1994

Cash Flow and the New Taxonomy of Financial Ratios for Manufacturing Firms

Thomas Zeller
Loyola University Chicago, tzeller@luc.edu

Brian Stanko
Loyola University Chicago, bstanko@luc.edu

CASH FLOW AND THE NEW TAXONOMY OF FINANCIAL RATIOS FOR MANUFACTURING FIRMS

by

Thomas L. Zeller
Brian B. Stanko*

ABSTRACT

Analysts derive a broad array of financial ratios from published financial reports to assess business enterprise performance. Only a few ratios, however, yield meaningful insight. The adoption of Statement of Financial Accounting Standards (SFAS) No. 95, The Statement of Cash Flows, by the Financial Accounting Standards Board (FASB) in 1987 provided the impetus for the recent interest in cash flow ratios. This study explores the usefulness of cash flow ratios, relative to accrual-based financial ratios, in assessing the performance of manufacturing firms. Our findings show that cash flow ratios render both complementary and unique insight regarding a manufacturing firm's performance and its "ability to pay." Therefore, we recommend that financial ratio analysis of a manufacturing firm should include both accrual-based and cash flow ratios.

INTRODUCTION

Financial ratios are vital tools in the financial analysis of a firm. Creditors, investors, and others track groups of key financial ratios by industry and across industries, with qualitative measures for predictive, explanatory and descriptive purposes (Barnes, 1987). Their objectives may include firm performance evaluation, liquidity analysis, future profit estimation, competitor analysis, prediction of corporate failure, and cash flow analysis. This study examines the relative utility of cash flow ratios in the financial ratio analysis of a manufacturing firm.

The adoption of SFAS 95, The Statement of Cash Flows (SCF), by FASB in 1987, provided the impetus for the recent interest in cash flow ratios. SFAS 95 was designed to bridge the information gap between accrual accounting and the cash flow activities of a business enterprise. This information gap had existed because the primary categories of cash flow activity had not been specified under the Statement of Changes in Financial Position (SCFP); furthermore, the term "cash" had not been defined. For these reasons, the SCFP lacked comparability over time and across firms (Drtina and Largay, 1985). Under the SCF, the primary categories of cash flow were specified as firm operating, investing and financing activity. The SCF also expanded the definition of "cash" to include cash and cash equivalents, such as Treasury bills, commercial paper and money market funds. As a result of SFAS 95, useful cash flow ratios can now be drawn from

*Assistant Professors, Graduate School of Business, Loyola University Chicago, Chicago, IL.

the SCF (Figlewicz and Zeller, 1991). This development is significant because reliable cash flow reporting is the best measure of business enterprise health (Rauh, 1990).

Cash flow ratios may close the information gap that existed under the SCFP. They offer a more complete picture of a firm's ability to generate an operating cash flow sufficient to service its debt and equity obligations, as well as an additional measure of a firm's performance [1]. The literature, however, does not furnish empirical evidence supporting the effectiveness of cash flow ratios in financial ratio analysis. In this paper, we have used a statistical-based taxonomy, via factor analysis, to investigate how cash flow and accrual-based financial ratios should be applied in the financial analysis of manufacturing firms (Standard Industrial Classification [SIC] codes 2000 to 3999). Our findings offer guidance in employing accrual-based, traditional cash flow, and new cash flow financial ratios for predictive, explanatory and descriptive purposes.

CASH FLOW RATIOS: NEW AND TRADITIONAL

Table 1 lists five cash flow ratios that have been discussed in recent professional business literature. The first ratio, cash flow from operations divided by average current debt (CFFOACD), indicates the approximate excess (or shortfall) of cash generated from operations that is available to meet current debt obligations. This is a useful liquidity measure, as the current and quick ratios do not accurately reflect a firm's "ability to pay" (Walter, 1957). CFFOACD represents the excess of operating cash flow after funding working capital needs and required payments on current liabilities (Stickney, 1991, p. 236).

Table 1. New Cash Flow Ratios.

Cash Flow Ratio	Abbreviation
Cash Flow from Operations[a, d] / Average Current Debts	CFFO[e] / ACD
CFFO Before Interest and Taxes[a, b, c] / Interest Paid	CFFOBIT / IP
CFFO[a, b] / Dividends Paid	CFFO / DP
CFFO - Total Dividend[b] / Total Debts	CFFOD / TD
CFFO[b, c] / Operating Income	CFFO / OI

[a] Figlewicz and Zeller, 1991.
[b] Carslaw and Mills, 1991.
[c] Giacomino and Mielke, 1993.
[d] Stickney, 1991.
[e] Cash flow from operations according to SFAS 95, Statement of Cash Flows.

The second ratio, cash flow from operations plus interest and taxes paid divided by interest paid (CFFOBITIP), indicates the operating cash flow coverage of interest paid to creditors. The conventional "times-interest-earned" ratio may not accurately reflect coverage of interest because of the noncash adjustments required by Generally Accepted Accounting Principles (GAAP) when calculating accrual income. In contrast, CFFOBITIP indicates the firm's ability to generate cash flow in relation to its interest payment obligations.

The third ratio, cash flow from operations divided by cash dividends paid (CFFODP), reflects the approximate coverage of dividends to equity holders after all creditors have been paid. The "dividend-payout" ratio, defined as dividends paid divided by net income, may be misleading because of the noncash adjustments required by GAAP. Again, CFFODP more accurately reflects the firm's ability to pay for equity out of operating cash flow.

The fourth ratio, cash flow from operations less dividends divided by total debt (CFFODTD), represents the percentage of current operating cash flow available to satisfy all debt obligations beyond the coverage of interest, taxes and dividends. A decreasing trend in CFFODTD may signal a potential problem with debt repayment out of operating cash flow, as well as a possible need for additional financing to satisfy interest charges, taxes and dividends.

The final ratio in Table 1, cash flow from operations divided by operating income (CFFOOI), indicates the percentage of operating income represented by CFFO. The significance of this ratio is that it signals the cash-generating productivity of continuing operations (Giacomino and Mielke, 1993). Traditionally, accrual-based operating income was used to measure this activity. Again, noncash adjustments required by GAAP may mask this perspective. Therefore, the "quality" of earnings can be assessed by its relationship to CFFO. If a trend of overstatement or understatement exists, this ratio signals that a firm's operating income may not be measuring true performance. Understanding the reasons for a difference between CFFO and net operating income should help analysts evaluate a firm's true economic performance.

The traditional cash flow ratios employed prior to SFAS 95 were CFFO divided by sales, CFFO divided by total assets and CFFO divided by total debts [2]. Before SFAS 95, CFFO had to be estimated from the SCFP and therefore suffered from the inherent limitations of cash flow reporting identified by Drtina and Largay (1985). For this reason traditional cash flow ratios are explored with CFFO coming from the SCF.

RELATED RESEARCH

Factor analysis is an established approach to classifying a firm's key financial characteristics. Chen and Shimerda (1981) reconciled prior studies that factor-analyzed financial ratios [3], concluding that the primary financial characteristics of firm activity were 1) capital turnover, 2) cash position, 3) financial leverage, 4) inventory turnover, 5) receivables turnover, 6) return on investment, and 7) short-term liquidity. Gombola and Ketz (1983a) used factor-analyzed ratios in their study of manufacturing firms for the years 1962 to 1980. They extended Chen and Shimerda (1981) by identifying an eighth financial characteristic: cash flow. The cash flow factor consisted of CFFO/sales, CFFO/total assets, and CFFO/total debts; however, CFFO was estimated from the SCFP.

Ketz, Doogar and Jensen (1990) (hereinafter referred to as "KDJ") extended this line of research to a wide range of industries in a study that covered the years 1978 to 1987. They used common-factor analysis to identify a separate taxonomy of financial ratios across seven industries, plus one combined "economy" group. The majority of firms in the economy group fell within SIC codes 2000 to 3999. KDJ identified seven factors for the economy group: 1) cash flow, 2) cash position, 3) debt, 4) inventory, 5) liquidity, 6) return/working capital flow, and 7) sales. The cash flow factor consisted of CFFO/sales, CFFO/total assets and CFFO/total debts; once again, CFFO was estimated from the SCFP. These studies furnish empirical evidence that financial ratios carry a wide range of financial characteristics to aid decision making.

METHODOLOGY

Factor analysis is used in this study to examine how cash flow ratios should be employed relative to accrual-based ratios. Factor analysis is a data reduction procedure that creates a statistical-based taxonomy of financial ratios, which in turn is defined as a grouping of an entire ratio set into several subsets, called common factors. According to Gombola and Ketz (1983b), factor analysis

> ...takes a correlation matrix (or covariance matrix) among original variables as input and constructs new variables where the number of new variables (called factors) to be retained is smaller than the number of variables in the original data set. If the correlation coefficient between one of the original variables and a factor is close to unity then the original variable can be used to represent the factor. In this manner, a larger set of variables can be reduced to a much smaller set, where the smaller set of variables is then used for some predictive, explanatory or descriptive purpose.

In the present study, the condition responsible for the common variability of a ratio subset has been labeled a financial characteristic of firm activity. Each condition is identified by the specific ratios that consistently load to the respective common factor (Gombola and Ketz, 1983a and 1983b). Benishay (1971) and Barnes (1987) refer to each financial characteristic of firm activity identified by factor analysis as either fully independent or semi-independent financial information. Ratios with a common factor loading greater than .70 can be used to represent such financial information (KDJ, 1990). Ratios with a factor loading less than .70 are labeled as redundant and serve only as complementary measures. Thus, factor analysis can be used to indicate the relative financial information of cash flow ratios.

If the condition driving the variability of cash flow ratios is the same condition that drives the variability of accrual-based ratios, then cash flow ratios will load with the accrual-based ratios to a common factor. This outcome would suggest that cash flow ratios should serve as complementary measures for predictive, explanatory and descriptive purposes. Conversely, if the condition driving the variability of cash flow ratios is unique relative to accrual-based ratios, then cash flow ratios will load on a separate common factor. This outcome would indicate that a distinct underlying condition is contributing to the variability of cash flow ratios, which in turn would suggest that cash flow ratios capture a unique financial characteristic of firm activity.

The sample consists of manufacturing firms (SIC codes 2000 to 3999); the necessary data was obtained from COMPUSTAT annual data tapes for the years 1988 to 1991. (The sample size for each year is given in Table 4.) A four-year limit was imposed in this study to parallel the introduction of the SCF in 1988.

Three considerations led us to make manufacturing firms the focus of our analysis. First, this SIC group is commonly used for research inquiry and financial analysis (Gombola and Ketz, 1983a). Second, the failure to focus on a general industry grouping would make interpreting the statistical output more difficult because of unique operating and economic constraints (Gombola and Ketz, 1983a; 1983b). And third, manufacturing firms provide a sample large enough to employ factor analysis effectively.

The factor analysis literature specifies a minimum number of observations necessary for valid, interpretable results. Tabachnick and Fidell (1983) and others suggest that approximately 500 observations are necessary to produce meaningful results. Guertin and Bailey (1970, p. 200) have noted the disadvantages of smaller samples:

> [T]he random errors of the less reliable correlations coefficients increase the absolute size of the correlations in the matrix. This results in greater communalities and a large amount of common factor variance, although the increase is due to spurious common factor variance.

Table 2 lists the ratios employed in this study. The first 29 ratios are identical to those used by KDJ (1990). These ratios are employed because they are typically found in research inquiry and financial analysis (KDJ, 1990). Ratios numbered 30 through 34 are the new cash flow ratios discussed above. The remaining two ratios, numbers 35 and 36, are included in the analysis for comparison to new cash flow ratios.

There are three criteria for naming primary factors: 1) eigenvalues should be greater than one, Kaiser's criterion; 2) there should be an identifiable factor above the level plane on the scree plot, Cattell's scree criterion; and 3) the common factor should be interpretable. This three-tier approach is consistent with prior work using factor-analyzed financial ratio data to identify the primary financial characteristics of firm activity.

Table 2. Financial Ratios.

No.	Financial Ratio	Abbreviation
1.	Cash/Current Debts	CCD
2.	Cash/Sales	CS
3.	Cash/Total Assets	CTA
4.	Cash/Total Debts	CTD
5.	Cash Flow from Operations/Sales	CFFOS
6.	CFFO/Total Assets	CFFOTA
7.	CFFO/Total Debts	CFFOTD
8.	Cost of Goods Sold/Inventory	CGSINV

Table 2. Continued.

No.	Financial Ratio	Abbreviation
9.	Cost of Goods Sold/Sales	CGSS
10.	Current Assets/Current Debts	CACD
11.	Current Assets/Sales	CAS
12.	Current Assets/Total Assets	CATA
13.	Current Debts/Total Debts	CDTD
14.	Inventory/Current Assets	INVCA
15.	Inventory/Sales	INVS
16.	Inventory/Working Capital	INVWC
17.	Long-Term Debt/Total Assets	LTDTA
18.	Operating Income/Sales	OPINCS
19.	Operating Income/Total Assets	OPINCTA
20.	Operating Income/Total Debts	OPINCTD
21.	Operating Income Plus Depreciation/Sales	OPIPDS
22.	Operating Income Plus Depreciation/Total Assets	OPIPDTA
23.	Operating Income Plus Depreciation/Total Debts	OPIPDTD
24.	Quick Assets/Current Debts	QACD
25.	Receivables/Inventory	RECINV
26.	Receivables/Sales	RECS
27.	Sales/Receivables	SREC
28.	Sales/Total Assets	STA
29.	Total Debts/Total Assets	TDTA
30.	CFFO/Average Current Debts	CFFOACD
31.	CFFO Before Interest and Taxes/Interest Paid	CFFOBITIP
32.	CFFO/Dividends Paid	CFFODP
33.	CFFO-Total Dividends/Total Debts	CFFODTD
34.	CFFO/Operating Income	CFFOOI
35.	Income Before Interest Charges and Taxes/Interest Charges	TIE
36.	Dividends Paid/Net Income	DP

EMPIRICAL RESULTS AND DISCUSSION

The findings serve as a guide to selecting the specific ratio to meet the user's objective(s). The results were based on interpretation of ratios loading to each factor with a promax rotation. A promax rotation enhances the interpretation of factor loadings because the ratios are not assumed to be independent, which is most likely true with financial ratio data (KDJ, 1990). For a factor to be included in this study, it first had to meet the first two criteria, and second be interpretable (criterion 3). Therefore, additional factors were identified with eigenvalues greater than 1 (criterion 1) or with points above the level scree plot (criterion 2), but interpretability (criterion 3) provided guidance for the final identification of factors.

New and Traditional Cash Flow Ratios

Table 3 recaps cash flow ratio factor loadings. New and traditional cash flow ratios capture complementary and unique insight regarding a manufacturing firm's activity.

The findings indicate that CFFOS, CFFOTA, CFFOTD, CFFOACD and CFFODTD render complementary insight into firm activity. In 1988 and 1989, the cash flow ratios loaded to the return factor with an average factor loading of .83, while the accrual-based return measures for 1988 and 1989 had an average factor loading of .81 (Table 4). The high loadings to the same factor indicates that cash flow and accrual-based ratios are driven by the same underlying financial characteristic. Therefore, for 1988 and 1989 cash flow ratios appear to provide complementary information about firm operating performance.

In 1990 and 1991, the cash flow ratios loaded to a separate cash flow factor. In a promax rotation, however, the correlation between the return factor and cash flow factor is significant at .56 and .51, respectively, indicating that the same underlying condition contributed to the variability of cash flow and accrual-based return ratios.

Table 3. New and Existing Cash Flow Ratio Factor Loading.

Ratio	1988 Factor	1989 Factor	1990 Factor	1991 Factor
CFFOS	Return/Cash Flow	Return/Cash Flow	Cash Flow	Cash Flow
CFFOTA	Return/Cash Flow	Return/Cash Flow	Cash Flow	Cash Flow
CFFOTD	Return/Cash Flow	Return/Cash Flow	Cash Flow	Cash Flow
CFFOACD	Return/Cash Flow	Return/Cash Flow	Cash Flow	Cash Flow
CFFOBITIP	Coverage	Coverage	Coverage	Coverage
CFFODP	None	None	None	None
CFFODTD	Return/Cash Flow	Return/Cash Flow	Cash Flow	Cash Flow
CFFOOI	Quality	None	None	None

Table 4. Factor Pattern and Specific Ratio Loading Promax Rotation.

1988 n = 487		1989 n = 523		1990 n = 519		1991 n = 494	
Return/Cash Flow		Return/Cash Flow		Return		Return	
OPIPDTA	.80	OPIPDTA	.85	OPINCTA	.90	OPIPDTA	.88
OPIPDS	.81	OPINCTA	.87	OPIPDTA	.89	OPIPDS	.85
OPINCS	.81	OPIPDS	.73	OPINCS	.85	OPINCTA	.89
OPINCTA	.78	OPIPDTD	.87	OPINCTD	.91	OPINCS	.89
OPINCTD	.83	OPINCTD	.87	OPIPDS	.78	OPINCTD	.87
OPIPDTD	.81	OPINCS	.74	OPIPDTD	.87	OPIPDTD	.83
CFFOTA	.84	CFFOTA	.85			CGSS	-.63
CFFOS	.83	CFFOS	.77				
CFFOTD	.85	CFFOACD	.82				
CFFOACD	.83	CFFOTD	.89				
CFFODTD	.77	CFFODTD	.81				
Cash Position		Cash Position		Cash Position		Cash Position	
CS	.95	CCD	.95	CCD	.96	CCD	.95
CTA	.91	CTA	.90	QACD	.90	CS	.88
CCD	.91	CS	.83	CTD	.92	CTA	.90
CTD	.85	CTD	.92	CS	.82	CTD	.94
CAS	.69	QACD	.90	CTA	.86	QACD	.83
		CACD	.78	CACD	.75	CACD	.70

Table 4. Continued.

1988 n = 487		1989 n = 523		1990 n = 519		1991 n = 494	
Inventory		Inventory		Sales		Inventory	
RECINV	.85	RECINV	.81	RECS	.86	INVS	.89
CGSINV	.86	CGSINV	.85	CAS	.81	INVCA	.76
INVS	-.89	INVS	-.86	CGSS	-.51	CGSINV	-.83
INVCA	-.79	INVCA	-.75	SREC	-.76	RECINV	-.80
Sales		Sales		Inventory		Sales	
SREC	.85	RECS	.86	INVCA	.82	RECS	.90
STA	.63	SREC	-.84	INVS	.86	CAS	.79
RECS	-.89			CGSINV	-.82	SREC	-.78
				RECINV	-.86	INVCA	-.74
Debt		Debt		Debt		Debt	
CDTD	.88	CDTD	.95	CDTD	.74	CDTD	.84
CATA	.72	LTDTA	-.86	STA	.70	STA	.71
TDTA	-.54	TDTA	-.46	CATA	.74	CATA	.78
LTDTA	-.75			TDTA	-.53	TDTA	-.51
				LTDTA	-.65	LTDTA	-.71

Table 4. Continued.

1988 n = 487		1989 n = 523		1990 n = 519		1991 n = 494	
Liquidity		Turnover		Cash Flow		Cash Flow	
CACD	.81	STA	.81	CFFOS	.87	CFFODTD	.89
QACD	.74	CGSS	.48	CFFOTA	.88	CFFOTA	.86
		CATA	.45	CFFODTD	.79	CFFOS	.78
		CAS	-.41	CFFOACD	.86	CFFOACD	.84
				CFFOTD	.84	CFFOTD	.86
Coverage		Coverage		Coverage		Coverage	
CFFOBITIP	.81	TIE	.80	CFFOBITIP	.87	CFFOBITIP	.81
TIE	-.77	CFFOBITIP	.76	TIE	.83	TIE	.87
Quality							
CFFOOI	.73						
DP	-.53						

Finding that CFFOS, CFFOTA, CFFOTD, CFFODTD, and accrual-based return measures load to the same factor may have an impact on the use of these ratios. Prior research by KDJ (1990) and others, based on estimates of CFFO under the SCFP, identified CFFOS, CFFOTA and CFFOTD as forming a separate cash flow factor. In these studies estimating CFFO from the SCFP may have introduced sufficient confounding to create a separate financial characteristic of firm activity. The current findings suggest that the accrual-based return ratios and cash flow ratios measure the same operating characteristic of firm activity, and that only one measure needs to be used for describing or predicting a manufacturing firm's operating performance.

For example, Table 4 indicates that a positive correlation exists among CFFOS, OPIPDS and OPINCS because the factor loading sign is positive. The analyst can use this finding for explanatory purposes by plotting these ratios over time. If the expected pattern does not develop, then the analyst should attempt to explain the lack of a positive relationship.

Figlewicz and Zeller (1991) demonstrate how cash flow ratios can be used to provide additional insight into firm activity. This study argues that cash flow return measures signaled a potential bankruptcy problem with W.T. Grant two years before accrual-based return measures did. Discrepancies over time between OPINCTA and CFFOTA, as well as OPINCS and CFFOS, suggested that management's declared expansion strategy was not supported by current operating cash flows. Figlewicz and Zeller's findings suggest that the specific analysis that worked in the W.T. Grant case study may also work for manufacturing firms. If this extrapolation is valid, then management can no longer hide behind the disguise of accrual accounting techniques and deny a firm's true economic performance.

The findings also indicate that CFFOACD can be used as a unique measure of a firm's "ability to pay." CFFOACD does not load with the "current ratio," CACD, a traditional liquidity measure (Table 4). In 1988 and 1989, CFFOACD loaded on the return/cash flow factor (Table 3). In 1990 and 1991, however, CFFOACD loaded on the cash flow factor. The flow concept of CFFOACD adds a dynamic perspective to static liquidity measures, such as CACD and QACD. A positive CFFOACD trend suggests that the firm should meet its short-term obligations, while a negative trend indicates that the firm may need to generate cash flow from financing or investing activities to fund its short-term obligations.

In addition, the findings demonstrate that CFFOBITIP is a complementary measure of a firm's interest coverage. For each year, CFFOBITIP and TIE loaded to the same factor (Table 4). This suggests that an analyst who wishes to predict a bond rating, for example, needs only one ratio to measure a firm's interest-paid coverage. For explanatory purposes, however, the analyst may gain insight by plotting each ratio over time. The empirical analysis suggests that a strong correlation exists between CFFOBITIP and TIE. If a positive trend does not develop for a firm, then the analyst should investigate why the relationship is not holding.

Last, the findings indicate that CFFODP and CFFOOI provide unique insight (Tables 3 and 5). CFFODP does not load to a factor in any year. Interestingly, CFFODP does not correlate with DP, meaning that cash generated for the period does not necessarily align with dividend policy. What information is supporting the dividend payment decision-making process, and from where are the funds coming?

Table 5. Manufacturing Firms Ratio Failing to Load to Any Factor.

1988	1989	1990	1991
CFFODP	CFFODP	CFFODP	CFFODP
----------	CFFOOI	CFFOOI	CFFOOI
CGSS	----------	----------	----------
----------	DP	DP	DP
INVWC	INVWC	INVWC	INVWC

CFFOOI does not load to a factor for 1989, 1990, or 1991, which suggests that this ratio provides unique information. Specifically, it can be used to bridge the information gap between cash flow and operating income. For example, this ratio signals when to investigate management's activities. Ideally, CFFOOI should approximate 1.0 and any trend away from 1.0 warrants investigation. Therefore, the existence of a "quality" operating income measure may prevent management from using accrual accounting techniques to disguise the true performance of the firm.

A New Taxonomy of Financial Ratios for Manufacturing Firms

Table 4 recaps a new taxonomy of financial ratios for the financial ratio analysis of manufacturing firms. The factors explain 78%, 75%, 74% and 74% of the total variance among the ratio set for 1988 to 1991, respectively. Thus, the identified factors capture the majority of the independent and semi-independent information available in the ratio data set.

The success or failure of management in generating sales, managing debt, and allocating resources is reflected in the ratios under the return and cash flow factor. The ratios that consistently loaded to the return/cash flow factor for 1988 and 1989, as well as to the return and cash flow factor for 1990 and 1991, emphasize this characteristic of firm activity. The average loading for the ratios that consistently load to one or both of these factors is between .80 and .90. The means only a select few ratios are necessary in evaluating firm performance or management activity.

This taxonomy also suggests that the general concept of liquidity analysis requires further attention. The findings indicate that the concept of short-term liquidity includes cash position and traditional liquidity measures: The average factor loading for CCD, CTA, CS, CTD, QACD and CACD was greater than .70. KDJ (1990) and other prior studies reported separate factors for cash position and short-term liquidity. Therefore, static measures of liquidity include cash reserves of a firm, which may be explained by the reduced inventory holdings of manufacturing firms. CFFOACD adds a dynamic perspective to a firm's "ability to pay" because it includes a flow of cash perspective.

The inventory factor, sales factor, and debt factor are consistent with KDJ (1990). For the inventory factor, RECINV, COGSINV, INVS, and INVCA all significantly loaded

in each year. These are the same ratios that KDJ (1990) identified as components of the inventory factor. For the sales factor, SREC and RECS significantly loaded in each year. These ratios were identified by KDJ (1990) as components of the sales factor. For the debt factor, CDTD, LTDTA, and TDTA significantly loaded in each year. KDJ (1990) identified these ratios as components of the debt factor. Thus, the preceding ratios are suggested to evaluate the respective financial characteristic of a manufacturing firm. Ratios that do not load consistently to a factor or do not load to any factor (Table 5) are not recommended for evaluating any of the financial characteristics identified in Table 4.

In conclusion, this new taxonomy may have an impact on research and financial analysis. It identifies the specific factors and the respective ratios that consistently signal the key financial characteristics of a manufacturing firm's activity (Table 4). In addition, Table 5 outlines the ratios that do not measure the financial characteristics identified in Table 4. Therefore, financial analysts should reevaluate their current applications of accrual-based and cash flow ratios for predictive, explanatory and descriptive purposes.

Additional Considerations

Data accumulation organizations, such as Robert Morris and Associates (RMA) and Dunns Analytical Services (DAS), classify manufacturing ratios in several broad categories. RMA uses four categories (liquidity, coverage, leverage, and operating ratios) while DAS uses three (solvency, efficiency, and profitability ratios). Accounting and financial textbooks follow a similar ordering. Such classifications may be too broad for financial analysis and research inquiry involving manufacturing firms. For example, the present study suggests that the classification of CACD or QACD as liquidity ratios may be misleading. The findings suggest that new and traditional cash flow ratios should be included in textbooks and industry-wide data reports to improve financial ratio analysis.

A manufacturing firm may want to use the new taxonomy as a guide in filing a Summary Annual Report (SAR). A SAR is a report to shareholders that contains a condensed presentation of a firm's financial and nonfinancial data in a readable format (Schroeder and Gibson, 1992). A firm can use the statistical-based taxonomy as a guide for selecting the qualitative and quantitative data to be included in the SAR. A manufacturing firm SAR built from a statistical-based taxonomy of financial ratios offers a reasonably concise picture of the primary financial characteristics of firm activity at a reduced cost of information transfer for the reporting firm.

CONCLUSION

Quantitative financial analysts face the challenge of selecting the key ratios that capture the primary financial characteristics of a manufacturing firm's activity. This study yields empirical evidence that both traditional and new cash flow ratios capture both complementary and unique financial characteristics of firm activity. This new taxonomy of financial ratios may have an impact on the financial ratio analysis of a manufacturing firm. Lenders, investors, researchers, and managers need financial ratio data to understand market changes on firm performance, as well as to evaluate management's operating decisions and a firm's ability to repay debt obligations. This study should help analysts select the ratios appropriate to their purpose. For instance, cash position and CFFOACD may measure a firm's liquidity better than CACD and QACD.

ENDNOTES

1. See, for example, Livnat and Zarowin (1990), Figlewicz and Zeller (1991), Carslaw and Mills (1991), Stickney (1991), and Giacomino and Mielke (1993).

2. See, for example, Ijiri (1975, 1978 and 1980), Gombola and Ketz (1983a, 1983b), Foster (1986), and Ketz, Doogar and Jensen (1990).

3. See, for example, Pinches, Mingo and Caruthers (1973), Pinches, Eubank, Mingo and Caruthers (1975), Stevens (1973) and Libby (1975).

REFERENCES

Barnes, Paul, "The Analysis and Use of Financial Ratios: A Review Article," *Journal of Business Finance and Accounting*, *14*, Winter 1987, pp. 449-461.

Benishay, H., "Economic Information in Financial Ratio Analysis: A Note," *Accounting and Business Research*, *1*, Spring 1971, pp. 174-179.

Carslaw, C.A. and J.R. Mills, "Developing Ratios For Effective Cash Flow Statement Analysis," *Journal of Accountancy*, *172*, November 1991, pp. 63-70.

Chen, Kung H. and Thomas A. Shimerda, "An Empirical Analysis of Useful Financial Ratios," *Financial Management*, *10*, Spring 1981, pp. 51-60.

Drtina, Ralph E. and James A. Largay III, "Pitfalls in Calculating Cash Flow from Operations," *The Accounting Review*, *60*, April 1985, pp. 314-326.

Figlewicz, R.E. and T.L. Zeller, "An Analysis of Performance, Liquidity, Coverage, and Capital Ratios from the Statement of Cash Flows," *Akron Business and Economic Review*, *22*, Spring 1991, pp. 64-81.

Financial Accounting Standards Board, "Statement of Cash Flows," *Statement of Financial Accounting Standards No. 95*, Stamford: FASB, 1987.

Foster, George, *Financial Statement Analysis*, New Jersey: Prentice-Hall, 1986.

Giacomino, Don E. and David E. Mielke, "Cash Flows: Another Approach To Ratio Analysis," *Journal of Accountancy*, *69*, March 1993, pp. 55-58.

Gombola, Michael J. and J. Edward Ketz, "A Note on Cash Flow and Classification Patterns of Financial Ratios," *The Accounting Review*, *58*, January 1983a, pp. 105-114.

Gombola, M.J. and J.E. Ketz, "Financial Ratio Patterns in Retail and Manufacturing Organizations," *Financial Management*, *12*, Summer 1983b, pp. 45-56.

Guertin, W.H. and J.P. Bailey, *Introduction to Modern Factor Analysis*, Ann Arbor, 1970.

Ijiri, Yuji, *Theory of Accounting Measurement*, *Studies in Accounting Research, No. 10*, Sarasota: American Accounting Association, 1975.

_____, "Cash-Flow Accounting and Its Structure," *Journal Of Accounting, Auditing and Finance*, *1*, Summer 1978, pp. 331-348.

_____, "Recovery Rate and Cash Flow Accounting," *Financial Executive*, *48*, March 1980, pp. 54-60.

Ketz, J. Edward, Rajib K. Doogar and David E. Jensen, *Across Industry Analysis of Financial Ratios: Comparabilities and Corporate Performance*, New York: Quorum Books, 1990.

Libby, Robert, "Accounting Ratios and the Prediction of Failure: Some Behavioral Evidence," *Journal of Accounting Research*, *1*, Spring 1975, pp. 150-161.

Livnat, Joshua and Paul Zarowin, "The Incremental Information Content of Cash-Flow Components," *Journal of Accounting and Economics*, *13*, Summer 1990, pp. 1-22.

Pinches, G.E., K.A. Mingo and J.K. Caruthers, "The Stability of Financial Ratio Patterns in Industrial Organizations," *Journal of Finance*, *28*, May 1973, pp. 384-396.

Pinches, G.E., A.A. Eubank, K.A. Mingo and J.K Caruthers, "The Hierarchal Classification of Financial Ratios," *Journal of Business Research*, *3*, October 1975, pp. 295-310.

Rauh, Thomas, "Early Warning Systems For Troubled Retailers," *Commercial Lending Review*, *6*, Winter 1990, pp. 59-69.

Schroeder, Nicholas and Charles Gibson, "Are Summary Annual Reports Successful?," *Accounting Horizons*, *6*, June 1992, pp. 28-37.

Stevens, D.L., "Financial Characteristics of Merged Firms: A Multivariate Analysis," *Journal of Financial and Quantitative Analysis*, *8*, March 1973, pp. 149-158.

Stickney, C.P., *Financial Statement Analysis, A Strategic Perspective*, San Diego: Harcourt Brace Jovanovich, 1991.

Tabachnick, Barbara G. and L.F. Fidell, *Using Multivariate Statistics*, New York: Harper and Row, 1983.

Walter, James, "Determination of Technical Solvency," *Journal of Business*, *30*, January 1957, pp. 30-43.