

## Bank Failures in Banking Panics: Risky Banks or Road Kill?

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**Abstract:** Are banks that fail in banking panics the riskiest ones prior to the panics? The free banking era in the United States provides useful data to examine this question because the assets held by the banks were traded on the New York Stock Exchange. We estimate the ex ante riskiness of a bank's portfolio by examining the portfolio relative to mean-variance frontiers and by examining its leverage and notes relative to assets. The ex ante riskiness of a bank's portfolio helps to predict which banks fail in a banking panic.

*JEL:* (G21, G11, G28)

*Keywords:* Bank failure, banking panic, risk, portfolio risk, bank risk

## I. INTRODUCTION

Are banks that fail in banking panics the riskiest ones or are they just in the wrong place at the wrong time, in short “road kill”? Many discussions of banking panics and banking crises suggest that the riskiest banks are the ones most likely to fail. There is no doubt that the banks that fail in a panic are those most susceptible to the problems at the time. Are these banks the ones that appear before the panic to be the most susceptible to problems? This question acquires some importance because banks are using value at risk to measure their riskiness, and banking regulators are encouraging banks to do so (Altman and Saunders 2001). Correctly measured, it is hard to imagine a world in which reducing an individual bank’s riskiness does not reduce its probability of failing (e.g. Wheelock and Wilson 1995; Kolari *et al.* 2002). It is not obvious, though, that reducing an individual bank’s ex ante riskiness is likely to reduce its probability of failing in a banking panic or financial crisis.

In this paper, we examine whether a bank’s ex ante riskiness is a reliable guide to its fate in a banking panic. In general, it is extremely difficult to tell whether the banks that appeared riskiest before the event were the ones that failed in banking panics such as at the start of the 1930s Great Depression. There is substantial evidence that banking panics are associated with events that have negative effects on the value of banks’ assets as opposed to being sunspot phenomena (Gorton 1988; Rolnick and Weber 1984; Hasan and Dwyer 1994; Gorton and Winton 2002). Banks’ ex post exposures to the actual events invariably are clear after the fact, whether the events are banking panics in the 1800s, the Depression in the 1930s, the Texas oil bust in the 1980s, or the Asian financial crisis in the 1990s. Deposit flows in the Great Depression are consistent with at least some depositors being able to predict in 1929 and later years which banks were more likely to fail (Saunders and Wilson 1996; Calomiris and Mason 1997), but riskier banks from the standpoint of 1928 may or may not have been those that

appeared most likely to fail in later years (Gorton and Winton, 2002). Banks generally hold nonmarketable assets and these assets' riskiness is not entirely apparent from banks' balance sheets at the time even if it is apparent now from information available to researchers today. Further clouding the evidence on the ex ante riskiness of banks, government authorities exercised substantial discretion concerning individual banks' fates.

Because of these problems with recent episodes, we use data from banking panics in 1860 to examine the importance of ex ante riskiness for banks' fates in a panic. There were runs on state banking systems in this period, which makes it possible to use these data to examine banks' fates in these panics (Hasan and Dwyer 1994; Bodenhorn 2003). Available evidence indicates that the single most important predictor of which banks failed during these runs are their ex post losses on bond portfolios (Economopoulos 1990; Hasan and Dwyer 1994; Dwyer and Hasan 2003). These banks' primary activity was issuing banknotes that were used as currency by the public with bonds held as required backing for the banknotes. Hence, these bond portfolios were not an ancillary part of a bank's business that happened to turn out badly; these portfolios were an integral part of the banks' business. The ex ante riskiness of these bonds can be estimated from market prices of the bonds in trades on the New York Stock Exchange (Dwyer, Hafer and Weber 1999). These market prices before the panics makes it possible for us to use standard financial tools to estimate banks' ex ante riskiness in an important part of their business.<sup>1</sup>

Before presenting the empirical analysis, we briefly describe free banking in the United States. These free banks were not laissez faire banks; there were substantial legal restrictions on how banks operated.<sup>2</sup> These banks were called *free banks* because there was no discretionary restriction of entry into banking, a business that revolved around issuing notes used as currency. These free banking systems were an innovation compared to the pre-existing chartered banking in which a bank had to be granted an individual legislative charter to operate. Runs on banking

systems occurred in various states in 1854, 1857 and 1860, but the paucity of data for 1854 makes the 1854 runs unlikely to be informative and the relatively few failures in 1857 make the 1857 panic useless by itself for comparing failed banks with other banks. As a result, we focus on panics at the onset of the Civil War in 1860 in which selected state banking systems had many free banks failing.

In our empirical analysis, we estimate the riskiness of banks' bond portfolios relative to the mean-variance frontiers and find substantial support for the proposition that this measure of their portfolio's ex ante riskiness is informative for predicting their fates. Banks' leverage and exposures to runs on notes also help to predict their fates.

## II. FREE BANKING

Free banking in the United States began in 1837 when Michigan passed the first free banking law and ended in the 1860s when the federal government created the national banking system. This era in U.S. banking history has received a great deal of attention, partly to examine whether these relatively unregulated banks engaged in widespread fraud and partly to examine the implications of more recent banking regulation.

Because the federal government did not charter banks, all banks in the free banking period were state banks. Bank entry in states with free banking laws was not subject to discretionary control and was easier than in states that did not have free banking laws (Economopoulos and O'Neill 1995). In a free banking state, a bank could be opened and issue banknotes after satisfying specific, legislative requirements. These requirements included meeting minimum bank capital requirements and providing collateral for banknotes issued.

### **TABLE 1 ABOUT HERE**

The aggregate balance sheets in Table 1 for free banks in Illinois, Indiana and Wisconsin illustrate the free banks' activities. Bonds and loans are over seventy percent of total assets, with

the percentage of assets that are state bonds varying substantially, from 61 percent in Illinois to 36 percent in Indiana and 28 percent in Wisconsin. Notes and deposits are approximately sixty percent of total liabilities, with the percentage of liabilities that are notes also varying substantially, from 57 percent in Illinois to 28 percent in Indiana and 25 percent in Wisconsin. Equity capital is a substantial source of funding for the free banks: 35 percent of liabilities in Illinois; 42 percent in Indiana; and 40 percent in Wisconsin. In these as in other free banking states, liabilities primarily are banknotes and equity capital. In this period, notes issued by banks are the predominant form of currency in the United States with no government-provided currency in existence.

#### **TABLE 2 ABOUT HERE**

The holdings of bonds and issuance of notes are related: state laws of the period required free banks to hold bonds as backing for their notes. Table 2 summarizes the free banking laws concerning banknotes and bonds, here illustrated by the laws in Illinois, Indiana and Wisconsin as of 1861. These free banking laws required that the banks hold bonds, with the banks having substantial latitude about exactly which bonds to hold. Hence, the attitude of a bank's owner toward risk could be reflected in the particular bonds held by a bank. The laws in all three states imposed substantial penalties on a bank for not redeeming its notes on demand, up to forfeiture of the bank's charter. The laws in many states also required that a bank keep collateral related to the value of the notes after the notes were issued. Failure to maintain sufficient backing in the bond account in Illinois and Wisconsin resulted in forfeiture of the bank's charter, a provision which was enforced. There was no such provision in Indiana.

Many free banks failed. Research on free banking has focused on whether free banks that failed were primarily due to owners operating unsound banks – sometimes called “wildcat banks” – or to exogenous events. The general conclusion from the research is that banks

generally were operated in a way that was consistent with the banks continuing operations absent some negative exogenous event (Rolnick and Weber 1984; Economopoulos 1988; Bodenhorn 2003.) A related argument about free banking is a claim that banks would locate in remote areas “where the wildcats roam”, thereby raising the cost of redeeming banknotes and of acquiring information about the banks. Dwyer (1996) examines this colorful view of banks’ choices of locations and finds evidence inconsistent with it after some experience with free banking.

The importance of exogenous events for explaining free banks’ failures has received a great deal of attention. For example, Rolnick and Weber (1983, 1984), Economopoulos (1988, 1990), Hasan and Dwyer (1994) and Dwyer and Hasan (2003) examine the effects on free banks of the decline in southern bond prices at the onset of the Civil War. All of these authors find that holdings of southern bonds and losses on those bonds are important determinants of whether free banks remained open or ceased operations.

Hasan and Dwyer (1994) and Dwyer and Hasan (2003) examine whether there were runs on the banking systems and conclude that such runs did occur, contrary to some prior suggestions. Dwyer and Hasan find that the much higher failure rate in Illinois than in Wisconsin in 1861 is partly explained by a suspension of payments in Wisconsin and not in Illinois. This suspension also reduced noteholders’ losses in Wisconsin. Dwyer and Hasan’s evidence also indicates that the ex post decreases in the value of the banks’ bond portfolios and their leverage are important for explaining both which banks closed and noteholders’ losses in those banks.

### III. THE RISKINESS OF BANKS' PORTFOLIOS

These ex post losses on southern bonds at the start of the Civil War do not imply that portfolios with substantial amounts of these bonds were riskier ex ante. Bond prices and constructed portfolios provide evidence concerning the riskiness of the bonds in banks' portfolios.

We concentrate on the runs on Illinois' and Wisconsin's banking systems at the start of Civil War, in which many banks failed. We also include data from Indiana, which had fewer bank failures, as a contrast. There also were runs on free banking systems in 1854 in Indiana and 1857 in New York. For 1854, there is little of the weekly data on bond prices that we use to estimate efficient portfolios of bonds (Dwyer, Hafer and Weber 1999). In 1857, relatively few banks failed.

#### A. Bond Prices

#### **FIGURE 1 ABOUT HERE**

Figure 1 shows weekly data on bond prices from 1859 through 1862 for northern, border state and southern bonds from Dwyer, Hafer and Weber (1999). The figure includes the prices of state government bonds that account for at least 10 percent of banks' portfolios in Illinois, Indiana or Wisconsin in October 1860. Bonds issued by Illinois and Indiana are more than ten percent of the banks' bond holdings in those states respectively, but these bonds are relatively unimportant in other states. United States bonds are included in the figure for comparison with the state bonds; these bonds were not held by any banks in Indiana and Wisconsin and they are less than ten percent of Illinois banks' aggregate portfolio.

The onset of the Civil War is evident in Figure 1. There are large decreases in the prices of southern bonds after Lincoln's nomination in May 1860 and precipitous decreases with the beginning of open warfare in April 1861. While the prices of southern and border state bonds

fall at the start of the Civil War, the prices of U.S. and northern bonds do not fall nearly as much.

The decreases in southern bond prices are an important contributor to the closure of 44 percent of the banks in Wisconsin and over 87 percent of the banks in Illinois during a period when two of the 20 banks in Indiana closed.<sup>3</sup> Almost two-thirds of the bonds held by Illinois and Wisconsin banks are the southern and border state bonds that so clearly reflect the onset of the Civil War. Only 35 percent of the bonds held by Indiana banks are southern bonds, but this does not reflect greater diversification: over 60 percent of the bonds held by Indiana banks are Indiana bonds. The price of Indiana bonds has a substantial fall, from about 90 percent of par in early 1861 to 70 percent of par later in the year, but this is small relative to the price decreases of southern and border state bonds.

Ex post, a portfolio of southern bonds was risky in the sense that there were large losses on those bonds. The criticism that free banks were risky because they held risky portfolios is long-standing (Dowrie 1913; Krueger 1933; Hammond 1957).

Ex ante, a portfolio of southern bonds may or may not have been particularly risky. Greater riskiness of southern and border state bonds even before Lincoln was nominated in May 1860 is suggested by these bonds' lower prices in Figure 1. Southern and border state bonds generally have the same 6 percent coupon as northern and U.S. bonds. Absent knowledge of any other differences, greater default risk could explain these lower prices. There is no other apparent evidence of greater risk, though, and the risk of a portfolio of bonds is a function of the covariance of the returns, not just the volatility of individual bond's returns or the probability of individual defaults.

Efficient portfolios of the bonds held by the banks and the riskiness of the banks' actual portfolios can provide more systematic evidence on the riskiness of these bond portfolios. The underlying bond data are weekly returns. The banks' actual portfolios included small amounts

of many securities, and data are not available for all of these securities. For example, six banks in Wisconsin have relatively small holdings of Michigan bonds, for which we have no prices. We estimate the riskiness of actual portfolios and the efficient portfolios using prices for securities that are widely held by the banks. These are prices of bonds issued by the United States government and the states of California, Georgia, Indiana, Kentucky, Louisiana, Missouri, North Carolina, Ohio, Pennsylvania, Tennessee and Virginia. We have no reason to think that the omission of other bonds biases our results one way or the other. The omitted bonds tend to be northern bonds, but they are likely to be less liquid precisely because they are not traded often enough to create a useful record. Overall, we think that it is better to omit the bonds on which we have no data than to make speculative assumptions about the first and second moments of their returns.

Figure 2 shows efficient frontiers estimated for dates chosen to highlight major events. These frontiers show the minimum variance given the rate of return, with the returns ranging from the lowest to the highest. We estimate efficient frontiers for: April 1860, just prior to Lincoln's nomination; October 1860, just prior to Lincoln's election; April 1861, the start of the hostilities; and October 1861, when the war is in progress. Each of these frontiers uses the most recent 26 weeks of data through the end of the month to estimate the means and standard deviations of the portfolios.<sup>4</sup>

#### **FIGURE 2 ABOUT HERE**

The frontiers in Figure 2 have rough parabolic shapes. The implication that a risk-return frontier must be parabolic relies on unrestricted weights of various securities, and the frontiers in Figure 2 are estimated subject to the restriction that bond holdings be nonnegative. We impose this restriction because a portfolio that is short some bonds is not consistent with the laws of this period or with the portfolio being held as backing for notes. We also do not include a risk-free

asset because very few banks held the risk-free asset – gold or silver that paid zero interest – as backing for their notes.<sup>5</sup>

The estimated frontiers reflect the dramatically worsening situation in terms of both the portfolios' returns and standard deviations. By April 1861, none of the bonds has a positive return for the prior 26 weeks.<sup>6</sup> The returns for the next half year, from April 1861 to October 1861, range up to 1.05 percent per week, but these high returns are accompanied by high standard deviations. The standard deviation of the minimum-standard-deviation portfolio is a good summary measure of the volatility of returns. The minimum standard deviations are 0.37 percent per week in April 1860 and 0.36 percent per week in October 1860. The minimum standard deviation in April 1861 increases almost 40 percent to 0.50 percent per week. The minimum standard deviation in the six months from April 1861 to October 1861 is higher yet: 0.83 percent per week. While this standard deviation indicates continuing substantial turmoil after the fall in bond prices, at least the prices of most bonds are increasing.

#### B. The Riskiness of Banks' Portfolios

### FIGURE 3 ABOUT HERE

Figure 3 shows the fates of banks with different portfolios combined with the efficient frontier for April 1860. The left-hand panel shows banks that remained open or closed, and the right-hand panel shows banks that failed.<sup>7</sup> We define a bank as *closing* if the bank ceased operating and noteholders were paid in full. We combine data on banks that close with those that remain open because noteholders suffer no losses in closed banks.<sup>8</sup> We define a bank as *failing* if the bank ceased operating and noteholders were paid less than the face value of their notes from the bank's bond account.<sup>9</sup> The data plotted are the weekly mean returns and standard deviations in April 1860 for banks in Illinois, Indiana and Wisconsin that existed in October 1860.<sup>10</sup> The estimates do not substantially reflect the banks' relative ability to estimate the risk

and implications of war because October 1860 precedes Lincoln's election and the dramatic drop in bond prices. The symbols in Figure 3 are letters indicating the state in which a bank is located. The letter *i* indicates a bank in Illinois, the letter *n* indicates a bank in Indiana and the letter *w* indicates a bank in Wisconsin.

The striking contrast visible in Figure 3 is the higher returns for banks that closed or remained open compared to banks that failed. For a given standard deviation, the banks that failed have noticeably lower returns. This is especially striking because these average returns are for November 1859 through April 1860, well before the election leading to the Civil War. It is not apparent that the banks which failed were the riskiest *ex ante* in terms of raw standard deviations. On the other hand, it is clear that the banks with lower returns for a given standard deviation were more likely to fail. That said, the banks in both sides of the figure are clustered around low returns, presumably at least partly due to deviations of *ex post* returns from expected returns. The banks in Indiana appear to have higher returns than the other banks, with many of the Indiana banks in the upper half of the area enclosed by the frontier.

#### **FIGURE 4 ABOUT HERE**

Figure 4 examines the riskiness of banks that failed compared to the riskiness of other banks in a different way. The *ex ante* standard deviation of the return on a bank's portfolios is one possible way to examine the bank's likelihood of failure. Leverage is another measure of risk, which can be measured in a variety of ways. In Figure 4, we measure leverage by the ratio of bonds to capital because this measure of leverage reflects the risk borne by stockholders for a given standard deviation of returns. Figure 4 is similar to Figure 3, with the open and closed banks in the left panel and the failed banks in the right panel and the same symbols for the observations. Figure 4 shows that banks which stayed open or closed have a low ratio of bonds to capital, a low standard deviation, or both. Many banks that failed have similar ratios of bonds

to capital and standard deviations as banks that did not fail, but a fair number of banks that failed in Illinois have relatively high ratios of bonds to capital and high standard deviations. Figure 4 also shows that banks in Illinois have far higher ratios of bonds to capital than banks in Indiana and Wisconsin. The average ratio of bonds to capital is 2.22 in Illinois, 1.12 in Indiana and 0.92 in Wisconsin. The lower ratio of bonds to capital in Wisconsin than in the other two states is explained by the legal restriction in Wisconsin limiting notes issued by banks to no more than their equity capital. There is no similar explanation for the contrast between Indiana and Illinois though. Combinations of high leverage and high portfolio risk appear to be associated with failure, although the relative importance of the two is not discernable from the figure alone.

#### IV. THE PREDICTABILITY OF BANK FAILURES CONDITIONAL ON EX ANTE RISKINESS

In this section, we report our statistical analysis of the relationship between banks' fates and the ex ante riskiness of their bond portfolios and their leverage. We estimate the probability of failure using a maximum likelihood estimator to estimate the relationship between a bank's riskiness and its fate. The equation for the probability of a bank remaining open is a standard probit with an underlying normal distribution of the unobservable variable, the present value of the bank's earnings.

The measures of ex ante risk that we use are related to a bank's bond portfolio and leverage. The leverage that matters to owners of a bank is the ratio of bonds to equity capital. The lower this ratio, the more the losses that can be absorbed by stockholders before a bank has a negative book value of capital. As an additional measure of risk, our statistical analysis includes the exposure of a bank to a run on its notes, measured by the ratio of notes to assets. Because we know that there was a run on banknotes in 1861, this measure of exposure to a run on notes may be an ex post measure of risk and not an ex ante measure, which means that caution is required in interpreting it as a measure of ex ante risk.

In our statistical analysis, we use the returns on banks' portfolios for the 26 weeks ending in May 1860. These data from late 1859 and early 1860 are prior to Lincoln's nomination and are unlikely to reflect the full effects of Lincoln's nomination, his election, the secession of southern states and the subsequent outbreak of war. They may partly reflect anticipation of those events. We measure the riskiness of the banks' portfolios using both the mean weekly return and the weekly return's standard deviation. Figure 3 also suggests that deviations from the efficient frontier may be important, possibly due to managerial inefficiency, an argument related to that in Wheelock and Wilson (1995). We measure a bank's deviation from the frontier by the horizontal, vertical and Euclidian distances from the frontier.

Some additional variables are from the banks' balance sheets. The balance sheet data are from balance sheets in October 1860 for banks in Illinois and Indiana and in January 1861 for banks in Wisconsin.

These measures of ex ante risk are not the only variables that are likely to be important for determining a bank's present value. Additional variables included in the statistical analysis are: a dummy variable equal to one for a bank in Indiana and Wisconsin and zero for a bank in Illinois; a bank's age; the population density of the county in which a bank is located; and the bank's assets. We include a dummy variable equal to one for banks in Indiana and Wisconsin and zero for Illinois, a grouping consistent with the characteristics of the banks and the regulatory environment.<sup>11</sup> The balance sheets of banks in Illinois have smaller deposits and loans compared to banks in Indiana and Wisconsin. In addition, Illinois closed banks when a bank's bond account was deficient or someone protested the bank's notes, but Wisconsin had an effective suspension of payments (Dwyer and Hasan 2003). Indiana never closed banks solely because of deficient bond accounts. We include the bank's age in the equations as a dummy variable equal to zero unless a bank is one year old or less in October 1861 in Illinois and

Indiana or in January 1862 in Wisconsin. This measure of age is consistent with Gorton's (1996) evidence on the riskiness of new banks. Population density is included because low population density may be associated with remote locations and wildcat banking. Finally, we include the asset size of each bank, which may be associated with sunk costs in building the bank's reputation or other factors. It is possible that larger banks are more likely to stay open than smaller banks, although there is no strong theoretical reason to expect any particular relationship.

### *Portfolio Riskiness*

Table 3 presents the results of estimating these equations including all variables other than deviations from the banks' efficient portfolio frontiers. Several variables are transformed by logarithms because the equation's fit is better when logarithmic transformations of the variables are used. The table reports the estimated coefficients and their standard errors. The table also presents the p-values of likelihood ratio tests of the hypothesis that each coefficient is zero and the marginal effects of a change in each variable. The marginal effects of continuous variables are the partial derivatives of the estimated equation evaluated at the means of the right-hand-side variables.<sup>12</sup> The marginal effects of dummy variables are the changes in the probability associated with a change in the dummy variable from zero to one. The table also includes the likelihood ratio statistic to test whether all coefficients other than the intercept are zero.

### **TABLE THREE ABOUT HERE**

The control variables' estimated coefficients in Table 3 that are statistically significant generally have the anticipated signs. The surprising result is the positive sign of the ratio of bonds to capital.<sup>13</sup> This estimate may reflect the endogeneity of this particular variable, with higher present-value banks holding more bonds relative to capital. This positive coefficient also can be interpreted as indicating that Wisconsin's restriction on note issuance relative to capital reduced the banks' present values.

These coefficient estimates in Table 3 provide substantial support for the informativeness of a bank's ex ante riskiness. A bank's ex ante riskiness is measured by the standard deviation of the portfolio's return, the mean return, the bank's leverage and its exposure to a run on notes. Both the standard deviation and the mean return are statistically significant; they also are jointly significant. In addition, higher notes relative to assets clearly increases the probability of failure, with this coefficient also having a p-value less than 0.1 percent.

The positive estimated coefficient of the mean return on bonds, which is the opposite of what would be expected if a higher return is associated with more risk and a lower probability of continuing in business, suggests a problem. This positive coefficient is more consistent with the mean return being a measure of a bank's ex post losses. The correlation between the mean return on the bond portfolio for the 26 weeks ending in April 1860 and an ex post measure of loss per dollar of notes is -0.526.<sup>14</sup> This negative correlation suggests that the mean return partly reflects later losses but is hardly sufficient to be sure.

This interpretation of the mean return also is consistent with the lower return in April 1860 for banks that failed compared to banks that did not fail, a comparison evident in Figure 3. In this figure, this appears as vertical deviations from the efficient frontier. These deviations from the efficient frontier may be due to unexpected decreases in the prices of bonds, decreases that continued into 1861 and resulted in the demise of many banks; they also may simply reflect inefficiency of many insufficiently diversified banks.

In any case, our conclusion about the importance of ex ante risk is not dependent on the mean return on bonds. The second estimated equation in Table 3 shows that the risk variables continue to be important when the mean return is excluded from the estimated equation. There is practically no effect on the other estimated coefficients. The standard deviation of returns still helps to predict whether a bank remains open and the Chi-square test statistic for the standard

deviation's coefficients being zero has a p-value of 0.3 percent. Notes relative to assets continue to be informative and consistent with higher values indicating higher risk. A bank's leverage appears to be informative, although this does not reflect risk directly: the coefficient on leverage is positive, an anomalous coefficient from the point of view of higher ratios of bonds to capital indicating higher risk.

The association between a bank's standard deviation and its fate is the clearest evidence that the ex ante riskiness of a bank's bond portfolio helps to predict whether a bank fails. The importance of exposure to a run on notes bolsters the result for the standard deviation, but the interpretation of its importance hinges on a judgement about the ex ante risk of a run on notes. The mean return on portfolios is quite statistically significant, but its interpretation is not obvious. In the next section, we explore the association between a bank's mean return, its fate and the possibility that lower mean returns are associated with ex ante inefficiency of banks' portfolios.

### *Portfolio Inefficiency*

#### **TABLE 4 ABOUT HERE**

Figure 3 suggests that deviations from the efficient frontier may be important for predicting which banks fail. The two panels of Table 4 present test statistics for examining the importance of those deviations. The first panel shows test statistics for horizontal and vertical deviations from the efficient frontier. We interpret these statistics as providing little support for the importance of inefficient portfolios, overall being consistent with the proposition that the mean return largely is important because it is a proxy for ex post losses. Vertical deviations associated with lower mean returns are statistically significant but horizontal deviations are not. The vertical deviations are more directly affected by unexpected decreases in bond prices than are the insignificant horizontal deviations. Further evidence that the mean return is a proxy for

the ex post loss is provided by the change in the p-value for the mean return when the vertical deviation is added to the equation: the mean return's p-value changes from a statistically significant 0.3 percent to a very insignificant 55.8 percent.

The bottom panel of Table 4 shows tests based on using Euclidian distance to measure deviations from the frontier. The Euclidian distance is the minimum distance to the frontier from the bank's mean return and standard deviation. This measure of distance has a p-value of 76.7 percent, nowhere near statistically significant at usual significance levels. This measure provides no support for the importance of the deviations from the frontier, although this measure of distance reflects the vertical deviation in addition to the horizontal deviation. Overall, we conclude that there is little evidence that deviations from the frontier are important, although there is some additional evidence that the coefficient of the mean return partly reflects ex post losses.

## V. CONCLUSION

Greater ex ante riskiness helps to predict a bank's fate, at least in this banking panic. The ex ante variability of returns on a bank's portfolio consistently helps predict its fate. While the importance of the standard deviation is the strongest evidence for the importance of ex ante risk, this is not the only evidence. We find that a bank's exposure to runs on notes is associated with a higher likelihood of failure. There is a clear association between a bank's mean return on its portfolio well before the panics and the final outcomes, but this is clouded by the correlation of the mean return and the later ex post loss.

The evidence in this paper is based on one episode, but it is a fairly typical banking panic with atypical data available. An exogenous event occurred that raised questions about the ability of the banks to honor their obligations and a run on the banks ensued. We find that riskier banks were more likely to fail. In this panic, measures of risk based on typical, everyday events are

informative about outcomes associated with an atypical event – a banking panic.

We conclude that predicting the fate of a bank in a banking panic may be like predicting the fate of a person crossing the road. Generally it's a car that you don't see that hits you, but you are less likely to get hit if you cross more prudently.

## Notes

<sup>1</sup> The notes issued by free banks were traded at less than par value at locations distant from the banks. There is virtually no useful information from the discount rates on these notes for our analysis because notes of continuing banks in a state generally were discounted at the same rate (Gorton 1996, 1999).

<sup>2</sup>. Bodenhorn (2003) provides a through overview of state banking before the Civil War, including free banking. Selgin and White (1994) summarize the literature on laissez faire banking and discuss its relationship to the literature on historical banking systems.

<sup>3</sup>. One of these two banks – the Boone County Bank – was a new bank whose owners issued fraudulent currency.

<sup>4</sup>. These frontiers are more informative than alternatives which we examined based on only 13 weeks of returns or as many as 52 weeks of returns.

<sup>5</sup>. The only United States government securities for which prices are available are long-term bonds. These long-term bonds are included in the portfolios.

<sup>6</sup>. While it might be desirable to examine the weights of individual securities, standard estimation procedures estimate the weights imprecisely relative to the frontier (Best and Grauer 1991; Britten-Jones 1999).

<sup>7</sup>. In Illinois, a bank is counted as closed or failing if there is no balance sheet information in the October 1861 report or it is reported to be ceasing operations in that report. In Indiana, a bank is counted as closed or failing if it is reported to be ceasing operations in the January 1862 report for the fiscal year ending October 1861. In Wisconsin, a bank is counted as closed or failing if there is no balance sheet information in the January 1862 report or it is reported to be ceasing operations in that report.

<sup>8</sup>. Fourteen of the ninety banks in the left panel of Figure 4 closed, and the bank with the

highest return in that figure is one that closed.

<sup>9</sup>The analysis in this figure reflects only information on what noteholders were paid by the state banking regulator. Noteholders may have received more payments, because banks had other assets and stockholders were liable for up to twice the book value of capital in the bank. Information on such payments is relatively difficult to acquire though because it is likely to be available only in the courthouses of the counties in which banks were located if the information exists at all.

The portfolios' mean returns and standard deviations are computed using banks' bond holdings in October 1860 because the earliest prior data are from late 1859, which is likely to be too far before the fall in bond prices early to be representative of the banks' actual portfolio.

<sup>11</sup>A statistical analysis with a separate dummy variable for Indiana is not particularly informative because no banks closed in Indiana and left adequate data available. A statistical analysis similar to that in the paper for Illinois and Wisconsin without Indiana in the final set of data produces similar results and the same conclusions.

<sup>12</sup> Losses relative to capital are measured in dollars per dollar. Population density is measured as persons per acre. The average mean return is 0.000220 per week with a standard deviation across banks of 0.000779 per week. The average standard deviation of the portfolios is 0.011254 per week with a standard deviation across banks of 0.002348.

<sup>13</sup>Dwyer and Hasan (2003) report a similar finding.

<sup>14</sup> The correlation of the loss per dollar of notes and the standard deviation of the portfolio's return is 0.19, smaller in magnitude.

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## References

- Altman, Edward I., and Anthony Saunders. 2001. "An Analysis and Critique of the BIS Proposal on Capital Adequacy and Ratings." *Journal of Banking and Finance* 25 (January), 25-46.
- Best, Michael J., and Robert R. Grauer. 1991. "On the Sensitivity of Mean-Variance-Efficient Portfolios to Changes in Asset Means: Some Analytical and Computational Results." *Review of Financial Studies* 4 (2), 315-42.
- Bodenhorn, Howard. 2003. *State Banking in Early America*. Oxford: Oxford University Press.
- Britten-Jones, Mark. 1999. "The Sampling Error in Estimates of Mean-Variance Efficient Portfolio Weights." *Journal of Finance* 54 (April) 655-71.
- Calomiris, Charles W., and Joseph R. Mason. 1997. "Contagion and Bank Failures during the Great Depression: The June 1932 Chicago Banking Panic." *American Economic Review* 87 (December), 863-83.
- Dowrie, George William. 1913. *The Development of Banking in Illinois, 1817-1863*. Volume 11, No. 4 of the series, University of Illinois Studies in the Social Sciences. Urbana: University of Illinois.
- Dwyer, Jr., Gerald P. 1996. "Wildcat Banking, Banking Panics and Free Banking in the United States." Federal Reserve Bank of Atlanta *Economic Review* 81 (December), 1-20.
- Dwyer, Jr., Gerald P., R. W. Hafer and Warren E. Weber. 1999. "Weekly U.S. and State Bond Prices." *Historical Methods* 32 (Winter), 37-42.
- Dwyer, Jr., Gerald P., and Iftekhar Hasan. 2003. "Suspensions of Payments, Bank Failures and the Nonbank Publics' Losses." Unpublished paper, Federal Reserve Bank of Atlanta.
- Economopoulos, Andrew J. 1988. "Illinois Free Banking Experience." *Journal of Money, Credit and Banking* 20 (May), 249-64.
- Economopoulos, Andrew J. 1990. "Free Bank Failures in New York and Wisconsin: A Portfolio

- Analysis.” *Explorations in Economic History* 27 (October), 421-41.
- Economopoulos, Andrew J. and Heather O’Neill. 1995. “Bank Entry during the Antebellum Period.” *Journal of Money, Credit and Banking* 27 (November), 1071-85.
- Gorton, Gary. 1999. “Pricing Free Bank Notes.” *Journal of Monetary Economics* 44 (August), 33-64.
- Gorton, Gary. 1996. “Reputation Formation in Early Bank Note Markets.” *Journal of Political Economy* 104 (April), 346-97.
- Gorton, Gary. 1988. “Banking Panics and Business Cycles.” *Oxford Economic Papers* 40: 751-81.
- Gorton, Gary, and Andrew Winton. 2002. “Financial Intermediation.” NBER Working Paper 8928.
- Hammond, Bray. 1957. *Banks and Politics in America from the Revolution to the Civil War*. Princeton: Princeton University Press.
- Hasan, Iftexhar, and Gerald P. Dwyer, Jr. 1994. “Bank Runs in the Free Banking Period.” *Journal of Money, Credit and Banking* 26 (May), 271-88.
- Illinois. 1851-1861. *Laws of Illinois*.
- Indiana. 1851-1861. *Laws of the State of Indiana*.
- Kolari, James, Dennis Glennon, Hwan Shin, and Michele Caputo. 2002. “Predicting Large U.S. Commercial Bank Failures.” *Journal of Economics and Business* (July-August), 361-87.
- Krueger, Leonard. 1933. *History of Commercial Banking in Wisconsin*. Madison: University of Wisconsin.
- Rolnick, Arthur J. and Warren E. Weber. 1983. “New Evidence on the Free Banking Era.” *American Economic Review* 73 (December), 1080-91.
- Rolnick, Arthur J. and Warren E. Weber. 1984. “The Causes of Free Bank Failures.” *Journal of*

*Monetary Economics* 14 (October), 269-91.

Rolnick, Arthur J. and Warren E. Weber. 1985. "Banking Instability and Regulation in the U.S. Free Banking Era." Federal Reserve Bank of Minneapolis *Quarterly Review* 9 (Summer), 2-9.

Saunders, Anthony, and Berry Wilson. 1996. "Contagious Bank Runs: Evidence from the 1929-1933 Period." *Journal of Financial Intermediation* 4 (October), pp. 409-23.

Selgin, George A., and Lawrence H. White. 1994. "How Would the Invisible Hand Handle Money?" *Journal of Economic Literature* 32 (December), 1718-49.

U.S. Congress. 1861. *House Executive Document 77*, 36th Congress, 2nd Session.

Wheelock, David C., and Paul W. Wilson. 1995. "Explaining Bank Failures: Deposit Insurance, Regulation, and Efficiency." *Review of Economics and Statistics* 77 (November). 689-700.

Wisconsin. *Laws of Wisconsin*. 1852-1861.

## DATA APPENDIX

This appendix indicates the sources of data not already given in the text of the paper.

### **Indiana**

#### *Banks and Their Fates*

The sources are: Auditor of State, Indiana (1858, pp. 31-43; 1860, pp. 36-47; 1862a, pp. 335-48; and 1862b, pp. 285-306). We include a bank in our statistical analysis if it reports balance sheet information for October 1860. We conclude that the bank closed if it does not report balance sheet information for October 1861 or is reported to be closing.

#### *Bond Holdings and Other Balance Sheet Data*

The holdings of bonds for October 31, 1860 are from Auditor of State, Indiana (1860, pp. 36-47). The data on the each bank's notes, capital and assets are from the same source.

#### *Counties in Which Banks Are Located*

The counties in which banks are located are determined from the reports by the Auditor of State and the U.S. Census. The reports by the Auditor of State list the towns in which the banks are located if it is not part of the name (Auditor of State, Indiana (1860, pp. 36-47). The 1860 Census (U.S. Department of the Interior, 1864, State of Indiana, Table No. 3, Population of Cities and Towns, pp. 113-28) gives the county in which many communities are located. In cases in which the community is not included in the 1860 Census, we also use the 1850 Census (U.S. Department of the Interior, 1854, Population of such Cities [etc.] in the United States, pp. 339-93) and the 1870 Census (U.S. Department of the Interior, 1872, Table III State of Indiana, pp. 122-31).

#### *Population*

The populations of counties in Indiana are from the 1860 Census (U.S. Department of

the Interior, 1864, State of Indiana, Table No. 2, Population by Color and Condition, pp. 111-13).

## **Illinois**

### *Banks and Their Fates*

The sources are: U.S. Congress (1859, pp. 290-93; 1861, pp. 214-48; and 1863, pp. 160-64); *Annual Reports of Bank Commissioners of the State of Illinois*; and Economopoulos (1988).

### *Bond Holdings*

Data on individual banks' holdings of individual bonds are not available from published sources. The data on individual bank's holdings of bonds are from unpublished data collected by Andrew Economopoulos. He estimates the stocks by following the deposits and withdrawals of bonds over time. There is a nontrivial difference between the aggregate data on holdings of each bond by all banks for October 1860 (U.S. Congress 1861, p. 290) and the total of Economopoulos's estimates for that date. Economopoulos's estimates of each bank's bond deposit are quite different than the amounts on reports submitted to the Bank Commissioner and, without an adjustment, these estimates imply quite unlikely ratios of bonds to other assets for individual banks. We estimate the bonds held by each bank by applying Economopoulos's estimate of the fraction of each bank's bonds held in the various bonds with the Bank Commissioner's data on each bank's total holdings of bonds in October 1860.

### *Other Balance Sheet Data*

The data on each bank's notes, capital and assets for October 31, 1860 are from U.S. Congress (1861, pp. 214-48.)

### *Counties in Which Banks Are Located*

The counties in which banks are located are determined from reports by the Bank Commissioner, the U.S. Census and banknote reporters. The *Report of Bank Commissioners of the State of Illinois*, January 11, 1861 published in the U.S. Congress (1861, pp. 214-29) gives the community in which banks are located if the community's name is not part of the bank's name. The counties in which banks are located are determined from reports to the Bank Commissioner, the U.S. Census and banknote reporters. The *Report of Bank Commissioners of the State of Illinois*, January 11, 1861 published in the U.S. Congress (1861, pp. 214-29) gives the community in which banks are located if the community's name is not part of the bank's name. The 1860 Census (U.S. Department of the Interior, 1864, State of Illinois, Table No. 3, Population of Cities and Towns, pp. 533-43) gives the county in which many communities are located. In cases in which the community is not included in the 1860 Census, we use the county given in one or more banknote reporters. Unfortunately, the counties in which several banks are located still are unresolved by this procedure. The main reason is that the Census Office did not receive information on subdivisions of several relatively large counties with several banks. As a result, we use the similar information from the 1870 Census (U.S. Department of the Interior, 1872, Table III, Population of Civil Divisions less than Counties, State of Illinois pp. 108-21) to determine the county for these banks.

This procedure determines the counties for all banks except the Bank of Southern Illinois in Bolton, Illinois. The comparable table in the 1880 Census (U.S. Department of the Interior, 1883, Population of Civil Divisions less than Counties, Table III, Illinois, pp. 145-47) provides the county for some unincorporated towns and Bolton is included. On the other hand, Dowrie (1913, p. 149) indicates that, in 1857, Bolton is a town in Williamson County with one family. We do not know if the bank moved after the 1857 amendment to Illinois' free banking law required that a bank be in a town or village with at least 200 people, and if it did move, where.

We put the Bank of Southern Illinois in Williamson County.

### *Population*

The populations of counties in Illinois are from the 1860 Census (U.S. Department of the Interior, 1864, State of Illinois, Table No. 2, Population by Color and Condition, pp. 86-87).

## **Wisconsin**

### *Banks and Their Fates*

The sources are: U.S. Congress (1857; 1861, pp. 249-55; and 1863, pp. 200-209); and Rolnick and Weber (1982; Appendix, 1983). The data on the number of banks are based on an unpublished worksheet, based on the state reports in the House Executive Documents, provided by Arthur Rolnick and Warren Weber.

### *Bond Holdings and Other Balance Sheet Data*

The distribution of each bank's bond holdings and the data on each bank's notes, capital and assets are from the *Annual Report of the Bank Comptroller of the State of Wisconsin* for the fiscal year ending September 30, 1860 published in the U.S. Congress (1861, pp. 249-55, 278-302).

### *Counties in Which Banks Are Located*

The counties in which banks are located are determined from reports to the Comptroller, the U.S. Census and banknote reporters. The *Annual Report of the Bank Comptroller of the State of Wisconsin* for the fiscal year ending September 30, 1860 published in the U.S. Congress (1861, pp. 249-55, 278-302) gives the community in which banks are located if the community's name is not part of the bank's name. The 1860 Census (U.S. Department of the Interior, 1864, State of Wisconsin, Table No. 3, Population of Cities and Towns, pp. 533-43) gives the county in which a community is located. In cases in which the community is not included in the 1860

Census, we use the county given in one or more banknote reporters. This procedure determines the county in which all but two banks are located. We assume that the community of New London in 1860 is located in Waupaca county in 1860, as is the current town with that name. We also assume that the community of North Pepin in 1860 is north of Pepin in Pepin county.

### *Population*

The populations in counties in Wisconsin are from the 1860 Census (U.S. Department of the Interior, 1864, State of Wisconsin, Table No. 2, Population by Color and Condition, p. 532).

### Data Appendix References

- Auditor of State, Indiana. 1858. *Annual Report of the Auditor of State of the State of Indiana ... for the fiscal year ending October 31, 1858*. Indianapolis: State of Indiana.
- Auditor of State, Indiana. 1860. *Annual Report of the Auditor of State of the State of Indiana ... for the fiscal year ending October 31, 1860*. Indianapolis: State of Indiana.
- Auditor of State, Indiana. 1862a. *Annual Report of the Auditor of State of the State of Indiana ... for the fiscal year ending October 31, 1861*. Indianapolis: State of Indiana.
- Auditor of State, Indiana. 1862b. *Annual Report of the Auditor of State of the State of Indiana ... for the fiscal year ending October 31, 1862*. Indianapolis: State of Indiana.
- Annual Reports of Bank Commissioners of the State of Illinois, Seventeen to Twenty-second General Assembly of Illinois. 1851-1861*. Springfield, Bailhache and Baker, Lanphier and Walker.
- Hodges' Journal of Finance and Bank Reporter*, June 9, 1860, January 1861 (volume 12, number 1), June 26, 1861 and January 15, 1862.
- Inventory of the Articles of the State Banking Department of Wisconsin. 1942*. The Wisconsin Historical Records Survey Project, Madison, Wisconsin.
- Rolnick, Arthur J., and Warren E. Weber, "A Theory of Free Bank Failures: Tests and Implications," *Staff Report 79*, Federal Reserve Bank of Minneapolis, April 1982.
- Thompson's Bank Note and Commercial Reporter*, January 14, 1860.
- U.S. Comptroller of the Currency. 1876. *Annual Report*.
- U.S. Congress. 1853. House Executive Document 66, 32nd Congress, 2nd Session.
- U.S. Congress. 1854. House Executive Document 102, 33rd Congress, 1st Session.
- U.S. Congress. 1855. House Executive Document 82, 33rd Congress, 2nd Session.
- U.S. Congress. 1856. House Executive Document 102, 34th Congress, 1st Session.

- U.S. Congress. 1857. House Executive Document 87, 34th Congress, 3rd Session.
- U.S. Congress. 1858. House Executive Document 107, 35th Congress, 1st Session.
- U.S. Congress. 1859. House Executive Document 112, 35th Congress, 2nd Session.
- U.S. Congress. 1860. House Executive Document 49, 36th Congress, 1st Session.
- U.S. Congress. 1861a. House Executive Document 77, 36th Congress, 2nd Session.
- U.S. Congress. 1861b. House Executive Document 25, 37th Congress, 2nd Session.
- U.S. Congress. 1863. House Executive Document 20, 38th Congress, 1st Session.
- U.S. Department of the Interior. 1854. *Statistical View of the United States*. Washington: A. O. P. Nicholson, Public Printer.
- U.S. Department of the Interior. 1864. *Population of the United States in 1860*. Washington: Government Printing Office.
- U.S. Department of the Interior. 1872. *The Statistics of the Population of the United States*. Ninth Census, Volume I. Washington: Government Printing Office.
- U.S. Department of the Interior. 1883. *Statistics of the Population of the United States at the Tenth Census*. Washington: Government Printing Office, 1883.

Table 1

**BALANCE SHEETS OF FREE BANKS  
IN ILLINOIS, INDIANA, AND WISCONSIN  
(THOUSANDS OF DOLLARS)**

AGGREGATES WITH SUMMARY COMMON CATEGORIES	ILLINOIS		INDIANA		WISCONSIN	
	OCTOBER 1, 1860	JANUARY 7, 1861	JANUARY 7, 1861	JANUARY 7, 1861	JANUARY 7, 1861	JANUARY 7, 1861
	DOLLARS	FRACTION	DOLLARS	FRACTION	DOLLARS	FRACTION
<b><u>Assets</u></b>						
Bonds	11,921	0.613	1,298	0.355	4,656	0.279
Loans	2,485	0.128	1,480	0.405	8,051	0.483
Notes of other banks	287	0.015	134	0.037	1,163	0.070
Cash and other cash items, due from banks and brokers	3,576	0.184	292	0.080	871	0.052
Specie	506	0.026	195	0.053	371	0.022
Real estate	518	0.027	70	0.019	364	0.022
Other accounts	145	0.007	189	0.052	1,199	0.072
Total assets	19,438		3,658		16,676	
<b><u>Liabilities</u></b>						
Notes in circulation	11,011	0.566	1,036	0.283	4,233	0.254
Deposits	808	0.042	782	0.214	4,081	0.245
Due to others	486	0.025	77	0.021	1,634	0.098
Other accounts	381	0.020	213	0.058	0	0.000
Capital	6,751	0.347	1,550	0.424	6,732	0.404
Total liabilities	19,437		3,658		16,681	

Notes: Data are from individual banks' balance sheets. We have used common titles for categories with slightly different titles in the originals and have combined related items to make the states' balance sheets comparable. Assets and liabilities do not add to exact equality in the originals. Sources: The data are from U.S. Congress (1861). The states and the respective pages are: Illinois, pp. 222-27; Indiana, pp. 231-32; Wisconsin, pp. 256-77.

**Table 2**  
**MAJOR PROVISIONS OF THE FREE BANKING LAWS**  
**ILLINOIS, INDIANA AND WISCONSIN AT START OF 1861**

RESTRICTION	ILLINOIS	INDIANA	WISCONSIN
<b>Backing for Banknotes</b>			
Eligible bonds	U.S. and states paying full interest	U.S., Indiana and states paying interest semi-annually or more frequently.	U.S. and states paying full interest. Also secured Wisconsin railroad bonds with 7 percent coupon, but not more than half of a bank's total bond deposit.
Value of bonds used to determine notes issues	Ninety percent of the last 6 months average price. Fifty percent if coupon less than 6 percent. Not more than par value or market value at time of deposit.	Ten elevenths of value. Shall be, or made equal to, 6 percent coupon bonds. Not more than par value or market value at time of deposit.	The average of the last 6 months price. Shall be, or be made equal to, 6 percent coupon bonds. Not more than par value or market value at time of deposit.
Other limits on notes issued	None	Total note issue for all free banks not more than \$6 million.	Total note issue not to exceed subscribed capital.
Bond account deficient when	Bonds lessened in value or insufficient as security.	Bonds have depreciated in value by 5 percent or issuer fails to pay interest.	Market value of bonds for 60 days less than value at which deposited.
Grace period to make up deficiency	Reasonable time (in practice before 1861, 40 days).	None specified	30 days
At end of grace period	Bank closed	Nothing	Bank closed
<b>Bank Size</b>			
Minimum size	Minimum subscribed and paid-in capital of \$50,000	At least \$50,000 in bonds deposited	Minimum subscribed capital of \$25,000
Maximum size	None	Total note issue not to exceed \$200,000	\$500,000
Stockholders' liability	Double subscribed capital	Double subscribed capital	Double subscribed capital plus bond for value of one-quarter of notes issued.
Liability after sale or transfer of stock	6 months	1 year	6 months
<b>Protested Notes</b>			
Grace period to redeem	10 days	None	10 days
At end of grace period	Bank closed	Bank closed	Bank closed
Penalty paid to holder of protested notes	12 percent per year	10 percent per year	5 percent damages

Sources: Illinois (1851-1861); Indiana (1851-1861); and Wisconsin (1852-61).

Table 3

**BANKS REMAINING OPEN AND CLOSING COMPARED TO BANKS FAILING  
ILLINOIS, INDIANA AND WISCONSIN 1861**

RIGHT-HAND-SIDE VARIABLES	ALL VARIABLES			RETURN DELETED	
	COEFFICIENT STD. DEV.	MARGINAL EFFECT P-VALUE	COEFFICIENT STD. DEV.	MARGINAL EFFECT	MARGINAL EFFECT
Intercept	-0.471 3.397	0.890	-2.544 3.172	0.667	0.667
Dummy variable for Indiana and Wisconsin	1.286 0.362	0.409 <10 <sup>-3</sup>	1.555 0.343	0.479 <10 <sup>-3</sup>	0.479 <10 <sup>-3</sup>
Standard Deviation of Bonds' Return	-171.022 52.612	-51.264 0.001	-151.982 51.842	-45.150 0.003	-45.150 0.003
Mean return on bonds	472.162 158.795	141.531 0.003			
Logarithm of bonds/capital	1.333 0.396	0.399 <10 <sup>-3</sup>	1.239 0.382	0.368 0.001	0.368 0.001
Logarithm of notes/assets	-2.242 0.451	-0.672 <10 <sup>-3</sup>	-2.163 0.437	-0.642 <10 <sup>-3</sup>	-0.642 <10 <sup>-3</sup>
Dummy variable for age not more than 1 year	-0.120 0.304	-0.041 0.692	-0.079 0.292	-0.027 0.786	-0.027 0.786
Population density	-0.507 1.900	-0.152 0.789	-1.871 1.857	-0.556 0.313	-0.556 0.313
Logarithm of assets	-0.108 0.281	-0.032 0.700	0.062 0.260	0.018 0.811	0.018 0.811
Maximized value of log likelihood	77.919		-82.682		
Number of observations	199		199		
Chi-square likelihood ratio test statistic	106.818		97.290		
Degrees of freedom	8		7		
p-value	<10 <sup>-3</sup>		<10 <sup>-3</sup>		

Table 4

## TEST STATISTICS FOR ALTERNATIVE HYPOTHESES

HYPOTHESIS	CHI-SQUARE TEST STATISTIC	DEGREES OF FREEDOM	P-VALUE
<i>Equations with Horizontal and Vertical Deviations from Frontier Added</i>			
No vertical deviation	9.155	1	0.002
No horizontal deviation	0.258	1	0.612
No horizontal deviation and no vertical deviation	9.399	2	0.009
No vertical deviation conditional on no horizontal deviation	9.141	1	0.003
No horizontal deviation conditional on no vertical deviation	0.244	1	0.622
No standard deviation	4.391	1	0.036
<i>Equations with Euclidian Distance from Frontier Added</i>			
No Euclidian deviation	0.088	1	0.767
No standard deviation	2.936	1	0.087

Figure 1  
 Prices of Bonds  
 January 7, 1859 to December 20, 1862

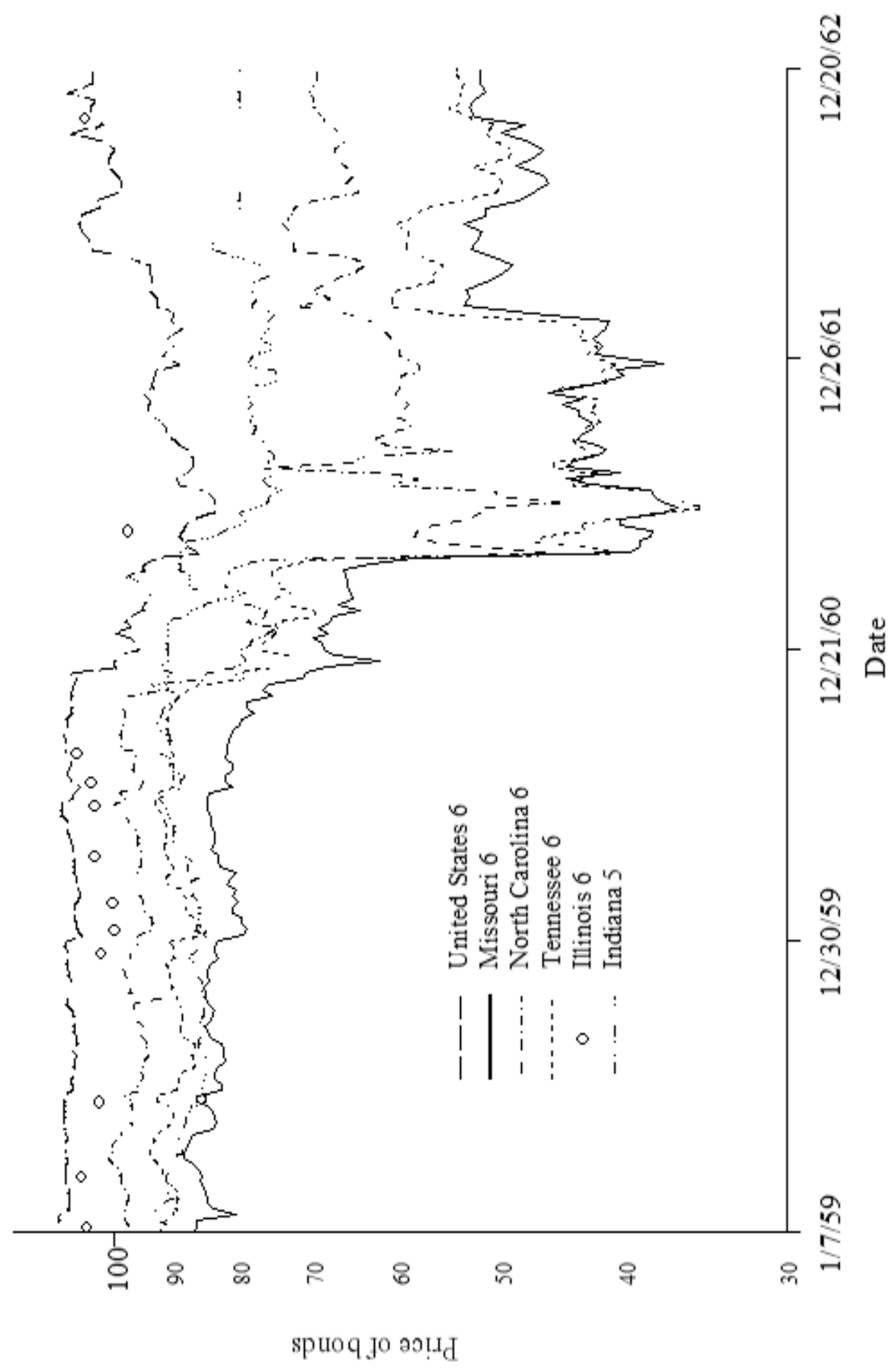


Figure 2

Efficient Frontiers

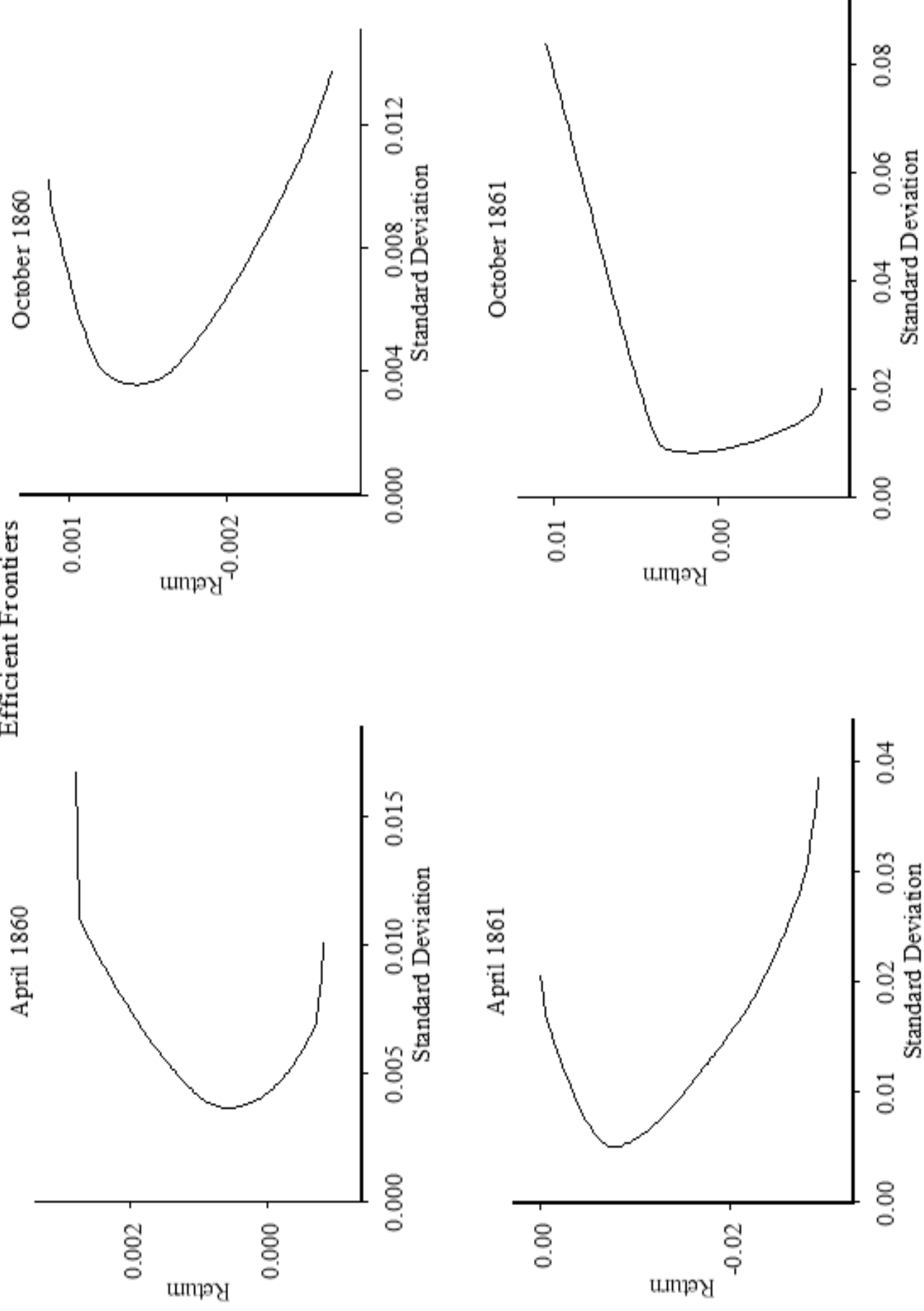
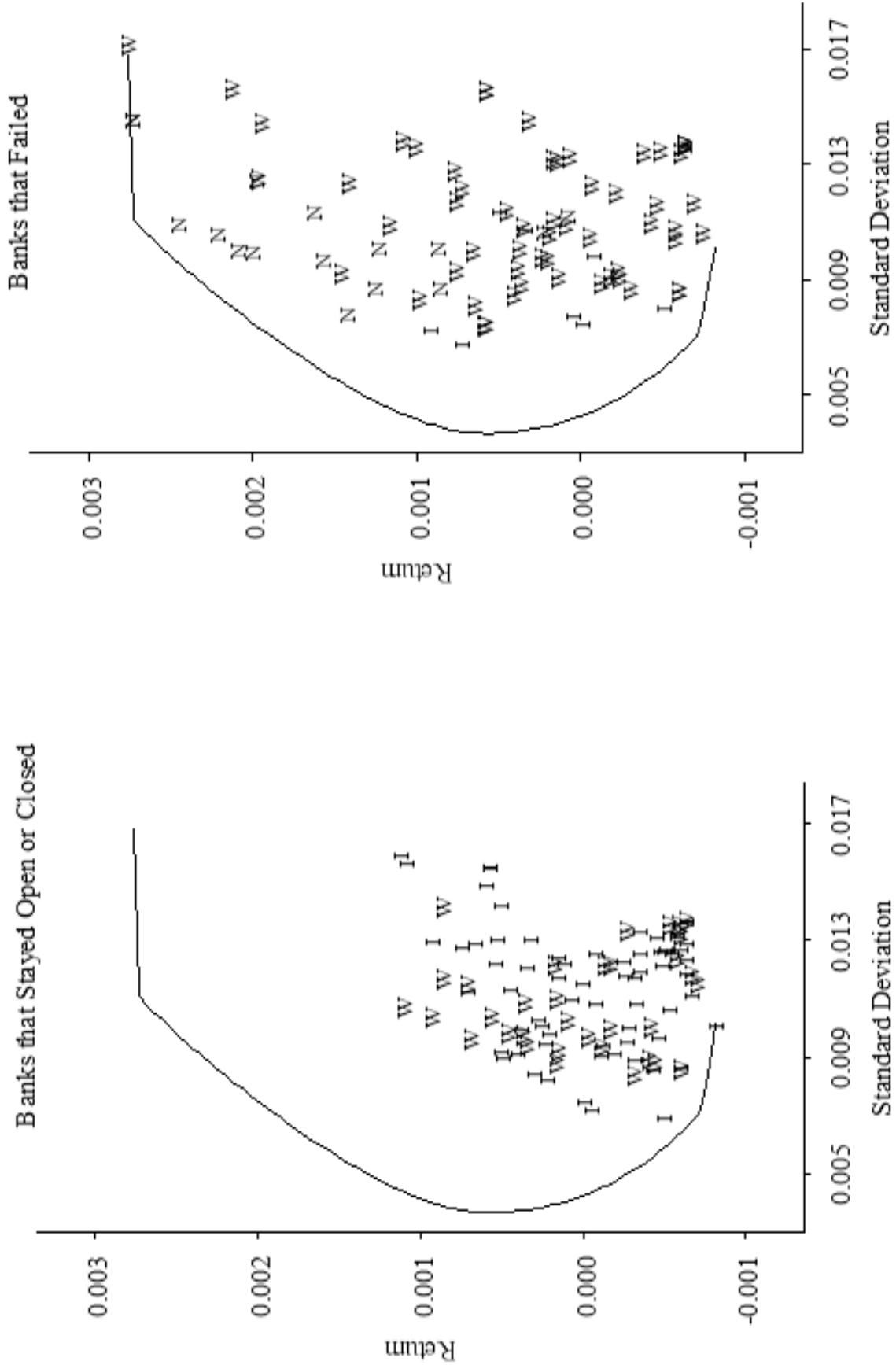


Figure 3  
Banks' Fates and Their Portfolios  
April 1860



Kane County Bank held no bonds

**Figure 4**  
 Leverage and Variability of Bond Prices

