An Empirical Analysis of Useful Financial Ratios

Kung H. Chen and Thomas A. Shimerda

Kung H. Chen is Associate Professor of Accounting at the University of Nebraska–Lincoln, and Thomas A. Shimerda is Assistant Professor of Accounting at Creighton University.

■ Financial ratios have played an important part in evaluating the performance and financial condition of an entity. Over the years, empirical studies have repeatedly demonstrated the usefulness of financial ratios. For example, financially-distressed firms can be separated from the non-failed firms in the year before the declaration of bankruptcy at an accuracy rate of better than 90% by examining financial ratios [1]. In determining bond ratings, when financial ratios were the only variables used, the resulting ratings were virtually identical with institutional ratings [21].

There is one recurring question with the use of financial ratios: which ratios, among the hundreds that can be computed easily from the available financial data, should be analyzed to obtain the information for the task at hand? We hope here to help resolve the problem of ratio selection by examining ratios found useful in recent empirical studies, reconciling the differences in the ones found useful in these studies, and categorizing them by seven factors suggested in the literature.

There are many useful ratios reported in the literature. Discrimination is needed to identify a limited set of financial ratios. Naturally, different researchers often include different ratios. Consequently, results on the usefulness of specific ratios vary. Exhibit 1 summarizes a number of such studies and the ratios they employed. The 26 studies analyze more than 100 financial items, of which 65 are accounting ratios. Forty-one of these are considered useful and/or are used in the final analysis by one or more of the researchers. Given such a heterogeneous set of useful financial ratios, the decision-maker has to be at a loss in selecting which ratios to use for the task at hand. Conceivably, 41 ratios cannot all be significant or equally important in a multi-ratio model. The decision-maker may hesitate to omit a ratio if it has been found useful in one or more of the empirical studies.

Yet, it is impossible to include most of the useful ratios found in the literature. Which ratios, then, should be deleted, and which should be included? Should the results from only one study, the results from a combination of studies, or the results from all the studies be used? If only one study is to be used, which one should it be?

Exhibit 1. Financial Ratios Incorporated in Predictive Studies

	NW/TL	NI/TA	QA/CL	NI+DDA/TD(1)	TD/TA	WC/TA	CA/CL	No Cr.Inter(2)	EBIT/TA	S/TA	RE/TA	CA/S	WC/S	NI+DDA/CL(1)	NW/S	CL/NW	Inv/S	QA/Inv	Quick Flow(3)	CA/TA	C+MS/TA	NI+DDA/S(1)
FIRM FAILURE																						
1966 Tamari	*	*					*						*				*					
1966 Beaver		*	X	*	*	*	*	*		X		X	X		X		X			X	X	X
1968 Altman	X				X	*	X		*	*	*		X				X					
1972 Deakin		*	*	*	*	*	*					*	*							*	*	
1972 Edmister	X		*	X		X	X			X			*	*	*	*	*					
1974 Blum	*			*														*	*			
1975 Libby		*	X	X	X	X	*					*	X							*	*	
1975 Elam	*		*	*	*		*		X	*			X		X		X					*
BOND RATINGS																						
1966 Horrigan	*		X				X		X	X			*		*		X					
1969 Pogue & Soldofsky		*																				
1970 West	*																					
1973 Pinches & Mingo		*								X			X		X							
MARKET RETURN																						
1971 Martin				*																		
1973 O'Connor	*									X			*									
MERGERS																						
1973 Stevens	X	X			X	*			X	*			X									
BETA																						
1973 Breen & Lerner	X				X																	
Sub- Found Useful*	6	6	3	5	3	4	5	1	1	3	1	2	5	1	2	1	2	1	1	2	2	1
Total Mentioned	10	7	6	7	7	6	8	1	4	8	1	3	11	1	5	1	6	1	1	3	3	2
PRIOR TO 1965																						
1932 Fitzpatrick	X																					
1935 Winakor & Smith	X					X																
1942 Merwin	X					X	X															
1945 Chudson							X														X	
1958 Hickman																						
1958 Saulnier	X						X															
1961 Moore & Atkinson	X					X	X															
1962 Jackendoff	X					X	X															
1962 Wojenlower	X					X	X															
1963 Jen		X			X																	
Subtotal	7	1			1	5	6														1	
Total Found Useful	12	7	3	5	4	9	11	1	1	3	1	2	5	1	2	1	2	1	1	2	3	1

	NI+DDA/TA(1)	NI/S	OI/S	LTD/TA	NI+Int/Int	Div Ratio	CL/Inv	NI/NW	NI+DDA/#Shs(1)	NW/FA	NW/TA	S/AR	LTD/FA	C+MS/CL	CL/TA	NI+DDA/NW(1)	NI/TD	QA/TA	S/C+MS	S/QA	C Inter(4)	Def.Inter(5)
FIRM FAILURE																						
1966 Tamari												X	X									
1966 Beaver	X	X		X				X				X		X	X	X	X	X	X	X	X	X
1968 Altman		X		X										X	X				X			
1972 Deakin														*				*	*	*		
1972 Edmister										X												
1974 Blum																						
1975 Libby														X				X	X	X		
1975 Elam	*	*	*					*		X		X		*	*	*			X	X		
BOND RATINGS																						
1966 Horrigan		X	*					X		X		X		X								
1969 Pogue & Soldofsky				*	*																	
1970 West																						
1973 Pinches & Mingo		X		*	*			X			X											
MARKET RETURN																						
1971 Martin			*			X		*														
1973 O'Connor						X	*	*	*													
MERGERS																						
1973 Stevens		X	*	*		X		X												X		
BETA																						
1973 Breen & Lerner						*																
Sub- Found Useful*	1	1	4	3	2	1	1	3	1					2	1	1		1	1	1		
Total Mentioned	2	6	4	5	2	4	1	7	1	3	1	4	1	6	3	2	1	3	5	5	1	1
PRIOR TO 1965																						
1932 Fitzpatrick								X														
1935 Winakor & Smith										X												
1942 Merwin																						
1945 Chudson				X							X											
1958 Hickman		X			X																	
1958 Saulnier																						
1961 Moore & Atkinson								X														
1962 Jackendoff		X																				
1962 Wojenlower																						
1963 Jen																						
Subtotal		2		1	1			2		1	1											
Total Found Useful	1	3	4	4	3	1	1	5	1	1	1			2	1	1		1	1	1		

	S/FA	GP/S	EBT/S	NI+Int/TA	CGS/Inv	S/CL	Inv/WC	CA/TD	NW+LTD/FA	EBT/TA	EBT/NW	OI/Int	NW/LTD	Cap Exp/S(6)	NI/EBT	OI/TD	LTD/CA	LTB/TA	Int/C+MS	EPS	Non OI BT/S(7)	NI/CE
FIRM FAILURE																						
1966 Tamari																						
1966 Beaver																						
1968 Altman	X	X	X	X	X	X																
1972 Deakin																						
1972 Edmister	X		X				X	X	X	X	X											
1974 Blum																						*
1975 Libby																						
1975 Elam	X											X	X			X	*					
BOND RATINGS																						
1966 Horrigan	X											X	X									
1969 Pogue & Soldofsky																						
1970 West																						
1973 Pinches & Mingo													X							X		
MARKET RETURN																						
1971 Martin														X								
1973 O'Connor															X						X	
MERGERS																						
1973 Stevens		X	X		X													X	X			
BETA																						
1973 Breen & Lerner																						
Sub- Found Useful*																	1					1
Total Mentioned	4	2	3	1	2	1	1	1	1	1	1	2	3	1	1	1	1	1	1	1	1	1
PRIOR TO 1965																						
1932 Fitzpatrick																						
1935 Winakor & Smith																						
1942 Merwin																						
1945 Chudson																						
1958 Hickman																						
1958 Saulnier																						
1961 Moore & Atkinson																						
1962 Jackendoff																						
1962 Wojenlower																						
1963 Jen																						
Subtotal																						
Total Found Useful																	1					1

*Ratio found useful in study; (X) Ratio mentioned in study; (1) Net Income plus Depreciation, Depletion, Amortization; (2) No Credit Interval = Quick Assets minus CL/Operating Expense minus Depreciation, Depletion, Amortization; (3) Quick Flow = C+MS+AR+(Annual Sales divided by 12)/[CGS−Depreciation+Selling and Administration+Interest) divided by 12]; (4) Cash Interval = C+MS/Operating Expense minus Depreciation, Depletion, Amortization; (5) Defensive Interval = QA/Operating Expense Minus Depreciation, Depletion, Amortization; (6) Capital Expenditure/Sales; (7) Non-operating Income before Taxes/Sales.

Most of the studies reported high predictive powers for their ratios. This would seem to suggest that good results can be attained by using the useful ratios from any study. The researcher can afford the luxury of studying a selected group of firms whose fates are known and then searching for the set of financial ratios that has the highest predictive power for the known results. Those whose business it is to make predictions, though, cannot afford such a procedure. Without further testing and re-examination of the findings, the result from any one study is applicable only to firms with the same characteristics as those included in that study.

Ideally, the financial ratios analyzed should be selected on some theoretical basis, coupled with demonstrated empirical evidence of their usefulness. An acceptable theoretical foundation for the selection of ratios for decision-making has yet to be found, and the scattered heterogeneous empirical evidence in published studies does not identify a complete set of useful ratios. Although in this paper an approach to obtain an efficient set of financial ratios will be presented, we do not present an absolute model for selecting specific ratios. The result will suggest, however, that a useful set of ratios can be developed from seven basic financial factors.

Overlapping of Ratios

Many of the ratios included in the studies are highly correlated with one other. Jackendoff [14] demonstrates this overlapping:

> Another type of redundancy arises from the use of ratios which are easily derived from one another, although the components are not identical as is true in inversions. . . . One of the most obvious sets of such related ratios includes:
>
> 1. Worth to total debt (or its inverse, total debt to worth).
> 2. Worth to total assets.
> 3. Total debt to total assets.
>
> These are simply variants of the equation:
>
> Total Assets = Total Debt + Net Worth
>
> [14, p. 7].

In spite of his extensive study, such overlapping can still be found in most of the recent studies. For example, the 56 items used in the computation of the 28 ratios included in the Elam study [9] are derived from only 18 different pieces of financial data, and the 28 items for Deakin's ratios [7] consist of only 10 separate pieces of data. The elimination of such overlapping would aid in the development of a useful set of financial ratios.

Uses of Principal Component Analysis

Not all overlapping ratios, however, can be eliminated by visual inspection. A statistical tool designed to summarize such inter-relationships is principal component analysis. One of the functions performed by principal component analysis is to group variables into a few factors that retain a maximum of information contained in the original variable set. This tool is a useful first step for subsequent analyses. The use of principal component analysis, along with other statistical methods, produces a more powerful and basic analysis [11, p. 319].

Five of the recent studies have employed principal component analysis. The results of these analyses are summarized in Exhibit 2. In each study, the number of variables was significantly reduced from the original set of variables, yet the reduced set of ratios still accounted for the majority of the variance accounted for by the original set of financial ratios. Pinches and Mingo [21] reduced their data set for bond ratings from 35 to 7 variables (an 80% reduction) and still accounted for 63% of the variation in the original data matrix. Stevens [27] reduced 20 variables to 6 (a 70% reduction) and accounted for 82% of the total variance. Libby [16] reduced his 14-ratio set to 5 ratios (a 64% reduction) with very little loss in the predictive ability of the model.

The attempt by Pinches, Mingo, and Caruthers [22;

Exhibit 2. Data Reduction in Factor-Analyzed Financial Ratio Space

Study	Variable Space	Factor Space	% Reduction In Space	% Variation Still Explained
Pinches and Mingo (1973)	35	7	80	63
Pinches, Mingo, and Caruthers (1973)	48	7	85	91, 92, 87, 92
Stevens (1973)	20	6	70	82
Libby (1975)	14	5	64	Not Reported
Pinches, Eubank, Mingo, and Caruthers (1975)	48	7	85	92

hereafter, PMC] to develop an empirically based classification of financial ratios resulted in seven classifications of ratios across industries. These seven patterns occurred in each year examined, accounting for a consistently high amount of the variance contained in the original data matrix. The composition of these classifications remained relatively stable over the 19-year period studied. A subsequent study by Pinches, Eubank, Mingo, and Caruthers [23; hereafter, PEMC] showed the short-term stability of these factors. They also demonstrated that a hierarchical classification of empirical financial ratios can be constructed.

Diversity of Factors

The PMC and PEMC studies suggest the existence of common ratio classifications and offer an empirical basis for grouping financial ratios. According to their findings, financial ratios can be represented by seven factors — Return on Investment, Financial Leverage, Capital Turnover, Short-Term Liquidity, Cash Position, Inventory Turnover, and Receivables Turnover. A slightly different set of factors is found in an earlier study by Pinches and Mingo [21]. The studies by Stevens and Libby mentioned above also attempt to derive a reduced set of financial ratios to represent the original set of financial ratios, using different sets of factors from those in the PMC and PEMC studies; these can be seen in Exhibit 3. A total of 12 factors is suggested in these studies, with each study seemingly proposing a different set of factors to represent the variable space portrayed by the financial ratios. For example, of the four factors found in Stevens's study only one is included in the PMC and PEMC factors. Similarly, only one of the five factors suggested by Libby is found among the factors in the PMC and PEMC studies.

It seems that the results from principal component analyses are as diverse as the financial ratios themselves. Different sets of factors can be found in different studies with very little commonality among any of them. Using such results as a guide for the selection of financial ratios is hardly a viable solution, if not actually a waste of time. Inevitably, before the results from principal component analysis can be applied to studies on financial ratios, a satisfactory answer to the question of what are the common factors representing the financial ratios must be formulated. A detailed analysis of the five studies reveals that some of the twelve factors vary in name only. They can be described according to the seven common factors suggested in Exhibit 4.

A Reconciliation of Factors

To a great extent, the diversity of factors reported in the literature can be attributed to the difference in variables included in the principal component analyses, as indicated in the following detailed analysis.

Profitability and Return on Investment

Stevens [27] found five ratios — earnings before interest and taxes (EBIT)/total assets, EBIT/sales, earnings before taxes (EBT)/sales, net income/net worth, and net income/total assets — with high loadings[1] on his profitability factor. Each of these ratios also had a high loading on the return on investment factor in the PMC and PEMC studies. The net income/total assets ratio was the most representative ratio among the ratios in Libby's [16] profitability factor. The profitability factor found by both Stevens and Libby was the same as the return on investment factor in the PMC and PEMC studies.

Activity, Receivable Turnover, and Capital Turnover

A slightly more confusing picture is found in the activity factor of the Stevens [27] study. Two ratios have high loadings on this factor — sales/quick assets (S/QA) has a loading of 0.794, and sales/total assets (S/TA) has a loading of 0.85. The S/QA ratio in the PMC and PEMC studies has a high factor loading on the receivables turnover factor, while the S/TA ratio has a high loading on the capital turnover factor. Such diverse results can be explained by differences in the original variables included in the principal component analysis in these studies.

Principal component analysis is variable-sensitive: different factors may be obtained if different sets of variables are fed into the principal component analysis. Substantially more ratios are included in the PMC and PEMC studies than in the Stevens study [27]. Among the ratios included in the PMC and PEMC studies are five ratios relating to receivable turnover, including the S/QA ratio. But Stevens includes only one of the five ratios in his analysis. Because the variances of these 5 ratios are similar, and 5 of a total of 48 ratios in a 7-factor result will cer-

[1]A factor loading represents the extent to which the variable is related to the factor and is commonly thought of as the correlation between the variable and the factor. For a more detailed discussion on the meaning of factor loadings, see William D. Wells and J. N. Sheth, "Factor Analysis in Marketing Research" [29].

Exhibit 3. Factors Found in Five Empirical Analyses of Financial Ratios

Factors	Pinches and Mingo (1973)	Pinches, Mingo, and Caruthers (1973)	Stevens**	Libby (1975)	Pinches, Eubank, Mingo, and Caruthers (1975)
Asset Balance				X	
Activity			X	X	
Profitability			X	X	
Liquidity			X	X	
Cash Position		X		X	X
Short-Term Liquidity		X			X
Receivables Turnover		X			X
Inventory Turnover		X			X
Return on Investment	X	X			X
Short-Term Capital Intensiveness	X	X*			X*
Long-Term Capital Intensiveness	X	X*			X*
Financial Leverage	X	X			X

*These studies had one factor, capital turnover, which included the ratios from the above two factors.
**Seven factors were found in the Pinches and Mingo study. Variables in three of the factors — size, debt and debt coverage stability, and earnings stability — were not ratio measures. Thus they were excluded. For the same reason, two factors found in the Stevens study — dividend policy and price earnings — were excluded.

Exhibit 4. A Reconciliation of Factors Depicting Financial Ratios

	Seven Basic Factors						
Study	Financial Leverage	Capital Turnover	Return on Investment	Inventory Turnover	Receivables Turnover	S-T Liquidity	Cash Position
PMC	X	X	X	X	X	X	X
PEMC	X	X	X	X	X	X	X
Stevens	X	Liquidity	Profitability		Activity		
Libby		Asset Balance	Profitability	Activity		Liquidity	X

tainly account for a significant portion of the total variance defined by the 48 ratios, the S/QA ratio forms a separate factor with other similar ratios in the PMC and PEMC studies.

On the other hand, the S/QA ratio is the only ratio out of the five ratios that is used in the Stevens study. The other four ratios represented by the receivable turnover factor in the PMC and PEMC studies are not included in Stevens's principal component analysis. Consequently, the S/QA ratio will either correlate with one other ratio in a different factor or not be represented at all in the factors selected. Nevertheless, this evidence suggests that the activity factor of the Stevens study is represented by factors found in the PMC and PEMC studies.

Liquidity, Asset Balance, and Capital Turnover

Similar reasoning can be applied to the importance of the current assets/total assets (CA/TA) ratio. Stevens does not include CA/TA as one of his ratios, but he does use net working capital/total assets (NWC/TA). This ratio loads heavily on the factor Stevens describes as his liquidity factor. This ratio is mentioned but is not included in the final factors in both the PMC and PEMC studies. A separate analysis, which will be discussed in detail later, reveals that the NWC/TA ratio is highly correlated ($r = 0.80$) with the current assets/total assets ratio (CA/TA). The result of a principal component analysis indicates that both NWC/TA and CA/TA ratios have high factor loadings, 0.85 and 0.91, respectively, on the same factor. This indicates that the NWC/TA ratio could be an important ratio in the same factor as the CA/TA ratio were it included in the same analysis.

In the PMC and PEMC studies, the CA/TA ratio is among the ratios with high loadings on the capital turnover factor. Thus, the liquidity factor in the Stevens study is similar to the capital turnover factor in the PMC and PEMC studies. Libby also uses the CA/TA ratio to represent one of his five factors. He

denotes the factor best represented by CA/TA as his asset balance factor. This means that one ratio, CA/TA, is used to describe a capital turnover factor, an asset balance factor, and, if employed in the Stevens study, could even describe a liquidity factor.

At first it appears somewhat confusing that one ratio can represent three basically different factors. This again can be reconciled if one examines the original ratio sample for the three studies. Stevens includes only two ratios that are slightly related to liquidity — NWC/TA and NWC/S. As no other ratios could represent liquidity in his study, an obvious choice for the factor containing high loadings on these ratios has to be liquidity. If Stevens had started with a larger variable set, his liquidity factor could very well not have included NWC/TA. The ratios Stevens calls liquidity could actually represent capital turnover as described by PMC and PEMC.

Libby started with a 14-variable set. Six ratios had total assets as their denominator, and four of those ratios had a current asset item for their numerator. Three other ratios related current asset items to current liabilities, while four ratios used sales as the denominator base. Because of the restricted set of ratios employed and the predominate use of total assets as a denominator base, Libby's result was not surprising. Why he chose "asset balance" to describe the factor represented by CA/TA was not reported, nor were any of the ratios' factor loadings. Without detailed information about the ratios and the factors, further analysis is impossible.

Given the set of ratios included in both the Stevens and Libby studies, it is possible for the three factors — capital turnover, liquidity, and asset balance — to capture basically the same information even though their titles differ. The ratio CA/TA is common to two and significantly correlated with a ratio in the third factor. With this common bond, it is possible to reconcile Stevens's liquidity and Libby's asset balance factors with PMC's and PEMC's capital turnover factor.

Other Factors

Two other factors are quite easily reconciled. The leverage factors in the PMC, PEMC, and Stevens studies are virtually identical. In all three studies, the long-term debt/net worth, long-term debt/total assets, and total liabilities/total assets ratios have high loadings on the leverage factor. The ratio with a high loading on Libby's liquidity factor is current assets/current liabilities. This same ratio also has a high loading on the short-term liquidity factor in the PMC and PEMC studies.

The final factor to reconcile is Libby's activity factor. The ratio designated by Libby to represent this factor is current assets/sales. This same ratio has a high loading on the inventory turnover factor in the PMC and PEMC studies. The cash position factor is common to the PMC and PEMC studies as well as to Libby's study. The ratio in Libby's study, cash/total assets, is also highly loaded on the cash position factor in both the PMC and PEMC studies. Results of the above analyses suggest that factors found in the Stevens and the Libby studies, although different in name, are included in the PMC and PEMC factors.

The evidence we have described so far confirms that financial ratios can be grouped and represented by the seven common factors defined in the PMC and PEMC studies. Each factor represents a unique dimension in the description of financial characteristics of a business firm. This finding offers a possible reconciliation of the diverse results of various empirical studies. This result can be applied to reconcile the seemingly disorganized state of useful financial ratios in the several studies on the prediction of firm failure reported in the literature.

Important Factors in Firm–Failure Prediction

Thirty-four financial ratios have been found by researchers to be significant variables in the prediction of firm failure in recent studies. If a smaller number of ratios could still convey substantially the same amount of information, the task of using them would be easier.

If the seven-factor space from the PMC and PEMC studies is used as the basis for classifying financial ratios, all but ten of the ratios found useful in the firm failure prediction studies can be classified by one of the seven factors. Exhibit 5 summarizes the seven studies and their ratios. Ten ratios could not be classified without further analysis because they were not included in the final factors of the PMC or PEMC study. They are quick assets/inventory, net income/common equity, quick flow ratio,[2] funds flow/current liabilities, net income/sales, funds flow/total debt, working capital/total assets, long-term debt/current assets, no-credit interval, and retained earnings/total assets.

[2]Blum [4, p. 16] defines quick flow as [Cash + Notes Receivable + Market Securities + (Annual Sales ÷ 12)] ÷ [(Cost of Goods Sold − Depreciation Expense + Selling and Administration Expense + Interest) ÷ 12].

Exhibit 5. Factor Classification of Important Ratios for Predicting Firm Failure as Found in Recent Empirical Studies

Factor	Ratio	Beaver	Altman	Deakin	Study by Edmister	Blum	Elam	Libby
Return on Investment	Net Income/Sales*						X	
	Funds Flow/NW						X	
	Funds Flow/TA						X	
	Net Income/TA	X		X				X
	Net Income/NW						X	
	EBIT/Sales						X	
	EBIT/TA		X					
	NI/Common Equity**					X		
Capital Turnover	QA/TA			X				
	Funds Flow/Sales						X	
	Current Assets/TA			X				X
	Net Worth/Sales				X			
	Sales/TA		X				X	
	WC/TA*	X	X	X				
Financial Leverage	Total Liabilities/TA	X		X			X	
	Total Liabilities/NW					X	X	
	Long-Term Debt/CA**						X	
	Funds Flow/TD**	X		X		X	X	
	Funds Flow/CL**				X			
	Retained Earnings/TA**		X					
Short-Term Liquidity	Current Assets/CL	X		X			X	X
	Quick Assets/CL			X	X		X	
	Current Liabilities/NW				X			
	Current Liabilities/TA						X	
Cash Position	Cash/Sales			X				
	Cash/Total Assets			X				X
	Cash/Current Liabilities			X			X	
	No Credit Interval**	X						
	Quick Flow**					X		
Inventory Turnover	Current Assets/Sales			X				X
	Inventory/Sales				X			
	Sales/Working Capital			X	X			
Receivables Turnover	Quick Assets/Inventory**					X		
	Quick Assets/Sales			X				

*Ratio not included in the final factors of the PEMC studies.
**Ratio not in the 48 ratios included in the PEMC study.

Empirical Results

To study the relationship of the ten ratios to the other ratios included in the factors, we conducted a principal component analysis of 39 ratios for the firms included in the COMPUSTAT tape. A total of 1,053 firms with complete data for both total assets and net sales in 1977 was included. The results from the test are summarized in Exhibit 6. Each of the ten ratios is paired with the ratio from the PEMC study for which its product moment correlation is the highest. The factor loadings of the paired ratios on a common factor are also reported.

Net Income/Sales, Net Income/Common Equity, and Return on Investment

The result of the analysis shows that two of the ten ratios correlate highly with ratios representing the return on investment factor in the PEMC study. Net income/sales is highly correlated (r = .98) with

Exhibit 6. Factor Loading and Product-Moment Coefficient of Correlation of Selected Ratios in 1977

Unclassified Ratio	Factor Loading	Classified Ratio	Factor Loading	Factor	Correlation Coefficient	Level of Significance
Net Income / Sales	.90	EBIT / Sales	.86	Return on Investment	.98	.001
Net Income / Common Equity	.62	Net Income / Net Worth	.87	Return on Investment	.39	.001
Working Capital / Total Assets	.85	Current Assets / Total Assets	.91	Capital Turnover	.80	.001
Funds Flow / Total Debt	.92	Net Worth / Total Debt	.89	Financial Leverage	.88	.001
Funds Flow / Current Liabilities	.91	Net Worth / Total Debt	.89	Financial Leverage	.84	.001
Long-Term Debt / Current Assets	-.81	Long-Term Debt / Total Assets	.63	Financial Leverage	-.31	.001
Retained Earnings / Total Assets	.62	Total Debt / Total Assets	-.71	Financial Leverage	-.72	.001
No Credit Interval	.82	Cash / Sales	.85	Cash Position	.80	.001
Quick Flow	-.86	Cash / Sales	.85	Cash Position	-.58	.001
Quick Assets / Inventory	.98	Receivables / Inventory	.97	Receivable Turnover	.98	.001

EBIT/Sales with factor loadings of .90 and .86, respectively, on the same factor. Net income/common equity and net income/net worth have high loadings (.62 and .87, respectively) on the same factor and are significantly correlated (r = .39). This is not surprising, since common equity and net worth differ only by the amount of preferred stock outstanding. The ratios EBIT/Sales and net income/net worth have high loadings on PEMC's return on investment factor. Thus the two ratios that correlate with these ratios could be classified as ratios exhibiting return on investment characteristics.[3]

Working Capital/Total Assets and Capital Turnover

The ratio, working capital/total assets, does not have a high factor loading score on any of the factors in the PEMC study. The ratio is significantly correlated with the ratio, current assets/total assets. The current asset/total assets ratio is represented in the capital turnover factor in the PEMC study. The ratio WC/TA is thus classified as a capital turnover ratio.

Ratios Pertaining to Financial Leverage

Four of the unclassified ratios correlate and load highly with ratios classified in the financial leverage factor of the PMC and PEMC studies. Two of these ratios, funds flow/total debt and funds flow/current liabilities, are highly correlated (.88 and .84, respectively) with the net worth/total debt ratio. Their loadings on a common factor are .92 for funds flow/total debt, .91 for funds flow/current liabilities, and .89 for net worth/total debt. The two ratios, long-term debt/current assets and retained earnings/total assets, can also be regarded as representative of the financial leverage factor. They load and are significantly correlated with ratios that are part of PEMC's financial leverage factor.

The ratio, retained earnings/total assets, was one of Altman's [1] most significant ratios in predicting bankruptcy, but it has not been incorporated in any other study on firm failure. The results of factor analysis applied to the 1977 data confirm its importance in the financial leverage factor.

[3] In the present analysis, all but net income/common equity and net income/net worth load on the same factor. These two ratios load on a separate factor. This slight difference can be attributed to differences in the original variable space.

No–Credit Interval, Quick Flow, and Cash Position

Two previously unclassified ratios, no-credit interval and quick flow, correlate with cash/sales. The coefficients of correlation are .80 and −.58, respectively. Further evidence that these two ratios can be grouped with ratios that measure cash position is provided in their factor loadings. The factor loadings of these two ratios on the cash position factor are .82 and −.86, respectively.

Quick Asset/Inventory and Receivables Turnover

The last ratio to classify is quick assets/inventory. This ratio correlates highly with receivables/inventory (r = .98), and both ratios have high loadings on the same factor. The ratio, receivables/inventory, loads heavily on the receivables turnover factor in the PEMC study. Because of this relationship, the ratio quick assets/inventory is classified in Exhibit 6 as belonging to the receivables turnover factor.

Based on the PMC and PEMC results and supplemented with the analysis of the 1977 data, all 34 financial ratios that were found useful in the various predictive studies on bankruptcy can be assigned by one of the seven major factors. Because ratios belonging to the same factor are highly correlated and reveal primarily the same information, a decision-maker can select an appropriate set of financial ratios that best represents these seven factors for the prediction of firm failure.

Conclusions

This paper demonstrates that the financial ratios investigated in previous predictive studies of bankruptcy can be classified by a substantially reduced number of factors. The ratios classified by the same factor are highly correlated, and the selection of one ratio to represent a factor can account for most of the information provided by all the ratios of that factor. Inclusion of more than one ratio from a factor leads to multicollinearity among ratios and distorts the relationship between the dependent and independent variables. In addition, high correlation between ratios causes the results to be sample-sensitive and possibly misleading. It is important then that a minimum number of ratios, one ratio in most cases, be selected to represent each factor for further statistical analysis.

Still, the question of which ratio should represent a factor has yet to be resolved. The popular procedure of selecting the ratio with the highest absolute factor loading makes the selection sensitive to the sample. Such a procedure may be satisfactory for data reduction purposes, but it is certainly not satisfactory for model building or theory construction. Concerted effort should be applied to the process of selecting the most representative ratios of these factors.

The selection of the best representative ratio for a factor is not independent of the ratios selected for other factors. Each ratio contains common as well as unique information. The common information contained in a ratio is represented by factors. The unique information is not shared by any other ratio in the factor. Consequently, the set of financial ratios used for further analysis should be selected in such a way that the ratios capture most of the common information contained in their factors and, as a group, contain more of the unique information than any other set of ratios. Unfortunately, such a theory is yet to be developed. Empirical evidence has so far been concerned with the extraction of common factors.

No study has reported on the type and amount of unique information contained in a ratio. Future studies on this problem will certainly enhance the usefulness of financial ratios and facilitate the selection of appropriate ratios for decision-making.

References

1. Edward I. Altman, "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy," *Journal of Finance* (September 1968), pp. 589–609.
2. William H. Beaver, "Alternative Accounting Measures as Predictors of Failure," *The Accounting Review* (January 1968), pp. 113–122.
3. William H. Beaver, "Financial Ratios as Predictors of Failure," *Empirical Research in Accounting: Selected Studies, 1966, Journal of Accounting Research* (1967), pp. 71–111.
4. Marc P. Blum, "The Failing Company Doctrine," *Journal of Accounting Research* (Spring 1974), pp. 1–25.
5. William J. Breen and Eugene M. Lerner, "Corporate Financial Strategies and Market Measures of Risk and Return," *Journal of Finance* (May 1973), pp. 339–351.
6. Walter A. Chudson, *The Pattern of Corporate Financial Structure,* New York, National Bureau of Economic Research, 1945.
7. Edward B. Deakin, "A Discriminant Analysis of Predictors of Business Failure," *Journal of Accounting Research* (Spring 1972), pp. 167–179.
8. Robert O. Edmister, "An Empirical Test of Financial Ratio Analysis for Small Business Failure Prediction," *Journal of Financial and Quantitative Analysis* (March 1972), pp. 1477–1493.

9. Rick Elam, "The Effect of Lease Data on the Predictive Ability of Financial Ratios," *The Accounting Review* (January 1975), pp. 25–43.
10. Paul J. Fitzpatrick, *Symptoms of Industrial Failures,* Washington, D.C., Catholic University of America Press, 1931.
11. Richard Gorsuch, *Factor Analysis,* Philadelphia, W. B. Saunders Company, 1974.
12. W. Braddock Hickman, *Corporate Bond Quality and Investor Experience,* Princeton, N.J., Princeton University Press, 1958.
13. James O. Horrigan, "Some Empirical Bases of Financial Ratio Analysis," *The Accounting Review* (July 1965), pp. 558–568.
14. Nathanial Jackendoff, *A Study of Published Industry Financial and Operating Ratios,* Small Business Management Research Report, Philadelphia, Temple University, 1962.
15. Frank Chifeng Jen, "The Determinants of the Degree of Insufficiency of Bank Credit to Small Business," *Journal of Finance* (December 1963), pp. 694–695.
16. Robert Libby, "Accounting Ratios and the Prediction of Failure: Some Behavioral Evidence," *Journal of Accounting Research* (Spring 1975), pp. 150–161.
17. Alvin Martin, "An Empirical Test of the Relevance of Accounting Information for Investment Decisions," *Journal of Accounting Research,* Supplement (1971), pp. 1–31.
18. Charles L. Merwin, *Financing Small Corporations,* New York, National Bureau of Economic Research, 1942.
19. Geoffrey H. Moore and Thomas R. Atkinson, *Risks and Returns in Small Business Financing,* 41st Annual Report, New York, National Bureau of Economic Research, 1961.
20. Melvin C. O'Connor, "On the Usefulness of Financial Ratios to Investors in Common Stock," *The Accounting Review* (April 1973), pp. 339–352.
21. George E. Pinches and Kent A. Mingo, "A Multivariate Analysis of Industrial Bond Ratings," *Journal of Finance* (March 1973), pp. 1–18.
22. George E. Pinches, Kent A. Mingo, and J. Kent Caruthers, "The Stability of Financial Patterns in Industrial Organizations," *Journal of Finance* (May 1973), pp. 389–396.
23. George E. Pinches, A. A. Eubank, Kent A. Mingo, and J. Kent Caruthers, "The Hierarchical Classification of Financial Ratios," *Journal of Business Research* (October 1975), pp. 295–310.
24. T. F. Pogue and R. M. Soldofsky, "What's in a Bond Rating," *Journal of Financial and Quantitative Analysis* (June 1969), pp. 201–228.
25. Raymond I. Saulnier, Neil H. Jacoby, and Harold G. Halcrow, *Federal Lending and Loan Insurance,* Princeton, N.J., Princeton University Press, 1958.
26. Raymond F. Smith and Arthur H. Winakor, *Changes in the Financial Structure of Unsuccessful Corporations,* Urbana, Ill., Bureau of Business Research, University of Illinois, 1935.
27. D. L. Stevens, "Financial Characteristics of Merged Firms: A Multivariate Analysis," *Journal of Financial and Quantitative Analysis* (March 1973), pp. 149–158.
28. Meir Tamari, "Financial Ratios as a Means of Forecasting Bankruptcy," *Management International Review* (1966), pp. 15–21.
29. William D. Wells and J. N. Sheth, "Factor Analysis in Marketing Research," in *Multivariate Analysis in Marketing,* David A. Aaker, ed., Belmont, California, Wadsworth Publishing Company, Inc., 1971, pp. 212–227.
30. Richard R. West, "An Alternative Approach to Predicting Corporate Bond Ratings," *Journal of Accounting Research* (Spring 1970), pp. 15–21.
31. Albert M. Wojinlower, *The Quality of Bank Loans: A Study of Bank Examination Records,* New York, National Bureau of Economic Research, 1962.