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Thomas O. Stanley
Southern Illinois University

John K. Ford
University of Maine

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THE APPLICATION OF PORTFOLIO CONCEPTS TO CREDIT ANALYSIS

Thomas O. Stanley and John K. Ford

The practical application of portfolio concepts has been one of the most important developments in finance in recent years. For example, it is now common to see the performance of professional investment managers evaluated relative to a diversified portfolio such as the Standard & Poor's 500. Investment firms express the risk of a stock in terms of its beta, the variability of the stock's return relative to a diversified portfolio. Index funds that seek to match the performance of the general market and options on the S&P 500 are new investment vehicles based on portfolio concepts. A review of finance textbooks indicates that portfolio concepts are now as basic a tool of financial analysis as are present value techniques or ratio analysis.

This paper demonstrates the application of portfolio concepts to the measurement and control of credit risk [1]. This paper explains the logic of portfolio analysis and applies the concepts to the evaluation of the risk of lending to retail firms. This practical example is based upon business failure statistics for twenty-two categories of retail firms. Business failures include those firms that ceased operations following assignment or bankruptcy; ceased with loss to creditors after such actions as execution, foreclosure or attachment; voluntarily withdrew leaving unpaid obligations; were involved in actions such as receivership, reorganization or arrangement; or voluntarily compromised with creditors. In other words, the business failure statistics indicate the proportion of firms that caused severe problems and losses for creditors [2].

Historical Failure Rates

Table 1 shows the average annual failure rate for twenty-two categories of retailing firms for the period 1964 to 1983. The average failure rate was highest for Infants' & Children's Wear (.77%) and lowest for Groceries, Meats & Produce (.17%). The average failure rate for all categories over the twenty-year period is .43%.

If these failure rates were the same year after year, there would be no risk in lending to retail firms. A risk adjusted interest rate could be charged for each retailing category which would compensate for the perfectly anticipated failure rate and the net outcome would be known in advance.

However, the uncertainty in lending stems from the substantial variability in failure rates. For example, the failure rate for Infants' and Children's Wear ranges from a high of 2.27% in 1983 to a low of .37% in 1969. The variability of the failure rate for this category is reflected in a standard deviation of .44%. This figure is a measure of the average amount by which the annual failure rates deviate from the .77% average for the category. The standard deviation indicates the amount of dispersion in the failure rate and therefore serves as a measure of risk.

Table 1
Failure Rates
1964-1983

	Average	Standard Deviation
Infants' & Children's Wear	.77%	.44%
Furniture & Furnishings	.67	.19
Dry Goods & General Merchandise	.36	.20
Sporting Goods	.59	.20
Lumber & Building Materials	.40	.24
Women's Ready-to-Wear	.67	.18
Men's Wear	.64	.22
Appliances, Radio & TV	.49	.17
Cameras & Photographic Supplies	.59	.16
Auto Parts & Accessories	.31	.10
Shoes	.36	.16
Books & Stationery	.49	.15
Bakeries	.34	.17
Eating & Drinking Places	.30	.14
Hardware	.24	.13
Automobiles	.26	.12
Gifts	.49	.18
Toys & Hobby Crafts	.48	.42
Jewelry	.24	.11
Women's Accessories	.24	.12
Groceries, Meats & Produce	.17	.07
Drugs	.23	.07
Column Average *	.43%	.18%

* The column average figures presented are simple averages or column mean values

Table 1 shows that the variability of the failure rate is highest for Infants' & Children's Wear (.44%) and Toys & Hobby Crafts (.42%). The variability is lowest for Groceries, Meats & Produce (.07%) and Drugs (.07%). The average variability for the twenty-two types of retailers is .18%.

The higher the variability, the less predictable is the failure rate. Whereas the average failure rates provide a measure of the relative default rates among the categories, the variability figures allow a comparison of the relative risk which is a function of the year over year uncertainty inherent in lending in each of these twenty-two categories.

Portfolio Effects

At the strategic or policy level of the bank, management's concern must be the failure rate of the entire portfolio of loans to retail firms. Therefore, at this level of analysis it is important to determine the effect of each category on the overall failure rate of the portfolio. The crucial question is how does adding a particular loan category affect the failure rate of the portfolio [3].

The Average Failure Rate

One of the effects of a particular category on the average failure rate of the portfolio can be evaluated using the average failure rates in Table 1. The average failure rate of a portfolio is simply the weighted average of the average failure rates of the individual categories. For example, a portfolio divided equally between Infants' & Children's Wear (.77%) and Toys & Hobby Crafts (.48%) would have an average failure rate of .625%.

The important point is that a loan category with a high average failure rate increases the average failure rate of the portfolio. A loan category with a low average failure rate decreases the failure rate of the portfolio.

The figures in the first column of Table 2 express the average failure rate relative to the average failure rate for the retailing portfolio assuming an equal weight for each type of firm. For example, the 1.79% figure for Infants' & Children's Wear is the .77% average failure rate of that category divided by the .43% average of the retailing portfolio. A figure greater than one indicates that adding the category increases the overall average failure rate of the portfolio. A figure less than one indicates that adding the category decreases the average failure rate of the portfolio.

Failure Rate Variability

However, Table 1 does not provide enough information to evaluate the effect of a particular loan category on the variability of the portfolio's failure rate. A category with a high variability does not necessarily increase the variability of the portfolio. For example, although the .22% standard deviation for Men's Wear is higher than the .18% average standard deviation for all categories, adding this category actually reduces the variability of the portfolio failure rate. A category with a low variability does not necessarily decrease the variability of the port-

folio. For example, although the .17% standard deviation for the appliance category is less than the .18% average standard deviation for all categories, adding this category actually increases the variability of the portfolio failure rate.

The effect of a category on the variability of the portfolio depends on both its own variability and its correlation with the other loan categories. The essential insight of portfolio theory is that variability can be reduced by diversifying among categories that are not perfectly correlated. The lower the correlation of a category with the others, the greater the diversification benefit of the category. The major difficulty in the implementation of portfolio theory is the computational burden of estimating all the correlations between a large number of categories.

The common practice in portfolio analysis is to correlate all categories with an index. This procedure has two advantages: it sharply reduces the number of calculations and it shows the variability effect of a category as a single number. The index used in this example is the portfolio of all retailing categories with each category given equal weight.

The important statistic produced by the index model procedure is the slope coefficient from a regression of the failure rate of the category on the failure rate of the index. This coefficient is a function of both the variability of the category and its correlation with the index. In other words, this statistic captures both of the factors that determine the effect of the category on the variability of the portfolio.

The second column of Table 2 shows the regression coefficient that is an estimate of the volatility of each category relative to the volatility of the index. A value greater than one indicates that adding the category will tend to increase the volatility of the portfolio failure rate. For example, the relative volatility coefficient of 1.14 for the appliance category indicates that including this type of lending increases the variability of the portfolio failure rate. This result is somewhat surprising because the variability of the appliance category (.17%) is less than the average variability of the retailing categories (.18%). The explanation lies in the very high 96% correlation between this category and the index. This high correlation means there is almost no diversification benefit in adding this category; the net effect is to increase the variability of the portfolio.

With a weak correlation of 58%, the men's wear category decreases the portfolio volatility even though its variability of .22% is higher than the .18% average. This dampening effect is reflected in the relative volatility coefficient of .89.

An Expanded Portfolio

An important implication of modern portfolio concepts is that an asset should be evaluated in terms of its effect on the portfolio. This paper advocates using this approach in credit analysis and provides an example analysis with figures compiled on the probable loss gathered for twenty-two categories of retail firms. This example was based on aggregate historical data and a portfolio with equal weight given to each category.

Table 3 is presented in order to provide a broader view of the application of portfolio techniques to bank lending policy. By including home mortgages and

Table 2
Portfolio Effects
1964-1983

	Relative ₁ Average	Relative Variability
Infants' & Children's Wear	1.79	2.83
Furniture & Furnishings	1.56	1.24
Dry Goods & General Merchandise	.83	1.13
Sporting Goods	1.37	1.02
Lumber & Building Materials	.93	1.45
Women's Ready-to-Wear	1.56	1.05
Men's Wear	1.49	.89
Appliances, Radio & TV	1.14	1.14
Cameras & Photographic Supplies	1.37	.85
Auto Parts & Accessories	.72	.64
Shoes	.83	.95
Books & Stationery	1.14	.77
Bakeries	.79	.99
Eating & Drinking Places	.70	.91
Hardware	.56	.80
Automobiles	.60	.73
Gifts	1.14	.86
Toys & Hobby Crafts	1.12	1.52
Jewelry	.56	.70
Women's Accessories	.56	.73
Groceries, Meats & Produce	.39	.47
Drugs	.53	.34

¹The values in the average failure rate column were derived by dividing the individual loan category failure rates by the column average.

Table 3
Expanded Portfolio
1964-1983

	Relative Average	Relative Variability
Personal Loans	1.30	.85
Automobile Loans	.56	.43
Home Improvement	.50	.52
Mortgages	.45	1.67
Infants' & Children's Wear	.77	3.13
Furniture	.67	1.32
Dry Goods & General Merchandise	.36	1.31
Sporting Goods	.59	1.18
Lumber & Building Materials	.40	1.66
Women's Ready-to-Wear	.67	1.05
Men's Wear	.64	.84
Appliances, Radio & TV	.49	1.22
Cameras	.59	.85
Auto Parts	.31	.73
Shoes	.36	1.02
Books & Stationery	.49	.73
Bakeries	.34	1.00
Eating & Drinking Places	.30	.99
Hardware	.24	.89
Automobiles	.26	.81
Gifts	.49	.79
Toys & Hobby Crafts	.48	1.36
Jewelry	.24	.74
Women's Accessories	.24	.74
Groceries, Meats & Produce	.17	.52
Drugs	<u>.23</u>	.32
Portfolio with equal weight in each category of loan	.47	

three of the most common consumer loan categories, it is possible to gain additional perspective into the nature of the contributory role that an individual loan category has on the bank's entire loan portfolio.

For example, the average failure rate of the 22 retailing firms in Table 1 is .43% while the average for mortgages was .45%. On the other hand, the average for the three consumer loan categories is .79%. This means that if a loan officer had funds available and was faced with a choice between making loans to retail firms or to consumers or for mortgages, it is clear that consumer loans have 1.83 times as much credit risk, on average, relative to loans to retail outlets. However, Table 3 demonstrates that combining the consumer and mortgage loans with the loans to retail outlets has significant diversification effects. For instance, the average failure rates for the three consumer loan categories, especially the personal loan category, are higher than most of the retail outlets. In addition, the standard deviations of personal loans, automobile loans, and mortgages are higher than most of the retail outlets. Yet, due to the extremely weak correlation coefficients between the retail firms and each of the consumer loan categories, the standard deviation of the broader portfolio actually declines to .13% from the .14% for the portfolios of the 22 retail firms. Furthermore, the mortgage loan category has a weaker correlation with the overall portfolio than 12 of the retail outlet categories. Therefore, the addition of both the consumer and mortgages loan categories indicates substantial diversification benefits.

Conclusion

The traditional approach to credit analysis is to conduct a thorough examination of the financial condition of the prospective borrower. This analysis of the individual characteristics of the borrower provides the basis for the final loan decision. Modern portfolio theory suggests that this strict focus on the individual borrower may not produce the best overall loan portfolio for the institution.

The important implication of portfolio theory is that credit analysis should consider the diversification effects of each loan. This paper demonstrated that an index model provides an efficient method for evaluating diversification effects. Adding this portfolio dimension to the traditional techniques of credit analysis provides a complete analysis of the total effect of each loan.

The example used in this paper was based on national data for failures in various categories of business and personal lending. A bank would probably find it valuable to derive the same information for its own market area as a basis for evaluating the results of its credit procedures and implementing the portfolio aspects of credit analysis.

The control of the loan losses of a financial institution is extremely important: with financial leverage, small variations in loan losses produce substantial variations in the return on equity. This paper demonstrated that the concepts and techniques of portfolio analysis can help in the control of the risk of the loan portfolio.

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Notes

- [1] Vojta as early as 1973 classified the potential risks inherent in commercial banking into six generic groupings. These risks are credit, investment, liquidity, operating, fraud and fiduciary (34). Vojta pointed out that each of these are important to a financial institution because they create the potential of some form of loss [2]. While the study was primarily concerned with evaluating the risks inherent in the loan portfolio of financial institutions, specifically a portfolio of consumer loans, this is not intended to ignore the importance of the other elements of potential risk (1, 4, 10, 13, 17, 26, 33). However, the focal point of the study was the assessment of risk associated with an institution's loan quality. This risk, credit or default risk, is concerned with whether or not the borrower will repay the principal and interest as contracted for under the terms of the loan. Obviously, those loans which an institution wishes it had not made are the basis for credit risk.

For a review of some of the discussions on the risks listed above and other issues of risk associated with the operations of depository financial institutions, see Baer 1982, Barth 1975, Dufey 1979, Heggstad 1977, Knobel 1977, and Pierce 1966.

- [2] For a detailed explanation of what constitutes "financial risk" or "credit risk" see Foster, George, **Financial Statement Analysis** (Prentice-Hall Inc., Englewood Cliffs, New Jersey) pp. 460-483.
- [3] For a review of portfolio analysis techniques that have been applied to depository financial institutions, see Adar et al. 1975, Aghili 1975, Balternsperger et al. 1976, Booth 1979, Edwards 1973, Hausofus 1976, Hendershott 1979, Lane 1974, Schwarg 1979, Sinkey 1975, Sinkey 1975.

Thomas O. Stanley is an Assistant Professor of Finance at Southern Illinois University at Carbondale. John K. Ford is an Associate Professor of Finance at the University of Maine at Orono.