Some Empirical Bases of Financial Ratio Analysis

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One unique product of accounting evolution in the United States is the development of financial ratios for analyzing accounting statements. These ratios were originally developed as short-term credit analytical devices, and their origin can be traced as far back as the late nineteenth century. A variety of financial ratios were developed by analysts in the early decades of this century; and by the end of the 1920's, a great outpouring of ratio data began to flow from many individual analysts and institutions.

It would seem that the next phase should have been the development of a body of empirical generalizations about financial ratios, which would have in turn been used to formulate hypotheses for developing a theory of financial ratio analysis. However, a system of empirical generalizations never materialized, much less a theory. This is not to say that facts about financial ratios are lacking. On the contrary, many facts about these ratios have been generated over the years; but these facts have remained scattered throughout the literature. It is the purpose of this paper to bring together some of these scattered facts and to provide a tentative synthesis of the empirical bases of financial ratio analysis.

This subject will be dealt with in two respects. First, the statistical nature of financial ratios will be analyzed; that is, the amenability of these ratios to statistical analysis will be evaluated. The usual concern here has been the computation of average ratios. It is contended that certain factors, such as differences in accounting methods, size of firm, and so forth, make it extremely difficult to obtain representative average financial ratios. In other words, financial ratios are not normally distributed, or their dispersion is very large—or both. As will be seen, the question of the statistical nature of financial ratios is even more complicated; correlations between ratios, and of single ratios over time, are also present. Second, the evidence bearing on the utility of financial ratios will be evaluated. Financial ratios are presented in almost apologetic tones in most contemporary texts, and it appears as though their expected utility is very low. Generally, financial ratios are held to be somewhat inefficient predictors of financial difficulties. The evidence bearing on this question is not overly abundant, but it appears as though this general low opinion of the utility of financial ratios may have to be revised.

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A Classification of Financial Ratios

The group of financial ratios which will be discussed here is a consensus, compiled by this author, of a large number of sources dealing with financial statement analysis in various contexts. In order to simplify the discussion, this group of ratios has been broken down into *liquidity* and *profitability* categories. The liquidity category has been broken down further into time divisions of short-term liquidity and long-term solvency; and the profitability category has been further classified along the lines of the du Pont return on investment analysis, as follows: capital turnover, profit margin, and return on investment. Within each of those categories, the following group of financial ratios makes up the basic list of this study:

1. *Short-term Liquidity Ratios*
   a. Current assets to current debt ("current ratio")
   b. Current assets less inventory to current debt ("quick ratio")
   c. Cash plus marketable securities to current debt
2. *Long-term Solvency Ratios*
   a. Net operating profit to interest ("times-interest-earned ratio")
   b. Net worth to total debt
   c. Net worth to long-term debt
   d. Net worth to fixed assets
3. *Capital Turnover Ratios*
   a. Sales to accounts receivable
   b. Sales to inventory
   c. Sales to working capital
   d. Sales to fixed assets
   e. Sales to net worth
   f. Sales to total assets
4. *Profit Margin Ratios*
   a. Net operating profit to sales
   b. Net profit to sales
5. *Return on Investment Ratios*
   a. Net operating profits to total assets
   b. Net profits to net worth

Two types of evidence will be considered here. A variety of studies from other sources ranging from the 1920's to the present will be evaluated, and an analysis by this author of a sample of thirty-two steel companies and twenty-four petroleum companies during the period 1948–57 will also be evaluated.[1] Unless specified otherwise, the evidence presented will pertain only to the general category of industrial firms and mainly the manufacturing sector of that broad category.

Statistical Nature of Financial Ratios

The most fundamental and perhaps most important question about the statistical nature of financial ratios concerns the type of *distributions* they exhibit. Surprisingly, formal information on this question is somewhat limited. Published statistical series provide average financial ratios; but frequency distributions are never provided, and measures of dispersion only rarely. However, an early series of studies conducted at the University of Illinois in the late 1920's and early 1930's is informative in this regard.[2] Tabular and graphic frequency distributions of the financial ratios of various industries, mainly public utilities, were presented in these studies.

It is apparent in these presentations that the financial ratios tended to be approximately normally distributed but were often positively skewed. My petroleum and steel samples exhibit the same pattern, approximately normal but positively skewed. The positive skewness in this pattern seems reasonable because most of these ratios have an effective lower limit of zero but an indefinite upper limit. The pattern itself is significant because it means that financial ratios can be sub-

[1] The data generated in this study are too voluminous to be presented here, but samplings of these data are presented in a few instances.

[2] E.g., A. H. Winakor, *Standard Financial Ratios for the Public Utility Industry* (Bul. No. 26, Bureau of Business Research, The University of Illinois, 1929).

TABLE 1

CORRELATIONS BETWEEN SELECTED RATIOS: 24 PETROLEUM COMPANIES: 1948–57[a]

Ratios Correlated*	Correlation Coefficients					
	CA/CD, QA/CD	*QA/CD, S/WC*	*NW/TD, NW/LD*	*S/FA, S/NW*	*S/NW, NI/S*	*NI/S, NI/NW*
Year						
1948	.80	−.86	.72	.81	−.72	.59
1949	.86	−.83	.70	.78	−.72	.54
1950	.83	−.78	.73	.81	−.72	
1951	.80	−.85	.78	.86	−.77	
1952	.80	−.90	.76	.90	−.78	.44
1953	.82	−.90	.80	.87	−.85	.55
1954	.85	−.76	.60	.85	−.83	.55
1955	.93	−.76	.70	.86	−.79	.54
1956	.93	−.90	.70	.84	−.74	.64
1957	.88	−.86	.77	.79	−.75	.80

[a] Only correlations significant at $\leq .05$ level are presented.

* Ratio identifications are as follows:

CA/CD—Current ratio
QA/CD—Quick ratio
S/WC—Sales to working capital
NW/TD—Net worth to total debt
NW/LD—Net worth to long-term debt
S/FA—Sales to fixed assets
S/NW—Sales to net worth
NI/S—Net income to sales
NI/NW—Net income to net worth

jected to the usual parametric statistical techniques, although logarithmic transformations of the ratios might be in order where the positive skew is extreme. Also, it means that certain types of hypotheses concerning the relationships of financial ratios with other variables may not be valid. In general, this question deserves more attention; a determination of the precise nature of financial ratios would be useful for the development of many types of theories.

Another fundamental aspect of the statistical nature of financial ratios is the extent of their *collinearity*—i.e., how great is the correlation, if any, of the various ratios with each other. There certainly must be abundant information on the collinearity of financial ratios, but this author has been unable to find published results. Some amount of collinearity can be expected merely because common components are used in many financial ratios. For example, all of the turnover ratios listed in this study have sales as their numerator. However, even when unique components are involved, collinearity may still be present because some items in accounting statements tend to move in the same direction as other items and more or less proportionately. Thus, the expectation here is that many of the financial ratios recommended in the literature are correlated significantly with each other.

On the basis of my study of petroleum and steel firms, this expectation is correct;[3] but the extent of the collinearity varies by types of ratios and sometimes between industries.[4] First, the short-term liquidity ratios were all highly correlated with each other; and they were also highly correlated with one ratio outside their classification, working capital turnover.[5] Second, the long-term solvency ratios were also highly inter-correlated as a group. The net worth to fixed assets departed from the pattern of

[3] For example, see Table 1.

[4] To simplify the discussion here, qualitative descriptions of the coefficients of determination (r^2) obtained will be used instead of the numerical measures. Ranges of explained variance in significant relationships between two ratios are designated as follows: .25–.49, "moderate" correlation; .50–.74, "high" correlation; and .75–1.0, "extremely high" correlation.

[5] The quick ratio exhibited extremely high collinearity (i.e., from .75 up) with the other two short-term liquidity ratios.

this group, however, because it was also significantly related to two ratios outside of its classification, namely, fixed assets turnover and total assets turnover. Third, the collinearity pattern of the profit margin varied between industries. Only one ratio, net profits to sales, was computed in this study.[6] In the petroleum industry, this ratio was moderately or highly correlated with turnover ratios involving long-term components—i.e., fixed assets, net worth, and total assets turnovers—and moderately with working capital turnover. On the other hand, the steel industry's profit margin was moderately related only to net worth turnover and the net worth to total debt ratio. Fourth, the collinearity pattern of the return on investment ratio was fairly simple. Only one of these ratios, net profit to net worth, was computed in this study.[7] This ratio was moderately correlated only with the profit margin ratio; in a sense, it stood virtually alone as a type of ratio.

The capital turnover ratios exhibited a somewhat complicated pattern of collinearity. As has already been described, these ratios were related significantly to many of the ratios outside of their category. Within this category, the greatest collinearity existed among the turnover ratios involving long-term components; these three ratios were all highly correlated with each other. On the other hand, the turnover ratios involving short-term components—i.e., accounts receivable, inventory, and working capital turnovers—were generally not related to the other ratios in this capital turnover category. The accounts-receivable and the working-capital turnovers tended to be moderately correlated with the net-worth and total-assets turnover in the petroleum industry, but that was the extent of the collinearity. Thus, with the exception of the capital turnover ratios composed of short-term items, financial ratios tend to be highly correlated with each other within the ratio categories established in this study.

This presence of collinearity is both a blessing and a curse for financial ratio analysis. It means that only a small number of financial ratios are needed to capture most of the information ratios can provide, but it also means that this small number must be selected very carefully. A selection of collinear ratios which are related to a dependent variable in the same fashion would obscure and possibly worsen the results of multi-variate analyses. On the other hand, collinearity of ratios could be useful if one of the ratios is not related significantly to the dependent variable. In this case, inclusion of the non-related ratio would probably improve the predictive ability of the other ratio. However, the first case is more probable in financial ratio analysis. Thus, it is clear that large numbers of financial ratios cannot be computed willy-nilly in an analysis. The collinearity of these ratios requires that a careful and parsimonious selection be carried out.

A third fundamental aspect of the statistical nature of financial ratios is the extent to which ratio distributions are *correlated over time.* There also must be abundant information about this aspect; but published results are somewhat sparse. Chudson determined in his study of financial structures that aggregate industry ratios of 1931 and 1937 were significantly correlated.[8] Similarly, Wojinlower found in his study of the quality of bank loans that the aggregate financial ratios of various industry-size groups maintained stable relative positions over the period 1953–57, even though the absolute levels of the ra-

[6] In a pilot study, this author found extremely high correlations between this ratio and the other profit margin ratio, net operating profits to sales.

[7] An extremely high relationship between this ratio and the other return on investment ratio, net operating profits to total assets, was also found by this author in a pilot study.

[8] Walter A. Chudson, *The Pattern of Corporate Financial Structure: A Cross-Section View of Manufacturing, Mining, Trade, and Construction, 1937* (New York: National Bureau of Economic Research, 1945).

tios changed.[9] These aggregate results are probably indicative of the patterns within industry groups. Firms in the same industry should experience more or less similar proportional changes in ratio components through time. If a fairly wide range of financial ratio values exists within the industry, its ratio distributions through time would tend to be highly correlated. Short-term ratio components will be more volatile than other types of components; and therefore, the firms' relative positions in ratios involving these short-term components will change more quickly than other types of ratios. On the other hand, their relative positions in ratios involving long-term components would change more slowly over time. Thus, the expectation here is that financial ratios, especially those involving long-term components, will be significantly correlated over time; or in other words, firms will tend to maintain stable relative financial ratio positions within their industry.

This expectation is also confirmed in my study of petroleum and steel firms in the period 1948–57.[10] The relationships were generally stronger in the petroleum industry and, of course, they tended to diminish as the time period lengthened. First, the short-term liquidity ratios showed the least correlations over time; but nevertheless, there were significant inter-temporal correlations even in this group. In the petroleum industry, these ratios were highly correlated in adjacent years and were at least moderately correlated up to four years. Second, the long-term solvency ratio distributions were very stable over time in both industries. These ratios were extremely highly correlated in adjacent years, were highly correlated up to four to five years, and were at least moderately correlated up to ten years.

The profit-margin ratio demonstrated essentially the same pattern as these long-term solvency ratios. Third, in regard to turnover ratios, the inter-temporal correlations of turnover ratios involving long-term components were the most impressive. These ratios were extremely highly correlated through periods of at least three years and were highly correlated up to ten years. The turnover ratios involving short-term components also exhibited strong relationships, although their patterns were somewhat irregular. They were highly correlated up to four to six years and, except for inventory turnover, were at least moderately correlated up to ten years. Finally, in regard to the return on investment ratio, high correlations were evident up to three years in the petroleum industry and moderate correlations through six years; but only moderate, irregular relationships were evident in the steel industry. On the basis of this evidence, it is hypothesized here that firms within an industry tend to maintain stable relative financial ratio positions over very long periods of time, although the patterns vary between types of ratios and industries.

This presence of inter-temporal correla-

TABLE 2

CORRELATIONS OF SELECTED RATIO DISTRIBUTIONS IN 1952 WITH THEIR DISTRIBUTIONS IN SUBSEQUENT YEARS; 32 STEEL COMPANIES: 1952–57[a]

*Ratios**	*Correlation Coefficients*				
	1953	*1954*	*1955*	*1956*	*1957*
CA/CD	.74				
QA/CD	.68				
NW/TD	.97	.79	.65	.81	.75
NW/LD	.96	.91	.75	.56	.57
S/WC	.74				
S/FA	.99	.89	.94	.99	.96
S/NW	.97	.80	.81	.88	.83
NI/S	.95	.79	.78	.75	.71
NI/NW	.88	.38		.46	.37

[a] Only correlations significant at $\leq .05$ level are presented.

* See note on Table 1 for identification of ratios.

[9] Albert M. Wojinlower, *The Quality of Bank Loans: A Study of Bank Examination Records* ("Occasional Paper"; No. 82; New York: National Bureau of Economic Research, 1962), n. 1, pp. 3–4.

[10] For example, see Table 2.

tions of financial ratios also has equivocal significance for financial ratio analysis. Disappointing results seem inevitable if financial ratios are used to predict dependent variables which are characterized by considerable shifting of the relative positions of firms. That is, correlations of independent variables which are correlated over time with dependent variables which are not will yield significant relationships only occasionally, at best.[11] However, financial ratios subject to inter-temporal correlation could be useful if they are correlated with this type of dependent variable under certain conditions—e.g., cyclical phases. In this type of analysis, the timing of the occurrence of the specified condition would be predicted through other means; but the impact of the condition on various firms would be gauged through an analysis of their relative financial ratio positions. Inter-temporally correlated financial ratios would also be useful if the dependent variable to be predicted is a one-time event—for example, failure of a firm—and, of course, is related to the ratios in a discernible fashion. In general, the inter-temporal correlation of financial ratios requires a careful, a priori determination of their proper usage in any prediction analyses.

A fourth fundamental aspect of the statistical nature of financial ratios, and the final one to be discussed here, is the extent of the *dispersion* present in ratio distributions. This aspect has received much attention in the literature; indeed, it is often the only matter discussed other than how to compute the ratios. The central point of these discussions is that certain factors tend to increase the inter-firm dispersion of financial ratios thereby making it difficult to obtain distinctive average ratios. This is an important question because wide dispersion in financial ratio distributions would make it difficult, if not impossible, to discriminate between firms on the basis of ratios. This would undermine the utility of financial ratios.

A large variety of the factors which are expected to increase the dispersion of financial ratios can be found in the literature, but the following are specified most often: industry classification; size of firm; cyclical conditions; seasonal conditions; geographical location; and accounting methods. There is wide agreement that industry classification is the most important factor, but the relative importance of the other factors is rarely specified. This could be interpreted to mean that sample of firms in ratio analysis should be stratified by industry classifications first, and subsequent stratifications, if any, should be made within the industry strata.[12] This would be sensible because there is a strong possibility that industry classification is highly correlated with the other factors. In any case, it is important to determine the relative need for stratifying by each of these factors because financial ratio analysis may be too unwieldy if all the factors are necessary.

First, in regard to industry classification, surprisingly few systematic analyses have been made of this important factor. Chudson found that aggregate short-term liquidity ratios, a long-term solvency ratio, and turnover ratios were significantly different between industries in 1937; but a return on investment ratio was not significantly different.[13] Howe also determined that short-term liquidity ratios were significantly different, between a group of six industries in 1955; but long-term solvency ratios were not significantly different.[14] It

[11] Independent variable predictors are hardly needed if the dependent variable itself is highly correlated over time.

[12] The dispersion caused by differences in accounting methods is unique in that it can be corrected through adjustments of the data. However, even in this case, the data could be stratified according to categories of accounting methods—e.g., Lifo firms vs. Fifo firms.

[13] Op. cit., pp. 68, 116–18, 141–42.

[14] Charles Warren Howe, "Corporate Saving Behavior: A Theoretical and Empirical Investigation of In-

TABLE 3

MEANS AND STANDARD DEVIATIONS OF SELECTED RATIOS OF 32 STEEL COMPANIES: 1948–57

Ratios	*Current Ratio*		*Net Worth to Total Debt*		*Inventory Turnover*		*Fixed Assets Turnover*		*Net Profits to Sales*	
	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
Year										
1948	2.85	.726	2.55	1.96	7.40	3.38	3.79	2.58	.0813	.0390
1949	3.46	.925	3.36	2.55	6.26	3.10	2.87	1.60	.0609	.0443
1950	2.58	.497	2.23	1.47	7.65	2.42	3.52	2.02	.0763	.0286
1951	2.07	.372	1.56	.96	7.71	1.71	3.82	2.36	.0583	.0252
1952	2.44	.658	1.76	1.25	5.82	1.56	3.06	2.47	.0495	.0213
1953	2.46	.530	1.89	1.32	6.16	1.55	3.36	2.58	.0558	.0305
1954	3.02	.803	2.12	1.22	4.74	1.33	2.44	1.61	.0580	.0348
1955	2.73	.680	2.10	1.16	6.36	1.39	3.30	2.18	.0715	.0353
1956	2.74	.711	2.23	1.68	6.04	1.14	3.22	2.24	.0725	.0340
1957	3.22	.898	2.75	1.82	5.21	1.36	2.83	2.24	.0598	.0243

would seem in this regard that the unique production and distribution functions of the various industries would lead to wide differences between their capital-turnover ratios and profit-margin ratios. However, the short-term liquidity, long-term solvency, and return on investment ratios would be determined mainly by the risks confronting these industries. Within the broad manufacturing sector, these risks will be of a similar magnitude for many industries. Thus, in many cases, stratification of the latter group of financial ratios by industry classifications will not significantly improve the ratio distributions; or in other words, the ratio distributions will not be significantly different among the many industries.

For example, two things were evident about the industry ratio distributions in my petroleum and steel study. On the one hand, the dispersion of the ratio distributions within these industries was generally very wide.[15] In the period 1948–57, their coefficients of variation—i.e., standard deviation to the mean—ranged from the current ratio's coefficient of approximately .20 to the net worth to long-term debt coefficient of approximately .90. Most of the coefficients of variation fell between .20 and .40. On the other hand, many of the ratios were significantly different among the industries, despite the wide dispersion. All of the capital turnover ratios, except working capital turnover, and the profit margin ratio were significantly different during the entire period. The short-term liquidity ratios, working capital turnover, and the return on investment ratio were significantly different for three to five years; and interestingly, these were usually recession years. This suggests that the risks confronting these industries, as reflected in financial ratios, became significantly different at cyclical downturns. In general, these results suggest that it is useful to stratify financial ratios by industry classifications.

The evidence bearing on the effects of the next two factors, size of firm and cyclical conditions, is quite abundant, although most of it is in the form of aggregate data. The various relationships of aggregate financial ratios to size of firm can be summarized as follows:[16]

1. Short-term liquidity and long-term

ternal Financing" (Unpublished Ph.D. dissertation, Economics, Stanford University, 1959), pp. 50–54.

[15] For example, see Table 3.

[16] These relationships are frequently disrupted by the largest size class and so there is often a kink in the tail of the relationships.

solvency ratios are related to size of firm in a positive, parabolic manner. In other words, the relationship is positive for smaller firms and negative for larger firms.

2. Profit-margin ratios and return on investment ratios vary directly with size of firm.

3. The capital-turnover ratios vary inversely with size of firm; but accounts receivable turnover varies in a parabolic, negative manner.

A shortcoming of this evidence is its aggregate nature. It remains to be seen whether or not these relationships hold within industries. Higher profit margins and lower capital-turnover ratios may well be characteristic of larger firms, without regard for industry classification; but it is also quite likely that they may be characteristic of industries in which large firms happen to predominate. For example, in my study of petroleum and steel firms, there was no evidence of significant relationships between size of firm and the various financial ratios. Also, there is another fundamental point involved here. One of the basic functions of financial ratios is to deflate accounting data by size of firm; and therefore, most of the size-of-firm effect should be washed out by the ratios themselves. Thus, a guess is hazarded here that size of firm stratifications are not necessary in financial ratio analysis.

In regard to cyclical conditions, the behavior patterns of financial ratios at cyclical turning points can be summarized as follows:

1. The short-term liquidity ratios and the net worth to total debt ratio vary inversely with cyclical fluctuations.

2. The other long-term solvency ratios, all the capital-turnover ratios except accounts-receivable turnover, the profit-margin ratio, and the return on investment ratio vary directly with cyclical fluctuations.

3. Accounts-receivable turnover does not appear to be related to cyclical fluctuations in any discernible manner.

The existence of these patterns means that it is not wise to pool financial ratio data from different cyclical periods. However, these aggregate data do not shed any light on the question of the dispersion in ratio distributions at different points in a business cycle. The various financial ratios in my petroleum and steel study followed those cyclical patterns fairly closely, but their coefficients of variation did not demonstrate any cyclical pattern. This is reasonable because any differential effects of cyclical forces upon financial ratios should be industry effects, rather than individual firm effects, and would be captured by industry stratification of ratio data. Therefore, cyclical conditions will not affect the dispersion of financial ratio distributions at one point in time; but dispersion will be increased by this factor if financial ratios from a number of time periods are combined in an analysis.

Finally, in regard to the other factors of seasonal conditions, geographical location, and accounting methods, only a few comments will be offered here about each factor. First, seasonal patterns will undoubtedly affect all financial ratios with the possible exception of long-term solvency ratios; but this factor should affect firms within an industry more or less uniformly. Therefore, it would be a problem in industry samples only when different accounting periods are used by the firms in their statements. In such a case, it may be wise to stratify ratio data by statement dates; but evidence on the actual impact of seasonal conditions is lacking.

Second, the significance of the geographical location factor seems doubtful. Most geographical location effects tend to be industry effects. Moreover, dispersion causing factors are troublesome only if

their dispersion does not constitute useful information. In those cases where location decisions are important and financial ratios would be affected, it would seem more sensible to allow the ratios to convey information about the various outcomes of the decisions. Third, there is no doubt that differences in accounting methods can cause financial ratio dispersion of varying patterns and degrees. Cerf, Holdren, and Nelson have provided interesting analyses of the effects of inventory valuation methods and long-term lease accounting methods upon financial ratios.[17] However, it is still not certain whether differences in accounting methods would significantly change ratio distributions within industries and whether adjustments of accounting data would make the ratios better predictors of various dependent variables.

In summary, the essential statistical nature of financial ratios appears to be as follows: they are approximately normally distributed, are highly correlated with each other, are highly correlated over time, and are subject to wide dispersion which can be reduced somewhat by industry stratification. Therefore, financial ratios are amenable to statistical analysis, but not without some difficulty. The important question remaining then is whether or not this somewhat complicated device can be useful.

The Utility of Financial Ratios

As was pointed out in the introduction, financial ratios are considered to be useful for predicting financial difficulties of firms, although their ability in this respect is not held in particularly high esteem. Accordingly, this evaluation of the utility of financial ratios will be a review of some studies involving the relationships of ratios to various degrees and types of financial difficulties.

First, there is a group of studies concerned with the ultimate form of financial difficulty, failure of firms. The initial studies of this type were conducted in the early 1930's. Winakor and Smith studied a sample of 183 firms which had experienced financial difficulties during the period 1923–31 and had failed by 1931.[18] They analyzed the prior ten-year trends of the means of twenty-one ratios and concluded that the ratio of net working capital to total assets, whose decline began ten years before the occurrence of financial difficulties, was the most accurate and steady indicator of failure. Actually, their data indicate that the long-term solvency ratios were equally good indicators.

Fitzpatrick followed a different approach by analyzing the prior three- to five-year trends of thirteen ratios of twenty firms that had failed during the period 1920–29.[19] He studied the data on a case-by-case method of analysis and followed it up with a comparative analysis of a matched sample of nineteen successful firms. He concluded that all his ratios predicted failure to some extent through declining trends, but his best predictors were the net profit to net worth ratio and the net worth to total debt ratio. Winakor and Smith's study lacked a contrasting control group of successful firms and Fitzpatrick's sample was small and too selective, but both studies were important early contributions to a determination of the predictive power of financial ratios.

[17] Alan R. Cerf, "Diverse Accounting Procedures, Price-Level Changes, and Financial Statement Ratios," *Journal of Business*, July 1957, pp. 180–92; George C. Holdren, "Lifo and Ratio Analysis," The Accounting Review, January 1964, pp. 70–85; A. Tom Nelson, "Capitalizing Leases—The Effect on Financial Ratios," *Journal of Accountancy*, July 1963, pp. 49–58.

[18] Raymond F. Smith and Arthur H. Winakor, *Changes in the Financial Structure of Unsuccessful Industrial Corporations* (Bul. No. 51, University of Illinois, Bureau of Business Research, 1935).

[19] Paul J. Fitzpatrick, *Symptoms of Industrial Failures* (Washington: Catholic University of America Press, 1931); Paul J. Fitzpatrick, *A Comparison of the Ratios of Successful Industrial Enterprises with Those of Failed Companies* (Washington: The Accountants Publishing Company, 1932).

Both of those studies were, in a sense, culminated in 1942 in Merwin's study of a sample of 939 firms in the period 1926–36.[20] Merwin divided his sample into two groups, "continuing" and "discontinuing" firms, and analyzed the prior six-year trends of a large, unspecified number of ratios of each group. He accomplished this by comparing industry mean ratios of the discontinuing firms with "estimated normal" ratios, which were estimates of what the discontinuing firms' ratios would have been had they maintained the same average ratios as the continuing firms. He concluded that three ratios were very sensitive predictors of discontinuance, up to as early as four to five years in some instances. These ratios were net working capital to total assets, net worth to total debt, and the current ratio; they all exhibited declining trends before discontinuance and were always below the estimated normal ratios. Merwin did not disclose his results in regard to the other ratios analyzed, and not all of his discontinuing firms were necessarily failures; but this was an extremely important study. Despite its age, this is the best study of the predictive power of financial ratios this author has encountered and its results still appear to be credible.[21] In summing up this group of studies, it is apparent that financial ratios can be used to predict the failure of firms many years prior to the event.

A second group of recent studies dealt with financial difficulties which were troublesome but not quite as dramatic as business failures, namely, defaults on debt and bank credit difficulties. Hickman studied the outcomes of corporate bond issues during 1900–43 and concluded that the times-interest-earned ratio and the net profit to sales ratio were useful predictors of defaults on bond issues, whether used jointly or separately. The firms with higher ratios went into default less frequently.[22] Saulnier and others found suggestive evidence from RFC lending experience during 1934–51 that borrowing firms with very low current ratios and net worth to total debt ratios were more prone to loan defaults.[23] Also, loan default rates of firms with a declining current ratio trend prior to the loan were about twice those of firms with stable or increasing ratios.

In regard to bank credit difficulties, the evidence is varied. Moore and Atkinson examined the aggregate data involving changes in bank credit use and financial ratios during 1955–57.[24] They found that firms with higher current ratios and working capital to total assets, net worth to total debt, and net profits to net worth ratios increased their use of credit more than other firms. Wojinlower analyzed the incidence of bank examiners' criticisms of loans in 1957 in three Federal Reserve districts.[25] His data showed that the criticized loans involved firms with below-average current ratios and net working capital to total assets ratios in virtually all of the industries studied, and the net worth to total debt ratio was below average in about two-thirds of the cases. Finally, Jen analyzed the availability of bank credit to a sample of small firms and found that the net profits to total assets and total debt to total assets ratios were principal determinants of credit availability; but the current ratio

[20] Charles L. Merwin, *Financing Small Corporations: In Five Manufacturing Industries, 1926–36* (New York: National Bureau of Economic Research, 1942).

[21] A more sophisticated study involving powerful statistical techniques is in process. See William H. Beaver, "Financial Ratios as Predictors of Business Failure" (multilithed materials presented at the Workshop in Accounting Research, University of Chicago, January 21, 1965).

[22] W. Braddock Hickman, *Corporate Bond Quality and Investor Experience* (Princeton University Press, 1958), pp. 395–431.

[23] Raymond J. Saulnier, Harold G. Halcrow, and Neil H. Jacoby, *Federal Lending and Loan Insurance* (Princeton University Press, 1958), pp. 456–81.

[24] Geoffrey H. Moore and Thomas R. Atkinson, "Risks and Returns in Small-Business Financing," *Towards a Firmer Basis of Economic Policy* ("Forty-First Annual Report"; National Bureau of Economic Research, 1961), pp. 66–67.

[25] Op. cit., pp. 11–12.

was not significant.[26] Therefore, this group of studies also indicates that financial ratios are very useful devices. Not all of these studies dealt directly with predictive ability, but their joint evidence suggests strongly that financial ratios can be fairly efficient predictors of a variety of financial difficulties.

A third set of studies dealt with a general financial condition which could be indicative of developing financial difficulties, namely, a lack of profits. In these studies, aggregate financial ratios were analyzed to determine if they identified profitable and unprofitable firms. Chudson determined that some short-term liquidity and long-term solvency ratios in 1937 were significantly different between profitable and unprofitable firms, with the profitable firms showing higher ratios; but capital turnover ratios were not significantly different.[27] Jackendoff also found that financial ratios consistently and clearly distinguished between profitable and unprofitable firms in the period 1949–55.[28] The current ratio and the working capital to total assets and net worth to total debt ratios of profitable firms were consistently higher, but the relationship of total asset turnover appeared to be inverse to size of firm. A study by the Department of Commerce of firms in various trade industries in 1956 also indicated that short-term liquidity and long-term solvency ratios of profitable firms were higher.[29] Profit margins and inventory turnovers of profitable trade concerns were also higher, but working-capital turnover was lower. On the basis of these studies, it appears as though higher financial ratios generally identify profitable firms. Some caution, however, may be in order in this regard. This does not necessarily mean financial ratios can identify degrees of profitability within a group of profitable firms.

Conclusion

In conclusion, it would be worthwhile to take a renewed look at financial ratios. Their statistical nature, as described in this paper, suggests they may not be so simple a device as has been assumed; but a more precise and larger body of knowledge about ratios will help surmount this difficulty. It would be extremely useful to explore the question of the predictive ability of financial ratios further. A sharper determination of their predictive ability should be possible because computers will allow for a greater usage of non-aggregate data and more sophisticated statistical techniques. Also, the development of funds-flows ratios should be promising in this regard. An efficient predictor of financial difficulties would be a valuable device for screening out undesirable investments; indeed, it would be a useful device for selecting investments if one were interested in selling short. However, there is even a more fundamental reason for determining the utility of financial ratios. It is inconceivable that accounting data can be analyzed without transforming it into ratios, in one way or another; and thus, a justification of financial ratios would also be an important justification of financial accounting.

[26] Frank Chifeng Jen, "The Determinants of the Degree of Insufficiency of Bank Credit to Small Business," *Journal of Finance*, December, pp. 694–95.

[27] Op. cit., p. 8 and passim.

[28] Nathaniel Jackendoff, "A Study of Published Industry Financial and Operating Ratios," *Economics and Business Bulletin* (Temple University), March 1962, p. 34.

[29] U. S. Department of Commerce, Business and Defense Services Administration, *Guides for Business Analysis and Profit Evaluation* (1959), pp. 38–39, 40–54.