability on economic activity.

Despite the state focus of the analysis here, the problems examined have become national in scope. Increasing numbers of bank failures nationally have given rise to heightened fears of the impact of a decline in bank services on economic activity. While a widespread banking collapse of the type suffered during the 1930s would likely have serious consequences for economic activity, our results suggest that concerns about the impact of credit availability resulting from a regional banking decline may be somewhat unwarranted, given current institutional arrangements.

Improvements in the processing and transmitting of information have lowered the cost of nonbank credit relative to bank credit. As a result, consolidation and shrinkage appear to be appropriate bank responses in light of technological advancement and the heightened competition in increasingly

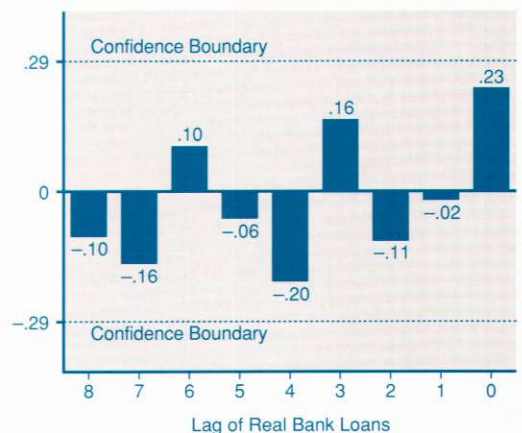
⁶ The recent proposal of the U.S. Department of the Treasury (1991) for restructuring the banking system advocates a move toward interstate branching.

Chart 7
Relationship Between Employment
and Real Bank Loans



integrated capital markets. Also, increased consideration should be given to removing the regulatory restrictions on geographical expansion under which banks currently operate. Financial markets have become increasingly integrated on a national and international basis. Banks, however, are still prevented from establishing national networks of branches.⁶ Greater diversification in bank lending, facilitated by nationwide banking, would reduce the cost of intermediation services provided by banks.

Chart 8
Relationship Between Bank Loans
and Employment



Appendix

Cross-Correlation Functions

The degree of association between two variables at different time periods can be estimated using the cross-correlation function. The cross correlations between two series, x and y , for different time periods are defined as

$$r_{xy} = \frac{E[(x_t - \mu_x)(y_{t+k} - \mu_y)]}{\sigma_x \sigma_y}, k = 0, \pm 1, \pm 2, \dots,$$

where E is the expected-value operator and where σ_x and σ_y are the standard deviations and μ_x and μ_y are the means of the stationary series x and y , respectively. (The other expressions are defined in text footnote 5.) The cross correlations need not be symmetric about $k = 0$. That is, $r_{xy}(k)$ is not equal to $r_{xy}(-k)$. If a particular variable—say, x_t —is a leading indicator of another variable, y_t , then x_t is strongly correlated with future values of y_t and is not correlated with lagged values of y_t . It is in this sense that cross correlations measure not only the *strength* of a relationship between two variables but also the *direction*.

The first step in calculating the cross correlations between two variables is to ensure that both series are stationary. When a series is highly correlated with its own past values, which is a common occurrence with economic data, then that time series is said to be autocorrelated. When a particular series is highly autocorrelated, the cross correlations can be very misleading. It is possible for two time series that are not related to show a high spurious correlation if each series is autocorrelated. As a result, the series must first be filtered, or "prewhitened," before calculating the cross correlations. This procedure entails obtaining the correct time series representation of each series, or what is known as the appropriate ARIMA

model for each variable, and then cross-correlating the white-noise residuals. Intuitively, if we want to judge whether one variable—say, x_t —can explain the behavior of another variable, y_t , we should first eliminate all variation in y_t that can be explained by past movements in y_t .

We fitted time series models to each of the variables used in our analysis: inflation-adjusted oil prices (OIL), real personal income in Texas (RPICTX), total Texas nonagricultural employment (EMPLOYMENT), and real loans extended by Texas commercial banks (RLOANS).¹ Each series needed to be differenced once in logarithms to obtain stationarity. After differencing, OIL was determined to be white noise, obviating the necessity of fitting an ARIMA model.² Investigation of the remaining series indicated that RPICTX is best represented by an ARIMA(2,1,0) model, and EMPLOYMENT by an ARIMA(4,1,0) model; RLOANS appeared to be well-represented by an ARIMA(1,1,0) model. Thus, the first difference of OIL and the residuals from these three ARIMA models were the variables used in the cross-correlation calculations.

¹ OIL is defined as the price of West Texas Intermediate crude divided by the consumer price index. RPICTX is personal income in Texas divided by the consumer price index. RLOANS is total loans at domestic offices of Texas banks, deflated by the consumer price index. The consumer price index is the index for all urban consumers and is obtained from the Citibase data bank, as is the price of West Texas Intermediate crude. Personal income in Texas and EMPLOYMENT are from the Federal Reserve Bank of Dallas Research Department, while total loans are from the Consolidated Reports of Condition and Income.

² The Box-Ljung test statistic for white noise for the first difference of OIL, at 18 lags, was 9.92.

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