FYI: An Update on Emerging Issues in Banking

A Portfolio Perspective for Evaluating the Adequacy of the Insurance Funds
December 10, 2003

FDIC economists have teamed up with prominent members of the academic community to develop a state-of-the art approach to measure risks posed to the bank (BIF) and savings association (SAIF) insurance funds.[1] This approach, referred to hereafter as the Loss Distribution Model or LDM, employs many of the same techniques and methods used in credit risk and economic capital models employed by large financial companies to measure and manage risk. The LDM not only introduces a greater degree of rigor and precision to determining the potential for BIF and SAIF losses due to failures, but it also represents a critical step toward developing an integrated fund model that accounts for all factors relevant to managing the insurance funds.

Background: Loss Expectations and Potential Loss Distributions are Basic Measures of the Insurance Fund Exposures to Bank and Thrift Failures
The LDM provides FDIC managers with a systematic and quantitative means of measuring potential losses to the BIF and SAIF resulting from potential bank and thrift failures. These measures include not only estimates of failure-related losses that are most likely given current industry conditions (i.e., expected losses) but also failure-related losses that might result from changes in the condition of the economy and the industry (i.e., unanticipated losses).

A rudimentary measure of expected losses to the insurance funds considers expected BIF and SAIF outlays associated only with institutions whose failure appears likely. Such measures, which satisfy the FAS 5 accounting definition of probable and reasonably estimable losses, form the basis for the contingent loss reserves recorded by the FDIC in its financial statements. A more precise statistical measure of expected loss also considers the failure probabilities of institutions where failure is not likely but nevertheless possible. In this case, the relevant expected loss equation, summed across all insured institutions, is expressed as follows:

Expected Loss = (Probability of Failure) x (Loss Rate Given Failure) x (Deposits)

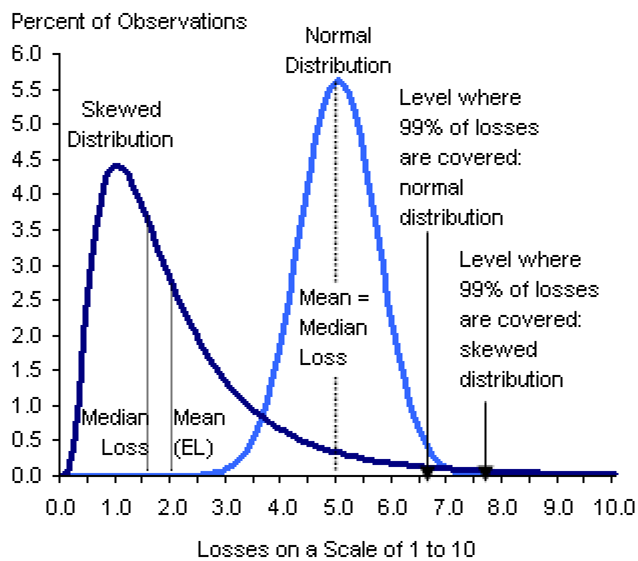
Note the similarity between components in this equation and the components used to determine capital levels for credit exposures of banks under the advanced internal ratings-based approach contained in the Basel II Capital Accord. Specifically, Probability of Failure is analogous to Probability of Default (PD), the Loss Rate Given Failure is analogous to Loss Given Default (LGD), and Deposit levels are analogous to Exposures at Default (EAD). In this sense, the Expected Loss equation above can be thought of as representing the credit risk elements inherent in insured depositories. Measures of expected losses are one output of the LDM.

Expected loss measures produce useful estimates to managers of the FDIC insurance funds for planning purposes. However, prudent funds management can not rely solely on single "point" estimates. Because of the uncertainty surrounding future events, actual results can and often do deviate from expectations. Accordingly, the FDIC must take into account potential events that could result in higher-than-anticipated losses to the insurance funds. Planning for these "unanticipated" events requires consideration of the entire range of reasonably possible loss outcomes as well as the numerical probability of each outcome's occurrence.

Chart 1 further illustrates the idea behind measuring unanticipated losses. The chart shows two different distributions: a normal distribution and a skewed distribution. Normal distributions are used to describe processes where possible outcomes are distributed symmetrically about the expected value or mean (that is, the likelihood of exceeding the expected value or mean is equal to the likelihood of falling below this expectation). Normal distributions, however, are not the best representation of potential insurance fund losses. Rather, the FDIC's experience with bank and thrift failures suggests that estimates of possible loss outcomes should more closely resemble the skewed distribution pattern shown in Chart 1. In other words, while most outcomes (or scenarios) will produce a low rate of failures (and resulting losses), there are a small number of scenario outcomes, such as the failure of a large bank, that produce large losses to the funds.[2]

Chart 1

Two Hypothetical Loss Distributions



Source: FDIC

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Why are such loss distributions relevant to the management of the FDIC insurance funds? Given the uncertainties surrounding expected loss projections, it is important to build fund balances to levels sufficient to absorb a large percentage of the potential outcomes suggested by the loss distribution.[3] The percentage of potential outcomes covered is often referred to as a "solvency standard," which in turn is typically related to the average default experience of corporate obligations.[4] The LDM gives FDIC management a systematic way to evaluate the range of potential or unanticipated losses stemming from bank and thrift failures as well as the probabilities associated with these outcomes. With this information, the FDIC is then able to determine the adequacy of the insurance funds relative to a given solvency standard.

How the Loss Default Model Works: A Nontechnical Description[5]

Figure 1 illustrates the basic structural components of the LDM. The approach can be broken down into three steps. As a first step, three separate models produce the key underlying "credit risk" parameters for bank and thrift failures:

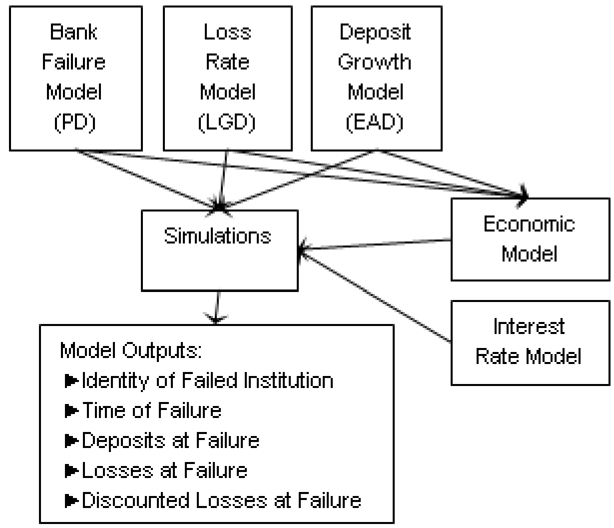
- A failure model produces estimates of failure probabilities (PDs) for each insured institution. These PDs are determined using a statistically-based model that is based on highly predictive variables such as examination ratings, problem asset ratios, capital levels, and profitability measures.[6]
- A model of FDIC loss experience produces loss or LGD estimates based on historical loss experience and the types of assets held and the liability structure (priority of receivership claims) of each individual institution.
- A deposit growth model uses statistically-based methods to predict estimated deposit levels in each insured institution (EAD). The model is driven by a variety of factors including previous deposit growth rates, examination ratings, and quarters-in-existence.

In the LDM approach, the above three models produce initial period estimates of PDs, LGDs, and EADs. The next step in the process uses an economic model to determine changes in these initial parameter estimates. Underlying this economic model are statistically-based relationships between the key parameters (PD, LGD, and EAD) and changes in the economic variables. The economic variables used are the term structure of interest rates (3 month and 3 year rates), 9 regional and 1 national bank stock price indices, and 9 regional house price indices.

The final step in the process is to use a computer simulation to consider a wide variety of different economic scenarios and the possible effects on banks and thrifts. This simulation produces a distribution of possible bank and thrift failures and related insurance fund losses. [7] All losses produced in the simulations are discounted back from the time of failure to the present time. The appropriate rate of interest to use in the discounting process is determined by a separate interest rate model. The key outputs of the simulation model include information relating to the identity of failed banks, the time of failure, the level of deposits at failure, and the losses produced by the failed institution (discounted back to the present).

Figure 1

Structure of the Loss Distribution Model



Step 1: Initialize key model parameters (PD, LGD, EAD)
Step 2: Use economic model to estimate changes in key model parameters
Step 3: Run simulations to determine instances of failure and resulting (discounted) losses

Source: FDIC

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How the Loss Default Model Improves Funds Management Practices at the FDIC
The LDM represents a significant advancement in FDIC processes for both quantifying risk exposures and formulating strategic plans and policies to respond to these risks. The nature of these improvements is detailed below.

LDM Can Add Precision to Informed Judgment:
By introducing rigorous and unbiased estimates of expected and unanticipated failure-related losses, the LDM provides a greater degree of precision to decision makers when it comes to establishing contingent loss reserves and developing funds management policies.

To illustrate how the LDM adds precision to the process, consider a situation where managers are tasked with determining the likelihood that a particular institution will fail during the next 12 months. Using informed judgment alone, the managers may initially equate the prospects of failure to the flip of a coin (implying a 50 percent probability of failure). If the LDM, which by design incorporates an unbiased view of historical experiences related to institutions with similar characteristics, produces a default probability closer to 30 percent, managers may decide to refine their estimates accordingly. In this purely hypothetical case, informed judgment alone was not able to discern the difference between a 30 percent probability of failure and a coin-toss. However, such differences in estimates can make a substantial difference in setting reserves for potential failures, particularly if the institution in question is large.

The Accuracy of LDM Estimates Can Be Verified Over Time:
Since the LDM model produces quantitative outputs, it is possible to evaluate the accuracy of these estimates by comparing them with actual results. If the model is found to produce biased estimates of potential losses over time, it can be recalibrated to improve its accuracy.

LDM Incorporates Consideration of Economic Conditions:
A major innovation of the LDM is the inclusion of macroeconomic variables. Past bank and thrift failures have certainly been heavily influenced by changes in economic factors such as interest rates and real estate values. The LDM uses information about the historical relationships between these economic factors and key risk parameters (PD, LGD, and EAD) to produce more informed estimates of potential failures and the ultimate loss produced by these failures. Incorporating macroeconomic variables into the model also lays the foundation for considering the impact of potential stress events (regional recessions, sharp rises in interest rates, or the bursting of a housing bubble, to name a few) on the insurance funds.

LDM Provides a Portfolio Perspective to FDIC Decision Makers:
A principal tenet of portfolio theory is that the total risk in a portfolio of investments (as measured by the standard deviation of portfolio returns) is not equal to a simple weighted average of individual investment risks. Rather, a manager can reduce or *diversify* risk in the total portfolio by adding investments whose returns are not perfectly correlated (the returns do not move up and down in a one-to-one relationship) with the returns of the existing portfolio. While the FDIC can not "select" the institutions it insures in the same sense as a portfolio manager selects among alternative investments, this concept of diversification nevertheless illustrates the importance of considering the degree to which bank failures, for example, are correlated across the entire spectrum of insured institutions in estimating portfolio-wide failure probabilities. The LDM is a true portfolio model because it implicitly accounts for correlations such as those between failure probabilities of individual institutions.

LDM Provides a Barometer of Overall Industry Conditions:
Because the LDM produces portfolio estimates of expected and unanticipated failure-related losses, it can serve as a general barometer of the health of overall industry conditions. If, for example, the LDM were to show a substantial rise in expected losses relative to past estimations (or a substantial increase in variation of potential losses - a widening in the loss distribution curve), FDIC managers could reasonably conclude that conditions in the industry are deteriorating and formulate appropriate policy decisions to respond to these deteriorating conditions.

LDM is a Critical Component of an Integrated Approach to Managing the Insurance Funds:
By dynamically considering the exposure of the funds to bank and thrift failures, the LDM provides a critical component in the design of an integrated funds management model. Over time, the LDM will be integrated with models that account for other fund considerations such as income related to investments and premiums, cash flow considerations, and insured deposit balances.

An Integrated Fund Model Will Facilitate the Evaluation of the Impact of Policy Decisions:
Once the LDM is incorporated into an integrated fund model, managers will have a powerful tool to evaluate the impact of policy decisions related to the deposit insurance funds. As an example, managers will be better able to quantify and evaluate how the funds would respond to different deposit insurance pricing schemes.

Conclusion
LDM represents a substantial advancement in the analytical capabilities the FDIC has at its disposal to assess risk to the BIF and SAIF deposit insurance funds. Of course, even with the most sophisticated of models, estimation errors can and do occur. Accordingly, management of the FDIC does not view the outputs of the LDM as a substitute for informed judgment. Rather, the LDM will be used as another important input into the funds management process and as a tool that will facilitate more informed decisions related to evaluating and maintaining the solvency of the insurance funds.

[1] Developers are Robert A. Jarrow of Cornell University's Johnson School of Management, Michael Fu and Huiji Zhang of the University of Maryland's Robert H. Smith School of Business, and Rosalind L. Bennett and Daniel A. Nuxoll from the FDIC.

[2] The skewed distribution in Chart 1 illustrates an additional point related to reserving policies. Note that the mean of the skewed distribution falls above the median of the distribution. The mean loss is the expected loss and is the appropriate benchmark for reserving policy. In contrast, by definition of median, realized losses would exceed the median loss half the time and be less than the median loss half the time. The two differ because mean loss (and expected loss) reflects the large losses that could result from one or more large bank failures.

[3] It is not feasible to have fund balances cover *all* potential losses since this would entail holding balances roughly equivalent to total insured deposits.

[4] For instance, a "triple-B" solvency standard suggests coverage of roughly 99.60 percent of possible losses (the average historical default rate of 'BBB' rated firms is roughly 40 basis points), while a "single-A" solvency standard suggests coverage of roughly 99.95 percent of possible losses. While the differences between these two solvency standards seem small, the resulting implied fund balances are significantly (billions of dollars) different.

[5] For technical specifications of the model, refer to *A General Martingale Approach to Measuring and Valuing the Risk to the FDIC Deposit Insurance Fund"* by Jarrow, Bennett, Fu, Nuxoll, and Zhang. For a copy of this paper, please contact the FDIC's Public Information Center at 801 17th Street, NW, Washington, DC 20434, telephone 800-276-6003, or e-mail publicinfo@fdic.gov.

[6] Examination ratings are supervisory-based assessments of insured institution risk. Composite ratings of '1' are accorded to institutions with little perceived risk, while composite ratings of '5' are accorded to institutions deemed likely to fail in the near-term.

[7] This process is commonly referred to as a Monte Carlo simulation, which determines the outcomes of literally thousands of different scenarios. These different scenarios can be determined empirically by drawing from historical information (note that such an approach determines the inherent correlation between model inputs and outputs) or more explicitly by the user (e.g., when considering a potential stress event such as a recession).

About the Author

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About *FYI*

FYI is an electronic bulletin summarizing current information about the trends that are driving change in the banking industry, plus links to the wide array of other FDIC publications and data tools.

Chart 1 - Two Hypothetical Loss Distributions	
Normal	**Skewed**
0.000000	0.000000
0.000000	0.033825
0.000000	0.386696
0.000000	1.120568
0.000000	1.994828
0.000000	2.806988
0.000000	3.459680
0.000000	3.928295
0.000000	4.225348
0.000000	4.378081
0.000001	4.416758
0.000001	4.369349
0.000003	4.259573
0.000006	4.106579
0.000013	3.925333
0.000027	3.727250
0.000054	3.520863
0.000105	3.312423
0.000201	3.106412
0.000378	2.905956
0.000696	2.713157
0.001256	2.529349
0.002221	2.355300
0.003850	2.191358
0.006540	2.037578
0.010891	1.893799
0.017778	1.759716
0.028445	1.634927
0.044611	1.518974
0.068578	1.411360
0.103335	1.311581
0.152624	1.219129
0.220959	1.133508
0.313555	1.054240
0.436145	0.980867
0.594651	0.912957

0.794709	0.850101
1.041040	0.791916
1.336722	0.738048
1.682398	0.688163
2.075537	0.641956
2.509843	0.599140
2.974929	0.559454
3.456374	0.522655
3.936217	0.488518
4.393913	0.456838
4.807706	0.427425
5.156305	0.400105
5.420674	0.374717
5.585758	0.351113
5.641896	0.329157
5.585758	0.308724
5.420674	0.289700
5.156305	0.271979
4.807706	0.255462
4.393913	0.240062
3.936217	0.225695
3.456374	0.212286
2.974929	0.199764
2.509843	0.188065
2.075537	0.177131
1.682398	0.166905
1.336722	0.157338
1.041040	0.148383
0.794709	0.139997
0.594651	0.132140
0.436145	0.124775
0.313555	0.117869
0.220959	0.111389
0.152624	0.105308
0.103335	0.099597
0.068578	0.094233
0.044611	0.089191
0.028445	0.084451

0.017778	0.079992
0.010891	0.075797
0.006540	0.071847
0.003850	0.068127
0.002221	0.064623
0.001256	0.061320
0.000696	0.058206
0.000378	0.055268
0.000201	0.052497
0.000105	0.049880
0.000054	0.047410
0.000027	0.045076
0.000013	0.042870
0.000006	0.040785
0.000003	0.038814
0.000001	0.036949
0.000001	0.035184
0.000000	0.033513
0.000000	0.031931
0.000000	0.030432
0.000000	0.029012
0.000000	0.027666
0.000000	0.026390
0.000000	0.025179
0.000000	0.024031
0.000000	0.022941
0.000000	0.021906
Source: FDIC	

Figure 1 is a schematic diagram that shows the structure of the Loss Distribution Model (LDM), the various component models and parameters that feed into the LDM model, and the main outputs of the LDM model. Starting at the top of the diagram, there are three separate boxes with the following labels: Bank Failure or PD Model, Loss Rate or LGD Model, and Deposit Growth or EAD Model. These three boxes represent the three initial LDM model parameters. Arrows from each of these three boxes point both to the right toward a box titled Economic Model and directly downward to another box titled Simulations. The arrows pointing toward the Economic Model box indicate that the LDM model parameters PD, LGD, and EAD are fed into an economic model, which estimates subsequent changes in these initial parameters. The Economic Model box also has an arrow pointing leftward toward the

Simulation box to indicate that the output of the economic model feed into the simulation. To the right of the diagram is another box titled Interest Rate Model, which also has an arrow pointing to the Simulation box. This interest rate model is needed in the simulations to calculate a discounted value for loss estimates. In summary, the simulations depend on initial parameter values from the PD, LGD, and EAD models, outputs of the economic model, and outputs of the Interest Rate Model. Finally, the Simulation box has an arrow pointing to a box titled Model Outputs, which lists the following output elements produced by the simulations: Identity of the Failed Institution, Time of Failure, Deposits at Failure, Losses at Failure, and Discounted Losses at Failure.