NBER Working Paper Series

THE FUNDAMENTAL DETERMINANTS OF RISK IN BANKING

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Working Paper No. 265

National Bureau of Economic Research, Inc.
204 Junipero Serra Boulevard, Stanford, CA 94305

July 1978

This research was supported by NSF-RANN Grant No. APR76-02511 through the National Bureau of Economic Research. We gratefully acknowledge the comments of Sherman Maisel, Vinay Marathe, David Pyle, and William Sharpe, and the Management Sciences Department of Wells Fargo Bank. Responsibility for errors is, of course, our own.

NBER Working Paper 26
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Abstract

This study is concerned with establishing the determinants of banks' exposure to risk and with predicting risk in banking. Using the COMPUSTAT data base, prediction rules have been developed for two aspects of risk: systematic risk (risk that is related to covariance with the market portfolio) and residual risk (the aggregate of specific risk and extra-market covariance). For each type of risk, several models have been estimated: one model employs only measures of the asset and liability characteristics of the bank; a second employs these characteristics and other data taken from annual reports; a third model adds the history of the behavior of the price of the bank's common stock. The central conclusion of the study is that systematic and residual risk in banks can be predicted from predetermined data. Prediction rules estimated in this way can serve a useful function in monitoring bank risk. Further, the predictive significance of each variable serves as a measure of the appropriateness of that variable as an indicator of risk, and hence as a target for regulation.

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I. Introduction and Overview

The operating risk in a bank can be precisely defined as the unpredictable variability of the present value of the bank. Risk is most commonly studied by observing changes in the earnings or worth of the firm. Such measures of risk, based as they are upon the bank's accounting practices, capture some aspects of risk accurately but overlook others. For example, changes in the market value of the bank's assets are imperfectly captured. Accounting measures of earnings also tend to smooth the time path of earnings and, in so doing, tend to obscure the fluctuations which can be used to establish the level of risk.

The market value of the bank's liabilities, at any point in time, is an estimate of the present value of the bank. The common stock is a large portion of the long-term capital of most banks, and it is that part with the greatest exposure to changes in the bank's present value. Since accurate measures of the market value of other bank liabilities are lacking, a study of the month-to-month variability in the outstanding value of the bank's common stock becomes a natural approach to measuring bank risk.

Two aspects of the risk of common stock are studied below. The first is the systematic risk, as measured by beta. The second is the residual variability, measured by the variance of the stock's residual or unsystematic return. A number of "descriptors" of the bank's operating characteristics are used as predictors for these two risk measures.

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Data on more than 100 banks for about 100 months are available; there are 11,219 data points in all. Predictive models for systematic and residual risk are fitted to this pooled cross-section time series.

The empirical results are quite satisfying. The estimated coefficients are generally consistent with our a priori expectations concerning the effects of a bank's operations upon its risk. The coefficients are estimated with fair precision, and a large number of the effects are statistically significant.

One important measure of the success of the prediction rule is the degree to which fundamental descriptors (descriptors of the operating characteristics of the bank) can substitute for historical risk measures as predictions of future risk. If all operating determinants of risk were perfectly captured, the historical risk measure would become redundant and would make an insignificant contribution to future prediction. Conversely, if the fundamental descriptors were inadequate, the historical risk measure would remain as an important predictor of future risk. In this study, the historical risk measures are only marginally significant and add very little to the explanatory power of the fundamental prediction rules.

Two other satisfying aspects of the estimated prediction rules are insensitivity to the time period selected and to the inclusion or deletion of various descriptors. We have estimated the models over several different time periods and found little change in estimated coefficients. Indeed, "Chow" tests of changed coefficients only weakly reject changes in the structure of the model. Also, the deletion of insignificant variables or of groups of variables of different types generally does not change the signs of the remaining coefficients. This makes it seem less likely that the coefficients of included variables are importantly influenced by surrogate effects for other variables which may have been excluded.

The results of the study may be useful in a number of ways. First, they provide prediction rules for investment risk that have potential usefulness in regulatory practice. Second, the information content of various descriptors is tested: some commonly used descriptors of operating characteristics are found to be important predictors of investment risk and others are not. Third, the risk coefficients for various asset and liability categories are a natural measure of the capital costs that should be associated with them.

The plan of the paper is as follows. Section II defines the components of risk. Section III explains the procedure used to fit prediction rules for systematic and residual risk. The exact formulas are given in the appendix to the paper. Section IV discusses the descriptors which have been employed. Section V explains the sample. Section VI reports the empirical results, and Section VII provides a conclusion.

II. The Components of Risk

The single-factor, market-index model of security returns has received widespread attention. It has the advantage of simplicity, and it exploits the fact that a large part of the covariance among security returns can be explained by a single factor analogous to a market index. Yet, in a pioneering study, King [5] concluded that there are important covariances among security returns beyond those attributable to an overall market factor. His conclusions are consistent with the beliefs of professional portfolio managers and security analysts, who generally agree that there are important components of security returns associated with the economic and financial characteristics of the firm. These components of return influence all (or almost all) firms having the associated characteristics and thereby induce correlations among the returns of different firms possessing such characteristics.

In a recent paper, Rosenberg [6] developed a multiple-factor model of security returns. This model implies a single-factor, market-index model of the usual form, which, however, possesses two additional interesting properties: (1) there exists a set of residual factors that contribute additional, or "extra-market," components of covariance among security returns; (2) the familiar beta coefficient (a measure of systematic risk) is a function of the parameters of the underlying multiple-factor model. With the additional assumption that both the specific risk and the factor loadings of the firm are linear functions of known characteristics of the firm, which can be represented by "descriptors" derived from accounting data and stock market price behavior, Rosenberg showed that it is possible to construct a set of transformed factors with loadings identical to the descriptors. These transformed factors may be directly estimated by ordinary regression. This approach--which is the one utilized in this paper--has the advantage of statistical simplicity, and it exploits such information as is available concerning the economic character of the factor loadings.

The single-index model of securitv returns provides a relationship between returns and two aspects of risk, systematic and specific; the multiple-factor model includes a third type of risk, extra-market covariance. To make this terminology a bit clearer, consider the following explanations of the three types of risk that contribute to security returns--systematic risk, specific risk, and extra-market covariance.

1. *Systematic risk* arises from the tendency of the asset price to move along with the market index. The amount of systematic risk of any asset is sometimes called its "volatility." The measure of systematic risk is widely known as "beta." If beta is 1, then the asset price tends to fall in the same proportion that the market falls, other things being equal, and to rise by the same proportion that the market rises. If beta is 1.5, the asset price tends to fall (or rise) proportionally by one and one-half times as much as the market falls (or rises).

2. *Specific risk* is the uncertainty in the return of an asset that arises from events that are specific to that firm. It is that part of risk that is due to events in the firm that are unrelated--or, at most, distantly related--to events that impact other firms. A leading example of this kind of risk was provided by the sudden announcement of Franklin National Bank's troubles. The news had a disastrous effect on the prices of its common stock and other liabilities. Of course, the announcement also conveyed, by implication, some fresh news about the state of the economy and banking in general. The interrelationship was negligibly small in comparison to the changed values of Franklin's own liabilities. This aspect of risk has been called the "unique" risk or "independent" risk of the company.

3. *Extra-market covariance* is the remaining component of risk. It is manifested as a tendency for the prices of related assets to move together in a way that is independent of the market as a whole. An illustration is the tendency for money center banks to rise and fall together as the prospects of the group change, at times when the market may be moving in the other direction. The term "covariance" refers to the tendency of the stock prices to move together, or "covary." The adjective "extra-market" rules out that part of the tendency of assets to move together that is related to the market as a whole. Covariance within an industry group is intermediate between systematic and specific risk: systematic risk impacts all firms in some way, specific risk impacts only one firm, and industry-group covariance impacts a group of firms. Other forms of extra-market covariance may impact a very large number of firms; for example, a contractionary monetary policy may reduce the values of firms that have assumed much financial risk, at the same time that the market as a whole is rising because of favorable economic news. In this example, a large group

of firms, which cuts across industries, will be exposed to the change in monetary policy and will covary.

Residual return is the sum of specific return and return due to extra-market factors. It is called the "residual" return because, in a regression model to explain the security return as a function of the market return, it is the residual from the market return (the difference between the actual security return and the predicted value).

The remainder of this paper deals with the prediction of systematic and residual risk for banks. The decomposition of residual risk will be reported in a later paper.

III. Evaluating and Fitting Prediction Rules for Systematic and Residual Risk

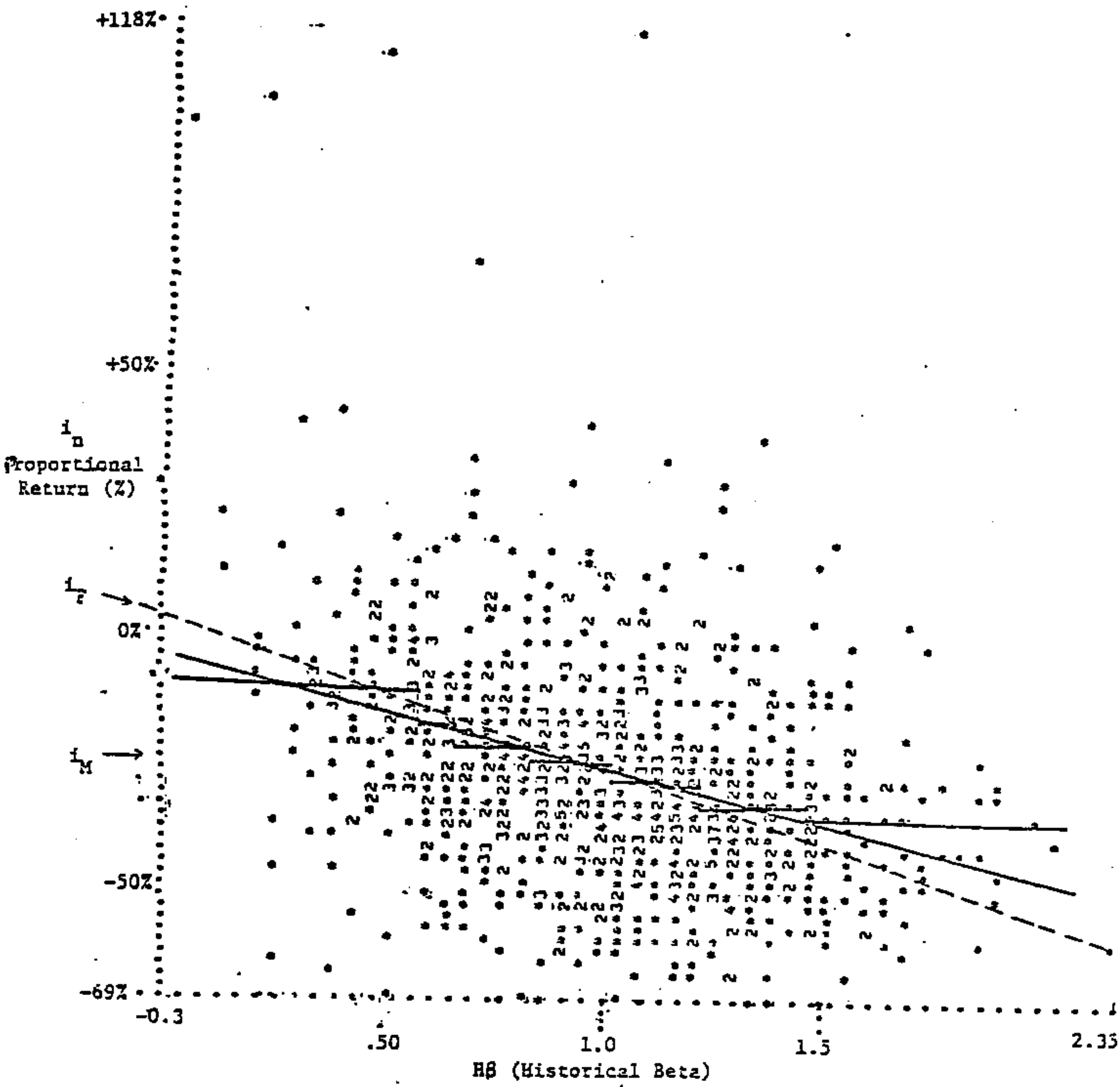
With respect to systematic risk, we will consider the prediction of beta, which is the response coefficient that determines relative exposure to market risk. To predict beta successfully, it is necessary to discriminate between stocks that will tend to move substantially when the market moves and stocks that will move little. Figure 1 shows an instance of relatively successful beta prediction. On the horizontal axis are plotted the betas published by Merrill Lynch for roughly 700 companies with largest capitalization on December 31, 1972. Hereafter, the beta computed by this formula on any date will be called the "historical beta" as of that date and will be denoted by the two-letter symbol $H\beta$. On the vertical axis are plotted the returns to these common stocks in the next six months. This was a period when the market declined substantially, so that if the historical betas were correctly predictive, stocks with high $H\beta$ should have declined more than stocks with low $H\beta$.

The figure clearly shows that this occurred. (The strength of this tendency is apparent when it is noticed that tightly clustered points are represented by integers (e.g., 7 indicates 7 cases).) The regression line through the data shows a pronounced downward slope, and the average returns for ten deciles of $H\beta$ (shown as ten horizontal steps extending across the decile ranges) decline in an orderly fashion as $H\beta$ increases. When the market falls, the results appear as in Figure 1. When the market rises, the results appear as if reflected about the axis of zero return: high $H\beta$ stocks show greater positive returns; low $H\beta$ stocks show smaller positive returns.

The criterion for a successful prediction rule for beta is that it accurately arranges stocks in proportion to the response to the market. The closer the fit of the predicted market response for the security to the actual security return, the better is the prediction. Each interval of market

FIGURE 1

Common Stock Returns 1/1/73 - 6/30/73 for 700 Large
U.S. Companies Plotted Against 12/30/72 Historical Beta



Regression line $r = b_0 + b_1(H\beta \dot{r}_M)$, and average returns by beta deciles are shown as solid lines. The dashed line shows the expected relationship, under the basic capital asset pricing model, if Hβ were a perfect predictor of β.

movement provides an opportunity to test the accuracy of predictions available at the start of the interval. A succession of monthly intervals provides a long history of evaluations and hence an extensive examination of a prediction rule.

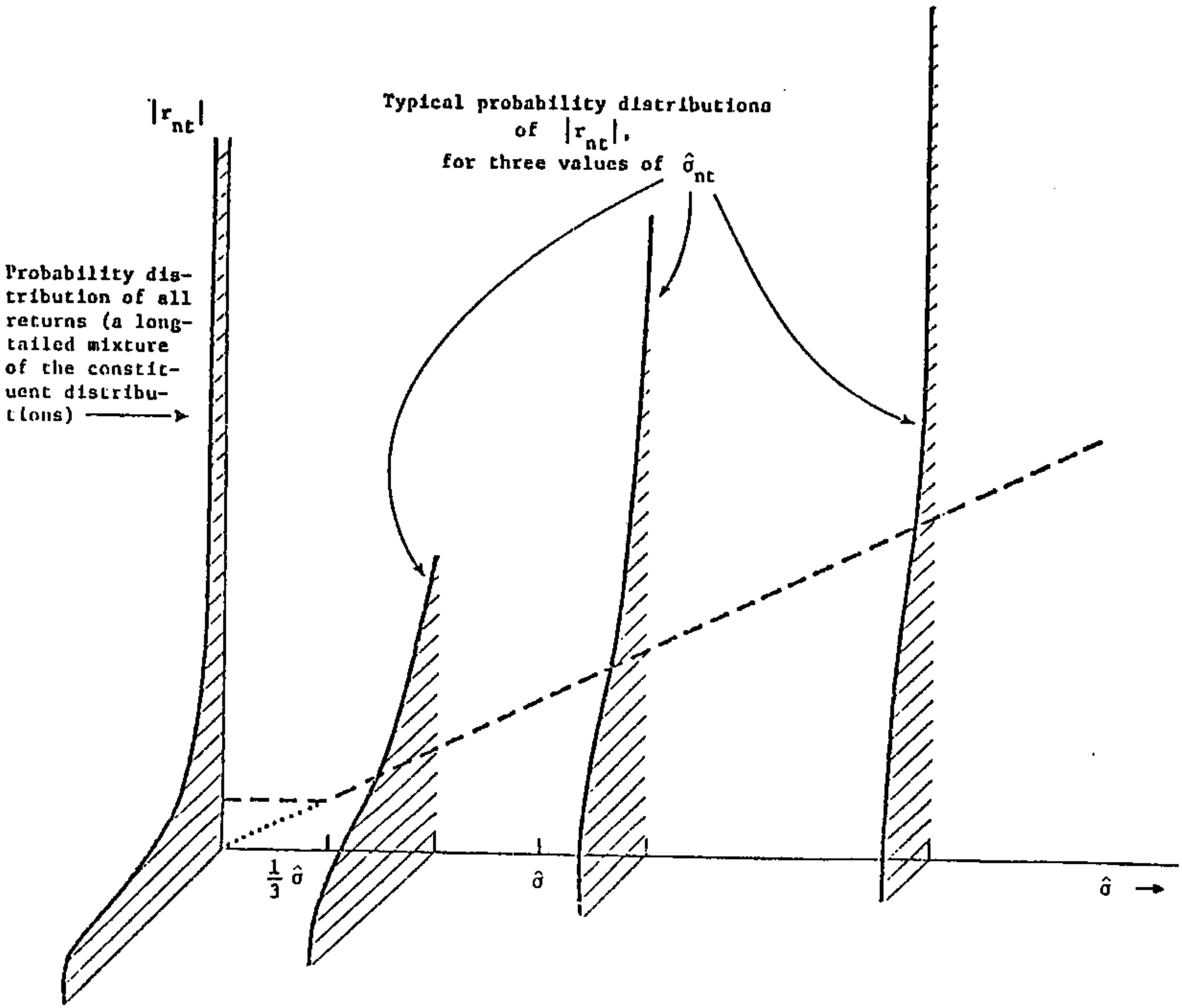
The solid line in Figure 1 is the line of best fit to the data. However, if we were actually predicting returns using Hβ, our predictions would lie along the dashed line. In the case of a stock with predicted beta of zero, predicted return is the riskless rate, which was roughly 4 percent over that six-month period. For other stocks, the predicted return equals the riskless rate plus beta times the market excess return. The measure of success is the degree to which the return predictions for individual stocks lying along the dashed line fit the actual returns. The measure of goodness of fit is the coefficient of determination or R-squared.

Although the regression line achieves a good fit, there remain large errors about the line. These errors are the manifestation of residual risk, or the residual returns of the stocks. Of course, the residuals are influenced by the predicted betas. If a better rule were used to predict betas, residuals would be typically smaller. Nevertheless, all of the improvements that appear to be possible in beta prediction achieve only a small reduction in the magnitude of the typical residual return. Further, we know, from a multitude of studies, that little of the variance of residual returns can be accounted for by means of security analysis predictions of mean returns. Hence, these residual returns are largely unpredictable elements of return. The problem of predicting residual risk is equivalent to the problem of predicting the expected magnitude (absolute value) of the residual return on a stock. If this expected magnitude is small, the residual risk is small--and conversely.

Figure 2 illustrates the prediction of residual risk. On the horizontal axis, the residual risk prediction, defined as the predicted standard deviation of residual return, or $\hat{\sigma}$, is plotted. Stocks with higher levels of risk appear to the right. The vertical axis represents the absolute residual return for the stock. At several points, the expected frequency distribution of residual returns for stocks at that level of residual risk is drawn. Since the absolute value of residual return is under analysis, it will always be positive. The shape of the curve is that of half of a bell-shaped curve. Even for stocks with very high levels of risk, as in the probability distribution at the right, the most likely residual return lies at the bottom of the bell-shaped half curve, a residual return of zero.

FIGURE 2

Prediction of Cross-Sectional Differences in Variance



However, for high-residual-risk stocks, there is a possibility of very large residual returns, and so the distribution extends upward to the top of the page. For low-residual-risk stocks, with small $\hat{\sigma}$, we expect a tightly bunched distribution of returns, as in the drawings nearer the vertical axis. The dashed line drawn in the figure plots the predicted mean absolute residual return. This is a constant proportion of the standard deviation (76 percent in the model that will be developed below). The small kink in the straight line near zero is explained in appendix A.

There is a natural statistical procedure to evaluate a prediction rule for residual risk. The dependent variable is the observed absolute residual return for the stock. The independent variables are predictions for the amount of residual risk. If the prediction is successful, then those stocks with high levels of predicted residual risk will show frequent large absolute residual returns, as in the distribution at the extreme right. Conversely, stocks having low levels of predicted risk will exhibit a tight distribution of residual returns, as in the distributions farther to the left. A suitably defined measure of goodness of fit for the regression, analogous to an R-square, summarizes the success of the prediction rule. This approach is explained in Section VI.

IV. The Descriptors: Information Sources Used in Risk Prediction

In an attempt to predict risk, one can draw on many different kinds of information. There are indications of future risk in the *current balance sheet and income statement*, such as proportions in various asset and liability categories, and operating margins. There are indications of the normal risk of the firm's operations in the *historical variability* of items in the income statement. When fluctuations obscure a policy of the firm, as in fluctuations over time in the payout ratio due to transitory earnings fluctuations, a *historical average* of the policy, such as a five-year cumulative payout ratio, is useful. *Trends* in variables measure the changing position of the firm and provide some indication of growth orientation. Variables capturing *market judgment*, expressed as ratios of market values to income-statement or balance-sheet variables, such as "leverage at market value," are often powerful indicators of the market's forecasts of the firm's prospects.

Another important item of information is the regional location and type (e.g., money center, New York, etc.) of the banks; we use indicator (dummy) variables for six such groupings. The final category of information is the behavior of the market price of the common stock. Table 1 lists the descriptors that we have used, along with a brief definition of each; detailed definitions are provided in Appendix B. Summary statistics for these descriptors are in Table 2.

The reader may complain that we are going too far afield in scrounging information from so many distinct sources. Why not restrict oneself to a historical measure of the aspect of risk in question? One justification is that it is important to ascertain the fundamental determinants of risk. And the second justification will be found in predictive performance.

A number of principles were observed in constructing the descriptors.

1. No descriptor was employed unless there were compelling a priori grounds to believe that it might be predictive of subsequent risk. Such descriptors were found in three categories:

(a) Historical statistics on past risk for the bank's stockholders: these may be viewed as estimates (subject to measurement error) of past underlying aspects of risk. As such, they are useful in predicting an aspect of subsequent risk to the degree that both the following conditions are satisfied:

(i) the historical estimate is an accurate estimator of the underlying aspect of past risk, not obscured by measurement error; and

(ii) that historical aspect of risk is correlated with the future aspect of risk that is to be predicted.

(b) Fundamental descriptors of the bank's operations and balance sheet, which economic theory leads us to believe are determinants of risk or correlated with risk. These may be subdivided into those that relate exclusively to business risk, those that relate exclusively to financial leverage, and those that measure the interaction of both.

(c) Indicators of the judgment of investors concerning the firm, which provide indirect measures of the bank's risk. Foremost among these are valuation ratios such as book/price and earnings/price (indicative of investors' expectations concerning the bank's future growth and success).

2. The second principle concerns the problem of multicollinearity. When a number of descriptors are included in the analysis, correlation among them will inevitably arise, and it will therefore be more difficult to discriminate among their effects. There is a remarkable widespread misunderstanding of the effects of multicollinearity in a multiple regression: many people believe that the presence of

TABLE 1[a]

THE DESCRIPTORS

A. Descriptors of Asset Mix

1	NCMLDA	- the ratio of net commercial lending to assets
2	COMLNA	- the ratio of commercial loans to assets
3	NCNLDA	- the ratio of net consumer lending to assets
4	CONLNA	- the ratio of consumer loans to assets
5	MUNIBA	- the ratio of tax-exempt bonds to assets
6	RELNSA	- the ratio of real estate loans to assets
7	ISECTA	- the ratio of all investment securities to assets
8	TRDASA	- the ratio of trading account securities to assets

B. Descriptors of Liability Mix

9	CONTDA	- the ratio of consumer time deposits to assets
10	DEMNDA	- the ratio of demand deposits to assets
11	NFFBA	- the ratio of (net) federal funds borrowed to assets
12	FORDPA	- the ratio of foreign deposits to assets
13	SAVEDA	- the ratio of savings deposits to assets
14	TBORA	- the ratio of total borrowings to assets
15	TCAPA	- the ratio of total capital to assets
16	TIMEDA	- the ratio of time deposits (other than savings) to assets

C. Descriptors of Asset/Liability Characteristics

17	ATOLB	- the ratio of assets to long-term liabilities (book value of equity, plus long-term debt)
18	BLEV	- leverage, at book value: the ratio of the book value of (equity plus debt) to the book value of equity
19	DILU	- potential dilution: the ratio of net income per share fully diluted to net income per share
20	DTOA	- the ratio of total debt to assets
21	KMTMN	- average maturity of tax-exempt bond portfolio, in months
22	KMTUS	- average maturity of taxable bond portfolio, in months
23	KPDEP	- the percentage depreciation in the bond portfolio: the ratio of the difference between bond portfolio market and book values to bond portfolio book value
24	RLTLTL	- the ratio of "risky" liabilities to long-term liabilities

D. Descriptors of Operating Characteristics

25	ATAX	- the ratio of income taxes to pretax income, last 5 years
26	FFMKT	- federal funds market-making activity: the ratio of the minimum of (federal funds purchased, federal funds sold) to assets
27	FLO1	- the ratio of average cash flow to current liabilities
28	FRGNO	- the ratio of foreign offices to total offices
29	PAY1	- payout: the ratio of common dividends to earnings available for common the prior year, last 5 years

TABLE 1--Continued

30	PNCV	- the estimated probability of noncoverage of fixed charges using a trended value for current operating income
31	SALTOR	- the ratio of salaries and related expenses to current operating revenue
32	TRDVRA	- the ratio of [the variability (standard deviation) of trading account income × 100] to assets
33	VCAP	- the variability of capital structure: the ratio of the sum of the absolute values of changes in the book values of equity and long-term debt to the sum of the book values of equity and long-term debt
34	VERN	- the variability of earnings: the ratio of the standard deviation of earnings to the absolute value of average earnings
35	VFLO	- the variability of cash flow: the ratio of the standard deviation of cash flow to the average absolute cash flow
36	ABET	- an accounting beta, equal to the "coefficient of explained variation" of the firm's earnings with respect to economywide earnings

E. Descriptors of Earnings Success

37	CUTD	- the average proportional cut in dividends, last 5 years
38	DELE	- the proportional change in earnings per share
39	DMNE	- a dummy variable indicating negligible earnings
40	MRGIN	- the ratio of net income to current operating revenue
41	REVENA	- the ratio of current operating revenue to assets
42	ROEQ	- return on equity: the ratio of net income to book value of equity, last 5 years

F. Descriptors of Growth

43	AGRO	- asset growth rate, equal to the ratio of the annual trend in assets to the average value
44	DMS5	- a dummy variable indicating the availability of a 5-year history of earnings information
45	EGRO	- earnings growth rate, equal to the ratio of the annual trend in earnings to the absolute value of the average
46	OFFEX	- domestic office expansion rate, equal to the ratio of the annual trend in the number of domestic offices to the average value
47	RSKLGO	- growth rate of risky liabilities, equal to the ratio of the annual trend in risky liabilities to the average value

G. Descriptors of Size

48	ASSI	- the (natural) logarithm of average (last 5 years) total assets (in millions)
49	MKTS	- current operating revenue (in millions)

TABLE 1—Continued

H. Descriptors of (Stock) Market Price Variability

50	HBET	- historical beta, the regression coefficient taken from the regression of monthly common stock returns on monthly returns for the market
51	BTSQ	- the square of HBET, defined above
52	HSIG	- historical sigma, the standard deviation of residual returns from the regression for HBET, defined above
53	SGSQ	- the square of HSIG, defined above
54	BS	- the square root of the product of HBET and HSIG, as defined above
55	BADJ	- the Bayesian adjustment to HBET, defined above, under the (erroneous) assumption that the underlying values of beta and sigma are independent
56	LPRI	- the (natural) logarithm of the stock price
57	RSTR	- the logarithmic rate of return over the last year
58	TREC	- a measure of common stock trading recency, equal to the reciprocal of the number of prior years of available monthly stock prices

I. Descriptors Dependent upon the Market Valuation of Common Stock

59	ATOLM	- the ratio of assets to long-term liabilities (market value of equity, plus long-term debt)
60	BBET	- "Beaver" beta: the regression coefficient taken from the regression of the normalized earnings-to-price ratio of the firm on the normalized earnings-to-price ratio of the economy
61	BTOP	- the ratio of book value to market value of equity
62	CAPT	- the (natural) logarithm of the market value of equity (in millions)
63	DMYL	- a dummy variable indicating extremely low dividend yield
64	ENTP	- the normalized earnings-to-price ratio
65	ETOP	- the ratio of earnings to price
66	ETP5	- the "typical" earnings-to-price ratio, last 5 years
67	LIQU	- a measure of liquidity, equal to the ratio of (cash plus receivables less current liabilities) to the market value of equity
68	MLEV	- leverage, at market value: the ratio of (market value of equity plus book value of debt) to the market value of equity
69	ECAP	- the market value of equity (in millions)
70	PTEQ	- the ratio of plant (fixed assets) to the market value of equity
71	YILD	- the ratio of dividends paid to the market value of equity
72	YLD5	- the "normal" value of dividend yield (over 5 years)

TABLE 1--Continued

J. Descriptors of Bank Type/Location		
73	DRMNY	- a dummy variable indicating a New York money center bank
74	DRMON	- a dummy variable indicating a money center bank outside of New York
75	DRSE	- a dummy variable indicating a southeastern bank
76	DRMW	- a dummy variable indicating a midwestern bank
77	DRSW	- a dummy variable indicating a southwestern bank
78	DRWC	- a dummy variable indicating a west coast bank

[a]See Appendix B for detailed descriptor definitions.

TABLE 2

SUMMARY STATISTICS OF THE DESCRIPTORS FOR THE JUNE 1977 CROSS SECTION

Descriptor		Minimum Value	Equal-Weighted Mean	Maximum Value	Capitalization-Weighted Mean	Standard Deviation
1	NCMLDA	-.1475	.1460	.4120	.1239	.0844
2	COMLNA	.1057	.2333	.3837	.2298	.0557
3	NCNLDA	-.6350	-.2385	.1193	-.3405	.1259
4	CONLNA	.0089	.1130	.2454	.0744	.0535
5	MUNIBA	.0156	.0891	.2267	.0691	.0446
6	RELNSA	.0061	.1249	.4460	.0883	.0701
7	ISECTA	.0537	.2017	.3648	.1576	.0727
8	TRDASA	0	.0073	.0495	.0102	.0102
9	CONTDA	0	.1456	.5266	.0960	.1435
10	DEMNDA	0	.3023	.4522	.2603	.0695
11	NFFBA	-.1106	.0227	.1874	.0338	.0518
12	FORDPA	0	.0747	.4860	.2007	.1054
13	SAVEDA	0	.1357	.4891	.0899	.1295
14	TBORA	.0011	.1131	.3119	.1220	.0610
15	TCAPA	.0441	.0785	.1543	.0698	.0170
16	TIMEDA	0	.3513	.6782	.4322	.1329
17	ATOLB	8.5768	16.8619	29.1167	19.4978	4.0698
18	BLEV	1.0000	1.1357	3.5593	1.0957	.2510
19	DILU	.7135	.9803	1.0000	.9813	.0432
20	DTOA	0	.0533	.2001	.0663	.0451
21	KMTMN	18.00	129.45	199.00	109.35	34.71
22	KMTUS	7.00	25.84	50.00	26.40	8.83
23	KPDEP	-.0530	-.0044	.0424	-.0071	.0165
24	RLTLTL	.2305	6.9374	18.3476	10.2528	3.5803
25	ATAX	0	.1945	.4367	.2767	.1113
26	FFMKT	0	.0425	.1811	.0359	.0391
27	FLO1	-.0503	.5694	2.6196	.5017	.6807
28	FRGNO	0	.0009	.0390	.0071	.0048
29	PAY1	.1453	.4405	.6564	.4245	.0925
30	PNCV	0	.0667	.8997	.0205	.1745
31	SALTOR	.0950	.2063	.3644	.1723	.0456
32	TRDVRA	0	.0295	.3160	.0313	.0485
33	VCAP	.0284	.1029	.2146	.1052	.0357
34	VERN	.0550	.3014	2.4219	.2114	.4270
35	VFLO	.0076	.2274	.8744	.2863	.1062
36	ABET	0	.0468	.4109	.0200	.0874
37	CUTD	0	.0271	.4870	.0055	.0932
38	DELE	-2.0000	.0753	2.0000	.0356	.5295

TABLE 2--Continued

Descriptor		Minimum Value	Equal-Weighted Mean	Maximum Value	Capitalization-Weighted Mean	Standard Deviation
39	DMNE	0	.0407	1.0	.0048	.1983
40	MRGIN	-.0390	.0817	.1733	.0830	.0404
41	REVENA	.0321	.0699	.0942	.0680	.0076
42	ROEQ	-.0732	.1192	.2201	.1378	.0377
43	AGRO	-.0544	.0760	.3186	.1031	.0537
44	DMS5	0	.9593	1.0	.9849	.1983
45	EGRO	-.3415	-.0068	.2059	.0643	.1336
46	OFFEX	-.8224	.0880	.9950	.0890	.3342
47	RSKLGO	-.2488	.0084	.2658	.0275	.0889
48	ASSI	6.5201	7.8866	10.9728	9.1057	.9347
49	MKTS	59.05	392.32	4844.75	1494.70	723.91
50	HBET	.1684	.9593	1.9306	1.0873	.3133
51	BTSQ	.0284	1.0129	3.1565	1.2484	.6166
52	HSIG	.0252	.0709	.1247	.0684	.0185
53	SGSQ	.0006	.0053	.0135	.0048	.0027
54	BS	.0796	.2573	.4235	.2705	.0633
55	BADJ	-.1787	-.0073	.2523	.0186	.0773
56	LPRI	1.3218	3.0758	4.0254	3.3659	.5323
57	RSTR	-.5275	.0231	.3881	-.0371	.1612
58	TREC	0	.0644	.2927	.0253	.0744
59	ATOLM	9.5411	21.7743	47.3130	19.1801	9.1119
60	BBET	-.3395	.1704	.2769	.1584	.0671
61	BTOP	.5498	1.3745	4.2768	1.0333	.5760
62	CAPT	14.3343	18.6962	22.2060	20.1191	1.0909
63	DMYL	0	.0163	1.0	.0009	.1270
64	ENTP	-3.3691	.0818	.2043	.1125	.3214
65	ETOP	-.1867	.1126	.2090	.1109	.0618
66	ETP5	-.0088	.1215	.2023	.1099	.0367
67	LIQU	-3.4624	1.5571	11.7263	1.9314	2.0686
68	MLEV	1.0000	1.2283	8.7087	1.1119	.7082
69	ECAP	1.68	247.27	2577.91	927.15	411.69
70	PTEQ	.0566	.4358	1.3210	.2711	.2861
71	YILD	0	.0531	.0893	.0444	.0185
72	YLD5	0	.0533	.0995	.0447	.0188
73	DRMNY	9				
74	DRMON	8				
75	DRSE	29				
76	DRMW	31				
77	DRSW	13				
78	DRWC	11				

These are the number of banks in each group.

multicollinearity results in bias in estimated coefficients, or estimated standard errors, or both. This is not true. The regression provides an unbiased indication of the coefficients for (partial derivatives with respect to) the descriptors, and of the degree to which these are accurately estimated in spite of the correlation with other descriptors. The t-statistics for the estimated coefficients provide a reliable test of the wisdom with which descriptors were constructed. With this in mind, we were not excessively afraid of multicollinearity.

On the other hand, when two descriptors are highly correlated, it becomes difficult to distinguish their effects; consequently, every effort was made to anticipate correlations in advance, and to construct well-differentiated descriptors that would exhibit significant variation relative to one another. For instance, instead of employing a multitude of financial ratios, we designed one or two which were believed to be the best measures of that aspect of financial condition. When two measures of the same conceptual variables were employed, it was always for one of two reasons: sometimes both measures were subject to independent measurement errors, so that a weighted average of the two would be a more accurate estimator of the underlying concept than either separately; sometimes we were uncertain a priori which would be the better descriptor, recognizing that the two definitions were clearly substitutes for one another, and relied on the regression to discriminate between the two. The latter was the case for four descriptors (NCMLDA, NCNLDA, FLO1, PAY1). Two definitions of each were employed in the early stages, and the best was chosen for the subsequent analysis.

3. The third principle was the requirement that each descriptor be valid across the entire cross section of banks. We were careful to operationalize our concepts through formulas that would be applicable to all cases. This aspect of our approach is best explained by an illustration of its violation: In many studies, the chosen measure of earnings growth blew up when earnings were negative, with the result that all banks that had had negative earnings had to be excluded from the sample; in contrast, we never deleted an observation because a computational formula failed. As another instance of this principle, we only employed descriptors for which there were available data for the majority of our sample.

4. A fourth principle was the search for robust formulas--in other words, for formulas that yielded reasonable descriptors for the conceptual variable regardless of the peculiar historical circumstances of the bank. This principle led in many cases to the use of five-year averages,

to smoothed values, or to the need for a truncation rule that wiped out otherwise extreme values. In general, the goal was a formula that would always produce a value that seemed reasonable when the raw data were examined.

5. A fifth principle was a variant of Occam's razor: When alternative formulas for a conceptual variable were available, and the difference in their validity was expected to be small, we chose the formula which was more familiar to professionals in the field of finance.

6. A sixth principle was that the descriptors were transformed to obtain a model that was linear. We attempted to transform descriptors and to draw in extreme outliers, so that the relationship between risk and the descriptors would be linear. In all cases, histograms of the descriptors were constructed to verify that the descriptor's range was appropriate and that a linear relationship would make sense. Only in the cases of historical beta, historical sigma, and capitalization (descriptors that have important predictive content for risk, and for which the relationship is clearly nonlinear) did we include several functions of the variables as descriptors in order to obtain a nonlinear relationship.

7. A seventh and final principle was that we relied on a priori judgment wherever possible. In other words, we attempted to select the descriptors on the basis of economic theory and in conformity with the above-mentioned principles. Then, we computed the values of each descriptor and examined them across a sample population to check for robustness and reasonability. We examined the correlation matrix among descriptors and redefined them in a few cases where extreme correlations showed up. Only after this was done were the descriptors introduced into a regression where any aspect of risk was the dependent variable.

Another important issue concerns the treatment of extreme or outlying values of the descriptors. No matter how robust a formula is, a few extraordinarily low or high values for banks in peculiar circumstances may be generated. Sometimes the formula is so constructed that these values represent equally extreme states of the underlying characteristic: In this case, the descriptor should be left as it is. But in other cases, the extreme values exaggerate the differences between the bank and the population of banks with ordinary values. In this case, it is appropriate to "pull in" the extreme value toward a more ordinary one. The reasoning behind this is that the bank really does not differ much from the group of banks at the boundary of the commonly observed region for the descriptor, so that the descriptor for this bank should be set equal to the value at the boundary.

This can be done by defining a lower and upper bound for the descriptor and redefining all values that fall outside the bounds to equal the bounds. Any value that falls below the lower bound is transformed to equal the lower bound; any value that is above the upper bound is transformed to equal the upper bound. This process may be called "Windsorizing," or, to use a more familiar but less specific term, truncation. For the majority of descriptors, the truncation criteria have been expressed in terms of multiples of the cross-sectional standard deviation among all banks. This means that values falling more than some number (5, for example) of cross-sectional standard deviations above the capitalization-weighted mean will be set equal to that upper bound.

The outcome of all this is that the descriptors seem to be fairly satisfactory. First, they appear to be meaningful in comparison across the full range of normal banks; this applies both within a cross section and in comparisons of the same bank over time. Second, the outlying cases have tended to coincide with a difficult period for the bank in question. Thus, the descriptors have proved to be accurate indicators of extreme risk.

Some descriptors which may indicate banks with potential or clear-cut problems are listed in Table 3, along with the banks so indicated (as of June 1977). In general, these outliers are quite far from the mean--the values for ROEQ, ENTP, ETOP, and MLEV are, for example, ten standard deviations. Two variables, DMNE and DMYL, are dummy variables; the outliers here are values of one. It is interesting to note that of all twelve descriptors, five are calculated from only accounting data (BLEV, PNCV, VERN, DMNE, ROEQ), one is a descriptor of market price variability (HSIG), and the remaining six utilize both accounting data and the market valuations of common stock. We feel that these findings are potentially important and deserve further study.

V. Procedure

Our primary data source is the COMPUSTAT bank tapes [1] which contain data on 124 large U.S. banks. Both the annual and quarterly tapes were used, although the only information taken from the latter was the monthly closing price of the common stock. A few additional items were drawn from the Keefe Bank Manuals [4]. Because of the pattern of data availability, the present study begins in March 1969 and continues through June 1977; this gives us a total of 11,219 data points, each being a monthly observation of a bank.

TABLE 3A

DESCRIPTOR OUTLIERS FROM THE JUNE 1977 CROSS SECTION

Descriptor	Outlier Direction	Outlying Banks[a]
18 BLEV - leverage at book	High	72
30 PNCV - probability of noncoverage	High	28, 66, 72, 99
34 VERN - variance of earnings	High	28, 57, 66
39 DMNE - dummy, negligible earnings	High[b]	24, 57, 66, 72, 87
42 ROEQ - income/equity	Low	72
52 HSIG - historical sigma	High	72
61 BTOP - book to price	High	72
63 DMYL - dummy, low yield	High[b]	72, 99
64 ENTP - normalized earnings to price	Low	72
65 ETOP - earnings to price	Low	72
66 ETP5 - earnings to price, 5 years	Low	66, 72
68 MLEV - leverage at market	High	72

[a]See table 3B for bank identification.

[b]A value of one.

TABLE 3B

BANK IDENTIFICATION

Number	Region	Name
24	Eastern	First Empire State Corporation
28	Eastern	Hartford National Corporation
57	Southeastern	Flagship Banks
66	Southeastern	Union Planters Corporation
72	Midwestern	Bank of Commonwealth, Detroit
87	Midwestern	Indiana National Corporation
99	Midwestern	Union Commerce Corporation

The first step is to compute, for each of the thirty-four quarters, the value of each descriptor for each bank in the sample, as it could have been computed at the beginning of that quarter. It is important to note that data are used for any quarter only if they would have been available at the start of that quarter. Data related to the stock market are presumed to be published immediately. Annual accounting data are not presumed to become available until four months after the end of the fiscal year; this allows for the ninety-day reporting delay and thirty more days for the data to be assembled into machine-readable form. This procedure insures that an observer could actually have computed these descriptors at the start of each quarter.

The sample of banks for any quarter is made up of all banks; any descriptor which is unavailable for a particular bank is assumed to be equal to the average value of that descriptor for that cross section. For each of the three months in the quarter, the monthly subsample is made up of all banks for which stock price returns in that month are available. These stock price returns are analyzed in relation to the descriptors computed as of the beginning of the quarter. Thus, three monthly samples are predicted with each set of descriptors, in conformity with a prediction rule that is revised quarterly and is based upon previously published information.

The model and the estimation procedure used are described in detail in Appendix A. Several interesting points which should be noted are:

(1) The estimation approach is iterative, in that the prediction rule for beta is estimated first; this is then used to define the dependent variable for the sigma prediction rule regression.

(2) Generalized Least Squares is used to account for heteroscedasticity. The resulting prediction rules are more statistically efficient.

(3) The prediction rules are estimated simultaneously for all individual banks in all time periods, through a pooled time-series, cross-sectional regression.

(4) The beta prediction rule is conditional upon the market return (the CRSP RETV index [3]), and the sigma prediction rule is conditional upon the typical cross-sectional standard deviation of residual return in any given month.

The study adhered strictly to the principles of experimental design. All procedures were specified in advance of examining the returns to be predicted. This was done to insure that the study would be self-validating. Otherwise, there would be no assurance that the results were likely to persist into the future.

VI. Empirical Results

As a preliminary to the multiple-regression results, Table 4 reports the simple regressions of investment risk on each of the descriptors. The predictive content of each descriptor, taken separately, is given for beta and for sigma. Since the multiple regression is not used, the predictive content of each descriptor includes its role as a surrogate for all other descriptors, as well as its own intrinsic relevance.

The t-statistics for the relationships and the relative order of importance of the descriptors are interesting. For beta, the single most powerful predictor is HBET, the historical estimate of beta. The second and fourth best predictors are, respectively, BS, the geometric average of the historical estimates of beta and sigma, and BTSQ, the square of HBET. The third most effective is ASSI, which measures the total assets of the bank: the larger the bank, the greater its beta. The fifth most important is the "relative strength" (RSTR) of the bank in the preceding year: the better the past market performance of the common stock, the lower the expected beta. Sixth is YLD5, the "normal" dividend yield. Seventh is total equity (market) capitalization (CAPT). Eighth is AGRO, the asset growth rate: the higher this growth rate, the higher the bank's beta. Next is a measure of leverage, the ratio of total assets to long-term liabilities or capital, valued at book (ATOLB). Tenth is ETP5, the bank's "typical" earnings-to-price ratio: the higher this ratio (or the lower the price-earnings ratio), the lower the bank's beta.

For residual standard deviation, or sigma, the two most important descriptors are measures related to historical sigma (HSIG, SGSQ). The third is the historical variability of earnings (VERN), while the fourth is related to historical sigma and beta (BS). Fifth is the logarithm of the price of the common stock (LPRI): the higher the price, the lower is sigma. Two different measures of leverage in the capital structure (MLEV and BLEV) are sixth and eighth in importance: the greater the leverage—whether calculated using book or market value of equity—the greater the residual variance. Seventh is a measure of "accounting beta" (ABET), and ninth is ETP5: the higher this ratio, the lower is sigma. Finally, historical beta (HBET) is tenth.

It is significant that those descriptors with the highest predictive content for beta are not the same as those for sigma; only three (HBET, ETP5, BS) are among the top ten for both beta and sigma. Thus, not only are systematic risk and residual risk fundamentally different aspects of

TABLE 4

INDIVIDUAL DESCRIPTORS AS PREDICTORS OF SYSTEMATIC AND RESIDUAL RISK

Descriptor		Prediction of Beta			Prediction of Sigma		
		Coef-ficient[a]	t-statistic[b]	Order of Importance[c]	Coef-ficient[a]	t-statistic[b]	Order of Importance[c]
1	NCMLDA	-.441	-2.92	41	-.029	-.31	71
2	COMLNA	-.211	-1.14	60	-.228	-1.97	50
3	NCNLDA	-.221	-2.02	50	.122	1.75	51
4	CONLNA	-.211	-.88	64	.626	4.15	28
5	MUNIBA	-1.187	-3.77	32	-.726	-3.64	32
6	RELNSA	-.422	-2.02	49	.223	1.68	53
7	ISECTA	-1.569	-7.45	12	-.351	-2.63	44
8	TRDASA	.406	.63	71	-1.090	-2.65	43
9	CONTDA	.185	1.67	53	-.063	-.90	63
10	DEMNDA	-.905	-7.47	11	-.294	-3.73	31
11	NFFBA	1.512	5.17	26	-.0051	-.03	78
12	FORDPA	1.139	7.18	14	-.030	-.30	72
13	SAVEDA	.121	1.04	62	-.087	-1.19	59
14	TBORA	1.093	4.86	28	-.011	-.07	77
15	TCAPA	-4.689	-5.59	21	-1.898	-3.61	33
16	TIMEDA	.207	2.20	45	.162	2.67	42
17	ATOLB	.026	8.12	9*	.014	6.47	19
18	BLEV	.208	3.75	33	.302	7.84	8*
19	DILU	-.739	-1.99	51	.719	3.14	40
20	DTOA	1.583	5.22	25	.179	.90	64
21	KMTMN	-.00037	-.81	65	.00031	1.06	62
22	KMTUS	-.0058	-3.74	34	-.00043	-.42	69
23	KPDEP	.483	1.22	57	-.475	-2.04	48
24	RLTLTL	.022	5.72	20	.0097	3.85	30
25	ATAX	-.185	-1.24	56	-.325	-3.59	34
26	FFMKT	-.039	-.10	78	-.468	-2.00	49
27	FLO1	-.038	-2.63	44	-.046	-5.08	26
28	FRGNO	6.401	3.17	37	-2.407	-2.17	46
29	PAY1	-.214	-1.40	55	.0077	.08	76
30	PNCV	-.303	-.69	66	1.282	6.44	20
31	SALTOR	.040	.16	77	.522	3.35	36
32	TRDVRA	.139	.28	75	-.421	-1.49	54
33	VCAP	1.443	4.80	29	.737	3.89	29
34	VERN	.134	1.06	61	.958	13.21	3*
35	VFLO	.542	3.48	36	.657	6.87	17
36	ABET	-.520	-1.14	59	2.006	8.03	7*
37	CUTD	1.293	2.05	48	2.076	5.60	25
38	DELE	.204	2.98	40	-.116	-3.18	39

TABLE 4--Continued

Descriptor	Prediction of Beta: Coef-ficient[a]	Prediction of Beta: t-statistic[b]	Prediction of Beta: Order of Importance[c]	Prediction of Sigma: Coef-ficient[a]	Prediction of Sigma: t-statistic[b]	Prediction of Sigma: Order of Importance[c]
39 DMNE	-.147	-.90	63	.589	6.02	23
40 MRGIN	-1.789	-5.79	19	-1.454	-7.57	11
41 REVENA	.274	.26	76	2.232	3.37	35
42 ROEQ	2.445	4.05	31	-.095	-.24	73
43 AGRO	2.162	8.33	8*	1.305	7.49	13
44 DMS5	.174	4.99	27	-.031	-1.34	56
45 EGRO	.145	.66	67	-.285	-2.15	47
46 OFFEX	.019	.44	74	-.014	-.48	68
47 RSKLGO	.148	2.09	47	.028	.58	67
48 ASSI	.125	9.29	3*	-.020	-2.39	45
49 MKTS	.00020	6.43	16	-.000014	-.77	65
50 HBET	.444	9.97	1*	.217	7.64	10*
51 BTSQ	.269	9.05	4*	.134	7.33	14
52 HSIG	6.778	6.72	15	8.844	14.44	1*
53 SGSQ	48.575	5.87	18	68.098	13.84	2*
54 BS	2.325	9.96	2*	1.594	11.00	4*
55 BADJ	1.015	5.48	23	.151	1.22	58
56 LPRI	-.068	-2.84	42	-.161	-10.12	5*
57 RSTR	-.411	-8.85	5*	-.039	-1.13	61
58 TREC	-.382	-7.23	13	.025	.74	66
59 ATOLM	.0046	3.15	38	.0033	3.26	37
60 BBET	-1.874	-5.92	17	-.921	-4.46	27
61 BTOP	-.013	-.49	73	.0059	.32	70
62 CAPT	.112	8.45	7*	-.027	-3.21	38
63 DMYL	.332	1.58	54	1.068	7.55	12
64 ENTP	.141	.61	72	-1.059	-6.89	16
65 ETOP	.292	1.18	58	-1.159	-6.92	15
66 ETP5	-4.230	-7.96	10*	-2.418	-7.81	9*
67 LIQU	.013	1.77	52	-.0059	-1.18	60
68 MLEV	.131	2.80	43	.268	8.65	6*
69 ECAP	.00019	5.51	22	-.000032	-1.46	55
70 PTEQ	.120	2.17	46	.245	6.63	18
71 YILD	-.346	-.63	70	-.077	-.21	75
72 YLD5	-9.248	-8.58	6*	-3.741	-5.91	24
73 DRMNY	.200	4.30	30	-.050	-1.68	52
74 DRMON	.030	.65	68	-.0064	-.21	74
75 DRSE	.097	3.00	39	.129	6.22	22
76 DRMW	-.152	-5.41	24	-.112	-6.28	21
77 DRSW	-.027	-.64	69	.033	1.26	57
78 DRWC	.175	3.73	35	.092	3.02	41

FOOTNOTES TO TABLE 4

[a]For beta, the coefficient gives the adjustment to predicted beta for a unit change in the descriptor. For sigma, the coefficient gives the adjustment to the relative value of sigma (i.e., sigma ÷ cross-sectional average sigma) for a unit change in the descriptor.

For purposes of interpretation, it is also useful to know the change in the dependent variable implied by a one-standard-deviation shift in the descriptor, i.e., the coefficient with respect to a normalized descriptor. This adjusted coefficient is obtained by multiplying the reported coefficient by the descriptor's standard deviation, which is given in Column 5 of Table 2.

[b]This is the t-statistic for the simple GLS regression in which the descriptor is the only information used to predict risk, with 11217 degrees of freedom. The critical point for the 99% confidence level is 2.58. The larger the absolute value of the t-statistic, the larger is the predictive content of this descriptor when used alone. The R^2 (coefficient of determination) achieved by each descriptor alone is proportional to the squared t-statistic.

[c]This is the rank of the descriptor, among all descriptors, in terms of explanatory power, with 1 being the highest. The asterisks denote the top ten.

the overall risk of a bank, but they are, in addition, determined by different aspects of the bank's operational characteristics.

Table 5 reports the results of regressions for beta, using descriptors of assets and liabilities. Using the simplest model of the investment risk of a portfolio of assets and liabilities, the systematic risk of the net portfolio (excluding capital accounts) is a linear function of the proportions in asset and liability categories, with coefficients that reflect the systematic risks of the various categories. The systematic risk of the shareholders' equity is then obtained by multiplying portfolio systematic risk by the leverage ratio, and is consequently a nonlinear (inverse) function of the proportion of long-term capital. However, for simplicity, we first estimated a model for beta as a linear function of asset and liability proportions. (The coefficient of the equity proportion in this equation can be interpreted as the first-order term in a Taylor expansion, and is therefore expected to be negative.)

Relationships including asset and liability proportions as descriptors were first estimated alone, and then with one added descriptor of the size of the institutions: ASSI, the logarithm of total assets. The total asset variable is highly significant: the coefficient is positive for beta and negative for sigma. The coefficients of asset and liability proportions generally change very little as ASSI is brought into the regressions. The major exception is in the coefficient of foreign deposits (FORDPA), which is positive for beta and negative for sigma when ASSI is excluded, and reverses sign in both cases when ASSI is brought into the regression. Clearly, the proportion of foreign deposits is a surrogate for bank size. The general insensitivity of other coefficients to inclusion of ASSI is a sign that multicollinearity is absent. To save space, the results are reported for only one set of regressions, those including ASSI.

The regressions for beta in Table 5 are of the form

$$\text{predicted beta} = \text{constant} + b_{ASSI}(\ln(\text{total assets}))$$

$$+ \sum_{j=1}^{J} b_j \left(\frac{\text{dollars in asset/liability category } j}{\text{total assets}} \right) .$$

The regressions for sigma in Table 6 are of the form

$$\frac{\text{predicted sigma}}{\text{average sigma}} = \text{constant} + s_{ASSI}(\ln(\text{total assets}))$$

TABLE 5[a]

ASSET/LIABILITY DESCRIPTOR REGRESSIONS FOR BETA

Descriptor	Assets Only	Liabilities Only	All Asset/ Liability Descriptors	With Net Asset/Liability Descriptors
Constant	.278 (.182)	.658 (.239)	1.013 (.285)	.731 (.213)
1 NCMLDA				.185 (.187)
2 COMLNA	-.381 (.218)		-.355 (.251)	
3 NCNLDA				.302 (.135)
4 CONLNA	.612 (.292)		.278 (.308)	
5 MUNIBA	1.764 (.514)		1.724 (.537)	1.698 (.528)
6 RELNSA	-.367 (.239)		-.737 (.295)	
7 ISECTA	-1.900 (.364)		-1.955 (.412)	-1.708 (.400)
8 TRDASA	-.983 (.671)		-1.538 (.711)	-1.378 (.703)
9 CONTDA		1.505 (.579)	1.394 (.585)	
10 DEMNDA		-.658 (.176)	-.645 (.179)	-.670 (.146)
11 NFFBA		.606 (.327)	.849 (.337)	.850 (.348)
12 FORDPA		.092 (.237)	-.442 (.295)	-.081 (.263)
13 SAVEDA		-.145 (.624)	.0010 (.638)	
14 TBORA		.078 (.285)	-.342 (.343)	.010 (.307)
15 TCAPA		-1.949 (1.009)	-1.953 (1.052)	-1.400 (.984)
16 TIMEDA		-.324 (.170)	-.111 (.187)	
48 ASSI	.109 (.016)	.086 (.020)	.085 (.021)	.083 (.020)

[a]The standard error of each coefficient is given in parentheses.

$$+ \sum_{j=1}^{J} s_j \left(\frac{\text{dollars in asset/liability category } j}{\text{total assets}} \right) .$$

The asset categories and liability categories are mutually exclusive, but not exhaustive. The coefficients b_i (or s_j) are not the beta (or sigma) *levels* for the categories, but rather are adjustments to the otherwise normal beta (or sigma) for a bank due to the category. The essential content of the results lies in the differences between any pair of coefficients b_i and b_j (or s_i and s_j). If funds are moved from category i to category j, the difference in coefficients gives the expected effect on risk. For example, if 1/10 of a bank's liabilities are shifted from net federal funds borrowed (NFFBA) to demand deposits (DEMNDA), the effect on risk can be found by comparing the coefficients for these two categories. For beta, $b_{NFFBA} = .849$ and $b_{DEMNDA} = -.645$. The difference in beta is $(-.645) - (.849) = -1.494$. A shift of 1/10 of liabilities from NFFBA to DEMNDA would cause 1/10 of this change, or a reduction in beta by .1494. For sigma, the difference is $1/10\ [(-.562) - (.239)] = -.080$. This is interpreted as a reduction in residual standard deviation (sigma) equal to .080 (8.0%) of average sigma. Of course, these computed values are only estimates, but the relatively small standard errors for the coefficients allow us to place some confidence in the results, as being representative of the sample period in which the model was estimated.

The first regression in Table 5 predicts beta based upon asset proportions. Tax-exempt bonds (MUNIBA) and to a lesser degree consumer loans (CONLNA) are found to be high beta categories, while investment securities other than tax-exempts (ISECTA) and the trading account (TRDASA) are found to be very low beta, and real estate loans (RELNSA) and commercial loans (COMLNA) are moderately low beta. The standard errors of the estimated coefficients are typically small relative to the estimated magnitudes.

The second regression includes liabilities only. Consumer time deposits other than passbook savings (CONTDA) is a high beta category, and net federal funds borrowed (NFFBA, the excess of borrowing over lending on the federal funds market) is moderately high beta. Demand deposits (DEMNDA) are relatively low beta. Shareholders' equity (TCAPA) greatly reduces beta, as is to be expected.

The third regression brings in both assets and liabilities. When compared to the two previous regressions, there are no changes in sign among the assets, and several changes in sign involving insignificant magnitudes in the liabilities. The stability of coefficients suggests that each group of variables is not an important surrogate for the opposite category.

The final regression uses alternative measures of the portfolio, which rely on net differences between asset and liability groups rather than the separate amounts in the categories. Net consumer lending (NCNLDA), for example, equals consumer lending (CONLNA) plus real estate loans (RELNSA) less passbook savings (SAVEDA) and consumer time (CONTDA). The original reasoning behind the definition of these net activities was that interest rate and liquidity risks of the paired asset and liability categories were similar, so that the net would be a parsimonious measure of exposure. As expected, the loss in explanatory power due to replacement of asset/liability categories by the nets is relatively small (Table 9 below). For consumer lending the net category is bound to be overly simplistic, for it lumps together real estate loans, a very low beta category, with consumer lending, a relatively high beta category. It probably would have been better to net consumer lending (CONLNA) against consumer time deposits other than passbook (CONTDA) and to net real estate lending against passbook deposits.

Table 6 reports the regressions for sigma. It is interesting to compare these regressions with the beta regressions. The sigma regressions are estimated with substantially greater accuracy: the typical standard error is about one-half as great as for beta. This generally occurs when the same data base is used to estimate systematic risk and residual risk, because the data are more informative concerning residual risk (a variance), than concerning systematic risk (a covariance).

Comparison of the asset/liability regressions for the two aspects of risk is also instructive. Equity capital and demand deposits are in both cases the two most risk-reducing liabilities. Conversely, net federal funds borrowing is a major risk-enhancing liability in both. However, two liability categories differently effect beta and sigma: consumer time deposits (CONTDA) and foreign deposits (FORDPA) negligibly affect sigma, but each variable has a substantial estimated effect on beta. Foreign deposits are estimated as reducing beta, as is natural, since the covariance of their profitability with the economy might be expected to be low. Consumer time deposits are the highest-beta liability.

On the asset side, consumer lending (CONLNA) is a high-risk category in both cases; the trading account and investment securities (TRDASA, ISECTA) are the lowest and second or third lowest in risk in the two cases. The risk contributions of municipal bonds (MUNIBA) are opposite in the two cases: municipal bonds are a far higher risk as regards beta, and a far lower risk as regards sigma.

TABLE 6[a]

ASSET/LIABILITY DESCRIPTOR REGRESSIONS FOR SIGMA

Descriptor	Assets Only	Liabilities Only	All Asset/ Liability Descriptors	With Net Asset/Liability Descriptors
Constant	1.399 (.118)	2.043 (.156)	2.163 (.184)	2.104 (.139)
1 NCMLDA				.035 (.116)
2 COMLNA	-.166 (.135)		-.152 (.157)	
3 NCNLDA				.176 (.086)
4 CONLNA	.579 (.181)		.502 (.190)	
5 MUNIBA	-.904 (.323)		-.657 (.334)	-.729 (.329)
6 RELNSA	-.015 (.152)		-.243 (.191)	
7 ISECTA	-.368 (.229)		-.459 (.258)	-.306 (.247)
8 TRDASA	-1.280 (.424)		-1.362 (.449)	-1.356 (.445)
9 CONTDA		.176 (.344)	-.059 (.349)	
10 DEMNDA		-.572 (.117)	-.562 (.118)	-.547 (.094)
11 NFFBA		-.033 (.216)	.239 (.225)	.185 (.225)
12 FORDPA		.121 (.152)	-.115 (.190)	.034 (.168)
13 SAVEDA		-.246 (.377)	-.217 (.388)	
14 TBORA		-.350 (.189)	-.540 (.227)	-.318 (.201)
15 TCAPA		-3.367 (.632)	-2.665 (.661)	-2.439 (.617)
16 TIMEDA		-.150 (.114)	-.116 (.127)	
48 ASSI	-.032 (.010)	-.065 (.013)	-.061 (.014)	-.069 (.013)

[a]The standard error of each coefficient is given in parentheses.

The coefficient of asset size (ASSI) remains to be discussed. It is negative and virtually constant in all regressions for sigma and positive and virtually constant in all regressions for beta. The coefficient for beta is quite similar to the simple regression coefficient, but the coefficient for sigma is larger in magnitude than the simple.

Table 7 reports regressions including all fundamentals. In addition to those relating to asset and liability proportions and total assets, descriptors of asset ratios, and of the operating characteristics and income statement of the bank are added. The coefficients of the first sixteen descriptors are directly comparable with the estimates in Tables 5 and 6. The sign of an estimated effect that is significant in one or the other table never changes as a result of including the other fundamentals. The insensitivity of signs and magnitudes of estimated effects to the added fundamentals is another encouraging indication of low multicollinearity.

A number of descriptors of operating characteristics are significant in the prediction of residual risk but only one is in the prediction of beta. Among the significant descriptors in prediction of residual risk, most signs are plausible: the higher the effective tax rate (ATAX), the lower the residual risk; the greater the ratio of average cash flow to liabilities (FLOW1), the lower the residual risk; the greater the payout ratio (PAY1), the lower the residual risk; the greater the earnings variability (VERN), the higher the residual risk; and the greater the covariability of earnings with economywide earnings (ABET), the higher the residual risk. However, one effect is puzzling: the greater the apparent probability that fixed charges will not be covered (PNCV), the lower is the predicted residual risk. Obviously, the reverse sign is the one to be expected. The simple regression coefficient was positive and highly significant. Apparently this variable is interacting with other measures of leverage. Also, the degree of variability in capital structure (VCAP) was expected to be predictive of higher residual risk but, in fact, has a significant negative coefficient. Finally, one significant effect was not clearly predictable from our a priori expectations: the extent of federal-funds-market-making activity (FFMKT) is found to be predictive of lower residual risk. This suggests that an active market maker can better control its destiny. The reverse sign would have suggested that market making leads to increased uncertainty, due to speculative risk from unpredictable short-term movements in the federal funds market.

In prediction for beta, only one of these descriptors of operating characteristics achieves significance. The

TABLE 7[a]

REGRESSIONS WITH ALL FUNDAMENTALS, INCLUDING DESCRIPTORS
DEPENDENT UPON THE MARKET VALUATION OF COMMON STOCK

Descriptor	Regressions for Beta		Regressions for Sigma	
	Selected	All	Selected	All
Constant	-.868	-2.890*	-.915	-1.737*
1 NCMLDA		.0055		-.111
2 COMLNA	-.776**	-.869**		-.381
3 NCNLDA		.123		-.0048
4 CONLNA		-.658		.041
5 MUNIBA		.421	-.810**	-.915*
6 RELNSA	-.382	-.529		-.278
7 ISECTA	-1.080***	-1.426**		-.447
8 TRDASA	-1.234	-1.384	-1.351**	-1.331*
9 CONTDA	.069	.611	-.267*	-.085
10 DEMNDA	-.988***	-.957***	-.229	-.242
11 NFFBA	.963*	1.011*		.227
12 FORDPA		.301	.200	.298
13 SAVEDA		.203		-.285
14 TBORA		1.094		-.105
15 TCAPA		-.258		.333
16 TIMEDA		.799*		.110
17 ATOLB	.012	.025	.028***	.024*
18 BLEV	.159*	.346*	.036	.103
19 DILU	-.600	-.528	.869***	.873***
20 DTOA		-1.101		-.822
21 KMTMN		-.00029		-.00067
22 KMTUS	-.0041*	-.0035		-.00056
23 KPDEP	-.537	-.715	-.472	-.737*
24 RLTLTL	-.021	-.058**	-.0025**	-.023
25 ATAX		.114	-.338*	-.325*
26 FFMKT	-.097	-1.164	-1.031***	-1.157*
27 FLO1	-.028	-.030	-.027**	-.024*
28 FRGNO		2.831		-1.187
29 PAY1	-.499*	-.575	-.340*	-.275
30 PNCV		.183		-.964**
31 SALTOR	.807*	1.160**		.346
32 TRDVRA		-.407		-.171
33 VCAP		.196	-.722**	-.762**
34 VERN		-.140	.383***	.497***
35 VFLO		.068		.132
36 ABET		.280	1.030***	1.173***

TABLE 7--Continued

Descriptor		Regressions for Beta		Regressions for Sigma	
		Selected	All	Selected	All
37	CUTD	1.592*	1.637*	1.426***	1.318**
38	DELE		.170		.00038
39	DMNE		.097		-.239
40	MRGIN	-.590	-.780	-1.125**	-.858
41	REVENA	-9.233***	-11.011***		-.664
42	ROEQ	1.858*	1.968		.458
43	AGRO		-.241	.367	.090
44	DMS5	.0075*	.088*		-.0070
45	EGRO		.230		.370
46	OFFEX		-.087		-.030
47	RSKLGO		.084		-.015
48	ASSI		-.146	-.177***	-.182***
49	MKTS		.000060	-.000044	-.000036
59	ATOLM		.0055		.0050
60	BBET		-.468		.187
61	BTOP		.047		.073
62	CAPT	.208***	.352***	.138***	.188***
63	DMYL		.250	.554***	.589***
64	ENTP		.061		-.602
65	ETOP	1.464**	.673	-.290	-.846
66	ETP5	-5.359***	-3.769*	-1.056	-1.259
67	LIQU		-.026*	-.012	-.034***
68	MLEV		-.115	.138*	.112
69	ECAP	-.00040***	-.00048***		-.00011
70	PTEQ		.034		.071
71	YILD	3.120**	5.432**	3.089***	3.768**
72	YLD5	-4.941	-6.286*	-2.333	-1.892

[a]Significance levels, as derived from the appropriate F-statistic, are denoted as follows: *: 95%; **: 99%; ***: 99.9%.

signs of the effects are typically the same, with the exception of PNCV and VCAP, where the expected positive signs occur, and VERN, where the expected positive sign is contradicted by a small negative coefficient.

Turning next to measures of earning success, the indicator for previous dividend cuts (CUTD) is a highly significant predictor of both higher systematic risk and higher residual risk. Operating margin (MRGIN) is predictive of lower systematic and residual risk. The ratio of operating revenue to total assets (REVENA) is likewise predictive of lower residual and systematic risk. Return on equity (ROEQ) is predictive of higher risk.

No measures of earnings growth are consistently important, although the indicator for an available earnings history is marginally predictive of higher systematic risk with a negligible effect on sigma. Of the two measures of size, only ASSI (asset size) achieves significance. The coefficients are somewhat greater in magnitude than they were in the previous regressions with asset/liability characteristics only, probably because of an interaction with the size of market capitalization descriptor (CAPT), to be discussed below. The coefficient for asset size (ASSI) in prediction of beta has changed sign and lost significance. Again, this is probably the result of interaction with the coefficient for market capitalization.

Finally, we come to measures of financial ratios and other characteristics which are dependent on the market valuation of common stock, taken in conjunction with income-statement and balance-sheet data. Here the nature of the effects must be interpreted with some care. First, the dummy variable for negligible yield (DMYL) is predictive of greater risk, as is to be expected. However, current yield is significantly predictive of higher risk. When this is contrasted with the negative coefficient for the five-year normal yield and for the payout ratio, it may be interpreted as a surrogate for a recent decline in the bank's circumstances. Current yield is defined as the ratio of the previous year's dividends to current price. This ratio is often high, relative to the payout ratio, because of a recent pessimistic adjustment in the future prospects of the bank, which causes a reduction in the denominator (price), but is not yet reflected in the numerator (last year's dividends). Thus, a high value of current yield, relative to past yield, often indicates that the circumstances of the bank have recently declined and is thus predictive of greater risk.

The same pattern of signs is seen in the earnings/price ratio. The normal earnings/price ratio (ETP5) is predictive of lower risk or, equivalently, a high price/earnings ratio is predictive of higher risk. This is consistent with a general property of growth-oriented firms, which is that the longer the apparent duration of the promised stream of future dividends, the greater is investment risk. The sign of the current earnings/price ratio (ETOP) is also negative for sigma, but it is positive for beta. This last effect can possibly be understood again as indicating that the decline in the present price is reflective of a downward adjustment in future prospects, relative to recent earnings.

Greater liquidity (LIQU) is predictive of lower residual risk and has a smaller effect upon systematic risk. Finally, greater market capitalization (CAPT) is predictive of higher risk. It is important to note here that (1) there is a substantial positive correlation (approximately .72 in our sample) between CAPT, the logarithm of market capitalization, and ASSI, the logarithm of total assets; and (2) their difference (ASSI - CAPT) is the logarithm of "the market valuation of each dollar of assets." This difference is thus a measure of the manner in which the bank is operated. Consequently, a positive coefficient for CAPT, in conjunction with a negative coefficient for ASSI, suggests that greater expected profitability with a given asset base results in higher risk.

Finally, Table 8 reports the regression coefficients for the six dummy variables which bring in the regional characteristics of the banks. The regressions show that the typical New York money-center bank is much higher in systematic risk than the norm, but a little bit below normal in residual risk. West Coast banks are next highest in systematic risk and also a little above the norm in residual risk. The Southeastern banks are significantly above normal in both the risk measures. All of the earlier regressions, reported in Tables 5 - 8, were also run in an alternative mode with regional dummy variables included. Happily, when the fundamental characteristics of banks are included, the regional dummies lose significance: the group as a whole generally lacked statistical significance (by the F-test), and when the regional variables were considered singly, only the dummy variable for the Southeast region was usually significant, with a small positive coefficient. Thus, most of the regional differences in systematic and residual risk can be attributed to various fundamental characteristics of the banks.

Table 9 reports the overall adjusted R^2 statistics for the regressions in the earlier tables. In addition, adjusted R^2 are reported for certain regressions of special interest which incorporate historical risk measures, as well as fundamental descriptors. The first row of the table relates to the assumption that all banks have identical risk

TABLE 8[a]

REGRESSIONS WITH ONLY THE REGIONAL-TYPE DUMMY VARIABLES

Descriptor		Beta Prediction Rule	Sigma Prediction Rule
73	DRMNY	.239***	-.035
74	DRMON	.083	.0048
75	DRSE	.135***	.116***
76	DRMW	-.055	-.070**
77	DRSW	.031	.041
78	DRWC	.217***	.095**

[a]Significance levels, as derived from the appropriate F-statistic, are denoted as follows: *: 95%; **: 99%; ***: 99.9%.

TABLE 9

SUMMARY OF ADJUSTED R^2 STATISTICS

Independent Variables	Regression for: Beta	Sigma
Constant	.2594	.0887
Historical estimate	.2659	.1052
Historical estimate for beta and Bayesian adjustment thereto	.2675	---
All market price variability descriptors	.2755	.1096
Asset proportions and asset size	.2671	.0929
Liability proportions and asset size	.2673	.0933
All asset/liability proportions and asset size	.2690	.0959
Net asset/liability proportions and asset size	.2685	.0954
Selected fundamentals (including market valuation descriptors)	.2830	.1222
All fundamentals (including market valuation descriptors)	.2829	.1235
All descriptors	.2852	.1321

levels in each period. R^2 in the predictive regression for beta is .2594, indicating that this proportion of the variance of monthly bank common stock returns can be attributed to a common and identical dependence on the overall market return. R^2 for the corresponding assumption for the prediction of sigma is .0887, indicating that this proportion of the variance in the average absolute residuals in the pooled cross-section time series can be attributed to month-to-month differences in cross-sectional average residual variability.

The second row refers to the attained R^2 when the only descriptor is the historical estimate of the risk measure (beta and sigma, respectively). Next is the R^2 achieved in prediction of beta, where a Bayesian adjustment term for measurement error in historical beta is included along with the historical beta. The fourth row of the table gives results when all market-price-variability descriptors are incorporated.

The second section of the table gives R^2 for the various regressions including asset/liability descriptors and asset size. The third section reports the regressions including all fundamental variables. The final row reports the regressions including all descriptors.

It is encouraging that the regressions including all fundamentals but no others (i.e., market-price-variability descriptors are omitted) achieve nearly the same R^2 as the regressions that include the market-price-variability descriptors as well. The increase in R^2 from use of all descriptors is .0258 (.2852 - .2594) for beta, and .0434 (.1321 - .0887) for sigma. The prediction rule for beta based on all fundamentals attains 90 percent of this increase, while the prediction rule for sigma attains 80 percent. Thus, the measures of the behavior of the stock price in the market add little to our ability to predict its subsequent variability in the market. Moreover, the fundamentals taken alone do substantially better than the market-price-variability descriptors taken alone. Since the market-price-variability descriptors include the natural Bayesian predictions from historical data, this result suggests that the explanatory power of the fundamental descriptors is fairly complete. Otherwise, the historical descriptors would serve as surrogates for the omitted fundamental variables and would achieve substantial importance in the prediction of systematic and residual risk. Because of the small significance of the market-price-variability descriptors, we chose to save space by omitting the tables referring to these regressions. It is sufficient to note that, in general, inclusion of the market-price-variability descriptors did not importantly affect the signs or significance of the fundamental variables.

The regressions reported thus far are related to the period from March 1969 through June 1977: thirty-three quarters and one partial quarter, or 100 months. We also had available to us less complete data on a smaller sample of banks for a longer history (forty-five quarters). We divided this longer history into two intervals and fitted separate regressions to each interval to investigate the stability of the coefficients. Tests for significant changes in the structure of coefficients were either insignificant or barely exceeded the 99 percent critical level. This was encouraging in indicating that the structure of the risk relationships has not substantially changed in the recent past.

VII. Conclusions and Implications

The central conclusion of the study is that systematic and residual risk in banks can be predicted from predetermined fundamental data. Prediction rules estimated in this way can serve a useful function in monitoring bank risk. The predictive significance of fundamental descriptors serves as a measure of the appropriateness of the descriptor as an indicator of risk, and hence as a target for regulation. For example, alternative formulas for capital adequacy can be validated and compared in terms of their predictive content.

The descriptors used in this study were restricted to the limited coverage of the COMPUSTAT data base and Keefe manual. It was not possible to test the various capital-adequacy formulas that are now used, since some data were missing. However, a number of natural descriptors of balance sheet, income statement, and operating variance could be computed. Some of these were found to be indicative of serious bank difficulties, in the sense that they produce substantial outliers when bank circumstances were aberrant. Perhaps more important, after the effect of the outliers was diminished by truncation of extreme values, the transformed descriptors were predictive of differences in risk across the full continuum of banks in the sample.

The fundamental descriptors were quite successful in predicting differences in risk. A large number of descriptors were statistically significant. The historical measures of market-price variability added little to the explanatory power of the fundamentals. The fundamental information, taken as a group, explains more than the market-price-variability data.

Interestingly, the predictors of systematic and residual risk differ importantly. Only three of the ten best simple predictors of beta are also included among the ten best simple predictors of residual risk, and two of these are historical measures of market variability. Among the important simple fundamental predictors of beta are descriptors of size, dividend yield, equity capitalization, and the asset-to-long-term-liability ratio. The most important simple predictors of residual risk are earnings variability, leverage in the capital structure (with common stock valued at book and market), and a measure of accounting beta. In the multiple-regression models, the signs of descriptors are generally the same for prediction of beta and residual risk, but the relative magnitudes are often significantly different.

Several aspects of the results are suggestive. For example, size (best measured by total assets or, alternatively, measured by market share or total value of common stock) is a good single predictor of beta: the larger the size of the bank, the higher the expected systematic risk. However, in the multiple-regression models, size is only one among a number of important descriptors and loses its dominant role. Thus, the larger banks are clearly more exposed to systematic risk in the economy, but most causes for this exposure are captured by other descriptors in the model.

It is interesting that net federal funds borrowed (NFFBA) is a predictor of increased risk in regressions for both beta and sigma (statistically significant for beta), but that federal funds market-making activity (FFMKT)--defined as the volume of offsetting borrowing and lending--is predictive of lower risk (significant for sigma). This suggests that measures of risk based on the gross amount of federal funds borrowed are incorrect. Instead, net borrowing, being predictive of higher risk, should be used as an indication of increased leverage.

It is also interesting that the ratio of long-term debt to total assets is predictive of lower risk, confirming that long-term debt is a stabilizing influence that can be regarded as an element of capital. However, from the point of view of variability of the common stock price, senior liabilities constitute a leveraging device that increases investment risk, and it is not surprising that leverage due to senior long-term liabilities, whether measured in terms of the book value of capital (BLEV) or the market value of capital (MLEV), is a good simple predictor of increased risk. In the multiple regressions, BLEV is the more important descriptor. The two measures of leverage which are the best simple predictors of beta are the ratio of total assets to long-term liabilities (ATOLB) and the ratio of risk liabilities to long-term liabilities (RLTLTL). These are also effective simple predictors of residual risk. However, in the multiple regressions, with a number of other highly correlated leverage descriptors present, ATOLB is less significant and the coefficient of RLTLTL changes sign.

No single descriptor in the model fully captures the profitability of the bank. One can think of profitability as the product of two ingredients: revenue per dollar of assets (REVENA) and operating profit per dollar of revenue (MRGIN). The former is a simple predictor of increased risk, but the sign changes in the multiple regressions for beta and sigma. Operating margin (MRGIN) is consistently a predictor of reduced risk, presumably due to the fact that the bank's assets are being managed more effectively. The extent of prior dividend cuts (CUTD) is another strong and consistent predictor of increased risk, which amplifies the effect of operating margin.

It is natural, from the point of view of capital asset theory, to assign capital costs for assets and liabilities in relation to the contribution of the item to systematic risk. For this purpose, the adjustments for systematic risk obtained from Table 5 are the appropriate estimates. For example, the beta coefficients for municipal bonds and for real estate loans differ by [1.724 - (-.737)] = 2.461. In a typical bank, after correction for the leverage in the capital structure, the beta of municipal bonds is estimated to be 2.461 greater than for real estate loans. Since the contribution to beta per dollar of assets in municipals significantly exceeds the contribution to beta from real estate loans, the capital cost assessed per dollar of municipal investment should be correspondingly greater. Investment securities other than municipals and trading account securities show up as other low-beta assets. On the liability side, capital accounts, demand deposits and foreign deposits show as low-beta liabilities, and consumer time deposits and net federal funds borrowed show as high-beta liabilities.

A number of measures of aggressiveness in the bank's growth policy show up as predictive of higher risk, particularly in regard to residual risk. These include the normal payout ratio and normal yield (both indicators of lower retention rates and hence of lower growth), which are predictive of lower risk, and the growth rate of total assets, predictive of higher residual risk.

Having discussed the prediction of differences in risk, mention should be made of the absolute risk levels in our sample of banks. Natural measures of risk are averages of beta, computed relative to the CRSP RETV index over a sixty-month history, and the average residual standard deviation (sigma) in these regressions. The sample average beta, with each bank weighted by the market value of outstanding common stock (market capitalization), was .71 for the sixty-month period ending in January 1969, and was 1.10 for the sixty-month period ending in January 1977. The equal-weighted average increased similarly, from .63 to .96. For residual risk, defined as the standard deviation of monthly residual returns, the capitalization-weighted average increased from .051 in the early period to .072 in the latter, while the equal-weighted average increased from .054 to .068. These increases signal increased difficulty in bank regulation. Increased systematic risk in the banking system raises the probability of widespread disaster, however small the probability may be, since the aggregate net worth of all banks is more unstable. Increased residual risk is associated with more frequent difficulties for individual banks, independent of the economy as a whole. The prevention of failure has become more difficult, and the insurance liability has grown because of the higher probability that extreme returns will occur as a result of the intrinsic uncertainty in the bank's operations.

APPENDIX A: THE MODEL USED

The Model and Definitions

The following definitions will be used:

$t=1,,,T$ the month, varying from 1 to T
$n=1,,,N$ the index of the individual bank, varying from 1 to N
$j=1,,,J$ the index of an individual descriptor, with J descriptors
$(1+i_{Ft})$ the riskless return in month t, defined as the 4-6 month prime commercial paper rate at the start of that month
$(1+i_{Mt})$ the market return in month t. We use the CRSP RETV (value-weighted returns), including dividends
$(1+i_{nt})$ the return on security n in that month
$r_{Mt} = \ln(1+i_{Mt}) - \ln(1+i_{Ft})$ the logarithmic excess return for the market index, closely similar to the arithmetic excess return $i_{Mt} - i_{Ft}$.
$r_{nt} = \ln(1+i_{nt}) - \ln(1+i_{Ft})$ the excess logarithmic return relative on security n
x_{jnt} the value of the j^{th} descriptor for bank n in month t.

In each month t, let the probability distribution of logarithmic return relatives be determined by the model:

$$r_{nt} = \alpha + \beta_{nt} r_{Mt} + e_{nt}, \qquad n=1,\ldots,N_t$$

with α = overall average excess return, approximately zero
β_{nt} = systematic risk coefficient of bank n in month t
e_{nt} = residual return of bank n in month t
N_t = number of banks in month t.

Let the model for β_{nt} be:

$$\beta_{nt} = b_0 + b_1 x_{1nt} + \ldots + b_J x_{Jnt},$$

for all time periods t and banks n, where $b_0,\ldots,b_J$ are the coefficients of the prediction rule for systematic risk. Let

$$E(e_{nt}) = 0, \; Cov(e_{nt}, r_{Mt}) = 0 \quad \text{for all} \quad t ,$$

and let σ^2_{nt} be the residual variance of e_{nt}. The model for the standard deviation is:

$$\sigma_{nt} = \bar{s}_t \; (s_0 + s_1 x_{1nt} + \ldots + s_J x_{Jnt}) \; ,$$

where $\bar{s}_t$ is the typical cross-sectional standard deviation in month t and $s_0, \ldots, s_J$ are the coefficients of the prediction rule for residual risk.

Define:

$\delta_{nt} = E(|e_{nt}|)$, the mean absolute residual return for security n in month t

$\gamma = \sigma_{nt}/\delta_{nt}$. It may be shown that $\gamma = \sqrt{1+c^2(|x|)}$ when $E(x) = 0$, where $c(|x|)$ is the coefficient of variation of $|x|$.

Then the model for residual risk can be rewritten as:

$$\delta_{nt} = \bar{\delta}_t (s_0 + s_1 x_{1nt} + \ldots + s_J x_{Jnt}) \; ,$$

where $\bar{\delta}_t = \frac{1}{\gamma} (\overline{s_t})$ is the typical mean absolute residual in month t.

The Estimation Approach

Each regression is run over the pooled sample of all data points n in all months t . The estimation proceeds in two passes: Each pass consists of two forms of regression. The first is a "market-conditional" regression for beta. In pass 1, it takes the form:

$$(1) \qquad r_{nt} = \alpha + b_1(x_{1nt} r_{Mt}) + b_2(x_{2nt} r_{Mt}) + \ldots + b_J(x_{Jnt} r_{Mt}) + e_{nt} \qquad n=1,\ldots,N_t \quad t=1,\ldots,T$$

This regression provides preliminary estimates of the prediction rule for beta, with coefficients $\hat{b}_1, \hat{b}_2, \ldots, \hat{b}_J$.

Then, for each bank in each month, a preliminary prediction of beta is computed as:

$$(2) \qquad \hat{\beta}_{nt} = \hat{b}_1 x_{1nt} + \ldots + \hat{b}_J x_{Jnt} .$$

These preliminary predictions for beta are substituted to obtain predictions of residual returns defined as:

$$(3) \qquad \hat{e}_{nt} = r_{nt} - \hat{\beta}_{nt} r_{Mt} .$$

The next regression is fitted to estimate residual risk. It takes the form:

$$(4) \qquad \frac{|\hat{e}_{nt}|}{\bar{\delta}_t} = s_1(x_{1nt}) + s_2(x_{2nt}) + \ldots + s_J(x_{Jnt}) + \varepsilon_{nt} ,$$

$$(5) \quad \text{where:} \qquad \bar{\delta}_t = \frac{\sum_{n=1}^{N_t} w_{Mnt} |\hat{e}_{nt}|}{\sum_{n=1}^{N_t} w_{Mnt}} ,$$

where w_{Mnt} is the capitalization weight for bank n at time t, equal to the proportion of the market value of all equity in that bank. Thus, $\bar{\delta}_t$ is the capitalization-weighted, cross-sectional average of absolute residual returns. This regression obtains the preliminary prediction rule for relative specific risk, with estimated coefficients $\hat{s}_1, \ldots, \hat{s}_J$.

Pass 2 involves repetition of each of these equations using generalized least squares. To accomplish generalized least squares, each observation is weighted inversely to its disturbance variance. In this model, the disturbance variance is proportional to the variance of the bank's residual return in both regressions! Therefore, we compute for each bank n in each month t a prediction of residual risk provided by:

$$(6) \qquad \hat{\sigma}_{nt} = \gamma \bar{\delta}_t (\hat{s}_0 + \hat{s}_1 x_{1nt} + \ldots + \hat{s}_J x_{Jnt}) .$$

To avoid extremely small predicted variances, $\hat{\sigma}_{nt}$ is set equal to $(1/3)\gamma\bar{\delta}_t$ if the prediction for relative standard deviation is less than (1/3); hence the kink in Figure 2. Then the market-conditional regression for beta is repeated, with observations divided by their predicted residual risk:

Type B Regression

$$(7)\quad \frac{r_{nt}}{\hat{\sigma}_{nt}} = \alpha\left(\frac{1}{\hat{\sigma}_{nt}}\right) + b_0\left(\frac{r_{Mt}}{\hat{\sigma}_{nt}}\right) + \ldots + b_J\left(\frac{x_{Jnt}r_{Mt}}{\hat{\sigma}_{nt}}\right) + e'_{nt} \,.$$

These weights obtain estimates that are efficient in the statistical sense of maximal accuracy. The intuitive meaning of the weights is best understood by noting that banks with low residual risk are given greater weights than banks with high residual risk, with the weights in proportion to $1/\hat{\sigma}^2_{nt}$. Also, the weights vary over time periods due to fluctuations in $\bar{\delta}_t$: A cross section with the highest level of residual variance is given about one-sixth the weight of a cross section with a very low level of residual variance. Predictions for systematic risk in Tables 4, 5, 7, and 8 were obtained from Type B regressions.

The fitted betas from the Type B regression are used to recompute the estimates of residual returns e_{nt}. With these modified residual returns, the next step is to carry out the second-pass regression for residual risk:

Type R Regression

$$(9)\qquad \frac{|e_{nt}|}{\hat{\sigma}_{nt}\bar{\delta}_t} = s_1\left(\frac{x_{1nt}}{\hat{\sigma}_{nt}}\right) + \ldots + s_J\left(\frac{x_{Jnt}}{\hat{\sigma}_{nt}}\right) + \varepsilon'_{nt} \,.$$

Notice that the same weights are used here as in the prediction rule for beta. Predictions for residual risk in Tables 4, 6, 7, and 8 were obtained from Type R regressions.

The rationale behind this estimation approach is derived in detail in Rosenberg and Marathe [8]. The only changes in the present approach, relative to the approach set forth in that paper, are (i) the ignoring of extra-market covariance in the second-pass generalized least squares regression for beta, and (ii) the use of a regression for absolute residual returns rather than for squared residual returns in the Type R regressions for residual risk. The first change simplified the computational procedure and will be reconsidered if time permits. The second change was taken in part because, in the presence of the slightly long-tailed distributions of security returns that we find, the use of absolute residual returns should slightly improve statistical efficiency.

APPENDIX B

DESCRIPTOR DEFINITIONS

Please note the following:

(1) We have utilized the CRSP RETV (value-weighted returns, including dividends), obtained from the Center for Research on Security Prices at the University of Chicago, as the market return for all descriptors dependent upon the market (e.g., HBET).

(2) We have decided that for some COMPUSTAT variables, "unavailable" is essentially equivalent to unimportant; if these variables are unavailable, they are therefore set at zero, and the calculations described herein are then carried out. These variables are:
- Cash and due from banks
- Trading account securities
- Federal funds sold and securities purchased under agreements to resell
- Total demand deposits
- Consumer-type time deposits
- Total savings deposits
- Money market certificates of deposit
- Total time deposits (other than savings)
- Federal funds purchased and securities sold under agreements to repurchase
- Mortage indebtedness
- Acceptances executed by or for the account of this bank and outstanding
- Total liabilities (excluding valuation reserves)
- Capital notes and debentures
- Preferred stock--par value
- Number of foreign offices

In addition, the COMPUSTAT variable "number of domestic offices" is set equal to one if it is unavailable.

(3) For many of the descriptors, we have included a brief discussion of the rationale for the definition. To conserve space, we have omitted discussions whenever we felt the rationale was relatively clear.

(4) The terminology of the Compustat data base documentation is used to identify data items in most cases.

1. NCMLDA <u>Net Commercial Lending to Assets</u>

$$\text{NCMLDA} = \frac{\text{(commercial or industrial loans)} - \text{(money market certificates of deposit)} - \text{(net federal funds purchased and securities sold under agreements to repurchase)}}{\text{total assets}}$$

<u>Availability criterion</u>: current data.

2. COMLNA <u>Commercial Loans to Assets</u>

$$\text{COMLNA} = \frac{\text{(loans to financial institutions)} + \text{(loans for purchasing or carrying securities)} + \text{(commercial or industrial loans)}}{\text{total assets}}$$

<u>Availability criterion</u>: current data.

3. NCNLDA <u>Net Consumer Lending to Assets</u>

$$\text{NCNLDA} = \frac{\text{(real estate loans, total)} + \text{(loans to individuals for household, family, and other consumer expenditures)} - \text{(total savings deposits)} - \text{(consumer-type time deposits } \textit{or} \text{ total time deposits, other than savings, } \textit{or} \text{ 0)}}{\text{total assets}}$$

<u>Availability criterion</u>: current data.

4. CONLNA <u>Consumer Loans to Assets</u>

$$\text{CONLNA} = \frac{\text{loans to individuals for household, family, and other consumer expenditures}}{\text{total assets}}$$

<u>Availability criterion</u>: current data.

5. MUNIBA <u>Ratio of Tax-Exempt Bonds to Assets</u>

$$\text{MUNIBA} = \frac{\text{obligations of states and political subdivisions}}{\text{total assets}}$$

<u>Availability criterion</u>: current data.

6. RELNSA <u>Ratio of Real Estate Loans to Assets</u>

$$\text{RELNSA} = \frac{\text{real estate loans, total}}{\text{total assets}}$$

<u>Availability criterion</u>: current data.

7. ISECTA <u>Ratio of Investment Securities to Total Assets</u>

$$\text{ISECTA} = \frac{\text{total investment securities}}{\text{total assets}}$$

<u>Availability criterion</u>: current data.

8. TRDASA <u>Ratio of Trading Account Securities to Assets</u>

$$\text{TRDASA} = \frac{\text{trading account securities}}{\text{total assets}}$$

<u>Availability criterion</u>: current data.

9. CONTDA <u>Consumer Time Deposits to Assets</u>

$$\text{CONTDA} = \frac{\text{consumer-type time deposits}}{\text{total assets}}$$

<u>Availability criterion</u>: current data.

10. DEMNDA <u>Demand Deposits to Assets</u>

$$\text{DEMNDA} = \frac{\text{total demand deposits}}{\text{total assets}}$$

<u>Availability criterion</u>: current data.

11. NFFBA <u>Net Federal Funds Borrowed to Total Assets</u>

$$\text{NFFBA} = \frac{\begin{array}{l}\text{(federal funds purchased and securi-}\\ \text{ities sold under agreements to re-}\\ \text{purchase)}\\ -\ \text{(federal funds sold and securities}\\ \quad\text{purchased under agreements to}\\ \quad\text{resell)}\end{array}}{\text{total assets}}$$

<u>Availability criterion</u>: current data.

12. FORDPA <u>Foreign Deposits to Assets</u>

$$\text{FORDPA} = \frac{\text{total foreign deposits}}{\text{total assets}}$$

<u>Availability criterion</u>: current data.

13. SAVEDA Ratio of Savings Deposits to Assets

$$\text{SAVEDA} = \frac{\text{total savings deposits}}{\text{total assets}}$$

Availability criterion: current data.

14. TBORA Ratio of Total Borrowings to Assets

$$\text{TBORA} = \frac{\text{total borrowings}}{\text{total assets}}$$

Availability criterion: current data.

15. TCAPA Ratio of Total Capital to Assets

$$\text{TCAPA} = \frac{\text{total capital accounts and minority interest}}{\text{total assets}}$$

Availability criterion: current data.

16. TIMEDA Ratio of Time Deposits to Assets

$$\text{TIMEDA} = \frac{\text{total time deposits other than savings}}{\text{total assets}}$$

Availability criterion: current data.

17. ATOLB Assets to Liabilities, Book Value

$$\text{ATOLB} = \frac{\text{total assets}}{\text{total book value (of equity)} + \text{(capital notes and debentures)}}$$

Availability criterion: current data.

18. BLEV Book Leverage

$$\text{BLEV} = \begin{cases} \dfrac{\text{total book value (of equity)} + \text{long-term debt}}{|\text{total book value (of equity)}|} & \text{if } 0 \leq \text{BLEV} \leq 10 \\ 10 & \text{otherwise} \end{cases}$$

where long-term debt is defined under VCAP.

Availability criterion: current data on all items.

Discussion: In theory, the business risk of the company is transferred to common stockholders to a degree that is magnified by financial leverage. On the other hand, recognizing this, management tends to reduce financial leverage when business risk is high. Thus, in a comparison across firms, high financial leverage may or may not be indicative of higher investment risk. However, to the degree that other descriptors in the analysis capture differences in business risk, the role of financial leverage as a surrogate for business risk will disappear, and it will remain as a predictor of investment risk directly attributable to financial leverage.

19. DILU <u>Potential Dilution</u>

$$\text{DILU} = \begin{cases} \dfrac{\text{net income per share, including extraordinary items, fully diluted}}{\text{net income per share, including extraordinary items}} \\ 0 \quad \text{if the above ratio is less than 0} \\ 1.2 \quad \text{if the above ratio is greater than 1.2} \end{cases}$$

<u>Availability criterion</u>: current data.

<u>Discussion</u>: This descriptor is the dilution factor arising from outstanding convertible senior securities, options, and warrants. A high value is indicative of past aggressive financial policy and hence greater risk. On the other hand, the presence of overhanging convertible assets may reduce fluctuations in common stock price, since the price may be held near the conversion ceiling.

20. DTOA <u>Total Debt to Assets</u>

$$\text{DTOA} = \frac{(\text{long-term debt}) + (\text{debt in current liabilities})}{\text{total assets}}$$

where: (1) long-term debt is defined under VCAP,

(2) debt in current liabilities = (other liabilities for borrowed money) + maximum of {[0], [(federal funds purchased and securities sold under agreements to repurchase) - (federal funds sold and securities purchased under agreements to resell)]}.

<u>Availability criterion</u>: current data.

Discussion: This descriptor measures the proportion of the book value of debt to the book value of assets.

As such, a higher value indicates that there may not be adequate liquidation value in the firm's assets to pay off debt and hence suggests a danger of bankruptcy with its attendant costs. The validity of the descriptor is limited by the accuracy of the book value of total assets as an estimate of their market value, but intraindustry comparisons--such as those we are dealing with here--may be fairly reliable.

21. KMTMN <u>Average Maturity of Tax-Exempt Bond Portfolio</u> (Keefe Data)

$$\text{KMTMN} = \text{average maturity, in months, of the tax-exempt bond portfolio}$$

<u>Availability criterion</u>: current data or most recent data.

22. KMTUS <u>Average Maturity of Taxable Bond Portfolio</u> (Keefe Data)

$$\text{KMTUS} = \text{average maturity, in months, of the taxable bond portfolio}$$

<u>Availability criterion</u>: current data or most recent data.

23. KPDEP <u>Percentage Depreciation in the Bond Portfolio</u> (Keefe Data)

$$\text{KPDEP} = \frac{\text{market value} - \text{book value}}{\text{book value}}$$

<u>Availability criterion</u>: current data or most recent data.

24. RLTLTL <u>Ratio of Risky Liabilities to Long-Term Liabilities</u>

$$\text{RLTLTL} = \frac{\begin{array}{l}\text{(acceptances executed by or for the account of this bank and outstanding)} \\ + \text{(total time deposits, other than savings)} \\ + \text{(other liabilities for borrowed money)} \\ + \text{maximum of } \{[0], [\text{(federal funds purchased and securities sold under agreements to repurchase)} - \\ \quad \text{(federal funds sold and securities purchased under agreements to resell)}]\}\end{array}}{\begin{array}{l}\text{(mortgage indebtedness)} + \text{(capital notes and debentures)} + \text{(preferred} \\ \text{stock--par value)} + \text{(total book value)}\end{array}}$$

Availability criterion: current data.

25. ATAX Applicable Federal Tax Rate

$$ATAX = \frac{\sum_{i=-4}^{0} \text{(income taxes)}}{\sum_{i=-4}^{0} \text{(pretax income)}},$$

where the sums are over the last five years. The descriptor is truncated at an upper bound of .55 and a lower bound of 0.

Availability criterion: one year's data.

Discussion: This descriptor gives the percentage of cumulative pretax earnings that has been paid out as tax. A high value for any one bank is indicative of past success, for a lower value would result if major write-offs were available to obtain tax reductions. Another interpretation of the variable is as an indicator of the conservatism of management, with a lower value suggesting the use of tax-reducing schemes or subsidiaries. The availability of tax-exempt bonds makes this descriptor less clear-cut for banks than for industrials. Nevertheless, a higher value is suggestive of a lower level of risk.

26. FFMKT Federal Funds Market-Making Activity

$$FFMKT = \frac{\text{minimum of }\{\text{[federal funds purchased and securities sold under agreements to repurchase], [federal funds sold and securities purchased under agreements to resell]}\}}{\text{total assets}}$$

Availability criterion: current data.

27. FLO1 Average Cash Flow to Current Liabilities

$$FLO1 = \begin{cases} \dfrac{\text{average cash flow}}{\text{current liabilities}} \\ 5 \text{ if FLO1 would otherwise be } > 5 \\ -5 \text{ if FLO1 would otherwise be } < -5 \end{cases}$$

where: (1) the average is taken over the last five years,

(2) cash flow = (net income *or* net income available for common) + (provision for loan losses) + (furniture and equipment depreciation, rental cost, servicing, etc.),

(3) current liabilities = (other liabilities for borrowed money) + maximum of {[0], [(federal funds purchased and securities sold under agreements to repurchase) - (federal funds sold and securities purchased under agreements to resell)]} + (acceptances executed by or for the account of this bank and outstanding) + (money market certificates of deposit).

Availability criterion: In the numerator, data for at least 2 years must be available; "available" here implies that all three components must be available in any given year for that year's data to be considered available. The denominator must be available.

Discussion: This descriptor is a measure of the liquidity of the firm's current financial position. A low value indicates that cash flow may not be adequate in relation to current liabilities.

28. FRGNO Proportion of Foreign Offices

$$\text{FRGNO} = \frac{\text{number of foreign offices}}{(\text{number of domestic offices}) + (\text{number of foreign offices})}$$

Availability criterion: current data.

29. PAY1 A Measure of Normal Payout in the Last 5 Years

$$\text{PAY1} = \begin{cases} \dfrac{\sum_{t=-4}^{0} \text{common dividends}}{\sum_{t=-5}^{-1} \text{earnings available for common}} \\ 1 \text{ if PAY1 would otherwise be negative} \end{cases}$$

where both pieces of data must be available before current dividends and previous year's earnings enter the summation.

Availability criterion: one year of data and a nonzero denominator.

Discussion: The payout ratio was proposed by Beaver et al. as an accounting-based risk measure. Low payout ratios are identified with high risk throughout the security-valuation literature. Firms with high payout ratios are expected to be more stable, and stocks of such firms should bear more resemblance to fixed-income investments than do stocks of low payout firms. This is not surprising, since a low payout company must provide returns to its shareholders through the earnings on new projects financed by new investment, rather than from the ongoing income of existing projects. The returns from new projects are presumably less easy to forecast and more sensitive to changing economic circumstances than those from existing projects.

30. PNCV <u>Estimated Probability of Noncoverage of Fixed Charges, Using a Trended Value for Current Operating Income</u>

$$\text{PNCV} = \begin{cases} 1 \text{ if } [(\text{fixed charges}) - (\text{forecasted operating income})] > 3\sigma \\ 0 \text{ if } [(\text{fixed charges}) - (\text{forecasted operating income})] < -3\sigma \\ z\left(\dfrac{(\text{fixed charges}) - (\text{forecasted operating income})}{\sigma}\right) \text{ otherwise,} \end{cases}$$

where: (1) $z(x) = \text{PROB}[N(0,1) < x]$ is the cumulative standard normal distribution.

(2) σ = the standard error of operating income over the last 5 years;

$$\sigma = \left[\frac{\sum_t (X_t - \bar{X})^2}{N - 1}\right]^{1/2} .$$

(3) "Forecasted operating income" = (average operating income over the last 5 years) + 2(TREND) and

$$\text{TREND} = \frac{\Sigma tX - \frac{1}{N}(\Sigma t)(\Sigma X)}{\Sigma t^2 - \frac{1}{N}(\Sigma t)^2} \text{, with:}$$

(a) X = operating income
(b) t = yearly index; t=1,2,3,4,5
(c) the sums are over the last 5 years
(d) N is the number of years for which data exist.

(4) Operating income = current operating earnings before income tax.

(5) Fixed charges = (interest on capital notes and debentures) + (preferred dividend deductions).

Availability criteria: (1) "fixed charges" must be available in the current year; (2) "Operating income" must be available at least 4 of the last 5 years.

Discussion: This descriptor is an estimate of the probability that operating income will be smaller than fixed charges in the coming year. This estimation is accomplished by fitting a normal distribution for operating income, with mean equal to the current value on a 5-year trend of operating income, and with standard deviation equal to the standard deviation about trend of operating income in the past 5 years. Then the probability in the lower tail of this distribution lying below current fixed charges is computed. As such, a high value for this descriptor is an indication of poor coverage of fixed charges, and thus of default risk from the conjunction of business risk and financial leverage.

31. SALTOR Ratio of Salaries and Related Expenses to Total Revenues

$$\text{SALTOR} = \frac{\text{(salaries and wages of officers and employees) + (pension and employee benefits)}}{\text{total current operating revenue}}$$

Availability criterion: current data.

32. TRDVRA Ratio of the Variability of Trading Account Income to Assets

$$\text{TRDVRA} = \frac{\left[\dfrac{\sum\limits_{t=-4}^{0} (x - \bar{x})^2}{N - 1}\right]^{1/2} \cdot (100)}{\text{total assets}}$$

where: (1) x = trading account income
(2) N = number of available data points.

Availability criterion: four years of data.

33. VCAP Variability in Capital Structure

$$\mathrm{VCAP} = \begin{cases} \dfrac{\sum\limits_{t=-4}^{0} \{|\text{total book value }(t-1) - \text{total book value }(t)| + |\text{long-term debt }(t-1) - \text{long-term debt }(t)|\}}{4|\text{total book value }(t) + \text{long-term debt }(t)|} \\ 0 \quad \text{if denominator is available and no data are available for the numerator,} \end{cases}$$

where long-term debt = (mortgage indebtedness) + (capital notes and debentures) + (preferred stock, par value).

Availability criterion: current values for the items in the denominator must be available.

Discussion: This item measures the proportional variation in capital structure effected by management in the last 4 fiscal years.

34. VERN Variability of Annual Earnings in Last 5 Years

$$\mathrm{VERN} = \frac{\sqrt{\dfrac{\sum\limits_{t=-4}^{0} (\text{earnings} - |\text{average earnings}|)^2}{T - 1}}}{|\text{average earnings}|}$$

where: (1) earnings = net income available for common,
(2) average earnings = the average, over the preceding 5 years, of earnings,
(3) T is the number of years that data exist,
(4) if VERN > 5, VERN is set to 5.

Availability criterion: two years of data.

Discussion: This is a pure number that measures the intrinsic proportional variability of earnings and is an accounting-based measure of risk.

35. VFLO Variability of Cash Flow

$$\mathrm{VFLO} = \begin{cases} \dfrac{\sqrt{\dfrac{\sum\limits_{t=-4}^{0} (\text{cash flow} - \text{average cash flow})^2}{T - 1}}}{\text{average } |\text{cash flow}|} \\ 5 \text{ if VFLO would otherwise be} > 5 \end{cases}$$

where: (1) cash flow = (net income or net income available for common) + (provision for loan losses) + (furniture and equipment depreciation, rental cost, servicing, etc.)
(2) average cash flow = the average of cash flow over the last 5 years
(3) T = the number of years of data averaged

Availability criteria: (1) Cash flow is available only if all of its components are available; 2 years of cash-flow data must be available.
(2) Average cash flow is available if cash flow is available for at least 2 years.

Discussion: This is an alternative to VERN as a measure of the variability of the bank's operations, computed through the identical formula applied to cash flow rather than earnings.

36. ABET Accounting Beta

$$ABET = \begin{cases} \left\{ \left[\left(\dfrac{\Sigma(\Delta X \cdot \Delta Y)}{\Sigma(\Delta X)^2} \right)^2 \cdot \left(\dfrac{\Sigma(\Delta X)^2}{N} \right) - \left(\dfrac{\Sigma \Delta Y}{N} \right)^2 \right] \cdot \dfrac{1}{\left[\dfrac{\Sigma Y}{N} \right]^2} \right\}^{1/2} \\ 0.0 \text{ if } ABET^2 \text{ would otherwise be negative} \\ 5.0 \text{ if } ABET \text{ would otherwise be} > 5 \end{cases}$$

where: (1) Y = earnings per share
(2) ΔY = earnings per share in year (t) - earnings per share in year (t-1)
(3) ΔX = U.S. corporate earnings in year (t) - U.S. corporate earnings in year (t-1)
(4) the sums are taken over all previous years for which data exist
(5) N is the number of years summed over.

Availability criterion: at least 2 years of consecutive data.

Discussion: This measure captures the covariance of the bank's earnings with aggregate earnings to all corporations. It is a pure number, expressing the proportion of normal earnings that is exposed to fluctuations in the aggregate economy. In statistical terms, it is the "coefficient of explained variation" of the bank's earnings with respect to the movements in economywide earnings. It is natural to view a measure of this kind as analogous to a beta for earnings, and we term it an "accounting beta" in the tradition of Beaver et al. [2]. The definition of accounting beta proposed by those authors, somewhat modified, is retained below as another descriptor (BBET).

37. CUTD Average Proportional Cut in Dividends, Last 5 Fiscal Years

CUTD = average over the last 4 years of DIF, where:

$$\text{DIF} = \begin{cases} 2\left(\dfrac{\text{yearly common div}(t-1) - \text{yearly common div}(t)}{|\text{com div}(t-1)| + |\text{com div}(t)|}\right) & \text{when: com div}(t) < \text{com div}(t-1); \\ 0 & \text{otherwise.} \end{cases}$$

Availability criterion: 2 consecutive years of available dividends in the past 5 years.

Discussion: This descriptor captures the apparent risk to the bank, as reflected in the frequency and magnitude of circumstances that caused it to reduce common dividends. In view of the great reluctance shown by firms in the matter of reducing dividends, any dividend reduction is likely to be a sign of straightened circumstances for the bank and is so viewed by the market. We do not pronounce on the rationality of this policy, but only upon the realities of the message conventionally associated with dividend reductions.

38. DELE Delta Earnings: A Measure of Proportional Changes in Earnings Per Share in the Last 2 Fiscal Years

$$\text{DELE} = \begin{cases} \dfrac{2[(\text{earnings/share, year } T) - (\text{earnings/share, year } T-1)]}{|\text{earnings/share, year } T| + |\text{earnings/share, year } T-1|} \\ 0 \text{ if earnings are zero in both years.} \end{cases}$$

Availability criterion: two years of data.

Discussion: This is a measure of earnings growth rate in the past year. The measure equals the trend rate divided by the average when earnings are positive in both years; the absolute values in the denominator insure reasonable values for the descriptor when earnings in one or both years are negative or zero.

39. DMNE Indicator of Negligible Earnings

$$\text{DMNE} = \begin{cases} 0 & \text{if} \quad \text{ETOP} \geq .005 \\ 1 & \text{if} \quad \text{ETOP} < .005 \end{cases}$$

where ETOP is defined below.

Availability criterion: ETOP must be available.

Discussion: This variable is zero unless annual earnings are less than 1/2 percent of the value of the common, in which case it is equal to one. Thus, it is an indicator of dangerously low current earnings --that is, of a situation that must be reversed if the bank is to survive--and hence can be expected to be positively related to risk. This descriptor may also be viewed as introducing a nonlinearity into the relationship between risk and E/P otherwise introduced by the ETOP descriptor.

40. MRGIN Earnings Margin

$$\text{MRGIN} = \frac{\sum_{t=-2}^{0} (\text{net income})}{\sum_{t=-2}^{0} (\text{total current operating revenue})}$$

Availability criterion: one year of data.

41. REVENA Ratio of Revenue to Assets

$$\text{REVENA} = \frac{\text{total current operating revenue}}{\text{total assets}}$$

Availability criterion: current data.

42. ROEQ Return on Equity

$$\text{ROEQ} = \frac{\sum_{t=-4}^{0} (\text{net income available for common})}{\sum_{t=-5}^{-1} (\text{total book value})}.$$

Availability criteria: (1) net income for one year and book value at the end of the prior year must be available for any pair of data to be included in the sums;

(2) there must be at least 3 years of data available.

Discussion: This is a measure of the average return to the bank on its equity investment, valued at book, over the past 5 years. The ratio of the sums is used, rather than the average of the ratios, because of the greater stability of the former when book value oscillates or approaches zero.

43. AGRO Asset Growth Rate, Equal to the Annual Trend in Total Assets Divided by Average Value, Last 5 Years

$$\text{AGRO} = \frac{\dfrac{\Sigma tX - \frac{1}{N}(\Sigma t)(\Sigma X)}{\Sigma t^2 - \frac{1}{N}(\Sigma t)^2}}{\frac{1}{N}(\Sigma X)}$$

$$= \frac{\text{regression coefficient of } X \text{ on } t}{\text{average value of } X}$$

where: (1) X = total assets
(2) t = yearly index; t=1,2,3,4,5
(3) the sums are over the last 5 years, or over years for which all data exist
(4) N is the number of years for which data exist.

Availability criterion: at least 4 years of data.

Discussion: This was proposed by Beaver et al. [2] as an accounting-risk measure, relying mainly on the argument that above-normal growth derives from opportunities to gain "excessive" earnings and that these are vulnerable to competitive pressures and more uncertain than "normal" earnings. Thus, rapid growth identifies with high risk and thus with high return.

44. DMS5 — Indicator of Availability of a 5-Year History of Earnings Information, from a Substantial Base

$$\text{DMS5} = \begin{cases} 1 & \text{if total capitalization 4 years previously} \geq \$20{,}000{,}000 \text{ and there are at least 4 data points available for the calculation of EGRO, or if earnings-per-share data are available for 1959.} \\ 0 & \text{otherwise} \end{cases}$$

Availability criterion: always available.

Discussion: This indicator variable is one for those banks having a 5-year history of earnings from a \$20,000,000 initial capitalization, equal to zero otherwise.

45. EGRO — Earnings Growth Rate

$$\text{EGRO} = \begin{cases} \dfrac{\left[\dfrac{\Sigma tX - \frac{1}{N}(\Sigma t)(\Sigma X)}{\Sigma t^2 - \frac{1}{N}(\Sigma t)^2}\right]}{\left|\frac{1}{N}(\Sigma X)\right|} = \dfrac{\text{regression coefficient of X on t}}{|\bar{X}|} \\ \text{if } |\text{EGRO}| \leq 0.5 \\ \dfrac{\left[\dfrac{\Sigma tX - \frac{1}{N}(\Sigma t)(\Sigma X)}{\Sigma t^2 - \frac{1}{N}(\Sigma t)^2}\right]}{\frac{1}{N}\Sigma|X|} \\ \text{if } |\text{EGRO}| > .5 \text{ and } |\text{EGRO}| \leq 1.0 \\ 1.0 \text{ if } |\text{EGRO}| > 1.0 \end{cases}$$

where: (1) X = earnings per share, adjusted for capital for capital transactions
(2) t = yearly index; t=1,2,3,4,5
(3) the sums are over the last 5 years
(4) N is the number of years for which data exist.

Availability criteria: (1) Number of shares outstanding must be available for the first year.

(2) Price per share at end of first year must be available.

(3) Total capitalization (shares outstanding times price per share), calculated at end of the first year, must be greater than \$20 million.

(4) There must be at least 4 years of available data.

Discussion: This measure of the growth rate of earnings per share seems to correspond reasonably well to the rate which an intelligent judge would deduce from the data, and it has the advantage of great validity in the frequent cases of large earnings fluctuations which destroy exponential or proportional growth models. The growth rate in earnings per share, adjusted for capital transactions, is used as a measure of the increased profitability of the bank and, hence, as a measure of recent success. The use of per-share figures, rather than total earnings, removes the contribution to growth from amalgamation, except to the degree that amalgamation occurs on terms that are favorable to the stockholders. The growth rate of total assets, defined above, captures the pure growth component of the bank. The requirement that the earnings growth begin at a substantial capitalization base is designed to remove those banks which may have achieved extraordinary and probably unrepeatable growth in their early years.

46. OFFEX Domestic Office Expansion Rate

$$\text{OFFEX} = \frac{\left[\dfrac{\Sigma tx - \frac{1}{N}(\Sigma t)(\Sigma x)}{\Sigma t^2 - \frac{1}{N}(\Sigma t)^2}\right]}{\frac{1}{N}(\Sigma x)} = \frac{\text{regression coefficient of } x \text{ on } t}{\bar{x}}$$

where: (1) x = number of domestic offices
(2) t = yearly index; t=1,2,3,4,5
(3) the sums are over the last 5 years
(4) N is the number of years for which data exist.

Availability criterion: at least 3 years of data.

47. RSKLGO Growth Rate of Risky Liabilities

$$\text{RSKLGO} = \begin{cases} \dfrac{\left[\dfrac{\Sigma tx - \frac{1}{N}(\Sigma t)(\Sigma x)}{\Sigma t^2 - \frac{1}{N}(\Sigma t)^2}\right]}{\frac{1}{N}(\Sigma x)} = \dfrac{\text{regression coefficient of } x \text{ on } t}{\text{average value of } x} \\ \text{if RSKLGO would otherwise be} > 0.5\text{, the denominator is replaced by the average of the absolute values of } x \end{cases}$$

where: (1) x = risk liability to long-term liability ratio, RLTLTL, defined above

(2) t = yearly index; t=1,2,3,4,5

(3) the sums are over the last 5 years

(4) N is the number of years for which data exist.

Availability criterion: 4 years of data.

48. ASSI Logarithm of Total Assets

ASSI = the natural log of the average, over the last 5 years, of total assets.

Availability criterion: at least one data point.

Discussion: Total assets was suggested by Beaver et al. [2]. They support the common belief that large firms are less risky than small, at least in terms of default risk. Moreover, if the investing public considers large firms safer, then the result of this belief will be to reduce the price reaction to any threatening news. For banks, however, the asset size is clearly a surrogate for systematic business risk.

49. MKTS Current Operating Revenue

MKTS = total current operating revenue.

Availability criterion: current data.

Discussion: This is another measure of the size of the bank.

50. HBET Historical Beta, the Regression Coefficient in a Regression of Monthly Common Stock Returns on Monthly Returns for the Market

$$\text{HBET} = \frac{\sum_{t=-59}^{0} \text{[(monthly return of stock - average return of stock)} \cdot \text{(return of the market - average return of the market)]}}{\sum_{t=-59}^{0} \text{[return of the market - average return of the market]}^2}$$

where the averages are over the last 60 months. If some returns are unavailable, the sums and averages are taken only over the period where data are available; the minimum number of data points is 36. The "returns" for the stock and for the market are actually in the form of logarithmic excess returns. For instance, the return on the stock in month t is defined as:

$$r_t = \ln((P_t)/P_{t-1}) - \ln(1 + i_{Ft}) ,$$

where ln denotes the natural logarithm, P_t denotes the month and price, and i_{Ft} is the risk-free rate of return.

Availability criterion: There must be at least 36 available monthly returns.

Discussion: Our experience has shown that the logarithmic return results in a more stable and more accurately predictive estimate of beta than the alternative specification in terms of monthly arithmetic rates of return, although the difference is very small. There are also plausible grounds for specifying the dependence of the security return on the market return as linear in logarithms rather than linear in arithmetic returns: In the former case, when the market level varies and then returns to its original position, the logarithmic model implies that securities are expected to return to their original levels, while the arithmetic model implies an implausible pattern of expectations.

51. BTSQ Beta Squared

$$\text{BTSQ} = (\text{HBET})^2$$

where HBET is defined above.

Availability criterion: available whenever HBET is available.

Discussion: BTSQ is the square of the truncated value of HBET, to introduce a nonlinearity in the prediction rule. To constrain this to take the appropriate shape, BTSQ is itself truncated; otherwise, the fitted relationship would turn downard too sharply at very high values of HBET.

52. HSIG Historical Sigma, the Standard Deviation of Residual Returns from the Regression for HBET

$$HSIG = \left\{ \frac{1}{T-2} \sum_{t=-59}^{0} \hat{e}_t^{\,2} \right\}^{1/2} ,$$

where: (1) $\hat{e}_t$ is the residual in the regression for HBET in month t

(2) T is the number of data points available.

Availability criterion: at least 36 months of data.

Discussion: HSIG is the conventional estimate of the residual standard deviation of returns, but applied to the logarithmic return model. A substantial improvement in estimation accuracy is obtained through the logarithmic specification, since the skewness and kurtosis of residuals are greatly reduced.

53. SGSQ Sigma Squared

$$SCSQ = HSIG^2 ,$$

where HSIG is defined above.

Availability criterion: availability of HSIG.

Discussion: SGSQ is the square of the truncated value of HSIG and is itself truncated, because previous experience has shown that the coefficient of SGSQ in beta is typically negative, offsetting the contribution of sigma at large values. If SGSQ were not limited at the upper bound, an excessive negative adjustment at the few banks with large sigma values would be implied. Thus, the truncation is an attempt to obtain the correct nonlinear form for the prediction rule.

54. BS Square Root of the Product of HBET and HSIG

$$BS = \{HBET \cdot HSIG\}^{1/2} ,$$

where HBET and HSIG are defined above.

Availability criteria: Available whenever HBET and HSIG are available, and HBET is nonnegative.

Discussion: This variable is also employed to allow for nonlinearity in the prediction rules. As in the case of BTSQ, BS is set to equal the product of HBET·HSIG (after truncation of these variables where appropriate), and is itself truncated.

55. BADJ Bayesian Adjustment to Historical Beta

$$\text{BADJ} = \frac{(\text{HBET} - \overline{\text{HBET}}) \cdot \text{VAR(HBET)}}{V_\beta + \text{VAR(HBET)}} ,$$

where: $\overline{\text{HBET}}$ is the estimated cross-sectional average of HBET, capitalization weighted, taken to be 1.03; V_β is the estimated cross-sectional variance of beta, capitalization weighted, taken to be .1; and VAR(HBET) is the estimated error variance for HBET, equal to:

$$\frac{\text{HSIG}^2}{\sum_{t=-59}^{0} \begin{bmatrix} \text{return of the market -} \\ \text{average return of the market} \end{bmatrix}^2} ,$$

where: HSIG is defined above and the sum is taken over months where data are available for the HBET regression.

Availability criterion: HBET and HSIG must be available.

Discussion: If sigma were independent of beta, the Bayesian prediction rule, as a function of HBET, that would yield minimum mean square error in estimating underlying historical beta would be essentially HBET - BADJ. Thus, BADJ is the Bayesian adjustment to historical beta, under the (erroneous) assumption that the underlying values of beta and sigma are independent.

56. LPRI Natural Logarithm of the Common Stock Price

LPRI = ln[price] ,

where price is the closing price for the most recent month.

Availability criterion: the month-end price must be available.

Discussion: This captures the current price level, perhaps useful as an indication of risk, because firms with high risk tend to maintain the stock price at a lower value to facilitate trading. Market folklore treats lower-priced stocks as more speculative than higher-priced stocks. This belief may reflect deliberate corporate control of the stock price, through capital transactions, or the effect of uncontrolled declines in value.

57. RSTR <u>Logarithmic Rate of Return over Last Year (Relative Strength)</u>

$$RSTR = \sum_{t=-11}^{0} \{\ln[\text{monthly stock closing price}] - \ln[\text{last month's stock closing price}]\}$$

<u>Availability criterion</u>: all data points must be available for all months.

<u>Discussion</u>: An indicator of recent success, this is the logarithm of the return to investors in the common equity of the bank over the past year, excluding dividends. The logarithm is taken to retain a more symmetric measure than would be provided by the arithmetic return.

58. TREC <u>A Measure of Common Stock Trading Recency, Equal to the Reciprocal of the Number of Prior Years of Available Monthly Prices</u>

$$TREC = 12 \div \{\text{maximum of } [12; \text{ the number of months ago a closing price/share was first recorded}]\}$$

<u>Availability criterion</u>: always available.

<u>Discussion</u>: This variable is equal to one for the first 12 months that monthly closing prices for a bank are contained in the data base and declines asymptotically to zero thereafter. After T years of data, the value of the variable is 1/T. The purpose of the descriptor is to capture the recency of the status of the bank as of interest to institutions, presuming that addition to the COMPUSTAT data base is correlated with this.

<u>Remark on Historical Values</u>: Since all banks added to that data base prior to 1964 were major banks at the date of inclusion, the value is set to zero immediately for these banks. Thus, if any data are available prior to 1964, TREC is set equal to zero throughout the history of that bank.

59. ATOLM   Assets to Liabilities, Market Value

$$\text{ATOLM} = \frac{\text{total assets}}{(\text{price times shares outstanding}) + (\text{capital notes and debentures at book})}$$

Availability criterion: current data.

60. BBET   "Beaver" Beta, Regression Coefficient for Normalized Earnings/Price Ratio of the Bank on Normalized Earnings/Price Ratio of the Economy

$$\text{BBET} = \frac{\sum_{s \geq t-10}^{t} \{\text{ENTP}_s \cdot \text{ENTPM}_s\}}{\sum_{s \geq t-10}^{t} \{\text{ENTPM}_s\}^2},$$

where: (1) ENTP_s is the normalized earnings/price ratio, defined elsewhere, for the bank in year s

(2) ENTPM_s is the same formula applied to: (a) aggregate quarterly corporate earnings, interpolated when necessary to correspond to the fiscal year of the firm, and (b) the S&P 500 index at that year end

(3) the sums are taken over years of available data.

Availability criterion: ENTP must be available for at at least two of the last five years.
NB: ENTPM is always available.

Discussion: This descriptor measures the typical relationship of the bank's E/P ratio to the economy-wide E/P ratio. A higher value implies that the E/P for the bank is typically higher than that for the economy, or conversely, that the P/E is typically lower. This descriptor differs from that introduced by Beaver et al. [2] (their version of accounting beta) only in that there is no constant term in the regression, so that the regression line is forced to pass through zero. Beaver et al. referred to it as an accounting beta, because it is the regression of the E/P ratio on the economy's E/P ratio. However, an inspection of the descriptor confirms that although it has something of the nature of a covariance of earnings, it is really closer to a measure of the normal value of E/P.

61. BTOP <u>Book Value to Price</u>

$$BTOP = \frac{\text{total book value}}{(\text{price}) \times (\text{shares outstanding})},$$

where price is the latest monthly closing price, if available; if not, the price at the end of the previous calendar year.

<u>Availability criterion</u>: current data.

<u>Discussion</u>: This is a measure of the pessimism with which the bank is valued. A high value, relative to other banks, corresponding to a low P/B ratio, implies that investors do not expect the bank to earn well on its past capital investment. This ratio is used in preference to the more familiar P/B ratio, because the latter behaves wildly as book value approaches zero and discontinuously as book value becomes negative.

62. CAPT <u>An Indicator of Capitalization, Equal to the Natural Logarithm of the Market Value of Common Equity</u>

$$CAPT = \ln\{\text{number of shares outstanding times price per share}\}$$

where price is the latest monthly closing price, if available; if not, the price at the end of the previous calendar year.

<u>Availability criterion</u>: shares outstanding and price must be available.

<u>Discussion</u>: This variable is an alternative measure of the size of the bank, equal to the logarithm of the aggregate value of its outstanding common stock. It is closely related to the descriptor ASSI, but measures the total value placed by the investing public on the potential flow through from the bank's activities to equity investors. Differences between the two variables arise from monopoly rents to capital, from differences in leverage, and from the past success of the bank as reflected in the ratio of book value of equity to market value of equity.

63. DMYL <u>Indicator of Extremely Low Yield</u>

$$DMYL = \begin{cases} 0 & \text{if YILD} > .005 \\ 1 & \text{if YILD} \leq .005 \end{cases}$$

where YILD is defined below.

<u>Availability criterion</u>: If YILD is available.

<u>Discussion</u>: This descriptor indicates those banks with yield less than .5%. Such banks are either in such trouble as to have omitted current dividends, or they are extremely strongly growth oriented. As such, they may be distinguished from other banks to such a degree that this indicator becomes useful. It may also be viewed as allowing for a nonlinearity in the relationship between risk and yield otherwise determined by the descriptor YILD.

64. ENTP <u>Normalized Earnings/Price Ratio</u>

$$ENTP = \frac{\frac{1}{N}\Sigma X + 2\left[\frac{\Sigma tX - \frac{1}{N}(\Sigma t)(\Sigma X)}{\Sigma t^2 - \frac{1}{N}(\Sigma t)^2}\right]}{\text{price}},$$

where: (1) X = earnings per share, adjusted for capital transactions

(2) t = yearly index; t=1,2,3,4,5

(3) the sums are over those of the last 5 years for which data are available

(4) N is the number of years for which data exist

(5) price is monthly closing price/share, if available; if not, the price at the end of the previous calendar year is used.

<u>Availability criteria</u>: (1) "earnings per share" must be available for at least 2 of the last 5 years

(2) "price" must be available.

<u>Discussion</u>: This descriptor is an alternative to ETOP. It differs only in that the latest year's earnings is replaced by the fitted value from a linear least-squares trend passed through the last 5 annual earnings-per-share figure. Transitory fluctuations in earnings are likely to play a smaller part in ENTP, so that it may be a better indication of the expected long-term growth rate.

65. ETOP <u>Earnings to Price</u>

$$ETOP = \frac{\text{latest annual earnings per share}}{\text{price per share}},$$

where price is: (1) latest monthly closing price, if available; if not,
(2) price at end of previous calendar year.

Availability criterion: current data.

Discussion: This is the reciprocal of the ratio commonly used in the financial press. The more usual price/earnings ratio has conceptual disadvantages, since it approaches extreme positive values when earnings are near zero, and then discontinuously becomes negative when earnings are negative. In contrast, the E/P ratio behaves smoothly when earnings fall. Low E/P stocks (those that are "expensive" when scaled against earnings) are presumably priced in this way because investors expect future earnings to be higher, implying that earnings recovery or future growth is expected. Thus, a low E/P ratio is indicative of expected growth in earnings.

66. ETP5 Typical Earnings Price Ratio, Last 5 Years

$$\text{ETP5} = \frac{\{\text{average over last 5 years of [earnings available for common} \div \text{total shares outstanding]}\}}{\{\text{average over last 5 years of [closing stock price]}\}}$$

Availability criterion: at least one data point must be available for each of the "average" calculations.

Discussion: This is a measure of the typical earnings/price ratio over the last 5 years. The ratio of the means is taken, instead of the mean of the ratios, because of its smaller sensitivity to extreme fluctuations in stock price.

67. LIQU Liquidity of Current Financial Position

$$\text{LIQU} = \frac{[(\text{cash}) + (\text{receivables}) - (\text{current liabilities})]}{(\text{shares outstanding}) \cdot (\text{price})},$$

where: (1) price is for latest month, if available; if not, price is for the end of the previous calendar year
(2) cash + receivables = maximum of {[0], [(federal funds sold and securities purchased under agreements to resell) - (federal funds purchased and securities sold under agreements

to repurchase)]} + (cash and due from banks) - (required reserve ratio for demand deposits × total demand deposits) - (required reserve ratio for savings deposits × total savings deposits) - (required reserve ratio for time deposits × total time deposits, other than savings) (3) current liabilities = (other liabilities for borrowed money) + maximum of {[0], [(federal funds purchased and securities sold under agreements to repurchase) - (federal funds sold and securities purchased under agreements to resell)]}.

Availability criterion: current data.

Discussion: This descriptor is a measure of the liquidity of the bank's current financial position. It attempts to improve upon other measures of liquidity by expressing current liquidity as a proportion of the market valuation of common equity. The thinking behind this is that only when the bank is illiquid and that illiquidity is a large proportion of the market value of common equity will there be an indication of default risk and, hence, of the credit stringency that follows from apparent default risk.

68. MLEV Market Leverage

$$\text{MLEV} = \begin{cases} \dfrac{\text{(shares outstanding times price)} + \text{(long-term debt)}}{\text{(shares outstanding times price)}} & \text{if this ratio is < than 10 and nonnegative;} \\ 10 & \text{otherwise} \end{cases}$$

where: (1) long-term debt is defined under VCAP

(2) price is monthly closing price, if available; if not, price at end of previous calendar year.

Availability criterion: current data on all items.

Discussion: This measure of financial leverage differs from BLEV in that common equity is valued at market. Ideally, senior securities should also be valued at market, but data on their prices are not generally available. Since their prices vary less proportionately than do stock prices, this omission is not too costly. In a theoretical analysis, for fixed business risk, it is leverage at market that should determine the risk to stockholders, rather than leverage at book.

69. ECAP Market Value of Equity

$$\text{ECAP} = \begin{array}{c}\text{market value of common equity}\\ \text{(capitalization) of the bank}\end{array}$$

Availability criterion: current data.

Discussion: This descriptor has a complex history. Briefly, in an analysis of the joint distribution of security returns, it can be shown that the specific variance of each bank contributes a small amount to its beta with respect to a market index in which it is included. The contribution from its *own variance* to its beta, with respect to a value-weighted index, is proportional to its market capitalization times its specific variance. OVAR thus captures the importance of this contribution to beta. In addition, OVAR is, of course, another measure of size.

70. PTEQ Ratio of Plant (Fixed Assets) to Common Shareholders' Equity

$$\text{PTEQ} = \frac{\text{bank premises, furniture, and fixtures}}{\text{(price)} \times \text{(shares outstanding)}}$$

Availability criterion: current data.

Discussion: The ratio of fixed assets to total assets has been proposed as a measure of the "fixity" of assets. Banks with high fixity should have high fixed costs and hence a greater dependence of earnings upon economic events. This relationship would suggest that a higher value of PTEQ would imply higher risk. However, in the presence of an imperfectly competitive market with freedom to vary prices, this effect might be offset by the reduction in risk associated with more stable operations.

71. YILD Dividend Yield

$$\text{YILD} = \begin{cases}\dfrac{\text{common dividends, last fiscal year}}{\text{shares outstanding} \times \text{price/share}}\\[2ex] 0.3 \text{ if YILD would otherwise be } > 0.3.\end{cases}$$

where price is: (1) price at end of latest month, if available; if not,
(2) price at end of previous calendar year.

Availability criterion: current data.

Discussion: Previous studies (e.g., Rosenberg and Marathe [7]) have confirmed that high dividend yield has been associated with low levels of systematic risk and specific risk throughout the past 50 years. In part, this relationship presumably arises from the fact that a high-yielding stock is typically high in payout also, so that the arguments previously advanced in connection with payout apply here as well. Also, high-yielding stocks are often identified as "income stocks" and purchased with this goal in mind by a group of investors who may be more risk-averse than the investment community at large; to the degree that this is the case, management, in response to the preferences of their investors, may pursue conservative policies. Again, we do not judge on the rationality of this behavior, but merely suggest that it may exist.

72. YLD5 Dividend Yield, Normal Value for Last 5 Years

$$\text{YLD5} = \frac{\{\text{average over last 5 years of [adjusted common dividends} \div \text{adjusted shares outstanding]}\}}{\{\text{average over last 5 years of [annual closing stock price]}\}}$$

Availability criterion: at least one data point must be available for each of the "average" calculations.

Discussion: This descriptor measures the typical yield over the last 5 years, as distinct from the yield indicated by current dividends and current prices. As such, it is an alternative measure of the same aspect of the firm as measured by current yield.

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