

Deposit-Institution Failures: A Review of Empirical Literature

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Introduction

The decade of the 1980s has been a particularly turbulent one for the U.S. banking and financial system. Since the establishment of the Federal Deposit Insurance Corporation (FDIC) in 1933, more than 1,500 banks have been declared officially insolvent and were subsequently closed, acquired, or received assistance to prevent closure (see table 1). More than 800 of these closures took place during the 1980s, with 200 institutions being closed in 1988 alone.

De facto failures, which are defined more broadly to include any regulator-induced cessation of autonomous operations, portray an even gloomier picture. This dramatic increase in the bank failure rate has intensified public criticism of deposit-institution regulators, since bank safety and soundness is a major regulatory responsibility.¹ The recent crisis in the savings and loan industry helped the already existing problem to surface, and the public has become more eager to assess and assign blame.

Deposit institutions fail primarily because they take risks, and subsequent events do not always turn out favorably. However, as Kane (1985) notes, when a series of failures occurs, or a major crisis is threatened, the general public blames regulators as much as it blames deposit-institution managers. Regulators are criticized for not being able to detect and curb different forms of unsuccessful risk-taking in time to prevent failures.

Potentially adverse consequences of bank failures include financial losses to bank stockholders and creditors, disruptions of community banking arrangements, contagious losses of confidence in other institutions, and widespread financial distress caused by sharp contractions in the money supply (Benston et al. [1986] and Kaufman [1985]). However, the consequences of an individual bank failure on the local economy are unlikely to be any more severe than those of the failure of any other firm of comparable size (Horvitz [1965], Tussing [1967], Kaufman [1985]). Even the commonly feared financial distress thought to result from multiple bank failures is unlikely to occur. Destruction of the means of payment is an indication that government has not fulfilled its macroeconomic responsibility. Under such circumstances, sensible monetary policy would call for an expansion of the monetary base. It is an established view that bank failures that produce a decline in the

■ 1 For a thorough discussion of safe and sound banking, see Benston et al. (1986).

T A B L E 1

U.S. Bank Closures For Various
Subperiods, 1934-1988

Years	Average Number of Closings per Year		Average Deposits in Closed Banks (Millions)	
	All Banks	Insured Banks	All Banks	Insured Banks
1934-40	64.2	51.1	68.2	62.3
1941-50	7.3	6.1	10.3	9.9
1951-60	4.3	2.8	11.5	10.5
1961-70	6.3	5.0	34.2	33.5
1971-80	8.3	7.9	537.2	529.1
1981-85	59.8	59.8	6,023.4	6,023.4
1986	138	138	6,471.1	6,471.1
1987	184	184	6,281.5	6,281.5
1988	200	200	37,200	37,200
1989 ^a	145	145	21,400	21,400

a. As of August 18, 1989.

SOURCE: 1987 FDIC Annual Report and telephone calls to FDIC.

T A B L E 2

Equity, Insolvency, and
Failure Definitions

Federally Contributed Equity	= the capitalized value of the deposit-insurance guarantees.
Enterprise-Contributed Equity	= the capital of the institution net of the federally contributed equity.
Book-Value Insolvency	= the book value of assets minus the book value of liabilities (book value of the net worth) is negative.
Market-Value Insolvency	= market value of assets minus market value of liabilities net of the value of insurance guarantees (enterprise-contributed equity) is negative.
Economic Insolvency	
De Facto Insolvency	
Official (De Jure) Insolvency	= capital is judged inadequate by the regulators and the institution is closed or merged out of existence.
Closure	
De Jure Failure	
De Facto Failure	= any regulator-induced cessation of autonomous operations.

SOURCE: Author.

money supply are the result of errors and misconceptions by central bankers (Thornton [1939], Friedman and Schwartz [1963], Brunner and Meltzer [1964], Cagan [1965]).

The consequences of contagious bank failures are no longer considered serious concerns because of the Federal Reserve System's macro-economic responsibilities. Yet the failure of individual institutions still remains a serious problem for the general taxpayer. As Kane (1985, 1989) notes, in a crisis, taxpayers are called upon to underwrite the cost to the Treasury of bailing out these institutions. The burden eventually falls on them in the form of higher taxes or higher rates of inflation.² The problem for taxpayers is to minimize their own loss exposure.

By developing an accurate model for predicting bank failures, and by understanding the behavior of bank regulators, it will be possible to identify and/or verify the changes necessary to reform the deposit insurance system, thus minimizing the future loss exposure of the U.S. taxpayer.³

The purpose of this article is to review empirical literature on deposit-institution failures. Section I introduces and discusses concepts crucial in the analysis. Section II compares and contrasts selected empirical studies. Section III identifies weaknesses in the various approaches to studying the problem and concludes by suggesting future avenues for research.

I. Bank Insolvency,
Closure, and Failures:
Explaining Regulatory
Decision-Making

The purpose of this section is twofold.⁴ First, it seeks to define and distinguish between the different insolvency and failure categories listed in table 2. Second, based on the distinction between insolvency and failure, it describes how failure should be modeled within the framework of a regulatory decision-making process.

■ 2 This fact is exemplified by the recent savings and loan bailout.

■ 3 The problems in the present deposit-insurance system and regulator behavior have been identified by Meltzer (1967), Scott and Mayer (1971), Merton (1977, 1978), Kareken and Wallace (1978), Sharpe (1978), Buser, Chen, and Kane (1981), Kane (1981a, 1981b, 1985, 1986, 1988, and 1989), McCulloch (1981, 1987), Kareken (1983), Pyle (1983, 1984), and Benston et al. (1986).

■ 4 The definitions and theoretical analysis presented in this section draw largely on Benston et al. (1986) and Kane (1985, 1989).

Insolvency Versus Failure

Official insolvency occurs when an institution's chartering authority judges its capital to be inadequate. The procedures by which this decision is made are not clear, however.

A firm's capital may be identified as a particular measure of its net worth. Net worth is the difference between the value of the firm's assets and nonownership liabilities. In order to determine the level of capital, itemization of assets and liabilities and adoption of an appropriate valuation rule are necessary (Kane [1989]).

To be able to define capital, various categories of assets and liabilities need to be itemized. A complete definition requires recognition of implicit assets and liabilities as well as explicit ones. Implicit assets and liabilities are defined as all sources of positive and negative future cash flows that are considered "unbookable" by the accounting profession.

Valuation of capital is crucial. Using different valuation rules leads to different asset and liability values. Measuring an institution's capital on the basis of historical cost at which it acquired its various balance-sheet positions is misleading. But historical-cost principles provide the basis for determining the book values of the balance sheet accounts of U.S. banks. Book values are recorded in terms of acquisition costs. As market prices change, these costs tend to depart from market values.

Kane (1989) notes two shortcomings of historical-cost accounting. First, using acquisition cost undervalues an institution's best portfolio decisions and overvalues its worst ones. Second, historical-cost accounting neglects potentially observable changes in the value of a firm's investments by not modifying the acquisition costs to reflect market developments. This method exaggerates the economic relevance of the acquisition costs of an institution's assets and liabilities and fails to appraise its investment successes and failures on an ongoing basis.

To determine a depository institution's level of capital for regulatory purposes, it is helpful to break down its capital into two components: enterprise-contributed equity and federally contributed equity (Kane [1989]). Enterprise-contributed equity is the capital of the institution net of the capitalized value of its deposit insurance guarantees. To the extent that federal guarantees are underpriced, the deposit insurer contributes de facto capital to the institutions. The present deposit insurance system allows aggressive deposit institutions to pass off poorly monitored and unpriced risks onto federal insurance

agencies.⁵ The federally contributed capital is determined by the amount of risk that insurance agencies stand ready to absorb.

These valuable guarantees are actually equity instruments that make the U.S. government a de facto investor in deposit institutions. Unless an appropriate recapitalization rule is imposed on managers and stockholders, the capitalized value of the guarantees increases as the institution's enterprise-contributed equity decreases or as the riskiness of either its portfolio or environment increases. Clearly, the value of the federally contributed capital should not be counted as a part of the institution's capital for regulatory purposes.

The traditional supervisory approach to regulation also neglects the role of subordinated debt as a potential source of market discipline, and views debt capital as less desirable than equity. However, permitting institutions to count subordinated debt toward capital-adequacy determinations would provide increased protection for the insurance fund in the form of increased market discipline (Benston et al. [1986]).

Holders of subordinated debt are a source of market discipline because, as opposed to depositor debtholders, they cannot withdraw their funds on demand. Also, as opposed to stockholders, they do not share the increased profits that increased risk-taking may bring. Therefore, they prefer safe and conservatively managed institutions. If banks were required to maintain relatively short-term subordinated debt as a certain proportion of equity, thus forcing them into the market on a frequent basis, subordinated debt could protect the insurance agency from losses.

An appropriate insolvency criterion is the market value of enterprise-contributed capital, which can be obtained by subtracting the value of federal guarantees from the institution's market value of equity.⁶

De facto or market-value insolvency exists when an institution can no longer meet its contractual obligations out of its own resources. This occurs whenever the market value of the institution's nonownership liabilities exceeds the market value of its assets; or, in other words,

■ 5 For a thorough review of this issue, see references in footnote 3.

■ 6 An estimate of the capitalized value of the federal guarantees can be obtained using different approaches. For a review of different techniques, see Merton (1977), Marcus and Shaked (1984), Ronn and Verma (1986), Kane and Foster (1986), Benston et al. (1986), Schwartz and Van Order (1988), and Demircü-Kunt (1990, forthcoming).

when the market value of its enterprise-contributed equity becomes negative. However, in determining official insolvency, regulators tend to look for book-value insolvency rather than market-value insolvency.

Book-value insolvency exists when the difference between the book values of an institution's assets and liabilities is negative. Even when an institution is book-value solvent, its market-value or economic insolvency may be suggested by refinancing difficulties that surface as an ongoing liquidity shortage. A liquidity shortage occurs whenever an institution's cash, reserve balances, and established lines of credit prove insufficient to accommodate an unanticipated imbalance in the inflow and outflow of customer funds.

If a continuing liquidity shortage is not relieved by outside borrowing or government assistance, assets may have to be sold at "fire-sale prices," that is, for less than their equilibrium value. Such sales erode the institution's capital, and may cause the uninsured customers of the institution to move their funds to safer locations. The resulting run on the institution's resources causes the institution to borrow nondeposit funds or to sell earning assets. Given that these runs are typically motivated by the presence of large unbooked losses in an institution's balance sheet, asset sales push the book value of the institution's assets toward their market value, eventually resulting in the institution's book-value insolvency.

Official (*de jure*) insolvency, or closure (*de jure* failure), occurs when the market-value insolvency is officially recognized and the firm is closed or involuntarily merged out of existence. *De facto* failure can be defined more broadly than closure as any regulator-induced cessation of autonomous operations.

The definitions in this section clarify the difference between economic insolvency and failure of financial institutions. Economic insolvency is a market-determined event. In contrast, *de jure* or *de facto* failure results from a conscious decision by regulatory authorities to acknowledge and to repair the weakened financial condition of the institution. Failure is an administrative option that the authorities may or may not choose to exercise even when strong evidence of market-value insolvency exists.

Failure as a Regulatory Decision

Economic theory can explain why deferring meaningful action can be the rational choice for federal officials. The theory of public choice ana-

lyzes the working of government by applying and extending economic theory to the realm of political or governmental decision-making.⁷ Myers and Majluf (1984), Narayanan (1985), and Campbell and Marino (1988) apply public choice theory to explain the managerial decision-making of an enterprise. Again, based on the public choice theory, Kane (1988 and 1989) develops a model of regulatory decision-making.

The Kane model incorporates the economic, political, and bureaucratic constraints as well as the career-oriented incentives of federal regulators in explaining the regulatory decision-making process. These constraints and incentives foster the difference between market-value insolvency and failure of financial institutions. Due to conflicts of interest between politicians and regulators, and between regulators and taxpayers, timely resolution of market-value insolvencies is often not attractive to deposit-institution regulators.

Kane (1989) argues that this conflict of interest between regulators and politicians complicates the regulatory task of serving the taxpayer. Deposit-institution regulators find it difficult to resist budget constraints imposed by politicians because they are subject to appointment and oversight controls from politicians. As appointed officials, they face political pressures to leave problems unsolved, thus keeping involved constituencies and political action committees willing to pay tribute to politicians.

Regulators also face oversight controls from their regulatory clientele, that is, from the institutions in the industry they regulate (Stigler [1977]). Federal officials have career-oriented incentives to keep their constituencies and clientele happy. Their explicit salaries are lower than what they can make in the private sector. Economists conceive this gap as being bridged by implicit wages. As Kane (1989) notes, these implicit wages consist of certain nonpecuniary benefits of holding a high government office and of future increases in wages that accrue in post-government employment—very often within the regulated industry.

The actions and policy decisions of regulators are closely overseen by their clientele. If regulators can successfully complete their term in government service, they can generally expect higher wages in postgovernment employment. The importance of the perceived quality of their

■ 7 See Buchanan (1960, 1967), Tulloch (1965), Niskanen (1971), Stigler (1977), and Buchanan and Tollison (1984).

performance makes federal officials very sensitive to the opinions of the institutions they regulate, as well as to those of the trade associations connected with these institutions.

These career-oriented incentives introduce political and bureaucratic constraints to regulatory decision-making. Therefore, federal regulators tend to be influenced by their constituencies, avoiding solutions unfavorable to them, or promoting solutions that they find particularly desirable. Lobbying activities exaggerate and make the negative early effects of public policies more visible, further slowing the adoption of substantial changes in financial regulation. For regulators, the economic, political, and bureaucratic constraints increase the career costs of serving the taxpayer well. This conflict of interest between the regulators and the taxpayers leads to the adoption of forbearance policies that allow the continued operation of market-value insolvent institutions.

In his model, Kane (1988 and 1989) envisions two extreme types of regulators: the unconflicted or faithful agent of the taxpayer, and the conflicted or self-interested agent.

A faithful agent is expected to work toward fulfillment of society's long-term goals. In the Kane model, faithful agents are modeled as maximizing the unobservable market value of the deposit-insurance enterprise. This value is calculated as the net present value of the future cash flows generated by its operations. A faithful agent protects the interests of the taxpayer, resisting politically imposed restraints and career-oriented incentives.

Self-interested agents do not resist economic constraints to avoid the possibility of conflict with politicians. In addition, they are tempted by career-oriented incentives and serve their own narrow interests rather than those of the taxpayer. In the Kane model, conflicted agents maximize their own perceived performance image in an effort to maximize their postgovernment wages. The self-interested agent's decision-making process is subject to economic constraints implicit in the budget procedures, as well as to the political and bureaucratic constraints implicit in career-oriented incentives. The agent, in an effort to serve himself well, gives in to all of these constraints and incentives, and imposes the resulting costs on the unwary taxpayer.

The Kane model is a theoretical model of regulatory decision-making that underlines the factors leading to the distinction between economic insolvency and failure of financial institutions. Clearly, in a realistic analysis, bank failures need to be modeled within the framework of a regulatory decision-making process.

II. Review Of Empirical Literature On Financial-Institution Failures

A summary of selected empirical studies on thrift-institution and commercial-bank failures is given in table 3. The first group of studies (Sinkov [1975], Altman [1977], and Martin [1977]) focuses on developing early warning systems. These systems statistically analyze financial ratios constructed from the balance sheets and income statements that institutions file regularly with federal agencies. The goal is to incorporate this information into monitoring systems and to help regulators by flagging financially troubled institutions as early as possible. To identify these institutions, researchers typically fit cross-sectional models for each year into their sample periods.

The second group of studies (Avery and Hanweck [1984], Barth et al. [1985], Benston [1985], and Gajewski [1988]) attempts to explain statistically *de jure* failures, labeled in this article as the closure process. Their models seek to identify financial factors that affect the likelihood of an institution's closure. Using cross-sectional data over a given sample period or cross-sectional data pooled from different years, researchers try to pinpoint determinants of closure by analyzing the same types of financial ratios used by the first group of studies.

To clarify the model specifications of earlier researchers, it is helpful to review briefly the regulatory supervision process.

Bank Supervision and Examination

Supervision refers to the oversight of banking organizations and their activities to ensure that they are operated in a safe and sound manner. Examination is a means by which supervisors obtain information on the financial condition of an institution (Benston et al. [1986]). Examination is an important part of the supervisory process. Through periodic examinations and continuous supervision, regulators try to prevent deposit institutions from taking excessive risks that could lead them to economic insolvency.

The supervision and examination of depository institutions are performed by one or more of the following institutions: The Federal Reserve System, state and federal chartering agencies, and federal deposit-insurance agencies. The Office of the Comptroller of Currency (OCC) and the Federal Home Loan Bank Board (FHLBB, now the Office of Thrift Supervision) charter national banks and savings and loan institutions, respectively. State

T A B L E 3

**A Summary of Selected Empirical
Studies on Deposit-Institution Failures**

Author	Institutions and Time Period	Estimation Technique	Dependent Variable	Ratio ^a
Sinkev (1975)	110 Problem 110 Nonproblem Commercial Banks (1969-1972)	Discriminant Analysis	Problem/ Nonproblem	Over 100 are tested, 10 are chosen, 6 are significant.
Altman (1977)	56 Serious Problem/49 Temporary Problem/107 No Problem Savings and Loans (1966-1973)	Discriminant Analysis	Serious Problem/ Temporary Problem/ No Problem	32/7
Martin (1977)	58 Closed/ 5,642 Nonclosed Commercial Banks (1970-1976)	Logit	Closed/ Nonclosed	25/4
Avery and Hanweck (1984)	100 Closed/ 1,190 Nonclosed Commercial Banks (12/1978-6/1983)	Logit	Closed/ Nonclosed	9/7 ^b
Barth et al. (1985)	318 Closed/ 588 Nonclosed Savings and Loans (12/1981-6/1984)	Logit	Closed/ Nonclosed	12/5
Benston (1985)	178 Closed/ 712 Nonclosed Savings and Loans (1981-1985)	Logit	Closed/ Nonclosed	28/4
Gajewski (1988)	134 Closed/ 2,747 Nonclosed Commercial Banks (1984-1986)	Two-Step Logit	Closed/ Nonclosed	25/10

a. The ratio of the total number of independent variables screened to significant independent variables.

b. Two are significant but have unexpected signs.

NOTE: Significant independent variable definitions are given in table 4.

SOURCE: See text.

banking commissions charter institutions with state charters. The deposit insurance agency for banks is the Federal Deposit Insurance Corporation (FDIC) and for savings and loan institutions it is the Federal Savings and Loan Insurance Corporation (FSLIC), now changed to the Savings

Association Insurance Fund by the 1989 Financial Institutions Reform, Recovery, and Enforcement (FIRRE) Act.

The 1989 FIRRE Act restructures the savings and loan industry. Under the new law, what was formerly the Federal Home Loan Bank Board is

divided into three parts: the Office of Thrift Supervision (OTS), the Savings Association Insurance Fund (SAIF), and the Federal Housing Finance Board. The Office of Thrift Supervision is responsible for the examination and supervision of savings and loans, and has the powers formerly vested in the FHLBB. The Savings Association Insurance Fund takes the place of FSLIC.

In addition, a new Bank Insurance Fund is created. Both the Savings Association Insurance Fund and the Bank Insurance Fund are FDIC agencies. The obligations issued by either fund are backed by the full faith and credit of the United States. A five-member Federal Housing Finance Board is established to oversee credit allocation by the 12 district Home Loan Banks to members in the form of advances. The five members are the secretary of the Department of Housing and Urban Development and four others appointed by the president with the advice and consent of the U.S. Senate. In addition, a new agency, the Resolution Trust Corporation (RTC), is created to oversee the liquidation of assets from insolvent thrifts.⁸ The FDIC is the day-to-day manager of the RTC. The new law restructures the financial institution industry, dismantles the independent Federal Home Loan Bank System, and gives the FDIC expanded powers.

Besides expanding the FDIC's regulatory turf and power, the new law does not substantially alter commercial bank supervision. National banks may be supervised by the Federal Reserve Board, the OCC, and the FDIC. However, unless the banks require assistance from the FDIC or the Federal Reserve, only the OCC supervises national banks. State-chartered banks are examined and supervised by the Federal Reserve if they are members of the Federal Reserve System, and by the FDIC if they are nonmembers. State-chartered banks can also be examined by their state banking supervisors, with or without the federal examiners.

The Federal Reserve is also responsible for regulating, supervising, and inspecting bank holding companies. Additionally, the states can regulate and supervise holding companies. Federally chartered savings and loan institutions are examined and supervised by the FHLBB (now by the OTS). State-chartered savings and loan institutions are examined and supervised by their state examiners and the FSLIC (now by the SAIF).

Federal examining efforts for banks are coordinated in such a way that an institution is visited by only one examination team from either the Federal Reserve, the OCC, or the FDIC. Federal and state examiners also coordinate their examination schedules and make an effort to conduct joint examinations. If the examinations are conducted separately, federal and state examiners share information by sending each other copies of their examination reports.

Regulators use on-site and off-site methods in order to obtain information about the economic condition of the institutions.

Traditionally, regulators have focused their monitoring efforts on sending teams of field examiners to conduct on-site examinations of each institution. On-site examinations are still heavily relied upon in regulatory monitoring efforts. States require exams every 12 to 18 months for their state-chartered institutions. In theory, sound national banks with assets of \$300 million and above are supposed to be examined every 12 months; smaller banks are examined every 18 months. However, in practice, these schedules are often not met, and federal regulators tend to concentrate on large institutions, those showing problems on their call reports, and those with low ratings on past examinations, in deciding how to allocate the limited time of their examiners.

Principles and standards for federal examinations are coordinated by the Federal Financial Institutions Examination Council (FFIEC). This council was established by the Financial Institution and Interest Rate Control Act of 1978. It coordinates the activities of five regulatory agencies: the Federal Reserve, the OCC, the FDIC, the FHLBB (OTS), and the National Credit Union Administration, which charters and regulates national credit unions. Efforts of the FFIEC are directed toward making the field examinations conducted by different agencies similar in scope.

Examiners focus mainly on the adequacy or inadequacy of the firm's capital account for meeting the particular forms of risk exposure. Traditionally, they have devoted their attention to risks from nonperforming and questionable loans and from problems rooted in incompetent management (Kane [1985] and Benston et al. [1986]). The documentation, collateral, and payment records of most large loans and a sample of small loans are examined, and the loans are classified into good, substandard, doubtful, and loss categories. The institution's internal control system and managerial practices are reviewed and evaluated. The examiners discuss their findings with management and may recommend changes in management practices to improve the

■ 8 See Kane (1989) for an analysis of the savings and loan crisis.

institution's performance, and increases in capital to strengthen the institution's balance sheet.

After the on-site examination, federal examiners prepare a formal report pointing out strengths and weaknesses in the firm's operation. This report is further summarized into a five-point CAMEL rating. CAMEL is an acronym for five categories of condition and performance on which the institutions are graded: capital adequacy, asset quality, management, earnings, and liquidity.

Capital adequacy is a measure of an institution's buffer against future unanticipated losses. As explained in section I, in the case of financial institutions, the market value of enterprise-contributed equity is the appropriate indicator of capital adequacy. However, regulators tend to focus on the book value of an institution's equity.

As previously mentioned, in evaluating an institution's asset portfolio, examiners focus on loan quality. Examiners go through loan documentation and check the quality of collateral, if any, backing each loan. Judgments are made as to the quality of each borrower and his ability to repay the loan. In addition, examiners check to see if the institution has a high concentration of loans to a specific industry or to a single borrower.

The determination of an institution's management quality is very subjective. Typically, examiners decide on the competence of management based on the institution's performance in the other four categories.

Examiners rate the earnings of an institution on both recent performance and on the historical stability of its earnings stream. Performance and stability are determined by looking at the institution's profit composition. Examiners try to see if the profits come from a solid operating base or are driven by one-time gains, such as those generated by the sale of assets (Whalen and Thomson [1988]).

Liquidity of the institution is analyzed to determine its exposure to liquidity risk. To determine the institution's ability to meet unanticipated deposit outflows, examiners look at the bank's funding sources as well as the liquidity of its assets.

Since troubled institutions often try to hide their problems from the public and the regulators, it is difficult for examiners to detect problems by looking at the institution's accounts and financial statements. On-site examinations are the most effective way of detecting fraud. As studies by Sinkey (1975, 1979) indicate, quality of management and honesty of employees are the most important factors leading to bank failures. However, examiners were not specifically asked to examine for fraud until 1984. The U.S. House of Representatives Subcommittee on Commerce,

Consumer, and Monetary Affairs of the Committee on Government Operations (1984) conducted a study of 105 bank and savings and loan failures between January 1980 and June 1983 and found that "...criminal activity by insiders was a major contributing factor in roughly one-half of the bank failures and one-quarter of the savings and loan failures...." The committee subsequently recommended that federal examiners be trained and advised to specifically examine for fraud.

The component ratings of CAMEL categories are subjectively weighed by the examiner to arrive at an overall rating for the institution. A bank's rating depends on the examining regulatory agency and the examination staff, since subjective judgments are made in obtaining the CAMEL rating (Whalen and Thomson [1988]). The CAMEL system grades an institution on a five-point scale. Institutions with ratings of 4 or 5 are considered "problem institutions." The FDIC publishes a list of problem banks, but the FSLIC does not publicize its parallel list of problem savings and loan institutions. Problem institutions are examined more frequently and monitored more closely.

The CAMEL rating is used by the federal examiners. State examiners conduct similar examinations, but they do not necessarily use the CAMEL system. Federal and state examiners disclose their overall rating to the institution's board of directors.

Regulators also use off-site monitoring to complement on-site examinations. Off-site monitoring focuses mainly on analyzing quarterly income and balance sheet statements obtained from Reports of Income and Condition (that is, call reports) filed with the regulatory agencies.

Statistical early-warning models have been available to supervisory agencies since the mid-1970s. These models were developed to evaluate the financial condition of institutions in order to determine the priority or urgency for on-site examinations. To a limited extent, off-site analysis also looks at market data (such as growth rates, deposit interest rates, and stock prices), public disclosures, and credit ratings assigned by private analysts.

Examiners seek to uncover regulatory violations and to identify problem institutions before their condition deteriorates to the extent that the deposit insurance fund is endangered. However, in addition to their inadequate emphasis on fraud

T A B L E 4

Definition of Independent Variables Found Significant in Summarized Empirical Studies

Author	Variable	Definition
Sinkey (1975)	<i>LRTR</i>	Loan Revenue/Total Revenue
	<i>OETR</i>	Other Expenses/Total Revenue
	<i>OEOI</i>	Operating Expense/Operating Income
	<i>LCR</i>	Loans/(Capital + Reserves)
	<i>SLRTR</i>	Revenue from State and Local Obligations/Total Revenue
	<i>LA</i>	Loans/Assets
Altman (1977)	<i>NWTA</i>	Net Worth/Total Assets
	<i>NOIGOI</i>	Net Operating Income/Gross Operating Income
	<i>RETA</i>	Real Estate Owned/Total Assets
	<i>ESTA</i>	Earned Surplus/Total Assets
	<i>TLTS</i>	Total Loans/Total Savings
	<i>HLBANW</i>	FHLB Advances/Net Worth
	<i>SRETA</i>	Real Estate Owned (SI)/Total Assets
Martin (1977)	<i>GCARA</i>	Gross Capital/Adjusted Risk Assets
	<i>NITA</i>	Net Income/(Total Assets-Cash Items in Process)
	<i>CI2LN</i>	(Commercial and Industrial Loans + Loans to REITs and Mortgage Bankers + Construction Loans + Commercial Real Estate Loans)/Total Assets
	<i>GCONI</i>	Gross Charge-offs/(Net Operating Income + Loss Provision)
Avery and Hanweck (1984)	<i>LNTA</i>	Natural Logarithm of Total Bank Assets Less Loan Loss Reserves (TA)
	<i>NLTA</i>	Net Loans/Total Assets
	<i>KTA</i>	(Equity Capital + Loan Loss Reserve Allowances)/TA
	<i>CI2LNL</i>	Commercial and Industrial Loans/Net Loans
	<i>NITA</i>	Net After-Tax Income/TA
	<i>HERF</i>	Herfindahl Index for Bank's Local Banking Market ⁴
	<i>PTD</i>	Semiannual Percentage Change in Total Deposits within Each Bank's Local Banking Market

risk, examiners are typically slow in identifying and evaluating new types of risks as they emerge. The exposure of institutions to interest volatility risk, foreign exchange risk, sovereign risk, and technology risk is still not explicitly priced.⁹

The recent risk-based capital adequacy guidelines established by the Federal Reserve System seek to explicitly price different categories of risk. The guideline is based on a regulatory measure of capital. Capital adequacy is determined by different capital requirement weights attached to assets that fall into broad risk categories. By the end of 1992, institutions are expected to meet a minimum ratio of qualifying total capital to weighted-risk assets of 8 percent.

The risk-based capital ratio focuses on broad categories of credit risk and limited instances of interest-volatility risk. However, it does not incorporate other risk factors mentioned above. Most important, "qualifying capital" is not defined in objective economic terms, that is, as enterprise-contributed capital.

Helping regulators perform the task of uncovering financially troubled institutions is the original motivation of the literature on deposit-institution failures. The next two subsections discuss different approaches taken by earlier empirical researchers.

Choice of Independent Variables

The first group of studies tries to develop early warning systems that are capable of mimicking the regulator's evaluation process. The hypothesis of these empirical studies is that appropriately selected financial ratios designed to measure CAMEL's five categories of information should be able statistically to discriminate between problem and nonproblem institutions. According to the definition of failure featured in this article, these studies do not deserve to be called failure studies because they analyze only the financial condition of the institutions. Moreover, their evaluation of this financial condition is accurate only to the extent that book values reported by an institution approximate market values.

The second group of researchers has a more ambitious goal. Instead of merely analyzing an institution's financial condition, these researchers

■ 9 For definitions of these risk categories and a discussion of how they should be priced, see Benston et al. (1986) and Kane (1985, 1989).

T A B L E 4 C O N T.

Definition of Independent Variables Found Significant in Summarized Empirical Studies

Author	Variable	Definition
Barth et al. (1985)	<i>NWTA</i>	Total RAP ^b Net Worth/Total Assets
	<i>NITA</i>	Net Income/Total Assets
	<i>ISFTF</i>	Interest Sensitive Funds/ Total Funds
	<i>LATA</i>	Liquid Assets/Total Assets
	<i>LNTA</i>	Natural Logarithm of Total Assets
Benston (1985)	<i>NWTA</i>	Net Worth/Total Assets
	<i>RETTA</i>	Net Income/Total Assets
	<i>YLDEAC</i>	Change in Interest and Fee Income/Earning Assets
	<i>COSTFDC</i>	Change in Interest and Depositors' Dividends/Earning Assets
Gajewski (1988)	<i>PKTAHAT</i>	Regulator-Recognized Capital/Assets
	<i>NALR</i>	Nonaccrual Loans/Total Assets
	<i>LPDR</i>	Loans Past-Due 90 Days or More, Still Accruing Interest/Total Assets
	<i>NLTA</i>	Net Loans/Total Assets
	<i>SENSDTD</i>	Sensitive Deposits/Total Deposits
	<i>AGTOTTL</i>	Total Agricultural Loans/ Total Loans
	<i>CILTL</i>	Commercial and Industrial Loans/ Total Loans
	<i>NITA</i>	Net Income/Total Assets
	<i>HCN</i>	Corporate Structure ^c
<i>OGINR82</i>	County-Level Oil and Gas Sector Earnings/Total County Earnings, 1982	

a. Herfindahl index is the sum of squares of market shares for banking organizations.

b. RAP stands for regulatory accounting principles. It is a more lenient set of accounting principles than the generally accepted accounting principles (GAAP). Under RAP, institutions have a higher book net-worth than under GAAP.

c. Corporate structure variable equals zero if the bank is independent or a one-bank holding company; it equals the number of banks in the multibank holding company if a subsidiary.

SOURCE: See text.

set out to explain why it fails. However, although they acknowledge the conceptual distinction between economic insolvency and failure (Avery and Hanweck [1984], Barth et al. [1985], Benston [1985], implicitly; and Gajewski [1988], explicitly), their models contain the same financial ratios used in the first group of studies.

Independent variables used in both groups of studies are intended to proxy different dimensions of the CAMEL rating system. Authors typically start out with either a large number of financial ratios that cover all the CAMEL categories, or selected financial ratios that were found to be significant in earlier studies. Independent variables found to be significant in the reviewed studies are summarized in table 4.

Interpretations of some financial ratios vary across different studies. When the same ratios are interpreted differently and classified under separate categories by different authors, this is noted and discussed. Authors' classifications of significant independent variables into CAMEL categories are given in table 5.

Choice of Statistical Methods

Statistical techniques used in these studies also differ. Earlier research used multiple discriminant analysis (MDA), while more recent researchers prefer qualitative response models (QRM).¹⁰

Although discriminant analysis (DA) and qualitative response (QR) models can be used interchangeably, the motivations behind the two models are quite different. What distinguishes a DA model from the ordinary QR model is that a DA model specifies a joint distribution of dependent (y_i) and independent (x_i) variables, not just the conditional distribution of y_i given x_i . In econometric QR models, the determination of x_i (bank characteristics) clearly precedes that of y_i (failure); therefore, it is important to specify $P(y = 1 | X)$, while the specification of the distribution of X may be ignored. On the contrary, in the DA model, the statement $y = 1$ (for example, being a problem bank) logically precedes the determination of X (problem-bank characteristics); therefore, it is more natural to specify the joint distribution of X and y (Amemiya [1981]).

In simple terms, DA is merely a classification technique, while QR models analyze a causal relationship. Because problem and nonproblem banks do not come from different groups, but the banks become problem banks through time, QR models are intuitively more appealing in our case. In other words, it is more natural to think of problem banks being assigned to the problem list because of their characteristics than vice versa.

In addition, QR estimators have desirable statistical properties. The discriminant analysis

■ 10 See Amemiya (1981) for a discussion of these two techniques. Judge et al. (1985), Chapter 18 contains a thorough discussion of qualitative response models.

T A B L E 5

Significant Independent Variables
Classified into CAMEL Categories

Variables	Sinkey (1975)	Altman (1977)	Martin (1977)	Avery and Hanweck (1984)	Barth et al. (1985)	Benston (1985)	Gajewski (1988)
Capital Adequacy	<i>LCR</i>	<i>NWTA</i> <i>HLBANW</i> <i>ESTA</i>	<i>GCARA</i>	<i>KTA</i> <i>LNTA</i>	<i>NWTA</i>	<i>NWTA</i>	<i>PKTAHAT</i>
Asset Quality	<i>LRTR</i> <i>LA</i>	<i>RETA</i> <i>SRETA</i> <i>TLTS</i>	<i>GCONI</i> <i>CI2LN</i>	<i>NLTA</i> <i>CILNNL</i>			<i>NALR</i> <i>LPDR</i>
Management Competence	<i>OEOI</i> <i>OETR</i>						<i>NLTA</i> <i>SENSDTD</i> <i>AGTOTTL</i> <i>CILTL</i>
Earnings	<i>SLRTR</i>	<i>NOIGOI</i>	<i>NITA</i>	<i>NITA</i> <i>HERF</i> <i>PTD</i>	<i>NITA</i> <i>ISFTF</i>	<i>RETTA</i> <i>YLDEAC</i> <i>COSTFDC</i>	<i>NITA</i> <i>OGINR82</i>
Liquidity					<i>LATA</i> <i>LNTA</i>		
Fraud							<i>HCN</i>

SOURCE: See text.

estimator is the *ML* estimator when *X* is multivariate normal. However, DA is not consistent when this assumption is violated. Still, studies analyzing robustness of discriminant analysis to non-normality report good performance by DA. QR models are not affected by the distribution of *X*. Properties of the two estimators are further discussed in Amemiya (1981).

Keeping in mind the underlying difference between the two models, DA might be useful if a dichotomous classification is the goal. On the other hand, QR models should be preferred when the model, the estimation of the coefficients of the independent variables, and thus the determination of the probability of the occurrence of the event, is important.

Review of Prior Empirical Literature

Sinkey's (1975) problem-bank study is one of the earliest on this topic. He uses linear multiple discriminant analysis (MDA) to evaluate data on 220 problem and nonproblem commercial banks for the period 1969-1972. Half of his sam-

ple consists of commercial banks that were listed as problem banks by the FDIC in 1972 and early 1973. Each problem bank is matched with a nonproblem bank based on the following characteristics: (1) geographic market area, (2) total deposits, (3) number of banking offices, and (4) Federal Reserve membership status. The sample contains mostly small banks (total deposits less than \$100 million).

After testing more than 100 ratios designed to cover all CAMEL categories, 10 financial variables are chosen. Among these, six significantly increase the overall discriminatory power of the model in a stepwise analysis. In table 4, these variables are ranked in decreasing contribution to discriminatory power. The loan revenue variable (*LRTR*), which is an indicator of asset quality, proves to be the best discriminator.

Sinkey interprets most of the variables in his study as proxies for management quality and honesty, including two operating efficiency variables (*OEOI*, *OETR*). The loan-to-capital ratio (*LCR*) is taken as a measure of adequate bank capital. Sinkey concludes that although the differences in the means of these variables are statistically significant, the classification accuracy of

the model is low due to group overlap among the problem and nonproblem banks.

Altman (1977) also uses multiple discriminant analysis to analyze three groups of troubled savings and loan institutions. Improving on Sinkey's (1975) study, he tests and rejects the equality of group dispersion-matrices, and therefore uses a quadratic structure. He examines data on 212 savings and loan associations during the period 1966-1973. Of these institutions, 56 are classified as having serious problems, 49 as having temporary problems, and 107 as having no problems. His definition of "serious problem" closely matches the definition of failure in this paper. He defines "temporary problem" institutions as those with problems similar to the ones in the serious problem group, but that have avoided regulatory interference.

Finally, the "no problem" group serves as the control group. It consists of institutions that did not show any indication of financial problems on the failure date of the serious-problem group, or thereafter. The range of asset size in all three samples is from \$1 million to \$100 million.

Altman tests 32 financial ratios that cover all CAMEL categories. His best predictor model includes only seven variables, listed in table 4. Altman concludes that operating income (*NOIGOI*) and its trend are the most important discriminators. He also finds net worth (*NWTA*) and real estate owned (*RETA*) variables to be important. He interprets these variables as reflecting an institution's profitability, capital adequacy, and asset quality.

Martin (1977) is the first author to use a logit probability model to evaluate commercial-bank failures. He analyzes data covering all commercial banks that were members of the Federal Reserve System between 1970 and 1976. In addition to closures, his failure definition includes banks whose net worth "...declined drastically over a year or less." Therefore, his analysis focuses on certain kinds of insolvency and not just on failure.

Martin's work represents the transition between the first and second group of studies. He analyzes an institution's probability of becoming insolvent in a book-value sense before analyzing the group characteristics. The second group of studies takes this analysis one step further to explain the closure process rather than merely to approximate an early-warning system.

Martin obtains his best results using 1974 data on 23 failed and 5,575 nonfailed commercial banks. He analyzes 25 ratios chosen for their usefulness in previous studies. The preferred model includes only four variables. These variables measure earnings (*NITA*), loan quality

(*CIZLN*, *GCONI*), and capital (*GCARA*).

Avery and Hanweck (1984) study commercial bank closures using semiannual data for 100 closed and 1,190 nonclosed commercial banks during the period December 1978 to June 1983. Their sample includes only institutions with assets of \$250 million or less. Although closure is acknowledged to be a regulatory decision, it is analyzed using only nine financial ratios, chosen because previous authors found them significant. They assume that the probability of closure depends on a distributed lag of the financial condition of the institution and estimate a logit probability model. Five financial-ratio coefficients prove significant and receive signs expected a priori. These ratios incorporate elements of earnings (*NITA*), asset quality (*NLTA*, *CILNNL*) and capital adequacy (*KTA*, *LNTA*).

Avery and Hanweck interpret bank size (*LNTA*) as an indicator of ability to raise new capital. Observing the reluctance of regulators to fail large banks, they state that larger institutions may raise capital more easily since it may be assumed that they are managed better and able to turn around faltering situations quickly. Local banking market variables (*HERF*, *PTD*) are also significant, but receive unexpected signs. Their most puzzling result is a counterintuitive sign for lagged financial-condition variables. They conclude that lagged financial ratios are not important in explaining bank closures.

Barth et al. (1985) study thrift institution closures using a logit probability model. They use semiannual data for 318 closed and 588 nonclosed savings and loan associations covering the period December 1981 to June 1984. They also mention that closure is a decision made by the regulators. Again, however, only 12 financial ratios similar to the ones used in earlier studies are analyzed. Five of these variables receive their expected signs and prove statistically significant. These measure capital adequacy (*NWTA*), asset quality (*ISFTF*), earnings (*NITA*), and liquidity (*LNTA*, *LATA*). They interpret size (*LNTA*) as an indicator of greater liquidity, since they believe larger institutions have a greater ability to borrow in order to alleviate unexpected liquidity problems. A possible alternative interpretation is that this variable captures the reluctance of regulators to liquidate large institutions (Conover [1984], Seidman [1986]).

Benston (1985) conducts a logit analysis of 178 closed and 712 nonclosed savings and loans for the period 1981-1985. Among the 28 financial ratios he includes, only four prove statistically significant. These are measures of capital adequacy (*NWTA*) and earnings (*RETTA*, *YLDEAC*, and *COSTFDC*).

Gajewski (1988) studies commercial-bank closures by analyzing a 1986 cross-sectional data set of 134 closed and 2,747 nonclosed banks. Emphasizing the need to differentiate between insolvency and failure, Gajewski is the first author to incorporate this distinction into his modeling. His model has two equations. The first mimics the regulatory screening process, in the spirit of an early-warning model. The second studies the closure process. Although Gajewski recognizes the importance of the regulatory decision-making process in explaining bank closures, his two equations differ only in their endogenous variables—book-value insolvency and closure. He analyzes both insolvency and closure using only financial ratios and county characteristics.

Characteristics of the bank's local economy are represented by the percentage of county-level oil and agricultural earnings to total county earnings. A total of 25 financial ratios covering CAMEL categories are chosen to study the financial condition and closure of the institutions.

The final specification of the logit probability model develops 10 significant variables, listed in table 4. These include measures of capital adequacy (*PKTAHAT*) obtained from the first equation, asset quality (*NALR*, *LPDR*), management competence (*NLTA*, *SENSDTD*, *CILTL*, *AGTOTTL*), earnings (*NITA*, *OGINR82*), and fraud (*HCN*). What Gajewski interprets as management-competence variables are interpreted as asset-quality variables by earlier authors.

Relative Importance of Different CAMEL Categories

Although cited studies analyze the relative discriminatory power of different CAMEL categories, it is difficult to compare the findings of one study against another, due to differences in data sets, proxies, and interpretations. Nevertheless, all authors find capital adequacy (*C*), generally proxied by the book value of net worth, to be significant. In addition, earnings (*E*), usually a measure of net income, are a significant indicator of financial condition.

After capital adequacy and earnings, asset quality (*A*), as proxied by various loan ratios, is found to be a significant indicator of financial trouble by most authors. Fraud and management competence (*M*) prove to be difficult categories to proxy. Instead of explicitly representing them by financial ratios, most authors prefer to consider the set of included variables as incorporating implicitly the effects of management and fraud. With the exception of the study by Barth

et al., liquidity (*L*) is not found to be a significantly important category.

III. Possibilities for Improving the Empirical Analysis of Deposit- Institution Failures

The literature on deposit-institution failures still leaves much room for improvement. The first group of studies seeks to discriminate between problem/nonproblem and closed/nonclosed institutions using only financial ratios. The choice of candidate regressors in the accounting-ratio models lacks a compelling theoretical foundation. Financial ratios are simply utilized in various statistical procedures until they "work." The second group of studies seeks to explain failure using only instrumental variables borrowed from accounting-ratio models. These studies fail to distinguish successfully between insolvency and failure in their modeling and have little theoretical underpinning.

In studying the failure of financial institutions, it is crucial to make a distinction between economic insolvency and failure. As discussed in section I, economic insolvency is a market-determined event. In contrast, the decision to fail an institution requires that a state commission or federal agency realize, often under the urging of the deposit-insurance agency involved, that a natural propensity to forbear is no longer in its bureaucratic interest (Kane [1985]).

Failure is a regulatory decision, influenced by conflicts of interest that exist between regulators, politicians, and taxpayers. These conflicts of interest allow political, bureaucratic, and economic pressures, and career-oriented incentives of the regulators, to shape failure decisions. Therefore, economic insolvency and failure of financial institutions should be distinguished but studied simultaneously.

Furthermore, failure should be modeled formally as the outcome of a regulatory decision-making process, explicitly taking into consideration regulators' constraints and conflicts of interest.

In studying economic insolvency of financial institutions, the appropriate measure is the market value of enterprise-contributed capital. Assuming an efficient stock market, the market value of enterprise-contributed capital summarizes the institution's financial condition, freeing the researcher of the dilemma of picking and choosing the "right" financial ratios among many possibilities. Also, if one uses financial ratios calculated from balance sheets and income state-

ments, the implicit assumption is that book values adequately proxy market values.

Adopting the market value of enterprise-contributed equity as the measure of economic solvency and analyzing failure within a theoretical model of regulatory decision-making brings a much-needed structure to the choice of independent variables, establishing a theoretical basis for the empirical research on deposit-institution failures.

Most studies of problem and failed banks concentrate on small-bank failures. They include few, if any, large banks in their samples. However, recent increases in large-bank insolvencies indicate the importance of developing a model of large-bank failures.

Developing a large-bank failure model has the further advantage of allowing us to use stock-market data. In addition, as Kaufman (1985) states, consequences of insolvency and failure of large banks are blown out of proportion by the regulators. Regulators publicly show a fear of large-bank failures, ostensibly because of the possible repercussions on the banking system and on economic policy. At the time of the Continental Illinois National Bank crisis, Comptroller of the Currency C. T. Conover (1984), in defense of his rescue of the bank, argued:

In our collective judgement (directors of the FDIC, the chairman of the Federal Reserve Board, and the Secretary of the Treasury), had Continental failed and been treated in a way in which depositors and creditors were not made whole, we could very well have seen a national, if not an international, financial crisis the dimensions of which were difficult to imagine. None of us wanted to find out.

What leads to forbearance policies and inefficient insolvency resolution methods, however, is not necessarily these vague and poorly documented consequences, but the hidden fears of what particularly visible large-bank failures can do to the perceptions of the quality of regulators' performance in office (Kane [1989]).¹¹ Thus, one would expect the political and bureaucratic constraints of the regulators to be especially binding when their decision to fail concerns a large bank.

Demirgüç-Kunt (1990, forthcoming) addresses the above issues.¹² It is a study of large commercial-bank failures for the period 1973-1989. Annual panel data are used in estimation. The failure model developed distinguishes between economic insolvency and failure, studying them simultaneously. An estimate of the market value of enterprise-contributed equity is taken as the measure of economic insolvency. Failure determination is based on a theoretical model of failure decision-making in the spirit of the Kane model. The theoretical model identifies and explicitly incorporates important regulator constraints and incentives. In the empirical model, the FDIC's number of examiners and size of the insurance fund are proxies for economic constraints, whereas failure rate (for banks and businesses), number of problem banks, variance of interest rates, and bank size are included to proxy political and bureaucratic constraints implicit in the career-oriented incentives of regulators.

As expected, results indicate that regulator constraint and incentives play a significant role in failure determination. The empirical model of bank failures developed in Demirgüç-Kunt (forthcoming) is more complete because it takes into consideration a previously ignored determinant of the decision-making process and brings theoretical structure to the empirical deposit-institution failure literature.

One possibility for future research in this area of deposit-institution failures is to investigate changes in regulatory decision-making through the years. Periodic restructuring of the financial system (most recently by the 1989 FIRRE Act) leads to shifts of power among different regulatory bodies and may affect failure decisions. It is also important to take into consideration differences among various insolvency resolution methods, that is, different categories of de facto failure (Maddala [1986]).¹³ Development of a failure model that distinguishes between different methods of insolvency resolution is the next challenging task facing economists.

■ 11 A discussion of these policies can be found in Kane (1985, 1989), Benston et al. (1986), and Caliguire and Thomson (1987).

■ 12 See Demirgüç-Kunt (1989) for a preliminary version of the study and empirical results. The theoretical model is fully developed in Demirgüç-Kunt (1990, forthcoming).

■ 13 For a discussion, see references in footnote 11.

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