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Application of the Factor Analysis on the Financial Ratios and Validation of the Results by the Cluster Analysis: An Empirical Study on the Indian Cement Industry

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Abstract
For saving considerable time and effort of the analyzers, it is necessary to select the most important financial ratios to be used for the financial analysis. To reduce the number of financial ratios and to find out the categories of financial ratios on the basis of empirical evidence, Factor Analysis technique is being used successfully by different researches during the last three decades. In this study Factor Analysis has been applied over audited financial data of selected cement companies of India for a period of 10 years. Initially 44 variables (financial ratios) grouped in 7 categories are selected for the study. Before conducting Factor Analysis, variables having low inter-correlation with the other variables are excluded. Factor Analysis, conducted over remaining variables, identifies 8 underlying categories (factors). Multiple Regression Analysis is conducted taking the factor scores for each such factor as dependent variable and constituent variables as independent variables. Statically insignificant variables, evident from the regression analysis, are eliminated from the study. Factor Analysis, conducted again over thus remaining 25 variables, resulted in 8 underlying categories with a few changes in their composition. To validate the results of Factor Analysis, Cluster Analysis is performed. Factors are named and representative ratios are identified for each of them.

Key words: Financial Ratio Analysis; Factor Analysis; Multiple Regression Analysis; Cluster Analysis.

Introduction

Financial ratio analysis is a useful measure to provide a snapshot of a firm's financial position (Muresan and Wolitzer 2004) at any particular moment of time or to provide a comprehensive idea about the financial performance of the company over a particular period of time. Use of financial ratios in finance is multi-dimensional. It is not only useful for judging the financial health or performance of a particular firm over time, it is also a useful tool for comparing a firm's financial position and performance with respect to others in the same or

different industry to pinpoint problem areas or to identify areas of further improvements (De, Bandyopadhyay and Chakraborty 2010).

Financial ratios are computed from financial statements of a company namely Balance Sheet, Profit & Loss Account or Income Statement, and Cash Flow Analysis. Interpretation of the financial ratios is complicated and multi-dimensional. While developing and computing the different financial ratios, consideration is given to capture the various aspects of financial position and financial performance of a company. In order to use a financial ratio, one needs to have a relatively decent knowledge of basic mathematical and accounting concepts. Over the years, there has been a proliferation in the number of financial ratios developed and applied by analysts and researchers (Hamdi and Abdelrazzak 1994).

However, it is impractical and sometimes improbable to compute all the ratios to reach to a conclusion desired for. With the presence of inter-relationships within and among the sets of financial ratios, a smaller number of representative ratios may be sufficient to capture most of the desired information (Hamdi and Abdelrazzak 1994). This inter-relationship is called as 'multicollinearity' in statistical language. Using some statistical methods we can reduce this effect by finding out the factors (latent variables) inherent into the total set of financial ratios. The traditional ad hoc grouping of ratio such as Earnings & Profitability, Liquidity, Leverage and Solvency, Asset efficiency, Operating efficiency, etc. is based on assumed relationships rather than empirical foundations. The need to use Inductive approach i.e. classification based on statistical techniques (Öcal, Oral, Erdis and Vura 2007) has grown momentum over the years. Factor Analysis is the most popular amongst them. Once the Factor Analysis identifies the latent factors (i.e. categories) inherent into the total set of financial ratios, at least one ratio may be selected from each such category on the basis of some criteria. In this way, we can identify a smaller number of financial ratios to be used for financial analysis.

To get rid of the heterogeneous behavior of financial ratios, companies belonging to a single type of industry are chosen for the analysis. In this backdrop, the companies belonging to the cement, asbestos and abrasive producing industry of India is identified for the study. This industry is one of the most important and extensive industries of India. The cement industry in India has been moving from strength to strength, over the years, it has emerged as the world's second largest cement producing industry (April, 2009).

For the purpose of the study, a set of 44 of financial ratios categorized in 7 distinct categories was identified. These categories are Earnings and Profitability, Liquidity, Cash Flow, Cash Balance, Long-term Solvency, Assets Management, and Operating Efficiency. Since the objective of this study is to identify smaller number of financial ratios which are able to capture the desired information, the ratios which have weak inter-correlation (i.e. $< \pm 0.5$) are identified and excluded from the study. On the remaining financial ratios (variables) Factor Analysis is conducted. Factor Analysis is a statistical tool which identifies the latent variables (i.e. factors) inherent in the total set of observed variables. Each such factor comprises of different variables (financial ratios) which are most similar in terms of correlation with each other. In an attempt to reduce the effects of a (possibly) incorrect presence of variable in the factors, Multiple Regression Analysis is conducted taking the Factor Scores of different factors as dependant variables and the constituent variables in the respective factor as independent variables. Variables with low t-values (i.e. $|t| \leq 2$) and the corresponding high p-values (i.e. p-values >0.05) are excluded. On the remaining set of variables, Factor Analysis is conducted once again. With an attempt to validate and improve the results of the Factor Analysis, another statistical method, Cluster Analysis, is conducted on the final set of variables. Cluster Analysis involves categorization by dividing a large group of observations into groups so that observations within

each group are relatively similar. Proper determination of number of clusters is an important aspect of Cluster Analysis. However, the objective of Cluster Analysis here is to test the composition of categories (i.e. factors) as indentified by the Factor Analysis and to reach to a final conclusion.

Literature Review

Factor Analysis was first applied to financial ratios by Pinches, Mingo and Caruthers (1973) in an attempt to develop an empirically-based classification of financial ratios. Since then, researchers are using Factor Analysis as a mean of eliminating redundancy and reducing the number of financial ratios needed for empirical research. Hamdi and Charbaji (1994) applied Factor Analysis to 42 financial ratios of International Commercial Airlines for the year of 1986 to reduce them to underlying factors. Tan, Koh and Low (1997) used the Factor Analysis on 29 financial ratios of the companies listed on the Stock Exchange of Singapore (SES) from 1980 to 1991 to derive 8 underlying factors. Öcal, Oral, Ercan Erdis and Vural (2007) applied Factor Analysis on 25 financial ratios of Turkish construction industry during 1998 to 2001 to derive 5 underlying factors. De, Bandyopadhyay and Chakraborty (2010) made an empirical study on the 44 financial ratios of selected companies from Indian iron & steel industry and derived 10 underlying factors.

Application of Cluster Analysis on financial ratios is also not a new one. Few researchers have done it before. Wanga and Leeb (2008) applied a new clustering method based on a fuzzy relation between financial ratio sequences. They also conducted an empirical study on 24 financial ratios of four Taiwan shipping companies using Cluster Analysis. De, Bandyopadhyay and Chakraborty (2010) also validated the results derived from the Factor Analysis by the Cluster Analysis.

Objectives of the Study

This study is aimed at confirming or modifying the conventional as well as previous researchers' identified categorization of financial ratios with the help Factor Analysis as validated by the Cluster Analysis and reducing the number of financial ratios to a smaller number of representative financial ratios which can capture almost the same amount of information available in the original larger set of ratios. It may help to understand the financial position and performance of the Iron and Steel companies of India in a more practical and time-saving manner.

Variables Selection

For the purpose of this study, 44 most commonly used financial ratios were selected. These ratios were drawn from two main sources: Foster, G. (1986) and a monograph by Koh, H C, M H Lee, A M Low and T M Tan (1989). However, a few more ratios are added and a few are modified. These ratios are grouped into 7 categories to represent 7 different aspects of a business namely earnings and profitability, liquidity, cash flow, cash balance, long-term solvency, assets management and operating efficiency. The detail list of ratios along with their formula to compute them has been produced in the Appendix A. While conducting Factor Analysis, we had to exclude either of the LTDTCE (LS3) or NWTCE (LS4). These two variables, being complementary to each other (LTDTCE + NWTCE = 1), made the determinant value of the

correlation matrix to zero with their simultaneous presence in the matrix. Therefore, we were left with the choice of excluding either of the two variables and we retained the Net Worth to Capital Employed (NWTCE) and eliminated Long-term Debt to Capital Employed (LTDTCE). Hence, the study is conducted on 43 financial ratios.

Sample Selection

This study is conducted on the selected companies of Indian Iron and Steel industry. Using CMIE Prowess 3.1 database software, a list of 224 companies which are registered under Indian Companies Act was derived first. Out of these 224 companies, a list of 74 companies was derived which were listed or permitted either in Bombay Stock Exchange (BSE) or National Stock Exchange (NSE) of India or both. Using the same database software, audited financial statements during the periods from 1999-2000 to 2008-2009 (i.e. 10 years) were collected. The companies which were not in operation during any of this 10 years period or where data were not available during any of these years were eliminated. 38 companies fulfilled all the criteria and were used for this study.

Statistical Methods

For the various statistical analysis required for this study, we have taken the help of statistical software, SPSS 16.0 version.

At first, inter-correlation matrix amongst the variables has been derived. An inter-correlation matrix is a k×k (k = the number of variables) array of the correlation coefficients of the variables with each other. With the help of this matrix, variables (financial ratios) with weak correlation (i.e. $< \pm 0.5$) with other variables are identified and excluded. However, elimination is effected only after exercising domain knowledge to ensure that no important variable (financial ratio) is excluded from the study.

After that, Factor Analysis with Principal Component extraction method is performed on the remaining set of variables. VARIMAX rotation is used to get better final results. Cut off value of factor loadings is kept more than 0.5. For the purpose of regression analysis, factor scores are saved as variables.

Statically, each such factor should be highly explained by the constituent variables of the same. In an attempt to reduce the effects of a (possibly) incorrect presence of variable in the factors, Multiple Regression Analysis is conducted taking the Factor Scores of different factors as dependant variables and the constituent variables in the respective factor as independent variables. Variables with low t-values (i.e. $|t| \leq 2$) and the corresponding high p-values (i.e. p-values >0.05) are eliminated on the basis of the regression results. On the remaining set of variables, Factor Analysis is conducted once again to identify the latent variables (or factors).

To validate the indentified categories (i.e factors) of variables ascertained by the Factor Analysis, Cluster Analysis is applied on the same set of variables and with the predefined number of clusters (same with the number of factors). To emphasize the degree of correlation amongst the variables as a measurement of similarity, hierarchical clustering approach using Ward's Method with the Pearson Correlation interval measure is applied here.

After the validation of the results of Factor Analysis is done, representative variables (financial ratios) are selected from each such factor so as to derive a smaller set of financial ratios than the original larger set of ratios.

Results and Implications

1.1 Correlation Study Results

With the help of inter-correlation matrix (43 X 43), 6 variables are excluded from the study because they had a very weak correlation (i.e. < ±0.5) with the other variables in the study. However, before elimination domain knowledge is exercised to ensure that no important variable (financial ratio) is excluded from the study. These variables are produced in **Table 1** below:

Table 1: List of variables eliminated with the help of Correlation Matrix

Category	Catg_Code	Ratio_Code	Ratio_Name
Operating Efficiency	OE2	TITEMEX	Total Income to Employees Expenses
Operating Efficiency	OE3	STSDEX	Sales to Selling & Distribution Expenses
Asset Management	AM6	STAR	Debtor Turnover
Asset Management	AM7	STINV	Inventory Turnover
Liquidity	LD3	EBITTI	Interest Cover
Long-term Solvency	LS7	FIFTEF	Capital Gearing Ratio

1.2 Multiple Regression Analysis Results

Factor Analysis is conducted on remaining 37 variables (43 minus 6) and it is resulted in 8 factors. Multiple regression analysis is conducted taking the Factor Scores of different factors as dependant variables and the constituent variables in the respective factor as independent variables. It is found that R-square (coefficient of determination) for each such regression analysis is very high. It signifies the presence of strong regression relationship amongst the factors and their constituent variables. However, presence of variables with low t-value (i.e. < 2) and the corresponding high p-value (i.e. > 0.05) are found in different factors. These variables are considered to be incorrectly present in the respective factors and hence liable to be eliminated from the study. 12 variables are eliminated on this basis. Details of these variables along with t-values and corresponding p-values are given in **Table 2** below:

Table 2: List of variables eliminated with the help of Multiple Regression Analysis

Category	Catg_Code	Ratio_Code	Ratio_Name	Factor	t-value	p-value
Cash Flow	CF6	CPTAVTA	Cash Profit to Avg. Total Assets	FAC_01	1.4274	0.1544
Earnings & Profitability	EP4	EBITTTA	Return on Total Assets	FAC_01	-0.785	0.4331
Cash Flow	CF4	CPTCE	Cash Profit to Capital Employed	FAC_01	0.6571	0.5116
Earnings & Profitability	EP5	EBITTCE	Return on Capital Employed	FAC_01	-1.547	0.1228
Earnings & Profitability	EP2	PATTTI	Net Profit Margin	FAC_01	0.9273	0.3544
Earnings &	EP1	EBTTTI	Pre-Tax Net Profit	FAC_01	-0.958	0.3389

Profitability			Margin			
Earnings & Profitability	EP7	PATTAVSHF	Return on Avg. Equity	FAC_01	-1.945	0.0526
Asset Management	AM2	STAVNFA	Sales to Average Net Fixed Assets	FAC_02	0.822	0.4117
Asset Management	AM3	TITTA	Total Assets Turnover	FAC_02	1.457	0.1461
Long-term Solvency	LS4	NWTCE	Net Worth to Capital Employed	FAC_04	0.6756	0.4998
Earnings & Profitability	EP3	PATTSHF	Return on Equity	FAC_05	1.4268	0.1546
Asset Management	AM8	NWCTTA	Working Capital to Total Assets	FAC_06	1.8876	0.0599

Results of the regression analysis (relevant portions only) have been given in the Appendix B.

1.3 Factor Analysis Results

Factor Analysis is conducted once again on the remaining 25 variables (37 minus 12). The Rotated Component Matrix is produced in the Appendix C. It is observed that 25 variables have been categorized in 8 factors. These factors account for about 89% of the total variance, which can be considered as excellent. Results of KMO and Bartlett's Test produced below in the **Table 3**:

Table 3: Results of KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.747
Bartlett's Test of Sphericity	Approx. Chi-Square	12885.627
	df	300.000
	Sig.	0.000

KMO sample adequacy is more than 0.7, which can be considered as reasonably good (Öcal, Oral, Erdis and Vural 2007).

1.4 Cluster Analysis Results

Cluster Analysis has been performed on the same set of 25 variables on which Factor Analysis has been performed already. No of clusters is also pre-defined, which is 8 (i.e. the number of factors already ascertained). The results of Cluster Analysis are produced in the Appendix D.

1.5 Comparison of the results of Factor Analysis and Cluster Analysis

Final results of Factor Analysis and Cluster Analysis have been arranged in a manner so that comparison is possible against each other. This comparison is produced in **Table** 4 below:

Table 4: Comparison of the results of Factor Analysis and Cluster Analysis

Factors	Variables (Financial Ratios)	No. of Var.	Clusters	Variables (Financial Ratios)	No. of Var.
FAC_01	CF2_CPTTA, CF8_CPTAVCE, EP6_EBDITTCE, EP8_EBITTAVCE, CF1_CPTTI, CF7_CPTAVSHF	6	CLUS_1	EP6_EBDITTCE, EP8_EBITTAVCE, CF1_CPTTI, CF2_CPTTA, CF3_CPTSHF, CF7_CPTAVSHF, CF8_CPTAVCE	7
FAC_02	CB2_CBTCA, CB4_CBTTA, CB1_CBTCL, CB3_CBTTI	4	CLUS_5	CB1_CBTCL, CB2_CBTCA, CB3_CBTTI, CB4_CBTTA	4
FAC_03	LS2_SHFTTL, LS5_NWTTA, LS8_TDTTA, LS6_NFATCE	4	CLUS_7	LS2_SHFTTL, LS5_NWTTA	2
FAC_04	AM1_STNFA, AM5_TITCE, OE1_RMETAVRM	3	CLUS_8	AM1_STNFA, AM5_TITCE, , OE1_RMETAVRM	3
FAC_05	LD1_CATCL, LD2_QATQL	2	CLUS_3	LD1_CATCL, LD2_QATQL	2
FAC_06	CF3_CPTSHF, LS1_LTDTSHF	2	CLUS_6	LS1_LTDTSHF, LS6_NFATCE, LS8_TDTTA	3
FAC_07	EP10_TDTPAT, EP9_EDTPAT	2	CLUS_2	EP9_EDTPAT, EP10_TDTPAT	2
FAC_08	AM4_STNWC, CF5_CPTNWC	2	CLUS_4	CF5_CPTNWC, AM4_STNWC	2
		25			**25**

Clusters are plotted against the identical or most identical (on the basis of constituent variables) factors. After a careful study on **Table 4**, it is observed that Factor 2, Factor 4, Factor 5, Factor 7 and Factor 8 are same with their corresponding clusters i.e. Cluster 5, Cluster 8, Cluster 3, Cluster 2 and Cluster 4. Factor 1 and Cluster 1 are almost identical excepting the presence of CF3_CPTSHF in the Cluster 1. Presence of variable CF3_CPTSHF (Cash Profit to Share-holders' Fund) is a mismatch in Factor 6, which is evident from the corresponding cluster (i.e. Cluster 6). CF3_CPTSHF is best suited in Factor 1 which is confirmed by its corresponding cluster (i.e. Cluster 1). Only two variables namely LS6_NFATCE and LS8_TDTTA are making the difference in the remaining 2 factors (i.e. Factor 3 and Factor 8) with their corresponding clusters (i.e. Cluster 7 and Cluster 6). These deviations are not significantly challenging the outcome of the Factor Analysis, rather the outcome it is improved and validated by the cluster analysis results. Therefore, we can accept the 8 factors as validated by the Cluster Analysis.

1.6 Naming the Factors

Factors names have been given considering the variables (financial ratios) featuring in each of them as well as in the corresponding clusters. Care is taken so that constituent variables in a particular factor as well as corresponding cluster are best represented by the factor name. This is provided in the **Table 5** below:

Table 5: List of Factors

Factor No.	Name of the Factors
FAC_01	Profitability & Return on Investment
FAC_02	Cash Position
FAC_03	Capital Structure
FAC_04	Asset & Material Management
FAC_05	Short-term Liquidity
FAC_06	Long-term Solvency
FAC_07	Dividend Policy
FAC_08	Productivity of Working Capital

1.7 Selection of Representative Variables (Financial Ratios)

Selection of representative variable from each factor should be based upon some appropriate criteria as well as their relative importance in the same group (here, factor) of variables. Variables having maximum factor loadings (absolute value) in the respective factors should have the strongest correlation with their respective factors. Factor loadings are the correlation of individual variables with its factor. Therefore, 10 representative variables (financial ratios) can be selected from the 10 finally concluded factors on the basis of maximum absolute value of the factor loadings on the respective factors. This approach has been adopted in the previous research studies also (for example, Tan, Koh and Low 1997). Care has been taken to somehow ensure that these selected variables should be able to reasonably explain the behavior of other variables in the same factor. In our study, representative ratios have been selected on the basis of maximum absolute value of factor loadings as well as their relative importance in the same factor. 7 out of 8 representative variables selected on the basis of maximum absolute factor loadings because these variables are able to represent their respective factors. In case of Factor 6 only, the representative variable is selected on the basis of domain knowledge because the selection on the basis of absolute value of factor loadings is unable to represent the factor. However, this selection is influenced by the corresponding cluster (i.e Cluster 6) composition as well. List of representative financial ratios have been produced in **Table 6**.

Table 6: Representative Variables (Financial Ratios)

Fac._No.	F actors	Variables (Financial Ratios)	Representative Financial Ratios
FAC_01	Profitability & Return on Investment	CF2_CPTTA, CF8_CPTAVCE, EP6_EBDITTCE, EP8_EBITTAVCE, CF1_CPTTI, CF7_CPTAVSHF	CF2_CPTTA (Cash Profit to Total Assets)
FAC_02	Cash Position	CB2_CBTCA, CB4_CBTTA, CB1_CBTCL, CB3_CBTTI	CB2_CBTCA (Cash & Bank to Current Assets)
FAC_03	Capital Structure	LS2_SHFTTL, LS5_NWTTA, LS8_TDTTA, LS6_NFATCE	LS2_SHFTTL (Share-holders' Fund to Total Liabilities)
FAC_04	Asset & Material Management	AM1_STNFA, AM5_TITCE, OE1_RMETAVRM	AM1_STNFA (Fixed Assets Turnover)
FAC_05	Short-term Liquidity	LD1_CATCL, LD2_QATQL	LD1_CATCL (Current Ratio)
FAC_06	Long-term Solvency	CF3_CPTSHF, LS1_LTDTSHF	LS1_LTDTSHF (Debt Equity Ratio)
FAC_07	Dividend Policy	EP10_TDTPAT, EP9_EDTPAT	EP10_TDTPAT (Total Dividend Distribution Ratio)
FAC_08	Productivity of Working Capital	AM4_STNWC, CF5_CPTNWC	AM4_STNWC (Working Capital Turnover)

Conclusion

The initial objective of the study was to identify the underlying categories present amongst the financial ratios so as to confirm or modify the conventional categorization of financial ratios. Another objective of this study was to reduce the number of financial ratios to a smaller number of financial ratios which can capture almost the same amount of desired information as the original larger set of ratios could do. We started the study with 44 financial ratios of 130 India Iron and Steel companies for a period of 10 years grouped in 7 conventional categories. However, with the help of a series of statistical analysis, we could reach to a final conclusion which speaks about the presence of 8 underlying categories. A comparison can be made between the categories of financial ratios used in the study and categories appeared in the final results. It is shown in **Table 7**.

Table 7: Comparison between initial grouping and the results

Starting Point		**Final Results of the Study**	
Category No.	**Categories**	**Factor No.**	**Factors**
CATG_01	Earnings and Profitability	FAC_01	Profitability & Return on Investment
CATG_02	Liquidity	FAC_02	Cash Position
CATG_03	Cash Flow	FAC_03	Capital Structure
CATG_04	Cash Balance	FAC_04	Asset & Material Management
CATG_05	Long-term Solvency	FAC_05	Short-term Liquidity
CATG_06	Assets Management	FAC_06	Long-term Solvency
CATG_07	Operating Efficiency	FAC_07	Dividend Policy
		FAC_08	Productivity of Working Capital

It is found that only two original categories (Liquidity, Cash Balance) of financial ratios held their place in the final results, though Liquidity is renamed as "Short-term Liquidity" because composition of this category indicates towards short-term solvency of a firm. "Long-term Solvency" has though held its place, but it has sacrificed a few of its constituent ratios to a new category i.e. "Capital Structure". "Profitability & Return on Investment" and "Dividend Policy" have emerged out of the 1st (Earnings and Profitability) and 3rd (Cash Flow) original categories. 6th (Assets Management) and 7th (Operating Efficiency) original categories together have given birth to new category of "Asset & Material Management", however in this process they have lost a few of their constituent variables. The last new category i.e. "Productivity of Working Capital" has emerged out taking one variable each from the original categories of "Assets Management" and "Cash Flow". The last i.e. 7th original category "Operating Efficiency" has lost its place in the final results after given one of its constituent variables to the new category of "Asset & Material Management".

Once the eight underlying categories are identified, at least one variable (financial ratio) is selected from each such category to represent eight different aspects of a business. Therefore, it can be concluded that while analyzing the performance and financial position of the companies of the cement industry of India with the help of financial ratio analysis, proper emphasis may be given to these eight financial ratios as indentified in this study. Considerable time and effort of the analyzers would be saved in this process.

However, it is to be noted that this study is industry as well as country specific and to some extent time specific. So, there is a huge research scope ahead for the future researchers across the globe.

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Appendix A: List of Financial Ratios

Catg.	Catg_ Code	Ratio_Code	Ratio_Name	Details
Earnings and Profitability	EP1	EBTTTI	Pre-Tax Net Profit Margin	(Earnings Before Tax)/(Total Income)
	EP2	PATTTI	Net Profit Margin	(Profit After Tax) / (Total Income)
	EP3	PATTSHF	Return on Equity	(Profit After Tax)/ (Share-holders' Fund)
	EP4	EBITTTA	Return on Total Assets (net of Fic. Assets)	(Earnings Before Interest and Tax)/(Total Assets - Fictitious Assets)
	EP5	EBITTCE	Return on Capital Employed	(Earnings Before Interest and Tax)/(Share-holders' Fund + Long-term Borrowed Funds – Fictitious Assets)
	EP6	EBDITTCE	Earnings Before Depn., Int. & Tax to Capital Employed	(Earnings Before Depreciation, Interest and Tax) /(Share-holders' Fund + Long-term Borrowed Funds – Fictitious Assets)
	EP7	PATTAVSHF	Return on Avg. Equity	(Profit After Tax) /(Average Share-holders' Fund)
	EP8	EBITTAVCE	Return on Avg. Capital Employed/Net Assets	(Earnings Before Interest and Tax)/(Average Capital Employed)
	EP9	EDTPAT	Equity Div. Distribution Ratio	(Equity Dividend)/(Profit After Tax)
	EP10	TDTPAT	Total Div. Distribution Ratio	(Total Dividend)/(Profit After Tax)
Liquidity	LD1	CATCL	Current Ratio	(Current Assets)/(Current Liabilities)
	LD2	QATQL	Quick Ratio	(Quick Assets)/(Quick Liabilities)
	LD3	EBITTI	Interest Cover	(Earnings Before Tax)/(Interest)
Cash Flow	CF1	CPTTI	Cash Profit to Total Income	(Cash Profit)/(Total Income)
	CF2	CPTTA	Cash Profit to Total Assets (net of fic. Assets)	(Cash Profit)/(Total Assets - Fictitious Assets)
	CF3	CPTSHF	Cash Profit to Share-holder's Fund/Equity	(Cash Profit)/(Share-holders' Fund)
	CF4	CPTCE	Cash Profit to Capital Employed	(Cash Profit)/(Share-holders' Fund + Long-term Borrowed Funds – Fictitious Assets)
	CF5	CPTNWC	Cash Profit to Net Working Capital	(Cash Profit)/(Current Assets – Current Liabilities)
	CF6	CPTAVTA	Cash Profit to Avg. Total Assets (net of fic. Assets)	(Cash Profit)/(Average Total Assets, net of Fictitious Assets)
	CF7	CPTAVSHF	Cash Profit to Avg. Share-holder's Fund	(Cash Profit)/(Average Share-holders' Fund)
	CF8	CPTAVCE	Cash Profit to Avg. Capital Employed	(Cash Profit)/(Average Capital Employed)
Cash Balance	CB1	CBTCL	Cash & Bank to Current Liabilities (inc. STL)	(Cash and Bank)/(Current Liabilities + Short-term Borrowings)
	CB2	CBTCA	Cash & Bank to Current Assets	(Cash and Bank)/(Current Assets)
	CB3	CBTTI	Cash & Bank to Total Income	(Cash and Bank)/(Total Income)
	CB4	CBTTA	Cash & Bank to Total Assets (net of fic. Assets)	(Cash and Bank)/(Total Assets - Fictitious Assets)

Long-term Solvency	LS1	LTDTSHF	Debt Equity Ratio	(Long-Term Debt)/(Share-holders' Fund)
	LS2	SHFTTL	Share-holders' Fund to Total Liabilities	(Share-holder's Fund)/(Total Liabilities)
	LS3	LTDTCE	Long Term Debt to Capital Employed/Net Assets	(Long-Term Debt)/(Share-holders' Fund + Long-term Borrowed Funds – Fictitious Assets)
	LS4	NWTCE	Net Worth to Capital Employed	(Share-holders' Fund - Fictitious Assets)/(Share-holders' Fund + Long-term Borrowed Funds – Fictitious Assets)
	LS5	NWTTA	Proprietary Ratio (net off Fic. Assets)	(Share-holders' Fund - Fictitious Assets)/(Total Assets - Fictitious Assets)
	LS6	NFATCE	Net Fixed Assets to Capital Employed	(Net Fixed Assets)/(Share-holders' Fund + Long-term Borrowed Funds – Fictitious Assets)
	LS7	FIFTEF	Capital Gearing Ratio	(Preference Share Capital + Borrowings)/(Share-holders' Fund – Pref. Share Capital)
	LS8	TDTTA	Total Debt to Total Assets (net off Fic. Assets)	(Long-Term Debt)/(Share-holders' Fund)
Assets Management	AM1	STNFA	Fixed Assets Turnover	(Sales)/(Net Fixed Assets)
	AM2	STAVNFA	Sales to Avg. Net Fixed Assets	(Sales)/(Average Net Fixed Assets)
	AM3	TITTA	Total Assets (net off Fic. Assets) Turnover	(Total Income)/(Total Assets – Fictitious Assets)
	AM4	STNWC	Working Capital Turnover	(Sales)/(Current Assets – Current Liabilities)
	AM5	TITCE	Total Income to Capital Employed	(Total Income)/(Share-holders' Fund + Long-term Borrowed Funds – Fictitious Assets)
	AM6	STAR	Debtor Turnover	(Sales)/(Accounts Receivables)
	AM7	STINV	Inventory Turnover	(Sales)/(Total Inventories)
	AM8	NWCTTA	Working Capital to Total Assets (net of Fic. Assets)	(Current Assets – Current Liabilities)/(Total Fixed Assets – Fictitious Assets)
Operating Efficiency	OE1	RMETAVRM	Raw-material Expenses to Avg. Raw-material	(Raw-material Expenses)/((Opening Raw-material Expenses + Closing Raw-material Expenses)/2)
	OE2	TITEMEX	Total Income to Employees Expenses	(Total Income)/(Total Employee Cost)
	OE3	STSDEX	Sales to Selling & Distribution Expenses	(Sales)/(Selling & Distribution Expenses)

Appendix B: Regression Analysis Results

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.411	.045		-31.568	.000
	CF2_CPTTA	5.973	2.581	.449	2.314	.021
	CF6_CPTAVTA	2.752	1.928	.230	1.427	.154
	EP4_EBITTTA	-1.591	2.027	-.123	-.785	.433
	CF8_CPTAVCE	-6.578	2.118	-.925	-3.106	.002
	CF4_CPTCE	1.157	1.761	.146	.657	.512
	EP8_EBITTAVCE	7.188	1.708	1.055	4.209	.000
	EP5_EBITTCE	-3.228	2.086	-.417	-1.547	.123
	EP6_EBDITTCE	1.999	.691	.273	2.895	.004
	EP2_PATTTI	.787	.849	.067	.927	.354
	EP1_EBTTTI	-.597	.623	-.061	-.958	.339
	CF1_CPTTI	3.480	.547	.319	6.363	.000
	CF7_CPTAVSHF	.493	.157	.179	3.145	.002
	EP7_PATTAVSHF	-.294	.151	-.107	-1.945	.053
a. Dependent Variable: REGR factor score 1 for analysis 1						

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.362	.038		-35.576	.000
	AM1_STNFA	.193	.050	.412	3.831	.000
	AM2_STAVNFA	.039	.048	.087	.822	.412
	AM3_TITTA	.118	.081	.054	1.457	.146
	AM5_TITCE	.378	.037	.416	10.339	.000
	OE1_RMETAVRM	.049	.006	.124	7.864	.000

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.362	.038		-35.576	.000
	AM1_STNFA	.193	.050	.412	3.831	.000
	AM2_STAVNFA	.039	.048	.087	.822	.412
	AM3_TITTA	.118	.081	.054	1.457	.146
	AM5_TITCE	.378	.037	.416	10.339	.000
	OE1_RMETAVRM	.049	.006	.124	7.864	.000

a. Dependent Variable: REGR factor score 2 for analysis 1

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.923	.020		-46.389	.000
	CB1_CBTCL	.767	.140	.179	5.461	.000
	CB2_CBTCA	3.898	.260	.470	14.999	.000
	CB3_CBTTI	2.090	.400	.128	5.229	.000
	CB4_CBTTA	5.112	.600	.253	8.526	.000

a. Dependent Variable: REGR factor score 3 for analysis 1

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.301	.283		-4.600	.000
	LS2_SHFTTL	13.574	3.214	1.948	4.223	.000
	LS5_NWTTA	-9.123	3.225	-1.324	-2.829	.005
	LS4_NWTCE	.210	.311	.048	.676	.500
	LS8_TDTTA	-1.592	.347	-.277	-4.586	.000

a. Dependent Variable: REGR factor score 4 for analysis 1

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.061	.023		2.670	.008
	CF3_CPTSHF	.411	.058	.516	7.046	.000
	EP3_PATTSHF	.084	.059	.106	1.427	.155
	LS1_LTDTSHF	-.083	.010	-.355	-7.963	.000
a. Dependent Variable: REGR factor score 5 for analysis 1						

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.754	.113		-6.683	.000
	LD1_CATCL	.832	.088	.641	9.498	.000
	LD2_QATQL	.182	.090	.101	2.034	.043
	AM8_NWCTTA	.692	.367	.092	1.888	.060
	LS6_NFATCE	-.834	.114	-.214	-7.304	.000
a. Dependent Variable: REGR factor score 6 for analysis 1						

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.198	.008		-24.497	.000
	EP9_EDTPAT	.379	.123	.425	3.093	.002
	EP10_TDTPAT	.502	.122	.565	4.113	.000
a. Dependent Variable: REGR factor score 7 for analysis 1						

Coefficients[a]				
Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.

		B	Std. Error	Beta		
1	(Constant)	-.238	.008		-30.521	.000
	CF5_CPTNWC	.103	.002	.525	41.902	.000
	AM4_STNWC	.013	.000	.521	41.609	.000
a. Dependent Variable: REGR factor score 8 for analysis 1						

Appendix C: Factor Analysis Result

Rotated Component Matrix[a]								
	Component							
	1	2	3	4	5	6	7	8
CF2_CPTTA	.933							
CF8_CPTAVCE	.922							
EP6_EBDITTCE	.899							
EP8_EBITTAVCE	.874							
CF1_CPTTI	.797							
CF7_CPTAVSHF	.745							
CB2_CBTCA		.939						
CB4_CBTTA		.913						
CB1_CBTCL		.902						
CB3_CBTTI		.861						
LS2_SHFTTL			.915					
LS5_NWTTA			.914					
LS8_TDTTA			-.808					
LS6_NFATCE			-.501					
AM1_STNFA				.892				
AM5_TITCE				.814				
OE1_RMETAVRM				.732				
LD1_CATCL					.906			

LD2_QATQL					.869			
CF3_CPTSHF						.949		
LS1_LTDTSHF						-.936		
EP10_TDTPAT							.991	
EP9_EDTPAT							.991	
AM4_STNWC								.943
CF5_CPTNWC								.942
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.								
a. Rotation converged in 6 iterations.								

Appendix D: Cluster Analysis Result

Cluster Membership	
Case	8 Clusters
EP6_EBDITTCE	1
EP8_EBITTAVCE	1
EP9_EDTPAT	2
EP10_TDTPAT	2
LD1_CATCL	3
LD2_QATQL	3
CF1_CPTTI	1
CF2_CPTTA	1
CF3_CPTSHF	1
CF5_CPTNWC	4
CF7_CPTAVSHF	1
CF8_CPTAVCE	1
CB1_CBTCL	5
CB2_CBTCA	5
CB3_CBTTI	5
CB4_CBTTA	5
LS1_LTDTSHF	6
LS2_SHFTTL	7
LS5_NWTTA	7
LS6_NFATCE	6

LS8_TDTTA	6
AM1_STNFA	8
AM4_STNWC	4
AM5_TITCE	8
OE1_RMETAVRM	8

Author Biographies

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