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Bank Failures and the Cost of Systemic Risk:

Evidence from 1900-1930*

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JEL Classification Codes: N11, N21, E44, E32

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Bank Failures and the Cost of Systemic Risk: Evidence from 1900-1930

Abstract:

This paper investigates the effect of bank failures on economic growth using data from 1900 to 1930, a period that predates active government stabilization policies and includes periods of banking system distress that are not coincident with recessions. Using both VAR and a difference-in-difference methodology that exploits the reactions of the New York and Connecticut economies to the Panic of 1907, we estimate the effect of bank failures on economic activity. The results indicate that bank failures reduce subsequent economic growth. Over this period, a 0.14 percent (1 standard deviation) increase from the mean value of the liabilities of the failed depository institutions results in a reduction of 17 percentage points in the growth rate of industrial production and a 4 percentage point decline in real GNP growth. The reductions occur within three quarters of the initial bank failure shock and can be interpreted as an important component of the cost of systemic risk in the banking sector.

Keywords: bank failures; systemic risk; financial accelerator, vector autoregressions; Panic of 1907; non-bank commercial failures

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I. Introduction

Do bank failures create negative externalities that reduce economic growth? These externalities, should they exist, are a manifestation of financial sector systemic risk. Banks are a source of systemic risk if the social cost of a bank failure exceeds the direct losses to the claim holders of the failing bank. One potentially important component of this social cost is the subsequent loss in output associated with a bank failure.[1] The failure of any firm will create externalities and losses in output, but because of their importance in the intermediation process, the costs and externalities associated with a bank failure are likely to be much larger than those created by the failure of a commercial non-bank entity.

But how important are the negative externalities associated with bank failures? What is the cost of systemic risk in the banking sector? While scholars have studied the issue for more than 100 years and central banks increasingly are focused on the identification and reduction of financial sector systemic risks, surprisingly, there are no published measures of the cost of systemic risk and no academic consensus on the magnitude of the effect that bank failures have on subsequent economic growth.

The modern literature on bank failures and economic activity is focused on two periods: the Great Depression (1930–1933) and the U.S. savings and loan and banking crises of the late 1980s and early 1990s (S&L crisis). There is consensus that a breakdown in the banking system intensified the Great Depression in the U.S., but Depression-era evidence from other countries as well as evidence from the S&L crisis is

[1] Recent papers on bank systemic risk focus on the strength of correlation among bank defaults and mechanisms that can propagate shocks among banks or other financial institutions. Kaufman and Scott (2003) and Schwartz (2008) provide overviews of the literature. A common feature of all discussions of systemic risk is the existence of a mechanism whereby losses to one institution create losses for many other institutions. Few if any of these models directly discuss the real economic effects of systemic risk.

ambiguous. For example, the Canadian experience during the Great Depression does not suggest that there are large negative externalities associated with bank failures (Haubrich, 1990; White, 1984). Analysis of data from the S&L crisis has also produced conflicting results (see, *inter alia*, Ashcraft, 2005; Alton, Gilbert, and Kochin, 1989; or Clair and O'Driscoll, 1994).

This paper investigates the effect of bank failures on economic activity using data from 1900 to 1930. Prior to the enactment of federal deposit insurance legislation in 1933, the United States experienced repeated banking panics, many of which occurred when economic conditions were quiescent. While many banks failed or temporarily suspended redemptions during banking panics, many of these banking panics were not caused by deteriorating macro-economic conditions.[2] Another important feature is the lack of federal government institutions or policies to counteract the effects of bank failures and exert a stabilizing influence on economic growth. We will argue that these two important characteristics of this sample period and the use of new data for measuring banking system distress allow us to extract more accurate estimates of the economic costs of bank failures relative to estimates derived from other historical data periods.

In the analysis that follows, we use vector auto regression analysis (VAR) to estimate the effect of bank failures on the volatility of industrial production and aggregate output growth. Bank failures are measured using newly constructed data on the share of banking system liabilities (predominantly deposits) in failed banks and trusts including

[2] Calomiris and Mason (1997) provide evidence against the hypothesis that asymmetric information in banking panics is a separate source of bank failure. They study banks that failed during the 1932 banking panic and conclude that failed banks were financially weak and would likely have failed under non-panic conditions as well. Carlson (2008) takes issue with these conclusions and instead finds that there is a high probability that many of the banks that failed in 1932 would have been acquired, merged or recapitalized in a non-panic period.

both state- and nationally-chartered institutions. We argue that the data are consistent with the hypothesis that bank failures create negative externalities if: (i) bank failures on average reduce subsequent economic growth; and, (ii) on average, poor economic growth is not followed by a higher incidence of bank failure. We use Granger causality tests to establish that an increase in the liabilities of failed banks, other things equal, will reduce industrial production and economic growth, but a reduction in economic growth or industrial production need not lead to an increase in failed-bank liabilities.

Our estimates suggest that, over the period 1900–1930, the variation in failed-bank liabilities explains about 8 percent of the volatility in output growth. Other things held constant, a one standard deviation shock to the share of liabilities in failed banks (an increase of 14 basis points over the mean value of the series) results in a cumulative 17 percent decline in industrial production (IP) and a cumulative 4 percent decline in GNP over the following three quarters. While the estimated effects of bank failures on economic activity may appear to be incredibly large, the "small-shock large-cycle" phenomenon is well-known in the financial accelerator literature (Bernanke, Gertler and Gilchrist (1996)) and studies that document linkages between the financial sector and the macro economy. Moreover, the estimated effects from the VAR model are consistent with the historical record. There are only 7 quarters in sample period in which the share of liabilities in failed banks exceeded 21 basis points (the mean value plus the shock) and many of these episodes are associated with a significant recession.[3]

[3] During the recession of 1907-08, real GNP posted a cumulative decline of 12.8 percent while IP fell by 31.7 percent. The recession of 1923-24 produced a cumulative drop of 3.1 percent in real GNP and 34.7 percent in IP. The large increase in the liabilities of failed banks in 1930 was associated with a 1-year drop of 4.7 percent in real GNP and 18.2 percent in IP.

We provide additional evidence on the link between bank failures and economic growth by comparing the economic performance of New York and Connecticut following the Panic of 1907. A year prior to the panic, business conditions in New York and Connecticut were similar to business conditions in the rest of the country and neither state had problems in their banking sectors. The 1907 banking panic resulted in important financial institution failures in New York, but none in Connecticut. At the height of the banking panic, economic conditions deteriorated substantially in New York and continued to deteriorate for another quarter as commercial failures mounted. In contrast, business conditions in Connecticut remained stable throughout the period. When economic performance is measured by time series data on the liabilities of non-financial commercial enterprise failures in each state, a formal difference-in-difference analysis supports the hypothesis that bank failures depress economic growth.

Taken together, our findings suggest that bank failures create important negative externalities that reduce economic growth. The estimate of the loss in aggregate output is a lower bound estimate of the cost of systemic risk in the banking sector as it excludes the direct deposit, equity and credit losses associated with bank failures. Our results can be used to support the case for well-designed government policies aimed at mitigating the negative economic effects of bank failures—policies such as prudential bank supervision, the provision of deposit insurance, and efficient bank resolution policies.[4]

This paper is only one of many that investigate the extent to which bank failures amplify economic distress. Section II reviews the contributions of several earlier studies. Subsequent sections discuss the importance of the sample period (Section III); the

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[4] We also recognize that poorly designed government policies may create additional social costs, so the net benefit associated with government intervention is an open issue. See for example, Demirguc-Kunt and Kane (2002) and Kaufman and Scott (2003).

macroeconomic data, the VAR model, and the empirical results (Section IV); and the difference-in-difference analysis of New York and Connecticut during the Panic of 1907 (Section V). Section VI concludes the paper.

II. Research on Bank Failures and Economic Activity: A Brief Overview[5]

Scholars have been studying the link between bank failures and subsequent declines in economic activity for well over a century. Jevons (1884) speculated that sunspots provide a link between banking crises and commercial failures. He argued that sunspots influence climate which creates volatility in the agricultural sector and commodity prices which in turn affect the banks and the economy. Jevons's theory does not emphasize the importance of banks in the economic growth process and, as far as we know, it has never been empirically tested.

In the aftermath of the Panic of 1907, a number of studies investigated aspects of banking sector stability as a prelude to new legislation and banking system reforms. Sprague (1910) studies bank failures and banking panics in the United States and finds that international gold outflows cause, simultaneously, bank failures and a decline in economic activity. Kemmerer (1910) finds that seasonal changes in the demand for money, stemming from changes in agricultural sector borrowing, explain the joint variation of stock prices, commercial failures, and banking panics between 1890 and 1908.

Friedman and Schwartz (1963) (FS) study the U.S. Great Depression and find that bank failures triggered a loss of public confidence in the banking system leading consumers to hold more currency and fewer bank deposits which reduced the money

[5] The literature on this issue is large and our selected review highlights only the key issues in the literature.

multiplier and the money supply. Because the decline in the money supply was not offset by monetary policy, nominal economic activity declined.[6]

Bernanke (1983) extends the FS analysis to incorporate the effect of bank failures on investment spending. In Bernanke's bank-centered model of business finance, firms depend on bank lending for investment and working capital funding. Firms typically have a long-term relationship with a single bank and when the bank fails, relationships are dissolved and the information and trust gained through the relationship are lost. When bank-dependent firms seek funding from new bankers, they face increased costs until they can establish new banking relationships. Thus, for some period after a bank failure, investments by bank-dependent firms are discouraged by increased funding costs and investments may be limited by the availability of internal funds.[7]

Bank failures can also have secondary effects on the lending behavior of surviving banks. Faced with heightened uncertainty regarding deposit redemptions, to preserve their own solvency, surviving banks increase their reserves by reducing loans to bank-dependent businesses. In contrast to FS's focus on the money supply, Bernanke focuses on the ramification of this change for business investment. Unable to tap external capital markets, businesses are forced to reduce investment spending which directly reduces GDP. The initial investment shock associated with a bank failure is magnified through the Keynes (1936) investment multiplier.

[6] FS argue that the banking failures of the Great Depression era could have been avoided, or at least mitigated, if the Federal Reserve System had been more generous in providing discount window lending to troubled banks, which would have given solvent banks access to liquidity without changing their need to hold currency reserves thereby stabilizing the money supply.

[7] For more evidence on how bank affiliations facilitated access to capital markets in the pre-Depression era, see Ramirez (1999) and Calomiris and Hubbard (1995).

Other researchers have confirmed the importance of the bank-dependent borrower channel. Calomiris and Mason (2003) estimate a loan supply function for local banking markets and find that a significant portion of the decline in economic activity from 1930 to 1932 is explained by reduced bank loan supply which reduced investment spending. Anari, Kolari, and Mason (2005) use vector autoregression methods to investigate the relationship between the liquidation of failed banks and the depth and duration of the Great Depression. They find that bank failures have a long-lasting adverse effect on economic activity partly because bank failures restrict access to the deposits in failed institutions. During this period, depositors at failed banks were precluded from accessing their funds for an extended time, and when their accounts became liquid, depositors generally faced sizable losses.[8] The loss in depositors' liquidity resulted in reduced consumption and investment spending.

In contrast to the U.S. experience, evidence from the Great Depression era in other countries fails to find strong bank failure externalities on economic growth. Haubrich (1990) studies the Great Depression in Canada using Bernanke's methodology. During the depression, Canada also experienced monetary contraction and a decline in output almost as dramatic as the one in the United States. Unlike the U.S., Canada did not experience a single bank failure during its Great Depression era notwithstanding the fact that there was no central bank in Canada until 1935.[9] While there were no Canadian bank

[8] The depositor recovery rate was not very high. For example, Goldenweiser et al. (1932) estimate that between 1921 and 1930 the deposit recovery rate was 55.7 percent (table 25, page 195). Although this figure does not cover the Depression period, it illustrates the gravity of the situation before the establishment of federal deposit insurance.

[9] The source of the Canadian system's resilience remains in dispute but some scholars have attributed it to the diversification benefits from branch banking (FS 1963; Bordo, 1986; Ely, 1988; O'Driscoll, 1988); the effective lender of last resort function provided by the Canadian Bankers Association (CBA) (Bordo, 1986); and the existence of a 100 percent implicit government guarantee on deposits (Kryazanowski and Roberts, 1993). These explanations are, however, not beyond dispute. For example, Carr, Matherson and

failures, Haubrich finds that the number of bank branches in Canada declined by about 10 percent. While it is possible that this decline caused disintermediation and reduced businesses funding, Haubrich rejects this hypothesis and finds that branch closures had no measurable effect on Canadian GDP.

Many countries in Central and Eastern Europe also experienced banking crisis during the Great Depression era.[10] Similar to Canada, the United Kingdom, Czechoslovakia, Denmark, Lithuania, the Netherlands and Sweden experienced depression conditions without breakdowns in their banking systems (Grossman, 1994). The literature has studied factors that may have provided stability to these national banking systems during the Great Depression, but to our knowledge, existing studies have not analyzed whether banking system distress magnified real sector weakness.[11]

Banking scholars also reach conflicting conclusions when studying data from the U.S. S&L crisis period. For example, Ashcraft (2005) investigates FDIC-induced closures of 38 subsidiaries of First Republic Bank Corporation in 1988 and 18 subsidiaries of First City Bank Corporation in 1992 and concludes that, as a result of the closures, real income declined by about 3 percent in areas served by these banks. In contrast, Alton, Gilbert and Kochin (1989), using county-level data from Kansas, Nebraska, and Oklahoma over the period 1981–1986, do not find any significant relationship between bank failures and measures of local economic activity. Clair and

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Quigley (1995) argue that the CBA did not arrange mergers for insolvent institutions nor were depositors protected by a government guarantee (or perception thereof) as some faced losses when banks were suspended.

[10] Grossman (1994) identifies a banking crisis if any one of the following occurs: (1) a large proportion of a country's bank's fail; (2) a large important bank fails; or (3) or extraordinary government intervention prevents (1) or (2) from occurring. Using this definition, the Great Depression was associated with banking crisis in Switzerland, Yugoslavia, France, Belgium, Latvia, Hungary, Poland, Estonia, Romania, Germany, Italy and Norway in addition to the United States.

[11] This gap in the literature likely reflects the fact that few countries have high quality measures of aggregate economic activity available for this historical period.

O'Driscoll (1994) use Gilbert and Kochin's methodology to study the impact of bank failures on local economic activity in several Texas counties between 1981 and 1991. Like Gilbert and Kochin, they do not find any significant relationship.[12]

The results of studies based on data from the S&L crisis period are not directly comparable to the results derived from Great Depression era data. During the S&L crisis period, both the Federal Reserve and banking regulators took actions to attenuate the economic impacts of banking system distress. Bank failures were delayed (relative to what would have happened in the Great Depression) as weak institutions continued funding themselves with insured deposits which reduced the risk of a bank run. While legislative inaction ensured that resource constraints slowed the supervisory resolution process, undercapitalized depository institutions continued to fund lending activity.[13] Deposit insurance quelled the public's demand for precautionary currency holdings while the Federal Reserve discount window was available to provide liquidity to solvent banks which mitigated their need to call in loans. The Federal Reserve also pursued a monetary policy designed to offset problems in depository institutions.[14] All of these factors likely worked to offset any negative effects of bank failures on economic growth.

Among existing studies, Grossman (1993) is the most closely related to our study. Using data on the fraction of national banks that failed during the National Banking Era (1863–1914), Grossman (1993) estimates a structural IS-LM model that includes the effects of bank failures. His estimates suggest that a "small" shock in bank failures can erase 8 percentage points of GDP growth, whereas a "large" shock in bank failures can reduce the GNP growth rate by 26 percentage points. Grossman notes that these

[12] See also Dell'Ariccia, Detragiache and Rajan (2005) and the references therein.
[13] See for example Kane (1989), or Romer and Weingast (1991).
[14] See for example Clouse (1994), or Mussa (1994).

estimated magnitudes are large, but he argues that they are reasonable when compared to the historical record.

Grossman analyzes the effects of the number of national bank failures. Over the period he examined (1863-1914), roughly a third of banking system assets were held by state-chartered institutions and in many years, state-chartered banks outnumbered national banks (White 1983, pp.12-13). Importantly, in some periods, banking distress was concentrated in the state-chartered institutions that are excluded from Grossman's study.[15] The Grossman study, moreover, does not account for the size of failed institutions. The importance of the negative externality generated by a bank failure should be related to the size of a bank as institution size is a proxy for the number (and size of) valuable relationships a bank shares with its borrowers.[16] Large banks also are more likely to have correspondent banking relationships which were particularly important during this era. The failure of a key correspondent bank can have wide-ranging affects on the reserves and lending capacity of many smaller state-chartered institutions (White pp. 68-9).

III. The Importance of the Sample Period

During the period 1900-1930, the United States experienced three major banking crises: one in May of 1901, another one in October of 1907, and one during the early

[15] An important example is the Banking Panic of 1907. Measured by the failure rate among national banks, the 1907 Banking Panic was a mild event as the crisis was concentrated in state-chartered depository institutions. Calomiris and Gorton (1991, p. 150) identify only six national bank failures during this episode while Wicker (2000, p. 87) reports that 17 state-chartered trusts and 18 state-chartered banks either failed or suspended redemptions as a result of the crisis. Wicker, moreover, estimates that the trust failures accounted for 57 percent of the liabilities of all institutions that failed during this period.

[16] Wicker (2000, p. 85) also notes the number of failed institutions is unlikely to be an accurate measure of banking system distress and the size of failed institutions must matter as well. Wicker, however, does not systematically exploit this observation.

1920s. In addition, it endured eight minor crises.[17] Many of the banking crises were not preceded by large negative shocks to economic activity. Moreover, during this period, no federal government policies were used to stimulate the economy, counteract recessions, or offset the negative economic impacts of bank failures. We use a simple econometric model to illustrate why these two data features enhance our ability to identify the economic cost of bank failures.[18]

Consider a simplified model in which the health of the banking system affects economic activity, and economic activity also affects the health of the banking system. Let Y_t and B_t represent, respectively, economic activity and banking system health at time t. Let G_t represent the government contribution to economic activity. G_t captures the effects of monetary, fiscal, and banking regulatory and resolution policies. Let X_t (a vector) represent all other factors which are assumed to be exogenous or predetermined in this example and $\tilde{u}_t$, $\tilde{v}_t$ and $\tilde{w}_t$ represent, respectively, shocks to economic activity $(\tilde{u}_t)$, the health of the banking sector $(\tilde{v}_t)$, and government activity, $(\tilde{w}_t)$. In most circumstances, these shocks will be correlated.

Beginning in the 1930s, government began introducing policies that were designed to offset direct shocks to economic activity as well as negative shocks to the health of the banking sector. The government reaction function has undergone many changes since the 1930s. As the public and their elected officials became more comfortable with a government role in aggregate demand management, countercyclical fiscal and monetary policies became an important feature of the macroeconomic

[17] Calomiris and Gorton (1991), p. 114; Miron (1986), p. 131; Kremmerer (1910), pp. 222-223.
[18] We are indebted to Thomas Philippon for suggesting that we include this discussion.

environment and regulatory measures were undertaken to mitigate the economic impacts of bank failures. To capture these time dependent effects, we write the government reaction function as $g_t\left(X_{t,}\tilde{u}_t,\tilde{v}_t\right)$. Using these definitions, we can model the relationship between economic activity, exogenous factors, banking sector health, and government responses as,

$$\begin{aligned} Y_t &= \alpha X_t + \lambda B_t + G_t + \tilde{u}_t \\ B_t &= \gamma Y_t + \tilde{v}_t \\ G_t &= g_t\left(X_t,\tilde{u}_t,\tilde{v}_t\right) + \tilde{w}_t \end{aligned} \tag{1}$$

The system of equations specified in (1) is inherently complex. To estimate this system directly, one would have to specify a model for the evolution of the government's reaction function, $g_t\left(X_t,\tilde{u}_t,\tilde{v}_t\right)$, as the government's role in economic stabilization expanded dramatically since the 1930s. Without properly controlling for government reactions to recessions and banking sector distress, the relationship between banking sector heath and economic activity cannot be accurately identified.

One important characteristic of our sample period is the role government played in shaping aggregate economic activity. During this period, the federal government and the Federal Reserve eschewed any policies to stabilize economic activity or mitigate the effects of banking sector distress. The details of the historical record are reviewed in the following subsections, but for purposes of this econometric example, the lack of any government stabilization activities allow us to ignore the effects of government and write the system as,

$$\begin{aligned} Y_t &= \alpha X_t + \lambda B_t + \tilde{u}_t \\ B_t &= \gamma Y_t + \tilde{v}_t \end{aligned} \tag{2}$$

The second important feature of the sample period is the prevalence of bank panics in which banks experienced unanticipated depositor runs, financial distress and failures against a background with quiescent economic conditions. Banking panics are equivalent to a large negative shock to the health of the banking system, $\tilde{v}_t$, that are independent of the shocks to economic activity, $\tilde{u}_t$. The independent nature of the shocks to the banking sector allows us to identify the magnitude of the health of the banking sector's independent affect of economic activity.[19]

This simple econometric example is used to formalize our arguments about features of the data that enhance our ability to detect a relationship between the health of the banking system and the level of economic activity. In the sections that follow, we will estimate the relationship between banking system health and economic activity using more advanced models that employ vector autoregression and difference-in-difference methods.

Fiscal Policy

From 1900 to 1916, federal government fiscal policy had little impact on U.S. aggregate demand. Over this period, federal expenditures varied between 1.5-2.5 percent of GDP (Romer, 1999) and budget surplus or deficits were of negligible size (DeLong, 1998). With the onset of World War I, federal government expenditures increased dramatically, to 20 percent of GDP by 1918, before declining throughout the 1920s (Romer, 1999).

Prior to the federal programs created under the New Deal, there is little evidence that federal expenditure policies were intentionally designed to counteract weak

[19] A proof is given in the appendix.

aggregate demand; indeed even New Deal programs do not appear to have been motivated by Keynesian economic ideas. Romer (1999) argues that the Employment Act of 1946 was the first law enacted that explicitly embraced the idea of using fiscal policy to regulate aggregate demand. More importantly, no fiscal stimulus policies were designed or implemented to counteract the economic impacts of any of the banking panics of this era.

Monetary Policy

The Federal Reserve System, created in 1913, was established to smooth regional credit cycles associated primarily with agricultural borrowing demands.[20] Miron (1986) argues that Federal Reserve policies were successful in dampening the seasonal variation of nominal interest rates which reduced the frequency of banking panics. Notwithstanding its impact on the seasonal agricultural cycle, early Federal Reserve policies did not include an explicit counter-cyclical (business cycle) role for monetary policy (White, 1983, p.115 ff).

In practice, the earliest coordinated Federal Reserve policies were dictated by the U.S. Treasury's desire to finance World War I on favorable terms. Under pressure from Treasury, the Federal Reserve abandoned the "real bills" doctrine and allowed member banks to discount Treasury certificates issued to finance the war at rates below those on the Treasury certificates (Meltzer, 2003, pp. 84-90). This discounting policy created monetary expansion and inflation. In late 1919, Federal Reserve System banks were

[20] The Federal Reserve did not begin operations until 1914. Throughout the early years, Federal Reserve officials believed that monetary policy should follow a "real bills" doctrine focused on discounting commercial paper at penalty rates and providing lender of last resort facilities when needed.

finally permitted to raise discount rates and penalize excessive borrowing.[21] The recession that followed was severe, with widespread unemployment, declines in industrial production and substantial deflation.[22] The wholesale price index fell from 100 in 1920, to 62.8 in 1923.

Federal Reserve operating policies were modified following the 1920-22 recession, but as late as 1924, few officials in the Federal Reserve System believed that open market operations should be used to attenuate recessions (White, 1983, p.122). Throughout the remainder of the 1920s, Meltzer reports that the Federal Reserve policies were guided by three perceived goals: (1) to establish the gold standard as the international system of exchange; (2) to maintain price stability and avoid repeating the events of 1920-22; and, (3) to curb the growth of speculative credit (i.e., credit used to purchase securities). The Federal Reserve did not embrace countercyclical monetary policies and indeed the system could not effectively coordinate monetary policy until after the 1935 Banking Act established the Federal Open Market Committee which allowed the Federal Reserve Board to coordinate operations among the reserve banks (Meltzer, 2003, p.5).

IV. Granger Causality Evidence

Data

A vector autoregressive model (VAR) is used to estimate the importance of bank failures in determining subsequent economic growth. The VAR model includes the share of liabilities in failed banks, a measure of aggregate economic activity, and two

[21] Following WWI, several regional Federal Reserve Banks had attempted to raise discount rates but were prohibited from doing so by the Federal Reserve Board (see Meltzer 2003).
[22] The severity of this recession has been in part attributed to a failure of Federal Reserve policy (Meltzer, 2003, p. 120-ff).

additional economic series that are used to control for non-bank failure related shocks to aggregate economic activity: an estimate of the inflation rate, and an estimate of the prevailing risk premium in credit markets. The data sources for the variables used in the VAR analysis are listed in Table A of the appendix. We discuss the characteristics of each data series in the remainder of this section.

We use two measures of banking system distress. Our primary measure is an estimate of the share of liabilities in failed institutions (SLFI). This series is constructed from data on the liabilities (primarily deposits) of failed depository institutions as reported in issues of *Dun's Review*. These data include nearly 6,000 quarterly observations for the 48 states from the first quarter of 1900 through the second quarter of 1931.[23] State figures are aggregated to produce national data for each quarter. The data include failed national banks as well as failed state-chartered banks and trust companies.[24] The failed depository liability series is normalized by total deposits as reported in Flood (1998).[25]

We also construct an estimate of the time series of the failure rate of depository institutions. The bank failure rate series is constructed from data on bank depository institution failures as reported in *Dun's Review* and the quarterly estimates of the number

[23] *Dun's Review* reports failure data beginning in 1895, but there are periods in the 1800s when the data are unreported. From 1900, the data are reported regularly for each quarter. *Dun's Review* stopped reporting these data after the second quarter of 1931. The original data are corrected for typographical errors.

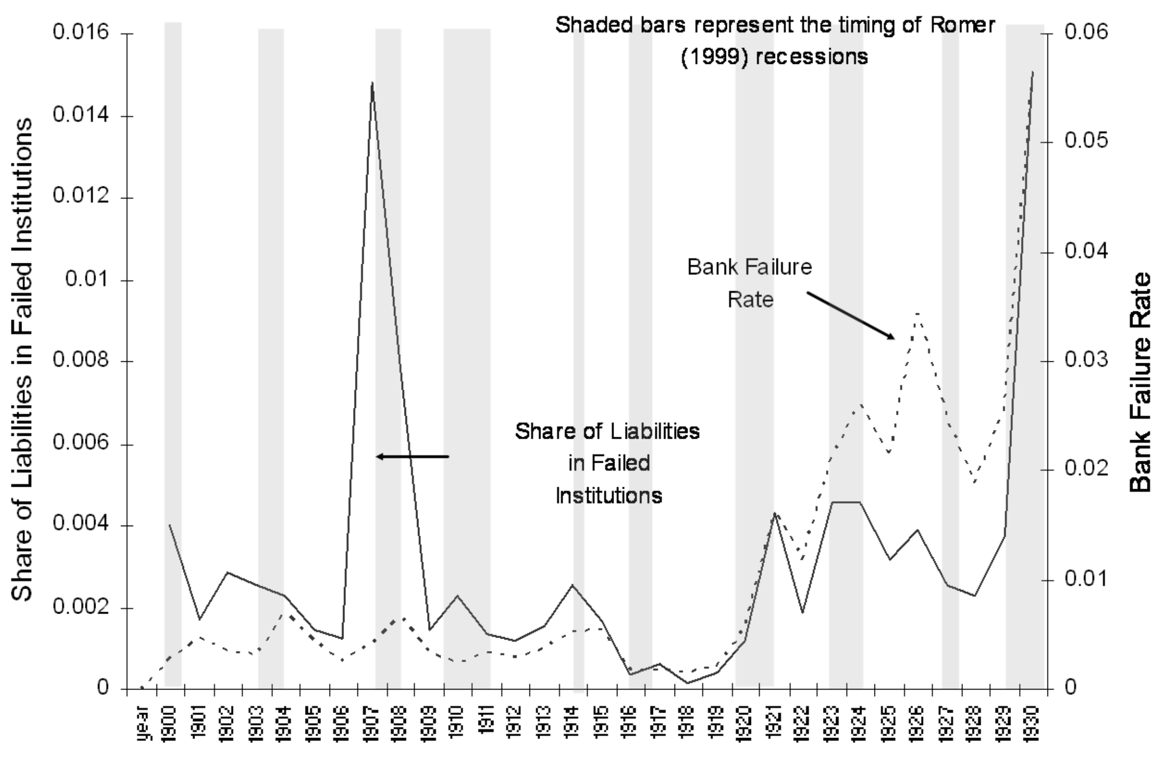
[24] *Dun's Review* does not clarify whether bank suspensions are included in bank failures. Compared to the aggregate number of U.S. bank failures reported by Goldenweiser (1933, table 1), our numbers are marginally higher than Goldenweiser's before 1921 but smaller thereafter. Because the Goldenweiser data specifically excludes national bank suspensions before 1921 (and includes them thereafter), the comparison suggests that our data may include a few suspensions, but not all suspensions. This feature of the data is unlikely have any significant effect on our results since the largest proportion of bank suspensions occurred after 1931 (Calomiris and Mason, 2003).

[25] The primary source for the data reported in Flood is *All Bank Statistics*. The denominator in our measure is a quarterly estimate of total liabilities interpolated from annual figures.

of banking institutions from data reported in *Historical Statistics of the United States* (1975).[26]

Exhibit 1 shows the depository institution failure-rate series and the SLFI series. Both series in the figure are annualized to visualize more clearly trends and cycles. The bank failure-rate series measures the proportion of depository institutions that were closed, either temporarily or permanently, between 1900 and 1930. Exhibit 1 also includes estimates of the recessionary periods (shaded bars) as identified by Romer (1999).

Exhibit 1: Depository Institution Failure Rate and Liabilities of Failed Institutions Relative to Total Deposits, 1900–1930



Source: *Dun's Review* (1900-1930), *Historical Statistics of the United States* (Series X585), *All Bank Statistics*, Romer (1999), and authors' calculations.

[26] Again, the denominator is a quarterly estimate interpolated from annual figures.

The two deposit institution failure series, plotted in Exhibit 1 at annual frequency, suggest a significantly different record of banking system distress. The depository institution failure rate series is strongly procyclical with increases in the recessions of 1900, 1903, 1907, 1910, 1920, 1924, and 1929. The bank failure rate series reaches a local peak at the end or shortly following most of the recessions in the sample period.[27] In contrast, the SLFI series declines during the recessions of 1900, 1903, 1907, 1910, 1915, and 1927. The SLFI series also has local peaks immediately prior to or very early into the recessions of 1900, 1907, 1910 and 1923. Exhibit 1 shows that the series diverge in the early 1900s when failures were dominated by larger institutions as well as in the 1920s when smaller institutions failed at a relatively higher rate.

The simple failure rate series is a misleading indicator of banking sector health in at least two important periods in the sample. The simple bank failure rate series suggests that banking system conditions were comparable during the 1903–1904 and 1907-1908 recessions, whereas the SLFI data clearly identifies the severity of the banking panic of 1907. The 1907 panic involved the failure or temporary suspension of only a few large money-center institutions, but these failures accounted for about 1.5 percent of all system deposits.[28] This level of banking system distress was not exceeded until the Great Depression. In a second example, the simple failure rate series overstates the degree of stress in the banking system over the period 1922–1929. Although a large number of banks failed during this period, the failed institutions were on average only modest in size.

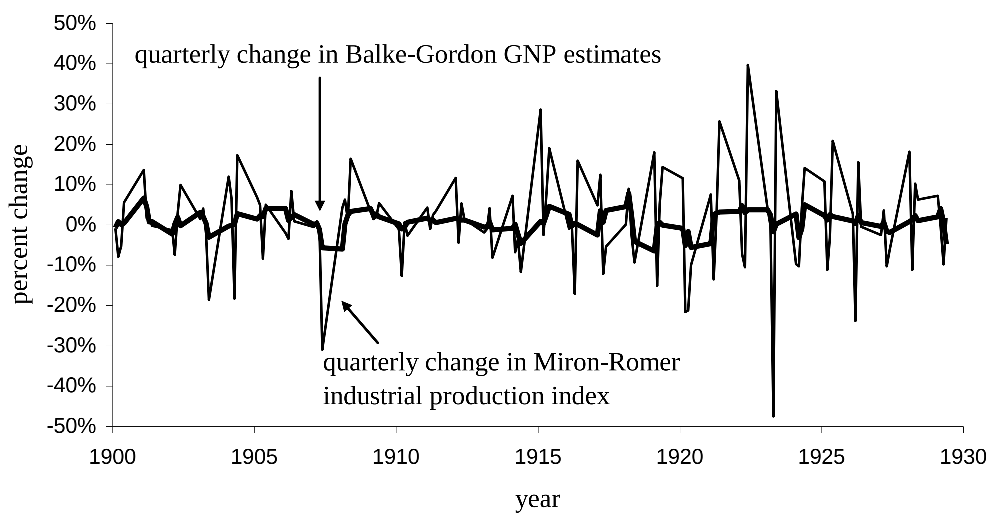
[27] This pattern is clearly evident in 7 of the 9 recessions in the chart.

[28] The institutions included Knickerbocker Trust, Hamilton Bank, International Trust Company, and United Exchange Bank.

It is well-known that measures of aggregate economic activity over the period 1900-1930 are imperfect (e.g., Romer, 1999) and alternative measures of aggregate output differ as to their historical volatility characteristics. We focus on two measures of aggregate economic activity, the Miron and Romer (1990) industrial production series and the Balke-Gordon (1986) estimates of real GNP.

The Federal Reserve did not publish a series on aggregate industrial production until 1919, and real GNP estimates were not reported by the U.S. Commerce Department until 1929. Among available measures of industrial production for the period 1900–1930, the Miron and Romer (1990)'s series is arguably the most comprehensive, as it is derived from production indices on at least 13 sectors of the economy. We use the Balke-Gordon real GNP series because it is (to our knowledge) the only series that estimates quarterly GNP for the period 1900-1930.

Exhibit 2: Alternative Measures of the Change in Aggregate Economic Activity



Source: Gordon (1986, p.781), Miron and Romer (1990, pp. 336-7), and the authors' calculations.

Exhibit 2 shows estimates of the quarterly changes in the alternative measures of aggregate activity. Within this era, industrial production is a much more volatile measure of aggregate economic output compared to GNP. The volatility difference between these series may be explained in part by a tendency for asynchronous changes in the data on outputs of the services, transportation, and other non-commodity sectors (Romer, 1999).

We use data on the spread between the New York call rate and the London open interest rate as a proxy for the risk premium in financial markets.[29] Bank lending and economic activity are likely to decline in reaction to an increase in the risk premium in credit markets. If, for example, investors became more risk averse when there is a significant gold outflow or a general deterioration in economic activity, the risk premium will have output effects independent of banking failures. The volatility of this interest rate spread is pronounced during the 1907 panic when the U.S. experienced heavy outflows of gold and again around the second quarter of 1914—a tumultuous year that saw the collapse of the classical gold standard the beginning of World War I.

We use the NBER inflation rate series as a measure of the ease of monetary conditions. We expect tight monetary conditions to lead to deflation and a decline in industrial production irrespective of the degree of distress in the banking sector. The inflation rate is remarkably stable before 1914 as a consequence of the gold standard. After the United States suspended the gold standard in 1914 and World War I began, prices increased and became much more volatile. Following the war, prices declined sharply reflecting in part the worldwide collapse in the price of agricultural commodities.

[29] Both rates are available from the National Bureau of Economic Research Historical Series Database.

VAR Analysis

We estimate and report estimates for two VAR models. One model includes: (1) the growth rate in Miron-Romer's index of industrial production (IP growth); (2) the spread between the New York call money rate and the London open market rate (Spread); (3) the inflation rate (Inflation); and, (4) the share of system liabilities in failed banks (SLFI).[30] The second VAR model substitutes the growth rate in the Balke-Gordon GNP series for the IP growth series. Both VAR models are estimated using five quarterly lags.[31]

The VAR estimates identify the temporal relationships among the model's variables.[32] In the context of this study, we are interested in whether increases in SLFI leads to subsequent declines in the growth rate of economic activity (IP growth and real GNP growth)--holding other important economic conditions unchanged. The SLFI series Granger-causes changes in IP growth (GNP growth) if lagged values of SLFI are helpful in explaining changes in output growth, but lagged values of IP growth (GNP growth) do not have a statistically significant influence on subsequent values of SLFI.

Exhibit 3 reports the Granger causality Chi-squared test statistics and the corresponding level of statistical significance (p-values) for the hypothesis that all coefficients of the individual lagged explanatory variable in the equation are jointly zero. For example, in equation 1, IP growth is the dependent variable; spread, inflation, and

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[30] The VAR system runs short of degrees-of-freedom if more than four variables are included in the model. The VAR system was also estimated using money growth instead of inflation, and the results did not change significantly. The VAR system was also estimated dropping the interest rate spread variable from the system. The results were similar to those reported in the paper for the larger model.

[31] Standard VAR model selection criterion favored 5 lags; with five lags there is no evidence of serial correlation in the residuals.

[32] The existence of temporal relationships need not imply economic causality, but causal relationships are expected to generate temporal relationships that can be identified in the data.

SLFI are the independent variables. The effect of SLFI on output growth is summarized by the Chi-squared statistic of 14.65 (p-value of 0.01) which indicates that the lagged values of SLFI are jointly statistically significant in explaining output growth (at the 1 percent level).

Exhibit 3: Granger causality when economic activity is measured by IP growth and banking system distress is measured by the share of liabilities in failed institutions

Left-hand-side variable	Right-hand-side (lagged) variable	Chi- squared	p-value
Equation 1: IP growth	Spread	13.50	0.02
	Inflation	36.78	0.00
	SLFI	14.65	0.01
	All Variables	63.66	0.00
Equation 2: Spread	IP growth	3.52	0.62
	Inflation	2.52	0.77
	SLFI	4.72	0.45
	All Variables	10.59	0.78
Equation 3: Inflation	IP growth	4.32	0.51
	Spread	9.97	0.08
	SLFI	0.70	0.98
	All Variables	5.93	0.39
Equation 4: SLFI	IP growth	4.35	0.50
	Spread	14.37	0.01
	Inflation	3.23	0.66
	All Variables	21.30	0.13

Equation 4 tests the reverse causality, where the dependent variable is SLFI and the independent variables are IP growth, spread, and inflation. The Chi-squared statistic on lags of output growth is 4.35 (p-value of 0.50) and so the lagged values of IP growth are not statistically significant in explaining SLFI. Thus, it is possible to conclude that SLFI Granger-causes variation in IP growth, even after one has controlled for shocks to interest rate spread and the inflation rate, both of which are also statistically significant predictors of output growth.[33]

[33] The Chi-square test results in Table 1 show that the interest rate spread and inflation also Granger-cause movements in IP growth.

Exhibit 4 reports the results of the Granger causality tests when economic activity is measured by the growth rate in the Balke-Gordon estimate of GNP. From equation 1, it is clear that the lagged values of SLFI are significant explanatory factors for explaining the variation in GNP growth holding the lagged values of inflation and the credit spread constant (Chi-squared statistic 10.97, p-value 0.05). From equation 4 it is clear that the reverse causality does not hold; lagged valued of GNP growth do not help to explain the variation in SLFI (Chi-squared statistic 6.29, p-value 028). Thus, SLFI Granger-causes variation in GNP growth, even after one has controlled for shocks to interest rates and the inflation rate.

Exhibit 4: Granger causality when economic activity is measured by GNP growth and banking system distress is measured by the share of liabilities in failed institutions

Left-hand-side variable	Right-hand-side (lagged) variable	Chi- squared	p-value
Equation 1: GNP growth	Spread	12.31	0.03
	Inflation	4.73	0.45
	SLFI	10.97	0.05
	All Variables	24.95	0.05
Equation 2: Spread	GNP growth	5.00	0.42
	Inflation	3.56	0.62
	SLFI	5.50	0.36
	All Variables	12.16	0.67
Equation 3: Inflation	GNP growth	2.59	0.76
	Spread	10.51	0.06
	SLFI	1.16	0.95
	All Variables	14.03	0.52
Equation 4: SLFI	GNP growth	6.29	0.28
	Spread	15.43	0.01
	Inflation	5.29	0.38
	All Variables	23.51	0.07

The quantitative effect of a bank-failure shock can be illustrated by estimating cumulative impulse response functions. Cumulative impulse response functions trace out the change that occurs over time to the value of one variable in the system as another variable in the system is shocked.[34] Exhibit 5 plots the cumulative impulse response function estimates that trace the IP growth rate effects of a one-standard deviation (.0012) shock to SLFI along with 90 percent confidence intervals around the cumulative impulse response estimates. The cumulative impulse response estimates suggest that a one-standard deviation shock SLFI has a statistically significant depressing effect on industrial production, causing a cumulative decline of about 17 percentage points after three quarters.

Exhibit 5: Cumulative Impulse Response of IP Growth to a 1-Standard Deviation Shock in SLFI

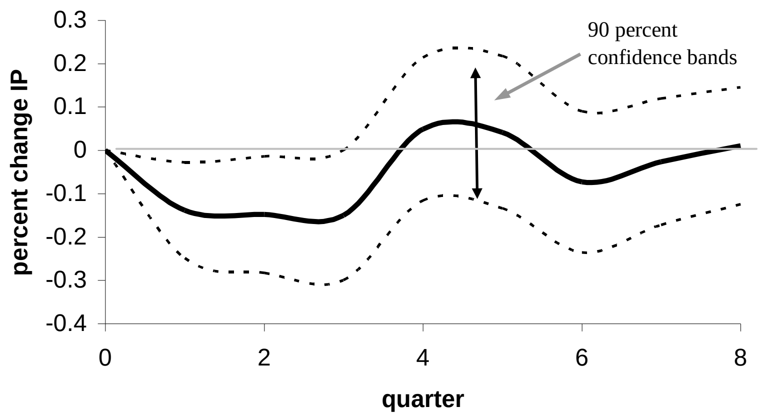
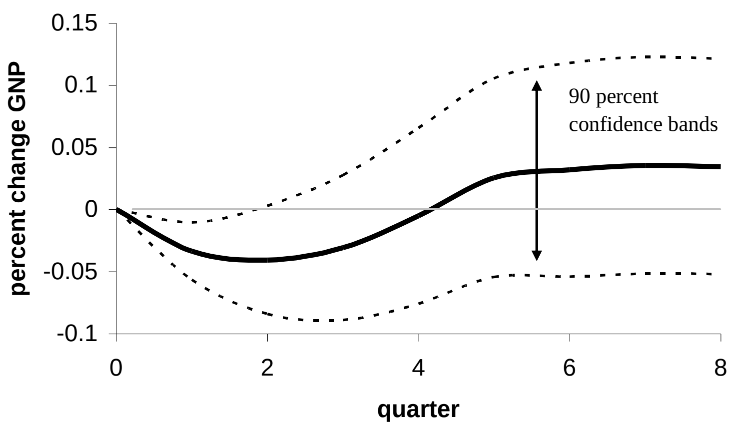


Exhibit 6 plots the cumulative impulse response function estimates for GNP growth along with 90 percent confidence bands. The cumulative impulse response estimates suggest that a one-standard deviation shock to SLFI has a statistically significant depressing effect on GNP growth, causing a cumulative decline of about 4 percentage points after two quarters.

[34] To obtain a structural model with orthogonal innovations we employ the Cholesky decomposition with the equations ordered as they appear in Exhibits 3 and 4.

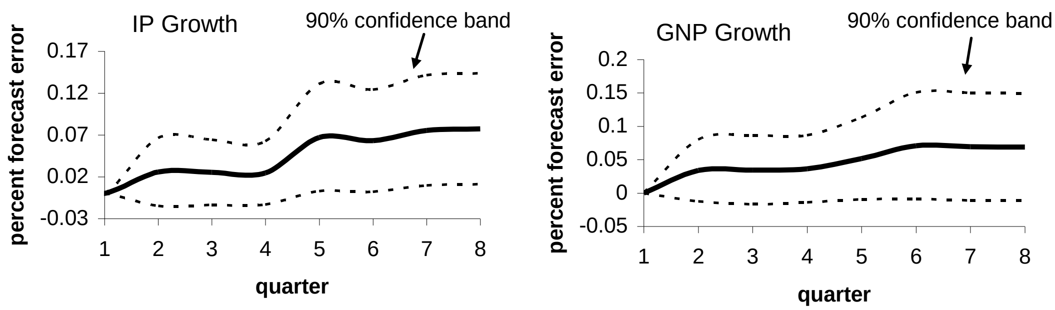
Exhibits 5 and 6 suggest that bank failures have a short-term but pronounced effect on output growth. Following a shock to SLFI, GNP growth is depressed for two quarters before the economy begins to recover. Industrial production is more sensitive to bank failures. Following a shock to SLFI, the growth rate in industrial production is depressed for three quarters before the effect diminishes. By the fourth quarter following a banking system shock, within the bounds of the statistical precision of our estimates, economy activity has returned to its pre-shock growth path. These results suggest that bank failures have important negative effects on output growth for about 3 quarters.

Exhibit 6: Cumulative Impulse Response of IP Growth to a 1-Standard Deviation Shock in SLFI



One way to measure the importance of bank-failure shocks for explaining variations in industrial production and GNP growth is the forecast error variance decomposition (FEVD). The FEVD measures the extent to which innovations in a particular variable in the VAR system contribute toward generating time-variation in a particular VAR dependent variable over a selected time horizon. Exhibit 7 plots the FEVD for SLFI on IP growth (left panel) and GNP growth (right panel). The model estimates suggest that time variation in SLFI is responsible for generating about 7.8 percent of the volatility of the IP growth rate over an eight-quarter horizon and about 6.9 percent of the volatility in GNP growth over a two-year interval.

Exhibit 7: Forecast error variance decomposition for IP growth and GNP growth for innovations in the share of liabilities in failed institutions



Recall from our earlier discussion that Grossman (1993) examined the effect of national bank failures over period 1863-1914 and found strong negative effects of bank failures on aggregate output using an alternative measure of bank failures—the number of failed national banks relative to the total number of national banks. For purposes of comparison, Exhibit 8 presents Granger causality test results when the bank failure rate is used in place of SLFI, our preferred measure of bank distress.

The results in Exhibit 8 show that when banking system distress is measured by the simple failure rate, bank failures no longer Granger-cause reductions in IP growth; the Chi-square value in equation 1 (7.33) is not longer statistically significant at conventional levels.[35] Moreover, the estimates in equation 4 suggest that lagged values of IP growth are statistically significant in explaining the bank failure rate. The Chi-square statistic of 42.32 is statistically significant. The results highlight the importance of the proxy

[35] The causality results for GNP growth are similar, so they are omitted in the interest of parsimony.

variable used to measure banking system distress. When banking system distress is measured by depository institution failure rate instead of SLFI, banking system distress appears to be caused by real-side economic disruptions whereas IP growth seems to be unaffected by bank failure rates.

Exhibit 8: Granger causality when economic activity is measured by industrial production growth and banking system distress is measured by the bank failure rate

Left-hand-side variable	Right-hand-side (lagged) variables	Chi- Squared	p-value
Equation 1: IP growth	Spread	11.82	0.07
	Inflation	27.49	0.00
	Bank Failure Rate	7.33	0.29
	All Variables	47.52	0.00
Equation 2: Spread	IP growth	5.50	0.48
	Inflation	4.54	0.60
	Bank Failure Rate	12.73	0.05
	All Variables	20.88	0.29
Equation 3: Inflation	IP growth	4.51	0.61
	Spread	11.81	0.07
	Bank Failure Rate	5.33	0.50
	All Variables	22.30	0.22
Equation 4: Bank Failure Rate	IP growth	42.32	0.00
	Spread	5.44	0.49
	Inflation	8.06	0.23
	All Variables	55.79	0.00

Overall, the results suggest that seemingly small shocks to the health of the banking system, measured by SLFI, can have large impacts on IP and GNP growth rates. There are at least two ways to make sense of these results. One standard of comparison is to relate these estimates to the literature that investigates linkages between the financial sector and real economic activity. The financial accelerator literature (Kiyotaki and Moore (1997), Bernanke and Gertler (1989), Bernanke, Gertler and Gilchrist (1996)) explains how relatively small changes in certain key variables that affect the financial sector can have large effects on aggregate economic activity. For example, small changes in interest rates or liquidity constraints may have large effects on aggregate demand. Similarly, relatively small shortfalls from required levels of bank capitalization may lead to significant declines in aggregate economic activity (Peek and Rosengren (1995)).

A more direct way to justify the magnitude of our estimated sensitivities is to compare them to the data itself. Table B in the appendix reports sample statistics for the SLFI data. The sample statistics show that the SLI series has a strong right skew. The quarterly series mean value, 0.07 percent, is larger than the median series value of 0.04 percent, and the maximum observed value is many standard deviations larger than the series average. The implication is that a one standard deviation increase in SLFI relative to the series mean value is a stressful event for the banking sector. Events of this magnitude (or larger) occur in only 7 quarters in the sample period including two episodes with large SLFI shocks in two consecutive quarters. In most cases, large SLFI shocks were coincident with or were immediately followed by a relatively severe recession (see Exhibit 1). For example, the pair of SLFI shocks from 1907-8 were associated with a recession that resulted in a cumulative decline of 12.8 percent in real GNP and 31.7 percent in IP. The large quarterly SLFI shocks in 1923-4 were associated with a cumulative drop of 3.1 percent in real GNP and 34.7 percent decline in IP. Overall, the magnitude of the estimated sensitivities is consistent with the data on economic activity from this sample period.

V. New York, Connecticut and the Panic of 1907

The Panic of 1907 began in New York in October after an unsuccessful investment ploy to corner the stock of the United Copper Company. The failed attempt at cornering the market caused the failure of two brokerage houses. In the days following the attempt, a number of banks and trusts with direct and indirect links to the cornering scheme experienced depositor runs. Ultimately, 42 depository institution failures have been linked to the 1907 Panic (Wicker, 2000, p.87) including 13 depository institution suspensions in New York in October 1907 (*ibid.* p.86). In contrast to the New York experience, there were no suspensions of depository institutions in Connecticut.

The financial panic of 1907 occurred against the backdrop of a steep recession that likely began in the early summer. Industrial production fell by 11 percent between May 1907 and June 1908; commodity prices fell 21 percent; and unemployment increased from 2.8 percent to 8 percent.[36] While no official GNP estimates are available for this period, estimates constructed by Romer (1989) suggest that GNP declined by about 4.2 percent while alternative estimates constructed by Balke-Gordon (1989) put the decline at 5.5 percent. In another measure of economic activity, the dollar volume of bankruptcies increased by almost 50 percent November 1907, the month following the onset of the banking panic.

Banking and economic conditions were largely similar in New York and Connecticut in the years leading up to the panic of 1907. Exhibit 9 presents statistics that can be used compare economic and banking conditions between New York and Connecticut. At the turn of century, income per capita estimates suggest that New York was slightly poorer than Connecticut, but both states enjoyed income levels and literacy

[36] These data are quoted from Bruner and Carr (2007), pp. 141-142 from primary sources.

rates that were well above the rest of the country. Both states were heavily involved in the manufacturing sector: New York's capital-to-output ratio was more than twice as high as the national average whereas Connecticut's was nearly three times as large. In addition, both states enjoyed high levels of financial depth—bank assets per capita and deposits per capita were 6 to 7 times larger than the levels for the rest of the country. These figures, along with the number of banks per 10 thousand inhabitants suggest that banks in New York and Connecticut were, on average, larger institutions than those in the rest of the country; New York institutions, moreover, were larger than those in Connecticut.

Exhibit 9: Selected statistics for New York, Connecticut and the rest of the country

VARIABLE	NEW YORK	CONNECTICUT	REST OF COUNTRY
Income per capita, 1900	$490	$540	$407
Illiteracy rate, 1900	1.6%	1.0%	2.8%
Manufacturing. Capital/State Income, 1900	1604	2216	750
Bank Asset per capita, 1896	$1,249	$1,062	$187
Deposits per capita, 1896	$1,000	$827	$111
Bank capital-Asset Ratio, 1896	7.3%	10%	22.2%
1900 Branching dummy	1	0	0.35
Min Capital Requirement ($1,000)	25	na	18
Num Bank per 10,000 pop, 1896	1.35	2.4	1.7
Double Liability dummy	1	0	0.58

Sources: Income per capita in 1900—Easterlin (1960), figures are in 1967 dollars; Illiteracy rate in 1900—defined as the number of illiterate persons over 21 years of age in 1900 divided by population in 1900, U.S. Bureau of the Census (1900); Manufacturing capital—U.S. Bureau of the Census (1900); Bank Assets (all banks)—Flood (1998), figures are in 1967 dollars; Bank Deposits (all banks)—Flood (1998), figures are in 1967 dollars; Capital Asset ratio—defined as total equity divided by total assets, equity figures are from Flood (1998); 1900 branching dummy—Dehejia and Lleras-Muney (2007); Minimum capital requirements—White (1983); Number of banks per 10,000 habitants—number figures are from Flood (1998); 1910 Double liability dummy—Welldon (1910), Table A.

There are no statistics that can be used to directly assess the *ex ante* relative risk of banks in New York compared to those in Connecticut. New York institutions were larger than those in Connecticut which, holding constant other things, should make them safer institutions. Although the capital-asset ratio was slightly lower in New York, banks in that state were allowed to open branches at the time and the literature supports the hypothesis that branching reduced the probability of failure. Double liability laws have also been shown to discourage bank risk-taking (Grossman, 2001), and the shareholders of failing banks in New York were subject to double liability. On balance, there is no strong reason to believe that bank risk exposures differed significantly across these states. Overall, the data suggests that conditions in New York and Connecticut are sufficiently similar enough prior to 1907 to justify using a difference-in-difference methodology to estimate the effect of the Panic of 1907 on economic conditions at the state level.

Exhibit 10: Bank failures and commercial failures between 1906 and 1909 in New York, Connecticut, and the rest of the country

	Bank Failures Per Capita			Commercial Failures Per Capita		
year	New York	Connecticut	Rest of Country	New York	Connecticut	Rest of Country
1906	$0.88	$0.00	$0.44	$5.94	$3.47	$2.72
1907	$30.21	$0.00	$2.92	$20.12	$7.89	$2.98
1908	$25.25	$0.00	$0.59	$15.99	$3.49	$4.44
1909	$1.06	$0.00	$0.52	$9.68	$4.18	$2.89

Source: *Dun's Review*, year-end figures for 1906, 1907, 1908 and 1909. All figures are in 1967 dollars. Conversion is done using Wholesale Price Index, Series E23, U.S. Bureau of the Census (1975). Population figures are from U.S. Bureau of the Census (1900).

Exhibit 10 presents summary statistics for the data used to isolate the effect of the Panic on 1907 on commercial failures in New York and Connecticut. In 1906, the liabilities of failed banks in New York amounted to $0.28 per capita. This figure increased to an average of $10.15 for 1907, and $8.18 for 1908, before returning to approximately normal (1906) levels in 1909. During this period, Connecticut saw no failures at all while the remainder of the country experienced bank failures, but at an intensity level far below the New York experience.

We use the liabilities of non-bank commercial failures per capita (commercial failures) to measure the effect of bank failure on economic activity.[37] Exhibit 10 also reports these figures for New York, Connecticut, and the rest of the country. Commercial failures per capita are roughly comparable across the three geographic regions in 1906, but they increase sharply in New York in 1907 and remain elevated in 1908. While the commercial failure series more than doubles in Connecticut in 1907, the relative increase is minor compared to New York and, the Connecticut series reverts to its 1906 level by 1908.

Difference-in-Difference Test

A "difference-in-difference" approach is used to estimate the effect of bank failures on these two states economies. The approach uses a control group to eliminate the effect of confounding factors. The variables used in the test are defined in Exhibit 11.

The difference-in-difference methodology isolates the commercial failure rate in a specific quarter and estimates the difference in the incidence of commercial failures for New York and then separately for Connecticut relative to the rest of the country in that specific quarter. The econometric specification is,

$$c_{it} = \sum_{i=1}^{48} \mu_i \ State_i + \alpha_1 \left(Quarter_j \right) + \alpha_2 \left(NY * Quarter_j \right) + \varepsilon_{1t} \qquad (3)$$

[37] Liabilities of bank failures are from *Dun's Review*, year-end figures. Liabilities of commercial failures are also from *Dun's Review*, year-end figures, and are defined as the sum of the classified failures for manufacturing, trading, and other commercial entities.

$$c_{it} = \sum_{i=1}^{48} \mu_i \ State_i + \alpha_1 \left(Quarter_j\right) + \alpha_3 \left(Conn * Quarter_j\right) + \varepsilon_{2t} \qquad (4)$$

c_{it} is a measure of commercial distress in state i on date t. Following Card and Krueger (1994), the coefficient estimates $\hat{\alpha}_2$ and $\hat{\alpha}_3$, are used to construct the difference-in-difference estimate of the effect of bank failures on commercial failures in Connecticut and New York. Because of the functional form, the coefficient estimates are elasticities.

Exhibit 11: Variable definitions for differences-in-differences analysis

c_{it}	$Log\left(1 + \frac{liabilities\ of\ commerial\ failures\ in\ state\ i}{population\ in\ state\ i}\right)$
$State_i$	An indicator variable for each of the 48 states
$Quarter_j$	an indicator variable that identifies the quarter for which we are estimating the economic impact of bank failures
NY	an indicator variable equal to 1 if the state is New York
$Conn$	an indicator variable equal to 1 if the state is Connecticut
$NY * Quarter_j$	Interaction term for quarter and New York State
$Conn * Quarter_j$	Interaction term for quarter and Connecticut

The sample includes 576 quarterly estimates of the commercial failure rate per capita, one for each quarter over the period 1906 Q1-1908 Q4 for each of the 48 contiguous states. We estimate treatment effects separately for four individual quarters: 1906 Q4 (exactly a year before the panic), 1907 Q4 (panic quarter), 1908 Q1 (first quarter after the panic), and 1908 Q2 (second quarter after the panic).

Exhibit 12 presents the regression results for the different quarters, starting with 1906 Q4, continuing with 1907 Q4, and 1908 Q1 and 1908 Q2. The first column of Exhibit 12 reports the treatment effect when the "state" is equal to New York, and the quarter of interest is 1906 Q4. The estimates suggest that the change in the rate of commercial failures in New York during the last quarter of 1906 was not statistically different from the change in the commercial failure rate experienced in all other states. The coefficient estimate, -0.073, is not statistically significantly different from zero.

Exhibit 12: Difference-in-difference regression results: New York vs. Connecticut

Effect in Quarter	1906 Q4	1906 Q4	1907 Q4	1907 Q4	1908 Q1	1908 Q1	1908 Q2	1908 Q2
$\hat{\alpha}_1$ (average quarter effect)	-0.066	-0.066	0.136	0.158	0.251	0.258	0.063	0.067
	(0.040)	(0.040)	(0.047)	(0.049)	(0.042)	(0.043)	(0.036)	(0.036)
	[0.098]	[0.095]	[0.004]	[0.001]	[0.000]	[0.000]	[0.085]	[0.063]
$\hat{\alpha}_2$	-0.073		0.757		0.233		0.078	
(NY effect)	(0.144)		(0.122)		(0.139)		(0.143)	
	[0.613]		[0.000]		[0.094]		[0.587]	
$\hat{\alpha}_3$		-0.042		-0.314		-0.069		-0.155
(Conn. effect)		(0.114)		(0.118)		(0.114)		(0.113)
		[0.712]		[0.008]		[0.548]		[0.171]
R^2-within	0.006	0.006	0.044	0.032	0.085	0.084	0.005	0.006
R^2-between	0.261	0.012	0.261	0.012	0.264	0.012	0.261	0.012
R^2-overall	0.002	0.003	0.047	0.018	0.057	0.05	0.005	0.003

Notes: The dependent variable is Log (1+(liabilities of commercial failures/population)). Each regression is estimated with 576 observations. "NY effect" is the interaction term for New York and the specific quarter indicated in the column heading. "Conn. effect" is the interaction term for Connecticut and the specific quarter indicated in the column heading. Fixed effects for each state are estimated but the estimates are not reported. White (1980) robust standard errors are presented in parenthesis under each estimated coefficient. P-values are presented in brackets.

The second column of Exhibit 12 estimates the treatment effect for Connecticut in 1906 Q4. For Connecticut, the treatment effect, -0.042 is also not significantly different from zero indicating that the quarterly change in commercial failures in Connecticut was close to the change experienced by all other states in 1906 Q4. Thus, exactly one year before the panic took place, business conditions as measured by the log of business failure liabilities per capita were normal in both New York and Connecticut relative to conditions in the rest of the country.

The remaining columns in Exhibit 12 show the effects of the banking failures associated with the Panic of 1907. Beginning in 1907 Q4, the quarter of the banking panic, the commercial failure experiences of New York and Connecticut diverge markedly. Column 3 in Exhibit 12 shows that New York experienced a tremendous increase in commercial distress ($\hat{\alpha}_2 = .757$), while column 4 shows that Connecticut experienced a *decline* in commercial failures ($\hat{\alpha}_3 = -.314$). A t-test of the difference of these two coefficients confirms that commercial failures in New York in 1907 Q4 are elevated relative to those in Connecticut. [38] Thus, during the panic, it is evident that New York suffered disproportionately more than the other states in terms of commercial distress, while Connecticut, if anything, experienced more benign economic conditions.

The regression results reveal that the effects of the banking panic on commercial distress in New York continued for at least another quarter. The treatment estimate for 1908 Q1 ($\hat{\alpha}_2 = .233$) is also positive and statistically significant. It is also statistically different from the 1908 Q1 estimate for Connecticut ($\hat{\alpha}_3 = -.069$). The estimates

[38] The t-test of the difference of these two coefficients is 6.31, which is statistically significant at the less than 1 percent level. The t-test of the difference of these two coefficients at t+1 is 1.68, which is statistically significant at the 5 percent level by a one-tailed test. The coefficients are not statistically different from each other in the other two quarters (t-4 and t+2, where t is the panic quarter).

indicate that economic distress associated with the 1907 banking panic continued in New York while Connecticut remained unaffected by the crisis. It is not until 1908 Q2 that the New York treatment coefficient ($\hat{\alpha}_2 = .078$) indicates that business conditions in New York returned to normal relative to those prevailing in the rest of the country. It should be noted, however, that this does not necessarily indicate that business conditions *everywhere* return to normal levels during the second quarter of 1908. If commercial distress had spread to the rest of the nation by this date, the situation in New York will not look to be out of the ordinary compared to the rest of the country but economic conditions could be more challenging than average in all states.

VI. Concluding Remarks

Using data from 1900 to 1930, a period that predates active government stabilization policies, we have shown that bank failures have a statistically and economically important negative effect on economic activity. Our results suggest that a 0.14 percent (1 standard deviation) increase in the share of liabilities in failed depository institutions will reduce the growth rate of industrial production by 17 percentage points and result in a 4 percentage point decline in the real GNP growth rate where these cumulative effects occur within three quarters of the shock to the banking sector.

Our estimates demonstrate that bank failures have important negative externalities that reduce economic growth and they place a lower bound on the cost of banking sector systemic risk during this era. These results support a case for using government policy to reduce the social costs associated with bank failures. Given the magnitude of our estimates, it is perhaps not surprising that banking policy was an active source of political debate during this era.[39]

It is unclear how our estimates of the costs of banking sector systemic risk in the early 1900s can be extrapolated as a guide for the cost of systemic risk in more modern times. There have been many important structural changes in the banking sector that may have changed the cost of systemic risk. These include industry consolidation, the development of bank holding companies, the removal of prohibitions against interstate branching, and the growth of international and non-interest sources of bank income. Moreover, the banking sector is now subject to many government policies and regulations—bank deposit insurance, efficient bank resolution policies, and prudential bank supervision-that likely help mitigate the cost of bank systemic risk. In addition, the 2008 federal income tax rebate, the subsidized purchase of Bear Sterns and other open bank assistance programs under Federal Reserve, Treasury, and FDIC jurisdiction highlight the fact that fiscal and monetary policies are now actively employed to offset losses that may be generated by banking sector distress.

While government policies may help to mitigate the impact of bank failures on economic growth, some argue (ourselves included) that these government policies also encourage moral hazard and additional bank risk-taking. The additional risk may create social costs by distorting resource allocation and partly offset the attenuating effect of government policies the on probability of banking sector distress. On balance, it remains

[39] Public debate on banking policies began well before the period studied in this paper. State deposit insurance began in 1829 (White, 1983, p. 190) with the founding of the New York Safety Fund. The first national debate on the merits of deposit insurance likely occurred in 1893 when William Jennings Bryan introduced a bill that would establish a national deposit insurance fund (*ibid.)*. Following the Panic of 1907, there was an important national debate focused on banking system reforms designed to enhance bank stability that led ultimately to the creation of the Federal Reserve System in 1913.

unclear whether modern government banking sector policies should be expected to reduce the costs of systemic risk in the banking sector relative to those that prevailed in the early twentieth century.

Appendix

A1. Identification of the Bank Health Coefficient Using a Covariance Restriction

The structural equations of interest, repeated from equation (2), are,

$$\begin{aligned} Y_t &= \alpha X_t + \lambda B_t + \tilde{u}_t \\ B_t &= \gamma Y_t + \tilde{v}_t \end{aligned} \tag{a1}$$

The reduced form of the system is,

$$\begin{aligned} Y_t &= \frac{\alpha}{1-\lambda\gamma} X_t + \frac{\lambda}{1-\lambda\gamma} \tilde{v}_t + \frac{1}{1-\lambda\gamma} \tilde{u}_t \\ B_t &= \gamma \frac{\alpha}{1-\lambda\gamma} X_t + \left(\gamma \frac{\lambda}{1-\lambda\gamma} + 1 \right) \tilde{v}_t + \gamma \frac{1}{1-\lambda\gamma} \tilde{u}_t \end{aligned} \tag{a2}$$

The reduced from equations to be estimated are,

$$\begin{aligned} Y_t &= AX_t + \tilde{\varepsilon}_{1t} \\ B_t &= GY_t + \tilde{\varepsilon}_{2t} \end{aligned} \tag{a3}$$

Let the ordinary least squares parameter estimates be represented by: $\hat{A}, \hat{G}, \hat{\sigma}_{\varepsilon 1}{}^2, \hat{\sigma}_{\varepsilon 2}{}^2$, and $\hat{\sigma}_{\varepsilon 1 \varepsilon 2}$, where the final three terms are, respectively, the OLS estimates of the variance of $\tilde{\varepsilon}_1$ and $\tilde{\varepsilon}_2$, and the covariance between $\tilde{\varepsilon}_1$ and $\tilde{\varepsilon}_2$.

Under the restriction $Cov(\tilde{v}_t, \tilde{u}_t) = 0$, the following relationships hold:

$$\begin{aligned} \hat{\sigma}^2_{\varepsilon 1} &= \lambda^2 \left(\frac{1}{1-\lambda\gamma} \right)^2 \sigma^2_v + \left(\frac{1}{1-\lambda\gamma} \right)^2 \sigma^2_u \\ \hat{\sigma}^2_{\varepsilon 2} &= \left(\gamma^2 \lambda^2 \left(\frac{1}{1-\lambda\gamma} \right)^2 + 1 \right) \sigma^2_v + \gamma^2 \left(\frac{1}{1-\lambda\gamma} \right)^2 \sigma^2_u \\ \hat{\sigma}_{\varepsilon 1 \varepsilon 2} &= \left(\frac{\lambda}{1-\lambda\gamma} + \gamma\lambda^2 \left(\frac{\lambda}{1-\lambda\gamma} \right)^2 \right) \sigma^2_v + \gamma \left(\frac{1}{1-\lambda\gamma} \right)^2 \sigma^2_u \end{aligned} \tag{a4}$$

Recall that λ is the structural parameter of interest. From the OLS estimates, it can be shown,

$$
\begin{aligned}
\hat{\gamma} &= \frac{\hat{G}}{\hat{A}} \\
\hat{\sigma}_v^2 &= \hat{\sigma}_{\varepsilon 2}^2 - \hat{\gamma}^2 \hat{\sigma}_{\varepsilon 1}^2 \\
\hat{\lambda} &= \left(\frac{\hat{\sigma}_{\varepsilon 1 \varepsilon 2} - \hat{\gamma}\hat{\sigma}_{\varepsilon 1}^2}{\hat{\sigma}_v^2} \right) \left(1 + \hat{\gamma} \frac{\hat{\sigma}_{\varepsilon 1 \varepsilon 2} - \hat{\gamma}\hat{\sigma}_{\varepsilon 1}^2}{\hat{\sigma}_v^2} \right)^{-1}
\end{aligned} \quad . \qquad \text{(a5)}
$$

A2. Data

Table A: Data and Sources

Data Series	Source
U.S. Commercial Paper Rates, New York City 01/1857-12/1971 (m13002)	http://www.nber.org/databases/macrohistory/contents/chapter13.html
Great Britain Open Market Rates of Discount, London 01/1824-11/1939 (m13016)	http://www.nber.org/databases/macrohistory/contents/chapter13.html
U.S. Index of the General Price Level 01/1860-11/1939 (m04051)	http://www.nber.org/databases/macrohistory/contents/chapter04.html
Miron-Romer Industrial Production Series, JEH	Journal of Economic History, Vol. 50, June 1990, p. 321-337
Balke-Gordon GNP Series	Gordon (1986), The American Business Cycle, Continuity and Change
Num of Bank Failures	Banking and Monetary Statistics, 1943, p. 283
Total Number of Banks, All banks	HSUS, Series X580
Deposits at Failed or Suspended Banks	Dun's Review, various years
Total Deposits, All Banks	HSUS, Series X585

Table B: Sample Statistics for SLFI Data Series

Mean	0.071
Median	0.045
Std Dev	0.140
Minimum	0.000
Maximum	1.419

References

Alston, Lee, Wayne Grove, and David Wheelock. 1994. Why Do Banks Fail? Evidence from the 1920s. *Explorations in Economic History* 31, no. 4:409–31.

Anari, Ali, James Kolari, and Joseph Mason. 2005. Bank Asset Liquidation and the Propagation of the U.S. Great Depression. *Journal of Money, Credit and Banking* 37, no. 4:753–73.

Ashcraft, Adam B. 2005. Are Banks Really Special? New Evidence from the FDIC-Induced Failure of Healthy Banks. *American Economic Review* 95, no. 5:1712–30.

Bernanke, Ben S. 1983. Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression. *American Economic Review* 73, no. 3:257–76.

Bernanke, Ben S. and Mark Gertler 1989. Agency Costs, Net Worth, and Business Fluctuations, *American Economic Review* 79, no. 3:14-31.

Bernanke, Ben S., Mark Gertler, and Simon Gilchrist, 1996. The Financial Accelerator and the Flight to Quality. *The Review of Economics and Statistics*, 78, no.1: 1-15.

Board of Governors of the Federal Reserve System. 1943. *Banking and Monetary Statistics*. Washington, DC: Federal Reserve System.

Bruner, Robert and Sean Carr. 2007. *The Panic of 1907.* New Jersey: John Wiley & Sons, Inc.

Calomiris, Charles W. 2000. *U.S. Bank Deregulation in Historical Perspective*. New York: Cambridge University Press.

Calomiris, Charles W. 1990. Is Deposit Insurance Necessary? A Historical Perspective. *Journal of Economic History* 50, no. 2(June):283-95.

Calomiris, Charles W., and Gary Gorton. 1991. The Origins of Banking Panics. In *Financial Markets and Financial Crises*, edited by R. Glenn Hubbard, 107–43. Chicago: University of Chicago Press.

Calomiris, Charles W., and R. Glenn Hubbard. 1995. Tax Policy, Internal Finance and Investment: Evidence from the Undistributed Profit Tax of 1936-1937. *Journal of Business*, Vol. 68, No. 4, pp. 443-82.

Calomiris, Charles W., and Joseph Mason. 1997. Contagion and Bank Failures During the Great Depression: The June 1932 Chicago Banking Panic. *American Economic Review* 87, No. 5:863-883.

Calomiris, Charles W., and Joseph Mason. 2003. Consequences of Bank Distress during the Great Depression. *American Economic Review* 93, no. 3:937–47.

Card, David and Alan B. Krueger. 1994. Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania. *American Economic Review* 84, no. 4:772-793.

Carlson, Mark. 2008. Alternatives for Distressed Banks and the Panics of the Great Depression. Federal Reserve Board: FEDS Working Paper No. 2008-07.

Chari, V.V. 1989. Banking Without Deposit Insurance or Bank Panics: Lessons from a Model of the U.S. National Banking System. *Federal Reserve Bank of Minneapolis Quarterly Review* (Summer): 3-19.

Ciamarra, Elif Sisli. 2006. Monitoring by Affiliated Bankers on Board of Directors: Evidence from Corporate Financing Outcomes. *Stern School of Business NYU manuscript*.

Clair, Robert T., and Gerald P. O'Driscoll. 1994. Is Banking Different? A Reexamination of the Case for Regulation. *CATO Journal* 13, no. 3:345–53.

Clouse, James A. 1994. Recent Developments in Discount Window Policy. *Federal Reserve Bulletin* 80, no. 11:965–78.

Dehejia, Rajeev and Adriana Lleras-Muney. 2007. "Financial Development and Pathways of Growth: State Branching and Deposit Insurance Laws in the United States from 1900 to 1940," *Journal of Law and Economics*, Vol. 50, No. 2, pp. 239-272.

Dell'Ariccia, Giovanni, Enrica Detragiache, and Raghuram Rajan. 2005. The Real Effect of Banking Crises. International Monetary Fund Working Paper No. 05/63.

Demirguc-Kunt, Asli and Edward J. Kane. 2002. Deposit Insurance Around the Globe: Where Does It Work? *Journal of Economic Perspectives* 16, no. 2 (Spring): 175-95.

Diamond, Douglas. 1991. Monitoring and Reputation: The Choice between Bank Loans and Directly Placed Debt. *Journal of Political Economy* 99, no. 4:689–721.

Dun's review. Various years. New York: Dun & Bradstreet Publications Corporation.

Easterlin, Richard A. 1960. "Interregional Difference in Per Capita Income, Population, and Total Income, 1840-1950." In William Parker (ed.) Trends in the American

Economy in the Nineteenth Century, Studies in Income and Wealth Vol. 24, pp. 73-140. Princeton, NJ: Princeton University Press.

Federal Deposit Insurance Corporation. 1997. *History of the Eighties: Lessons for the Future*. Vol. 1. Washington, DC: Federal Deposit Insurance Corporation.

———. 1998. *Managing the Crisis: The FDIC and RTC Experience 1980–1994*. Washington, DC: Federal Deposit Insurance Corporation.

Federal Reserve Bank of Boston. Panic of 1907. Federal Reserve Bank of Boston Web site: http://www.bos.frb.org/education/econedpubs.htm.

Flood, Mark D. 1998. United States Historical Data on Bank Market Structure, 1896-1955 (Computer File). ICPSR Version. Ann Arbor, MI: Inter-university Consortium for Political and Social Research (distributor).

Friedman, Milton, and Anna J. Schwartz. 1963. *A Monetary History of the United States, 1867–1960*. Princeton, NJ: Princeton University Press.

Gilbert, Alton, and Levis Kochin. 1989. Local Economic Effects of Bank Failures. *Journal of Financial Services Research* 3:333–45.

Goldenweiser, Emanuel A., et al. 1932. *Bank Suspensions in the United States, 1892–1931*. Prepared by the Federal Reserve Committee on Branch, Group, and Chain Banking. Federal Reserve System.

Gordon, Robert. 1986. *The American Business Cycle, Continuity and Change.* Chicago: The University of Chicago Press.

Grossman, Richard. 1993. The Macroeconomic Consequences of Bank Failures under the National Banking System. *Explorations in Economic History* 30, no. 3:294–320.

Grossman, Richard. 2001. Double Liability and Bank Risk-Taking, *Journal of Money, Credit, and Banking,* Vol. 33, No. 2, pp. 143-159.

Historical Statistics of the United States: Colonial Times to 1970. 1975. Washington D.C.: United States Department of Commerce.

Haubrich, Joseph G. 1990. Nonmonetary Effects of Financial Crises: Lessons from the Great Depression in Canada. Journal of Monetary Economics 25, no. 2 (March): 223-52.

Jevons, William Stanley. 1884. *Investigations in Currency and Finance*. Edited by H. S. Foxwell. London.

Kane, Edward. 1989. The High Cost of Incompletely Funding the FSLIC Shortage of Explicit Capital. *The Journal of Economic Perspectives*, Vol. 3, No. 4, pp. 31-47.

Kaufmann, George G., and Kenneth E. Scott. 2003. What Is Systemic Risk, and Do Bank Regulators Retard or Contribute to It? *Independent Review: A Journal of Political Economy* 7, no. 3:371–91.

Kemmerer, Edwin W. 1910. Seasonal Variations in the Relative Demand for Money and Capital in the United States. National Monetary Commission, Senate Document 588, 61st Cong., 2nd sess.

Kiyotaki, Nobuhiro and John Moore 1997. Credit Cycles. *Journal of Political Economy*, 105, no.2: 211-247.

Kormendi, Roger C., Victor L. Bernard, S. Craig Pirrong, and Edward A. Snyder. 1989. Crisis Resolution in the Thrift Industry: Beyond the December Deals. Report of the Mid America Institute Task Force on the Thrift Crisis. University of Michigan.

Kroszner, Randall S. 2006. The Effect of Removing Geographic Restrictions on Banking in the United States: Lessons for Europe. Remarks presented at the *Conference on the Future of Financial Regulation*. London School of Economics, London. Available online at http://www.federalreserve.gov/boarddocs/Speeches/2006/20060406/default.htm

Meltzer, Allan. 2003. *A History of the Federal Reserve: Volume I, 1913-1951.* Chicago: The University of Chicago Press.

Miron, Jeffrey A. 1986. Financial Panics, the Seasonality of the Nominal Interest Rate, and the Founding of the Fed. *American Economic Review* 76 (March): 125-40.

Miron, Jeffrey, A. and Christina D. Romer. 1990. A New Monthly Index of Industrial Production, 1884–1940. *Journal of Economic History* 50 (June): 321–37.

Mussa, Michael. 1994. U.S. Monetary Policy in the 1980s. In *American Economic Policy in the 1980s*, edited by Martin S. Feldstein, chap. 2. Chicago, IL: University of Chicago Press.

Peek, Joe, and Eric Rosengren 1995. The Capital Crunch: Neither a Borrower or a Lender Be. *Journal of Money, Credit and Banking* , 27, no.3:625-38.

Rajan, Raghuram. 1992. Insiders and Outsiders: The Choice between Informed and Arm's Length Debt. *Journal of Finance* 47, no. 4:1367–1400.

Ramirez, Carlos D. 1999. Did Glass-Steagall Increase the Cost of External Finance for Corporate Investment? Evidence from Bank and Insurance Company Affiliations. *Journal of Economic History* 59, no. 2:372–96.

Redlich, Fritz. 1951. *The Moulding of American Banking, Men and Ideas, Part II, 1840–1910*. New York: Hafner Publishing Company.

Romer, Christina D. 1989. The Prewar Business Cycle Reconsidered: New Estimates of Gross National Product, 1869-1908. *Journal of Political Economy* , Vol. 97, No. 1, pp. 1-37.

Romer, Christina D. 1999. Changes in Business Cycles: Evidence and Explanations. *Journal of Economic Perspectives* 13, no. 2: 23–44.

———. 2002. Business Cycles. In *The Concise Encyclopedia of Economics,* edited by David R. Henderson. Indianapolis, IN: Liberty Fund, Inc. Online, available from http://www.econlib.org/Library/Enc/BusinessCycles.html.

Romer, Thomas and Barry Weingast. 1991. Political Foundations of the Thrift Debacle, in *Politics and Economics in the Eighties.* Alberto Alesina and Geoffrey Carliner editors. Chicago: University of Chicago Press, pp. 175-214.

Schwartz, Steven. 2008. Systemic Risk. *Georgetown Law Journal*, Vol. 97, No. 1.

Sprague, Oliver M. W. 1910. *History of Crises under the National Banking System*. Washington, DC: National Monetary Commission.

Stiglitz, Joseph, and Andrew Weiss. 1981. Credit Rationing in Markets with Imperfect Information. *American Economic Review* 71, no. 3:393–410.

U.S. Bureau of the Census. 1900. *Twelfth Census of the United States (1900), Volumes 1 through 10*. Washington, DC: Government Printing Office

Webb, David. 1991. Long-Term Financial Contracts Can Mitigate the Adverse Selection Problem in Project Financing. *International Economic Review* 32, no. 2:305–320.

Welldon, Samuel A. 1910. *Digest of State Banking Statutes*. National Monetary Commission, 61st Congress, 2nd session, Senate Document No. 353. Washington, DC.

Wheelock, David C. 1992. Regulation and Bank Failures: New Evidence from the Agricultural Collapse of the 1920s. *Journal of Economic History* 52:806–825.

Wheelock, David C., and Paul W. Wilson. 1994. Can Deposit Insurance Increase the Risk of Bank Failure? Some Historical Evidence. Federal Reserve Bank of St. Louis *Economic Review* (May/June): 57–71.

White, Eugene N. 1983. *Regulation and Reform of the American Banking System, 1900-1929*. Princeton University Press, Princeton, NJ.

White, Eugene N. 1984. "A Reinterpretation of the Banking Crisis of 1930." *Journal of Economic History* 44, pp. 119-138.

White, Halbert. 1980. "A Heteroskedasticity-consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity," *Econometrica* 48, pp. 817-838.

Wicker, Elmus. 2000. *Banking Panics of the Gilded Age*. New York: Cambridge University Press.