OCTOBER 8, 2009

MOODY'S ANALYTICS

BANK FAILURES PAST AND PRESENT: VALIDATING THE RISKCALC V3.1 U.S. BANKS MODEL

MODELING**METHODOLOGY**

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ABSTRACT

This document outlines the validation results for the RiskCalc v3.1 U.S. Banks model, and highlights the deteriorating financial ratios present in the banking sector. We contrast trends of key risk measures to those of the savings and loan crisis of the late 1980s and early 1990s. We also explore the speed and nature of recent bank failures and demonstrate the model's strong performance in light of this rapidly changing environment.

Published by:
Moody's Analytics

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TABLE OF CONTENTS

1 OVERVIEW

In 2006, Moody's KMV released the RiskCalc v3.1 U.S. Banks model.[1] This model builds upon extensive research and experience with its previous version, and utilizes information from more than 2,000 bank failures across 19 years of data.[2] The model estimates the Expected Default Frequency (EDF™) credit measure for private banks using recent call report information. The model is based on the historical relationship between key financial ratios and bank failures. The EDF credit measure also includes a forward-looking credit cycle adjustment based on the EDF credit measures of public banks from the Moody's KMV public firm model.[3]

When the RiskCalc v3.1 U.S. Banks model was released, the banking sector was stable, had profitable balance sheets, and the industry appeared relatively safe. Indeed, it was difficult to find a bank with a high probability of failure at the end of 2006. During the summer of 2007, private bank EDF credit measures began to increase. This increase was driven largely by the Credit Cycle Adjustment (CCA), which incorporated negative signals from the rapidly increasing EDF credit measures of public banks. Since the second half of 2008, a regular pattern of Friday afternoon bank closures emerged, highlighting the ongoing importance of monitoring banking sector risk.

During the savings and loan (S&L) crisis, banks remained undercapitalized for extended periods before closure, and it was relatively easy to determine which banks would fail at the one-year horizon. These past bank failures resulted in a model with a very high Accuracy Ratio (95.3%) over the development sample, which was much higher than any of our other default models.[4] Consequently, when building the model, we focused on choosing a set of risk drivers that would explain risk over longer horizons. When measured at the five-year horizon, the model's power was 85.0%.

In this paper, we assess the performance of the RiskCalc v3.1 U.S. Banks model during the current banking crisis. We show that the EDF credit measure effectively differentiates risk across the population, and demonstrate that the EDF levels of failed banks have risen faster and were higher than the EDF levels of non-failing banks. As benchmarks for testing, we compare the model's performance to other popular measures of financial strength, such as the Tier I capital ratio and the Texas ratio.[5] It should be noted that the current period provides a pure out-of-sample model test.[6]

We also track the risk drivers used in the model to highlight the elevated risk levels that persist throughout the banking sector. We compare key financial ratios prior to closure during the current period with those of the historical period. This comparison reveals an interesting pattern—banks are closing faster and with less warning during the current crisis relative to the S&L crisis. This finding is not surprising, as legislation enacted after the S&L crisis was intended to enable the Federal Deposit Insurance Corporation (FDIC) to take *prompt corrective action* upon signs of financial distress.

This paper is organized in the following way.

- Section 2 describes the data used in model development and the data used to assess recent model performance.
- Section 3 briefly describes legislation changes that followed the S&L crisis and their intended impact on failing banks.

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[1] Dwyer, Guo, and Hood, 2006.

[2] Kocagil, et. al., 2002.

[3] cf. Crosbie and Bohn, 2003.

[4] Bank failures differ from corporate defaults. For both corporates and banks, leverage (total liabilities divided by total assets) is an indicator of default risk; however, corporates typically have less leverage than banks. For a bank, when equity falls below a certain level, their regulator will typically shut the bank down unless they can find an investor willing to inject equity into the bank. In contrast, corporate book liabilities can exceed book assets for a variety of reasons while they remain a viable business.

[5] The Texas Ratio is a measure of credit risk, calculated as the ratio of non-performing assets divided by the sum of equity and loan loss provisions. Higher Texas Ratios indicate a higher risk of insolvency, as the bank's non-performing loans increase past the available equity to cover potential losses. A Texas Ratio above one indicates that the bank has negative equity if all the non-performing loans end up being charged of at 100% of their book value. In practice, there are several variations of the Texas Ratio, but they all share this basic interpretation.

[6] After a RiskCalc model is released and actively used, we do not change the model. The independent variables used to predict default change as new information becomes available. The ratios in the model, their transforms, and their coefficients, do not change.

- Section 4 summarizes financial ratio trends in the banking sector by looking at the drivers of risk in the model as well as other risk drivers.
- Section 5 assesses the early warning ability of the EDF credit measure both during the current banking crisis and during the previous crisis. This section also contrasts the performance of the EDF credit measure with other measures of banking risk.
- Section 6 details the model's discriminatory power using a Cumulative Accuracy Profile and Accuracy Ratio statistics.
- Section 7 discusses level validation.
- Section 8 examines two recent bank failures as seen through the model.
- Section 9 provides concluding remarks.

2 U.S. BANKING DATA

The data for the development and calibration of the RiskCalc v3.1 U.S. Banks model was collected from multiple sources, including the FDIC's Research Information System (RIS) database and the Federal Reserve Bank's bank data. This data compiles extensive information on banks, thrifts, S&L institutions, and bank holding companies from 1986-2005. The data is thoroughly cleaned for consistency. For this validation, we have further collected and verified data through August 2009 to measure the model's out-of-sample performance.

TABLE 1 Description of Development Sample and Recent Sample

FDIC Insured Institutions	Development Sample	Recent Sample
Financial Statements	242,003 (annual)	589,714 (quarterly)
Unique Number of Institutions	21,200+	12,066
Closed Institutions	2,219	113 [7]
Time Period	1986-2004	Jul 2004–Aug 2009

While the current crisis has caused a small number of closures to date relative to the prior banking crisis period, the FDIC continues to expand the "problem bank" list, which currently stands at over 400 institutions.

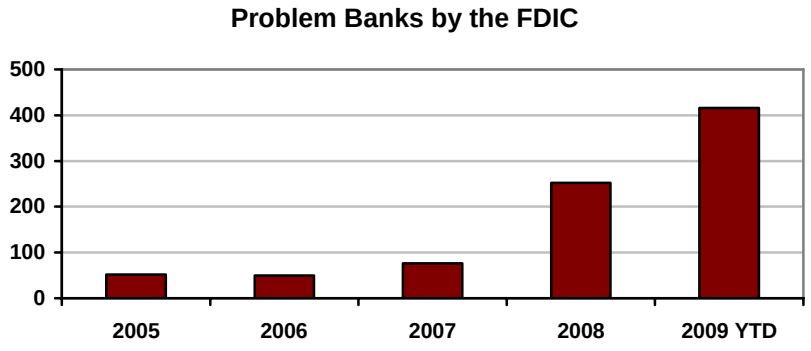

FIGURE 1 Problem Bank Listing as of August 31, 2009

Beginning in 2008, we saw the first significant wave of U.S. bank failures since 1994. In 2008, there were a total of 26 failures, which were approximately 0.29% of banks insured by the FDIC. In 2009, there have been 84 failures to date—approximately 0.94% of banks insured by the FDIC. While the current failure rate remains lower than that of the S&L

[7] As of August 31, 2009.

crisis, bank failures continue to mount as economic conditions weigh on loan portfolios. As shown in **Error! Reference source not found.**, closures are dominated by the banking crisis of the 1980s and 1990s.

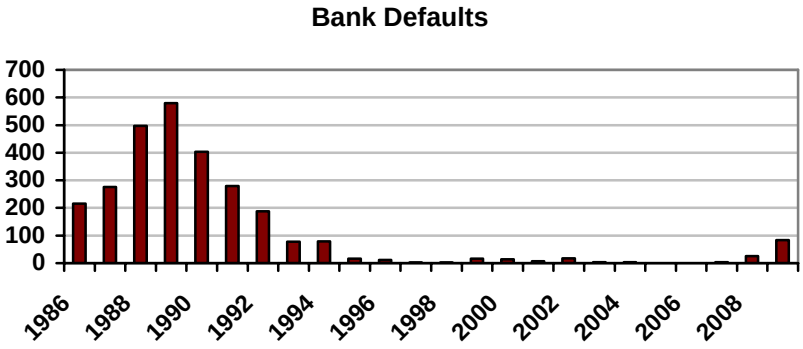

FIGURE 2 U.S. Bank Closures, 1986–2009

Bank closures exhibit different characteristics than defaults by their corporate counterparts. Corporate defaults are characterized by the obligor's ability to pay, as reflected by the status of its outstanding loans (non-accrual, 90 days past due, charge-off, or bankruptcy). In contrast, bank deposits are insured and guaranteed by the FDIC to a specific threshold. Bank failures are determined by the regulators' assessment of the bank's ability to pay, with the objective to protect the deposit fund from substantial losses. Because of this, it is important to consider historical changes to legislation regarding the FDIC and the implications on how they respond to failing institutions.

3 LEGISLATIVE CHANGES SINCE THE LAST BANKING CRISIS

In response to the banking crisis of the 1980s, Congress enacted significant legislative changes in an attempt to address the cost of the banking crisis to the FDIC and to taxpayers. For example, the Crime Control Act of 1990 "prohibited undercapitalized banks from making golden parachute and other indemnification payments to institution-affiliated parties… increased the authority of the FDIC to take enforcement actions against institutions operating in an unsafe or unsound manner." Additionally, the Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991 "mandated a least-cost resolution method and prompt resolution approach to problem and failing banks and ordered the creation of a risk-based deposit insurance assessment scheme… FDICIA created new supervisory and regulatory examination standards and put forth new capital requirements for banks."[8]

The FDICIA was intended to reduce the cost of bank failures to both the FDIC and, ultimately, taxpayers. Some economists have used the theory of moral hazard to argue that the prior banking crisis was worsened by deposit insurance leading to excessive risk taking on the part of banks.[9] The FDICIA aimed at mitigating this issue through stricter regulations such as prompt corrective action provisions. Congress and regulators reasoned that preventing bank management from "doubling down" on bad risks would reduce exposure of the insured deposits and would better protect the FDIC fund.

The majority of banking failures in our development sample predates the FDICIA. If the FDICIA is working as designed, we should see differences in banking failure patterns during this crisis compared to the last crisis. Notably, we should see the FDIC closing problematic institutions faster than they had during the prior crisis.

[8] The source is the *Important Banking Legislation* section of the Federal Deposit Insurance Corporation's website (www.fdic.gov)
[9] cf. Bentson and Kaufman, 1998.

4 RECENT FINANCIALS

In this section, we look at a number of key risk measures, comparing the past and present banking crises. Measures include equity to assets, net income to assets, other real estate owned to assets, and the RiskCalc v3.1 U.S. Banks EDF credit measure. From these measures, we see that risks in the banking sector persist.

Risk measures can be updated frequently to reflect the most recent call report information and the most recent market information. These risk measures provide meaningful signals to the aggregate risks in the banking sector. Prior to failure, the banks typically had substantial foreclosed property holdings, negative net income, weak equity, and an excess of non-performing loans relative to equity and loan loss provisions.

Figures 3–8 present the distribution of key ratios from 1986–2009. The left panel presents the distribution by year (illustrated by percentile) from 1986–2005. The right panel represents the quarterly distribution (illustrated by percentile) from 2005–Q1 2009.

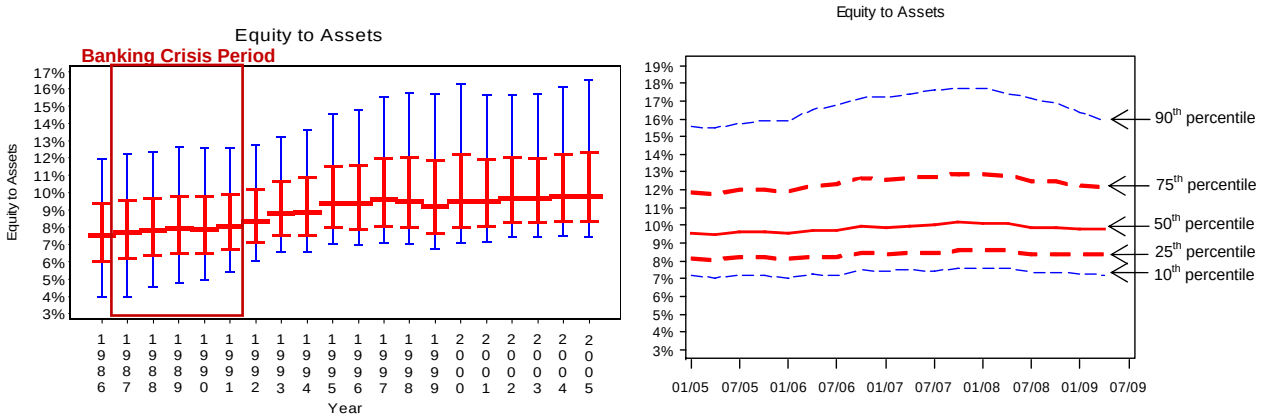

FIGURE 3 Distribution of Key Ratios: 1986–present. Stable Bank Book Equity

Although Figure 3 shows that equity appears to be relatively stable, the equity of many banks will likely decline as more provisions are made for non-performing loans and as these loans are charged off.

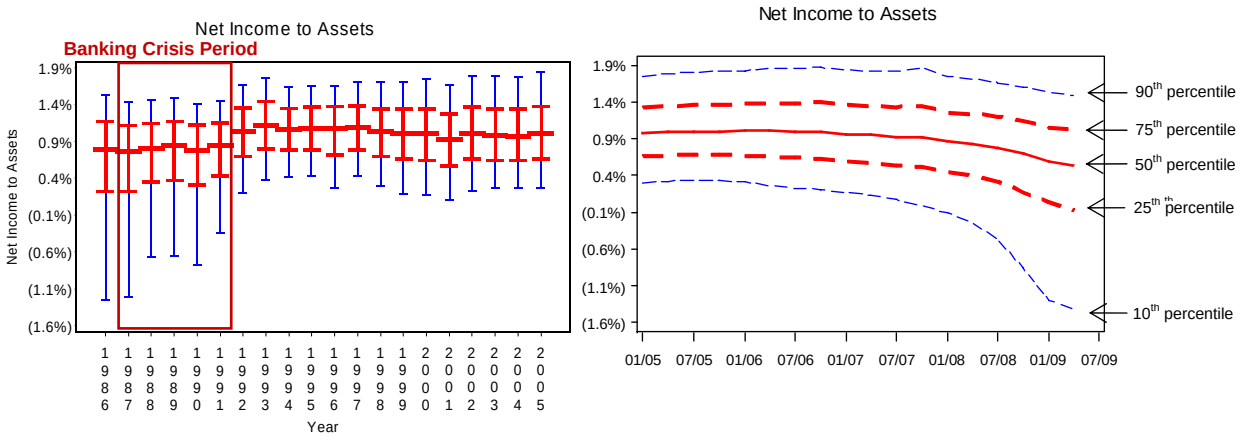

FIGURE 4 Distribution of Key Ratios: 1986–present. Net Income Decline

Net income has declined substantially; currently, the bottom ten percent of banks are losing money, as shown in Figure 4. The magnitude of these losses is now comparable to the levels seen during the S&L crisis. As Figure 5 shows, Other Real Estate Owned is also on the rise, with levels starting to approach those seen during the S&L crisis.

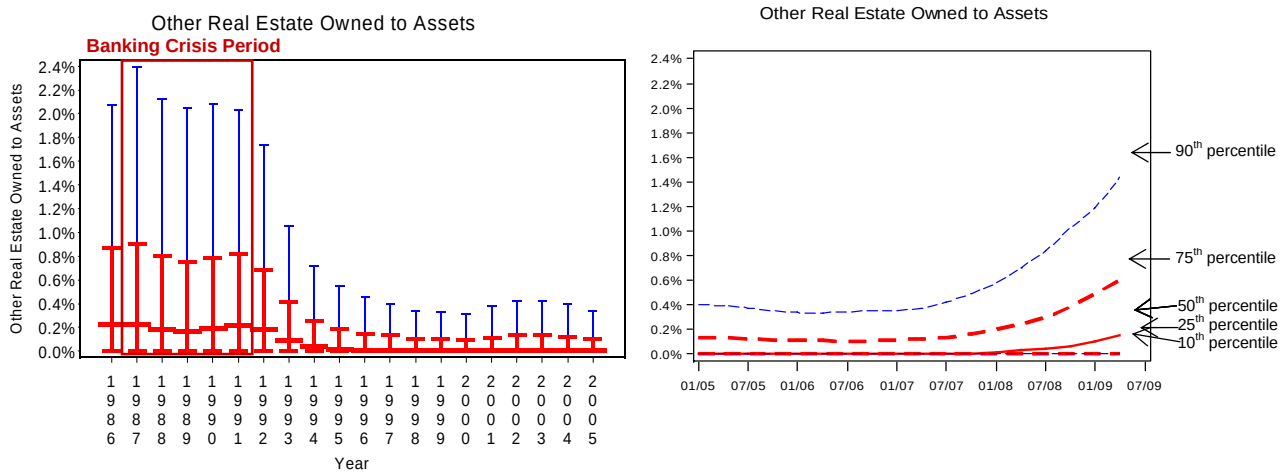

FIGURE 5 Distribution of Key Ratios: 1986–present. Increase in Foreclosed Properties

The EDF levels of failed banks and non-failed banks increased during 2008. EDF credit measures combine relevant ratios such as equity to assets, net income to assets, and measures of concentration risk, along with a credit cycle adjustment, to provide a forward-looking summary measure of risk for these banks. Currently, the 75th and 90th percentile of EDF levels are 1.6% and 2.9%, respectively. These measures represent a significant increase from the prior year, when these ratios were 0.9% and 1.7%, respectively.

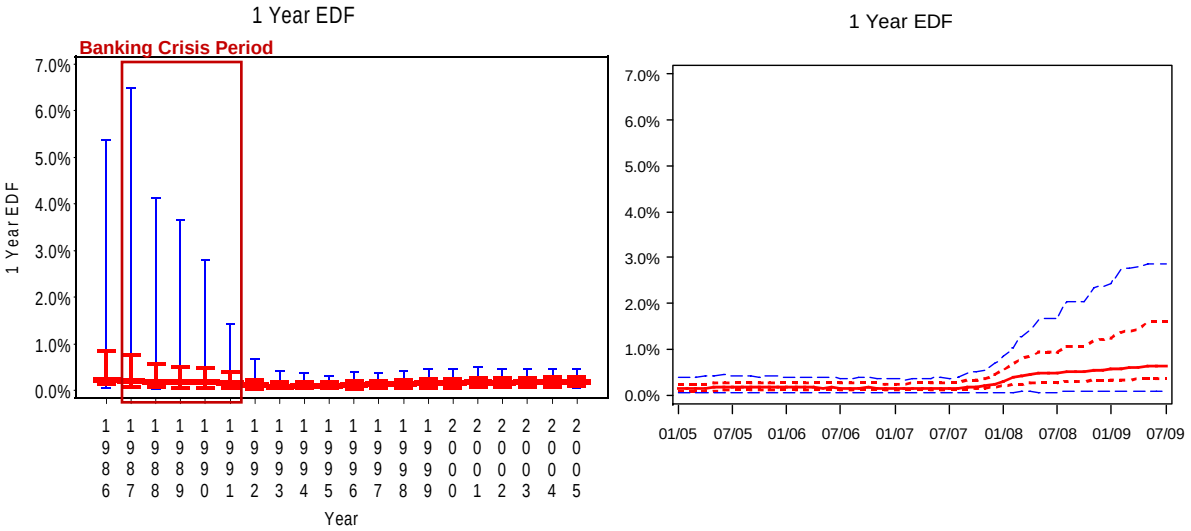

FIGURE 6 Distribution of Key Ratios: 1986–present. EDF Levels Rising

Although not used directly in the model, tracking non-current loans on the bank's books is a relevant risk measure. Banks make allowances for non-performing loans. Figure 7 and Figure 8 display distributions for non-current loans to assets and loan loss allowance to assets. These figures illustrate the increase in non-performing loans on bank portfolios. In addition, the loan loss allowances across institutions are more stable. This may indicate that many of these institutions are experiencing rapid declines in asset quality that may not be fully accounted for in their loan loss allowances. Consequently, the equity of some banks may decline further as the non-current loans become charge-offs, and the banks become better able to estimate the actual recovery on these loans. These factors would, in turn, further increase the EDF levels of these banks.

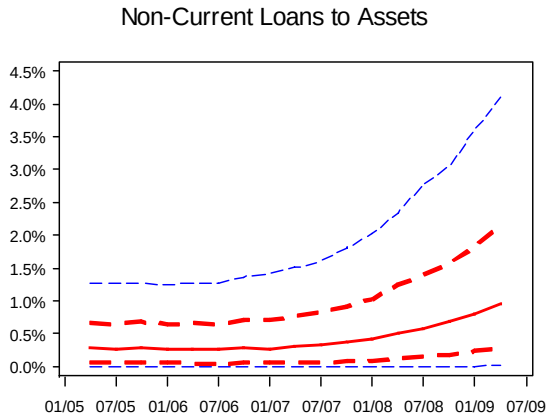

FIGURE 7 Distribution of Key Ratios: 1986–present. Recent Non-current Loans to Assets

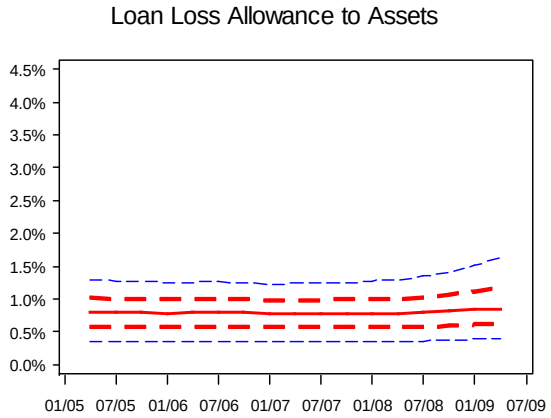

FIGURE 8 Distribution of Key Ratios: 1986–present. Recent Loan Loss Allowance to Assets

5 CHARACTERISTICS OF FAILURES

To highlight the changing characteristics of failures, we look at key risk measures prior to a bank's failure. Historically, troubled banks were critically undercapitalized for extended periods before being closed. Given the nature of the regulatory changes discussed in Section 3, during the recent banking crisis, we find that banks are closing at earlier stages of financial distress.

We continuously monitor the risk levels of FDIC insured banks as well as their holding companies. In this section, we track equity to assets, the Texas Ratio, and the EDF credit measures calculated from the RiskCalc v3.1 U.S. Banks model. We calculate the Texas Ratio as the ratio of non-performing loans to the sum of equity and loan loss provisions. Texas ratios in excess of one indicate a higher risk of insolvency as the bank's non-performing loans exceed available resources to cover potential losses. The RiskCalc EDF credit measure is a probability of failure based on a mixture of market information and financial statement ratios.

As noted below, the time between the elevation of risk measures and the failure of a bank has shortened considerably. For banks that closed during the S&L crisis, the median equity to assets and median Texas Ratio one-year prior-to-failure were 2% and 110%. In contrast, during the recent period (2008–2009) these ratios were 9% and 37% respectively. In Figure 9, the left panel displays the historical period (1982–2004), while the right panel displays recent events (July 2004–August 2009). Furthermore, the left panel in Figure 9 highlights that more than half of insolvent firms during the historical period closed with negative equity, which contrasts with the positive equity of most firms closed during the recent period.

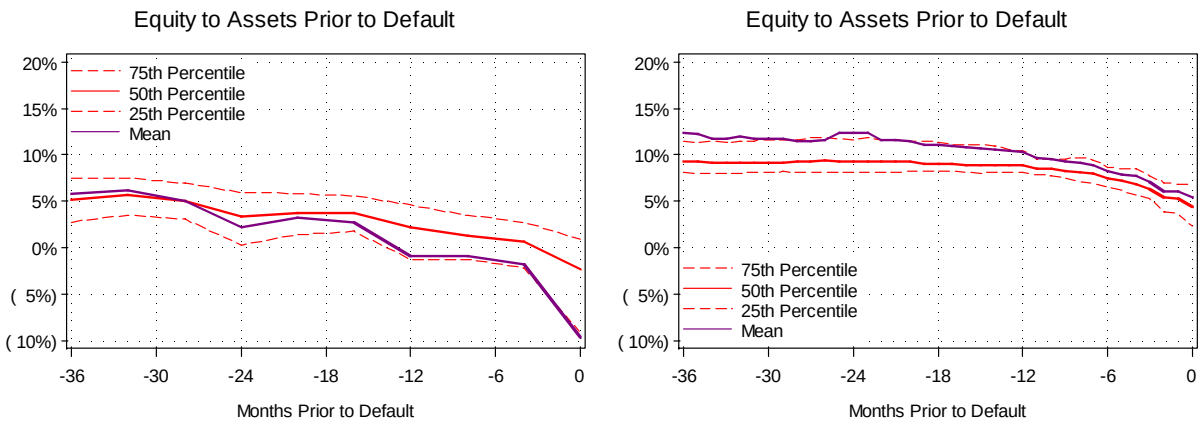

FIGURE 9 Equity to Assets for Failing Banks Prior to Closure: Development Sample and Recent Period

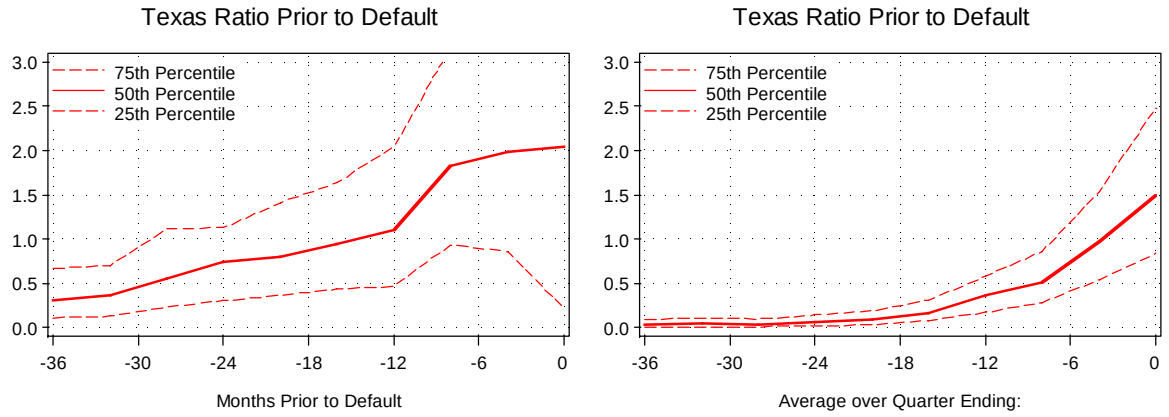

FIGURE 10 Texas Ratio for Failing Banks Prior to Closure: Development Sample and Recent Period

The left panel in Figure 10 displays the historical time period (1982–2004), while the right panel displays recent events (July 2004–July 2009). As displayed in the figure, the Texas Ratio was much more pronounced during the historical period prior to closure. Indeed, more than 25% of failing banks during the S&L crisis had non-performing loans on the order of five times their available loan loss provisions and equity. During the recent period, we do not observe the same extreme trends in balance sheets; the 75th percentile for the Texas Ratio at closure during the current crisis is 2.5.

These changes are apparent in our measure of risk, the EDF credit measure, as produced by our RiskCalc banking model. Historically, the EDF credit measure was quite elevated prior to closure. This is expected, since many of these firms were operating with negative equity, mounting concentration risk, and negative net income. In the current period, our EDF credit measure has responded as well. Although failing banks are being shuttered at earlier signs of distress, the RiskCalc EDF credit measure distinguishes firms at risk of failure well before being closed. We explore these findings further in Section 6.

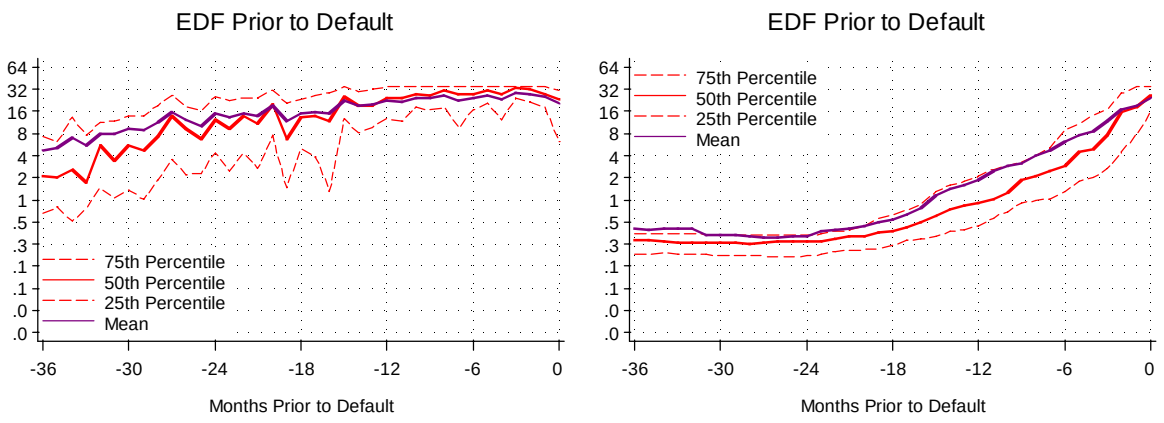

FIGURE 11 Expected Default Frequency (EDF) for failing banks prior to closure: Development Sample and Recent Period

The left panel in Figure 11 displays the historical time period (1982–2004), while the right panel displays recent events (July 2004–August 2009). Across all three measures of risk, the time between the onset of financial distress and the closure of the bank has decreased relative to the S&L crisis. This reduction in the time that a bank is allowed to operate while in final distress is consistent with the intent of the 1991 FDICIA's prompt corrective action provisions.

6 VALIDATION AND PERFORMANCE

In this section, we present the results of the RiskCalc v3.1 U.S. Banks model and demonstrate its strong performance in the recent environment. The speed of recent failures presents challenges for risk managers. In the current environment, balance sheets provide fewer signals before closure, so it is important to evaluate current risk management techniques. Models must account for the risk in a loan portfolio well before deterioration surfaces.

Figure 12 displays the distribution by quartile of the RiskCalc EDF credit measure for recent bank closures versus the remaining population. The red lines track the EDF credit measure for bank failures between January 2009 and July 2009. The RiskCalc v3.1 U.S. Banks model has produced elevated levels of risk for these failed firms well in advance; where the median of these at-risk firms crossed the 75% of all banks as early as October 2005.

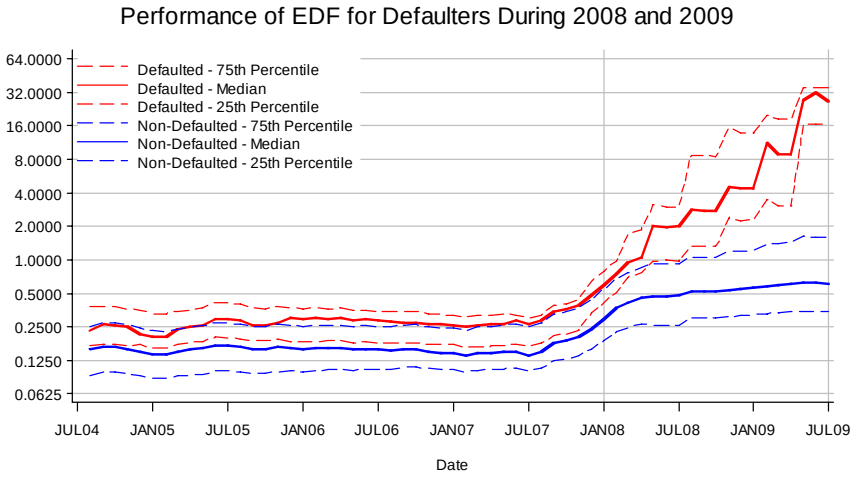

FIGURE 12 EDF Performance for Defaulters During 2008 and 2009

Figure 13 presents the same chart for the first and second parts of the crisis—January 2008–March 2009, and April 2009–August 2009, respectively. In this figure, the left panel tracks banks closed between July and March 2009, while right panel tracks banks closed between April and August 2009. As the crisis unfolds, the difference in risk levels between failing banks and non-failing banks becomes clearer. In April 2009, the median EDF levels of banks that failed between April and August 2009 was 8%, compared with a median EDF level of 3% for banks that failed between July and March 2009.

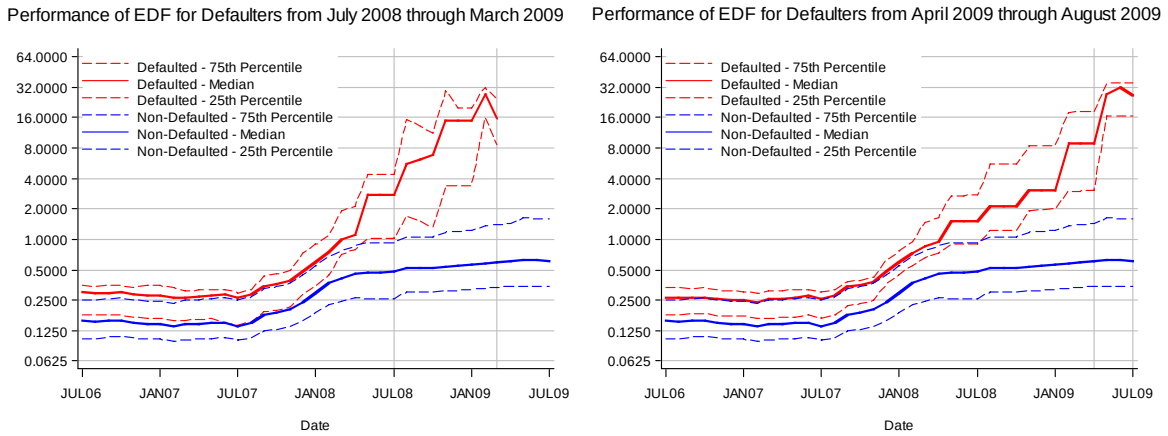

FIGURE 13 EDF Percentile Distributions over Time: Recently Closed Private Banks vs. All Private Banks

Table 2, Figure 14, and Figure 15 highlight the performance of the RiskCalc v3.1 U.S. Banks model at discriminating failing banks from the population. We present the Accuracy Ratios in Table 2 and the corresponding Cumulative Accuracy Profiles in the figures. These tests display the model's ranking power across the population and its ability to sort credits from worst to best.

TABLE 2 Accuracy Ratios for Recent and Historical Samples

Sample	Accuracy Ratio RiskCalc US Banks v3.1	Accuracy Ratio Texas Ratio	Accuracy Ratio Tier 1 Ratio
Recent Sample	83.1%	81.6%	71.2%
Historical Sample	95.0%	79.5%	---
Historical Sample[10]	75.5%	---	48.2%

[10] Tier 1 capital ratio information was only available from 1996–2002. The historical sample was restricted to this time period for accurate comparison of the RiskCalc EDF credit measure and the Tier 1 ratio.

Figure 14 presents the cumulative Accuracy Profile and Accuracy Ratios for the RiskCalc EDF credit measure and the Texas ratio. The left panel highlights the development sample performance (1982–2004), while the right panel presents results on the recent sample (July 2004–July 2009).

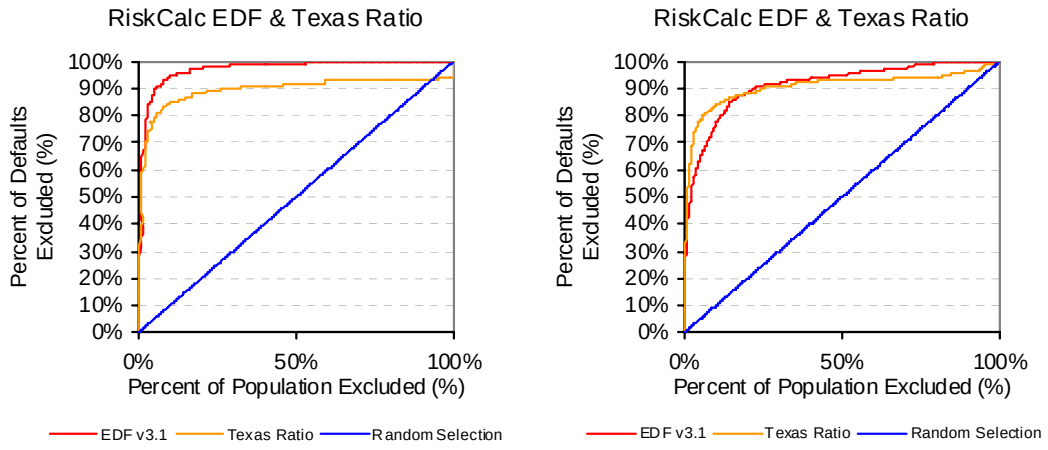

FIGURE 14 Cumulative Accuracy Profile of RiskCalc EDF and the Texas Ratio: Development Sample (Left Panel) and Recent Sample (Right Panel):

Figure 15 presents the cumulative Accuracy Profile and Accuracy Ratios for the RiskCalc EDF credit measure and the Tier 1 ratio. The left panel highlights the historical sample performance (1996–2002), while the right panel presents results on the recent sample (July 2004–July 2009).

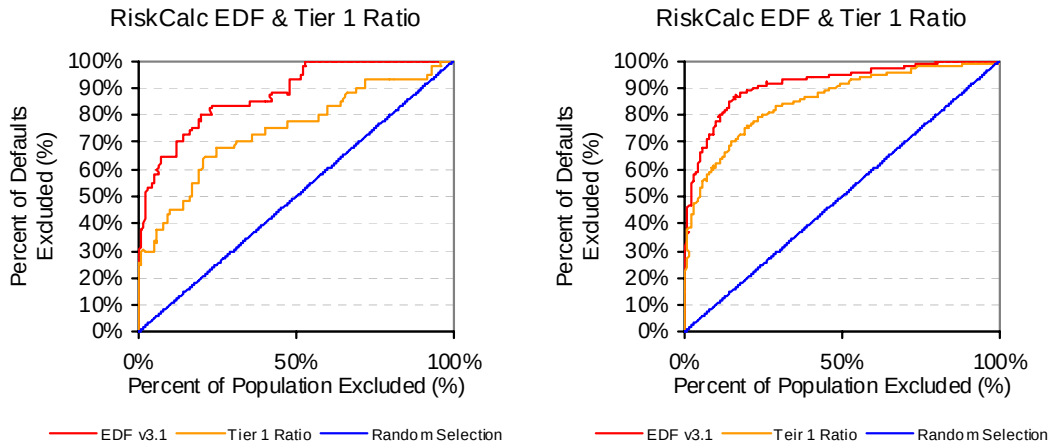

FIGURE 15 Cumulative Accuracy Profile of RiskCalc EDF and the Tier 1 Ratio: Development Sample (Left Panel) and Recent Sample (Right Panel):

These results highlight that the EDF credit measure differentiates risk better than the Tier 1 ratio and the Texas ratio. With respect to the Tier 1 ratio, many leading indicators of financial distress often appear on the balance sheet before changes are reflected in capital ratios. Banks in distress often experience decreasing net income and net interest margins while in a position of high concentration risk and increased leverage. The EDF credit measure accounts for all of these inputs and more, allowing a thorough assessment of the bank's status.

By the time a bank's Texas ratio is in excess of one, the solvency of the bank is already highly questionable. Therefore, in a sense the bank has already failed. An interesting exercise would be to compare the predictive power of the RiskCalc EDF credit measure to other benchmarks at different time periods prior to closure. To test the discriminatory power at specified quarters before closure, we construct lagged datasets as follows: we take all recently closed banks from the past two years and find the ith lagged quarterly statement before closure. This isolates the ith lagged statement for failed banks. Next, we collect all EDF credit measures of non-failed banks in the same time range of the statements for failed institutions mentioned above. This allows us to appropriately compare the EDF levels of failed banks to non-failed banks at a lagged interval before closure. Results from this analysis are presented in Table 3. We observe that, shortly before the bank closure, the Accuracy Ratios of the RiskCalc EDF credit measure and the Texas ratio are very similar, but as we move back from the closure date the gap widens. Two years prior to the failure, the RiskCalc Accuracy Ratio exceeds that of the Texas ratio by 20 points.

TABLE 3 Accuracy Ratios by Time to Default (in quarters)

Statement Lag (in quarters)	Data Description			Accuracy Ratios		
	Statement Date Range in Sample	Number of Closures	Number of Statements	RiskCalc EDF	Texas Ratio	Tier I Ratio
1	6/30/2006–12/31/2008	112	93,062	92%	90%	85%
2	3/31/2006–9/30/2008	112	93,519	86%	84%	75%
3	12/31/2005–6/30/2008	113	93,954	82%	80%	66%
4	9/30/2005–3/31/2008	113	94,356	76%	74%	58%
8	9/30/2004–3/31/2007	113	95,966	45%	23%	41%
12	6/30/2004–3/31/2006	110	70,559	43%	3%	33%

We look further at the discriminatory power of these ratios by size category. As seen in Table 4, the model outperforms the Tier 1 ratio and Texas ratio across asset size. The RiskCalc EDF credit measure is a robust measure of risk across banks of different sizes.

TABLE 4 Accuracy Ratios by Asset Size

Asset Size	Data Description		Accuracy Ratios		
	Number of Closures	Number of Statements	RiskCalc EDF	Texas Ratio	Tier I Ratio
Less than $200 million	40	339,800	81.1%	78.0%	68.3%
$200 million to $500 million	41	105,100	88.1%	87.8%	68.2%
Greater than $500 million	40	76,500	77.9%	77.5%	60.4%

7 LEVEL VALIDATION

In addition to the model's ability to discriminate risky institutions, practitioners are concerned with the model's EDF level, and whether a 1-in-36 measure of default risk is actually a 1-in-36 chance of default. This question is harder to address, and the methodologies to test this are still developing. Nevertheless, clients using the model to measure value at risk or to estimate reserves will be very concerned with this measure of model performance.

In Figure 16, we compare the expected closure rate during the last year to that predicted by the model.[11] The expected closure rate distribution was numerically calculated assuming a single factor framework and using the EDF credit measures as of August 2008 and August 2009 for the individual probabilities of closure. An underlying asset correlation of 24% is taken from the Moody's KMV GCorr model for asset correlation for Banks and S&Ls. We focus on the

[11] For more information on level validation, refer to Kurbat and Korablev (2002).

August-to-August time interval because failed bank information for September was incomplete when the data was collected.

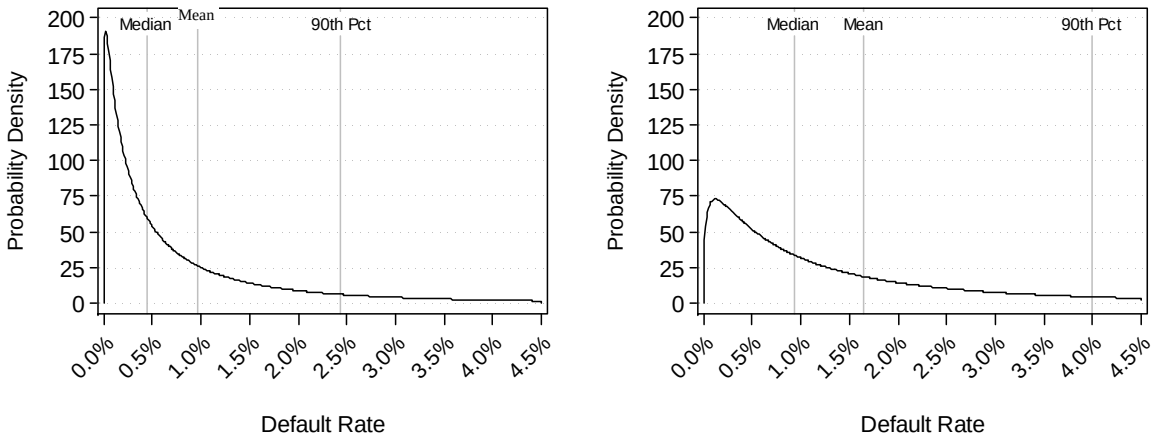

FIGURE 16 Expected Annual Closure Rate Distribution: June 2008 and June 2009

The left panel in Figure 16 compares the expected distribution to the realized closure rate over September 2008 through the end of August 2009. From the data in this panel, we see that the observed failure rate (1.06%) lies in the intended range and is closely predicted by the mean (0.97%) of the expected distribution. The right panel highlights the forward-looking closure rate distribution expected from September 2009 through the end of August 2010. The data in this panel highlights the further deterioration of the banking sector, and how the expected failure rate has increased substantially. The median and mean default rates have more than doubled. Moreover, the tail risk associated with this sector has increased, where the 90th percentile of the distribution has increased from 2.5% to 4%.

From a level perspective, the realized failure rate is in-line with the model's predictions. Nevertheless, given the highly correlated nature of the banking sector risk, a wide range of failure rates is possible going forward.

8 TEST CASES

In this section, we examine two recent bank failures as seen through the model: Freedom Bank in Bradenton, Florida, and The Community Bank in Loganville, Georgia. For Freedom Bank, the model gave very early warning of the high potential for failure, while Community Bank's collapse was more sudden.

Figure 17 displays the EDF credit measure over time for Freedom Bank, which closed on October 31, 2008. Figure 18 presents the bank's risk drivers at the end of 2007 and just prior to closure in 2008.[12] Freedom Bank's risk was always elevated relative to other banks. By the end of 2007, other real estate owned was elevated for this bank, about 1.4% of assets, and they had negative net income. These two ratios led to an elevated level of risk, despite reasonable risk levels in the other ratios (the bank's equity was more than 8.0% of total assets). By the time the institution actually closed, losses were larger, net interest margins had become further depressed, and equity to total assets had fallen to 4.7%. These risk factors resulted in a very elevated EDF credit measure. The model detected the poor asset quality through measures of concentration risk and of other real estate owned, as well as with the limited equity capital available. The company operated with a very low interest margin and substantial losses. All these factors indicated that this institution maintained a relatively high level of risk compared to the population.

[12] See Appendix A for more details about reading the percentile map.

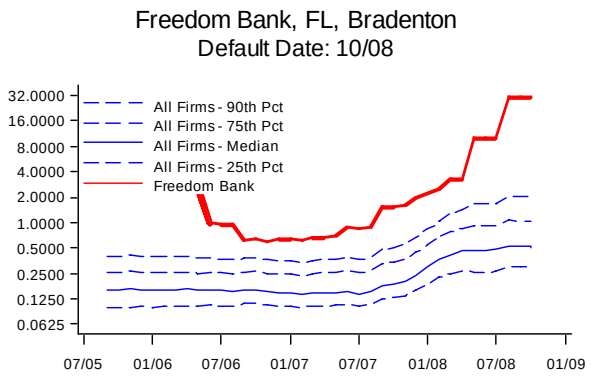

FIGURE 17 Freedom Bank EDF Compared to Percentiles Across the Population

Figure 18 displays the EDF credit measure components for Freedom Bank before its closure. The left panel charts the risk drivers of the EDF at the end of 2007, while the right panel details the risk drivers just prior to failure in June 2008. The majority of inputs contributed to the elevated measure of risk.

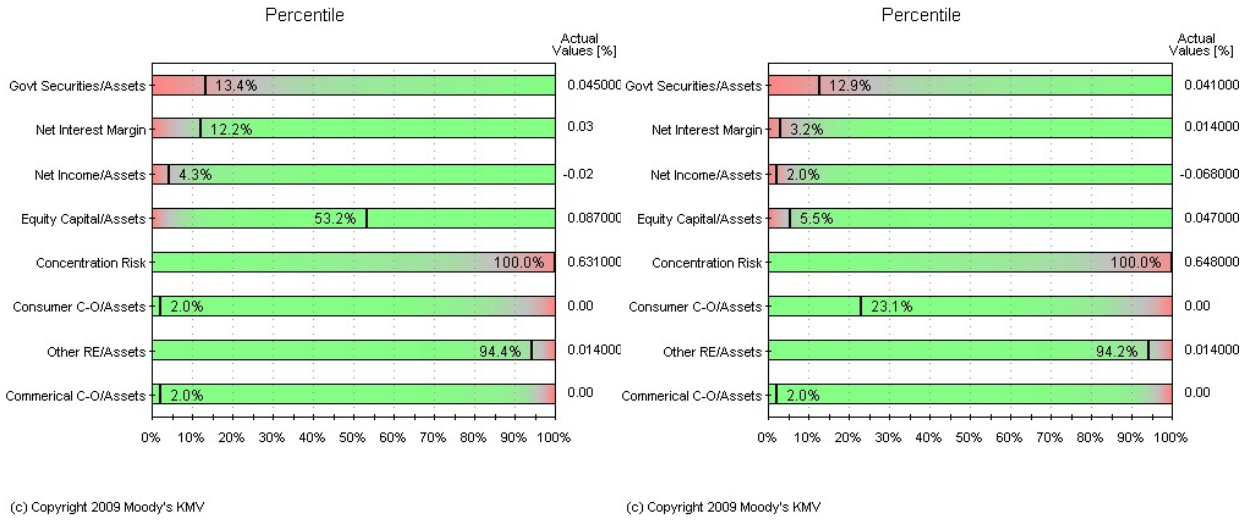

FIGURE 18 EDF Components for Freedom Bank before Closure

The collapse of The Community Bank was more sudden. The left panel in Figure 20 displays the ratios that contributed to the EDF credit measure in the 4th quarter of 2007. These ratios show that the bank appeared to be in a strong financial position, with equity at 8.6% of total assets and a Return on Assets of 1.0%. Nevertheless, other real estate owned was 4.0% and their concentration risk was very elevated. The bank's financial statements revealed that past-due and non-accruing loans increased to $122 million in the quarter out of the $602 million in assets, while they reported only $10.7 million in provisions. During the following quarter, the bank's past-due and non-accruing loans increased to $139 million but provisions only increased $10.8 million. In hindsight, it is clear that these provisions understated the true potential for losses across the portfolio. Two quarters later, the June 2008 call reports showed a clearer picture regarding the bank's actual viability. Equity to total assets fell to 6.5%, which was accompanied by a return on assets of negative 1.1%. Other real estate owned had increased to 6.1%. These factors increased the bank's EDF credit measure to 10.0%, well above the 95th percentile of EDF credit measures produced by the model. The Community Bank failed on November 21, 2008.

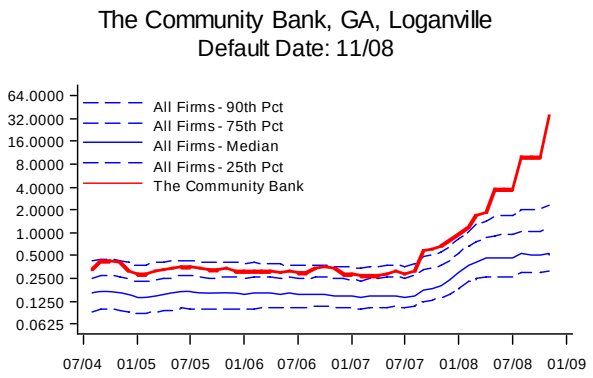

FIGURE 19 The Community Bank EDF Compared to Percentiles Across the Population

Figure 20 displays the EDF credit measure components for The Community Bank before closure in November 2008. The left panel charts the risk drivers at December 2007, while the right panel details the risk drivers in June 2008.

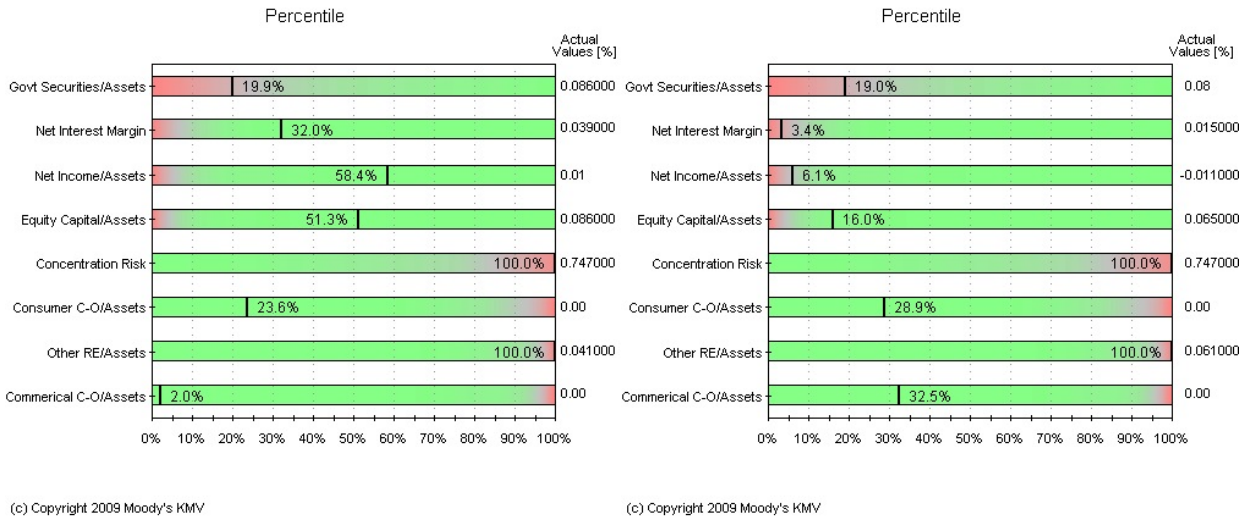

FIGURE 20 EDF Components for The Community Bank before Closure in November 2008

9 CONCLUSION

The current banking crisis has rapidly impacted exposed loan portfolios, leaving many institutions insolvent with little warning. These events highlight the need for robust risk management techniques to differentiate risk and provide lead warnings of deterioration. The RiskCalc v3.1 U.S. Banks EDF credit measure has proven effective across a range of risk measures at differentiating failing institutions, and has performed comparably to or better than other risk measures, such as the Tier 1 ratio and the Texas ratio, at a variety of horizons in a pure out-of-sample context. The RiskCalc v3.1 U.S. Banks model performs well at differentiating riskier banks from the population as a whole, and has proven robust to the rapidly changing environment.

The Texas ratio performs comparably well as a short-term predictor of banking failure. This indicator performed well during the rapid deterioration of the recent environment, but it provided little warning of bank failures two years prior to closure.

Recently, key measures of risk in the banking sector remain at elevated levels and, in some cases, are approaching historic highs. Furthermore, when we look at these key ratios prior to closure, we observe that failing institutions are being shuttered with much less prior indication of trouble than they were historically. The FDIC is reacting differently, moving more quickly to close banks with problematic balance sheets.

Every Friday from May 29, 2009 until August 28, 2009, the FDIC shut down at least one bank, with the exception of July 3, 2009, a Federal holiday. On Thursday July 2, however, they shut down seven banks. Undoubtedly, more bank failures are likely to come. While it is difficult to anticipate how restoration of the U.S. banking industry's financial health will unfold, the RiskCalc v3.1 U.S. Banks model proves to be a useful tool for monitoring the process.

APPENDIX A THE PERCENTILE MAP

The percentile map is an analytical tool that allows users to quickly isolate the problematic ratios for a given company. As shown in Figure 21, each horizontal bar represents a ratio that is labeled on the left (e.g., Government Securities to Assets). The column on the right gives the actual value of the ratio. The percentage number within the horizontal bar graph represents the percentile of the ratio within the development sample (e.g., only 3.2% of the development sample had a prior year Net Interest Margin of less than 1.4%). The shading represents the risk level associated with the ratio: green is low risk, red is high risk, and grey is neutral risk. The variables shaded red to green are the "good" ratios, for which higher values lower risk. The variables shaded green to red are the "bad" ratios, for which higher values increase risk. For this firm, the ratios Government Securities to Assets, Net Interest Margin to Assets, Net Income to Assets, Equity Capital to Assets, and Concentration Risk are problematic and worth noting.

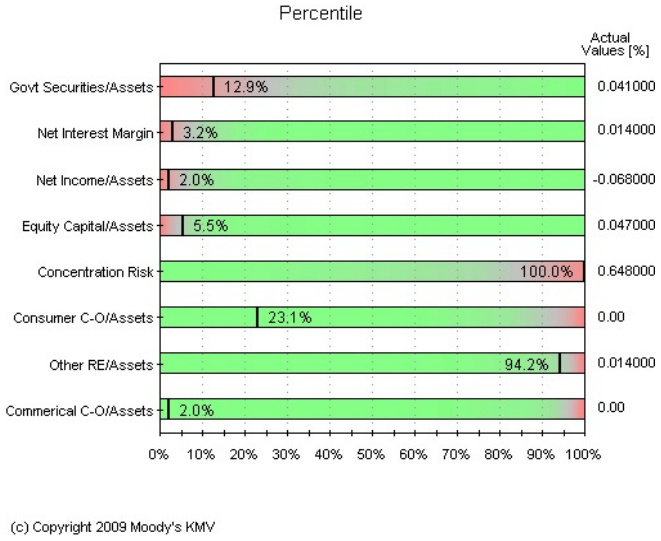

FIGURE 21 Percentile Map

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