Variables Affecting Working Capital Management of Indian Manufacturing Firms: Factor Analysis Approach

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Abstract

Working Capital Management (WCM) is concerned with the problems that arise in attempting to manage current assets and current liabilities. This paper analyzes the variables affecting working capital management of Indian manufacturing firms using factor analysis. The analysis uses eleven variables as a combination of working capital ratios and cash flows. The authors apply principal component analysis to extract the maximum amount of variance accounted for a minimum number of factors. The study finds cash conversion cycle to be correlated with the other variables and eliminated. Net working capital to total assets ratio has a complex structure, so it is dropped from the analysis. The factor analysis classifies the nine variables into four factors. It was obvious from the classification that the factors pertained to assets, policy, convertibility and operational, which can give a direction to the decision makers.

Keywords: Working Capital Management, Factor Analysis, Principal Component Analysis.

1. Introduction

Working capital management is one of the sensitive areas in the field of financial management. Working capital management (WCM) is the administration of firm's liquid resources. The principle problem of WCM is choosing values for the controllable or decision variables in order to maximize goal attainment for the coming periods. WCM ensures a company has sufficient cash flow in order to meet its short-term debt obligations and operating expenses. It can be expected that the way in which working capital is managed will have a significant impact on the profitability of firms. The two main aspects of WCM are the ratios and cash flow analysis.

Working capital is an important issue during financial decision making since it is being a part of investment in asset that requires appropriate financing investment. Working capital ratios are useful tools in appraising the financial strength and immediate solvency of a company. The financial analyst must rely on these ratios. From an operational point of view, however, the money manager's primary concern is with the current cash flows and those flows expected in the near future. An examination of the combination of working capital ratios and cash flows are helpful to identify the relevant factors affecting the management of working capital. The assets employed in the business have high impact on making the profitability and liquidity position of the firm. The ratios relating to the assets can be treated as a factor to assess the efficiency of WCM. From the operational point of view, the policies of the firms with respect to creditors and debtors are important factor, and also, the inventory conversion period. It is important that the firm has ability to convert its assets in to cash to meet its short term obligations. The liquidity ratios will be helpful in this regard.

There has been a growing interest in working capital management (WCM) analysis, exemplified by a number of empirical studies examining various aspects. Previous studies have adopted different methodologies. Empirical analysis have been adopted to identify the relationship between independent variables and dependent variable, survey based approaches and modeling. The factor analysis is applied in different areas of management like marketing, leadership, portfolio management, and knowledge management. We find that factor analysis approach has not been used by the researchers to identify the existence of the correlation and linear dependency among the independent variables. Previous studies use

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the variables relating to the policy of the firm, operational factors, convertibility factors and ratios of assets (Deloof, 2003; Pandachi, 2006; Lazaridis and Tryfonidis, 2006; Raheman and Nasr, 2007; Teruel and Solano, 2007;Yadav et al., 2009; Falope and Ajilore, 2009; Sen and Oruc, 2009; Ramachandran and Jankiraman, 2009; Charitou et al., 2010; Alipour, 2011).

The primary aim of our study is to examine and assess the factors affecting the management of working capital of the manufacturing companies that are provided in the Centre for Monitoring Indian Economy (CMIE) database. The variables considered in this work for factor analysis are Debtors Days (DTRDAYS), Inventory Days (INVDAYS), Creditors Days (CTRDAYS), Cash Conversion Cycle (CCC), Current Ratio (CR), Ratio of Current Liability to Total Assets (CLTOTA), Assets Turnover Ratio (ATR), Financial Assets to Total Assets (FATOTA), Gearing Ratio (GR), Net Working Capital to Total Assets Ratio (NWCL) and Size (SIZE). Variables except DTRDAYS and CTRDAYS are derived variables.

According to Malhotra and Dash (2012), factor analysis is used in the following circumstances: a) to identify the underlying dimensions, or factors, that explain the correlations among a set of variables. b) to identify a new, smaller set of uncorrelated variables to replace the original set of correlated variables in subsequent multivariate analysis. c) to identify a smaller set of salient variables from a larger set for use in subsequent multivariate analysis. Here we conduct the factor analysis for third circumstance. Our results show that the variables converge into four factors, which can be referred as assets factor, policy factor, convertibility factor, and operational factor.

The rest of the paper is organised as follows: Section 2 presents data and variables, Section 3 describes briefly the empirical methodology utilized in the paper, and Section 4 discusses the empirical results followed by the last section which provides some concluding remarks.

2. Data and Variables

India is attracting significant attention as an attractive location for manufacturing industries in recent times. As an important sector in the overall economic growth, manufacturing sector requires in depth analysis at industry as well as firm level. Working capital management efficiency is vital especially for manufacturing firms, where a major part of assets is composed of current assets (Horne and Wachowitz, 2000).

Table 1: Variables Used in the Analysis

No	*Variable*	*Symbol*	*Calculation Method*
1	Debtors Days	DTRDAYS	[accounts receivable * 365] / Sales.(It is taken from executive summary of the firms)
2	Inventory Days	INVDAYS	[Inventories*365] / Cost of goods sold
3	Creditors Days	CTRDAYS	[accounts payable*365] / Cost of goods sold. (It is taken from executive summary of the firms)
4	Cash Conversion Cycle	CCC	DTRDAYS + INVDAYS – CTRDAYS
5	Current Ratio	CR	Current Assets / Current Liability
6	Ratio of Current Liability to Total Assets.	CLTOTA	Current Liability / Total Assets
7	Assets Turnover Ratio	ATR	Sales / Total Assets
8	Financial Assets to Total Assets	FATOTA	Financial Assets / Total Assets
9	Gearing Ratio	GR	Debt / Total Assets
10	Net Working Capital to Total Assets Ratio	NWCL	Net working capital / Total Assets
11	Size	SIZETA	Natural Logarithm of Total Assets

This study uses financial statements of executive summary, assets, and liability statements of manufacturing firms listed in Centre for Monitoring Indian Economy (CMIE) for a period of 5 years (i.e. 2005-06 to 2009-10). The data was collected for 1211 firms and the firms with the 1 percent outlying values for Debtors Days (DTRDAYS), Inventory Days (INVDAYS), Creditors Days (CTRDAYS) were left out. Thus the samples size consists of a balanced panel set of 5990 firm year observations of 1198 firms.

Table 1 presents the variables and its calculation methods used in the analysis.

3. Empirical Methodology

Factor analysis obtains a reduced set of latent variables using a set of linear combinations of the original variables, so as to maximize the variance of these components. Specifically for a given set of *m* factors and *k* variables, the model can be described in the matrix notation which can be represented as follows:

$$r - \mu - AF + \in \ldots \ldots \ldots .1 \qquad (1)$$

With $m < k$ and where r = denotes the multivariate vector of stock returns,) is the corresponding mean vector, is the resulting common factor vector, is the matrix of factor loadings, denotes the loading of the i^{th} variable on the j^{th} factor and is the specific error of r_i.

Principle component analysis using correlation matrix is taken for analysis. The factors with eigen values greater than one are retained for determining the initial factor matrix. The factor matrix contains the coefficients used to express the standardized variables in terms of the factors. Complex structure occurs when one variable has high loadings or correlations (0.40 or greater) on more than one component. Variables are only checked for complex structure if there is more than one component in the solution. Variables that load on only one component are described as having simple structure. If a variable has complex structure, it should be removed from the analysis. Through factor rotation, the factor matrix is transformed into a simpler one that is easier to interpret. In this analysis varimax procedure of orthogonal rotation is used. In orthogonal rotation the axes are maintained at right angle. Under an orthogonal transformation the communalities and the specific variances do not change. Varimax procedure minimizes the number of variables with high loading on a factor, thereby enhancing the interpretability of factors.

The model fit is checked using 'Reproduced Correlation Matrix'. The difference between the observed correlations as given in the input correlation matrix and the reproduced correlations as estimated from the factor matrix can be examined to determine the model fit.

4. Empirical Results

The correlation matrix among the eleven independent variables specified in Table 1 is calculated. The resultant matrix is found not to be positive definite. So, we checked the covariance matrix among the independent variables and also found not to be positive definite due to the presence of the variable CCC. Hence, CCC is eliminated from the list of variables and found that the resultant matrix was positive definite. Most of the works in the literature (Deloof, 2003; Lazaridis & Tryfonidis, 2006; Teruel & Solano, 2007; Raheman & Nasr, 2007; Zariyawati et al., 2009; Falope & Ajilore, 2009; Sen & Oruc, 2009;

Table 2: Correlation Matrix

Dtrdays	*1.000*	*.031*	*.561*	*.013*	*.004*	*-.043*	*-.002*	*.005*	*.004*	*-.100*
Invdays	.031	1.000	.171	.035	-.015	-.035	-.007	-.014	.032	.007
Ctrdays	.561	.171	1.000	-.053	.036	-.029	.007	.037	-.063	.022
Cr	.013	.035	-.053	1.000	-.018	-.008	-.002	-.017	.390	-.081
Cltota	.004	-.015	.036	-.018	1.000	.916	.899	.999	-.607	-.037
Atr	-.043	-.035	-.029	-.008	.916	1.000	.895	.918	-.385	-.046
Fatota	-.002	-.007	.007	-.002	.899	.895	1.000	.895	-.491	-.003
Gr	.005	-.014	.037	-.017	.999	.918	.895	1.000	-.598	-.037
Nwcl	.004	.032	-.063	.390	-.607	-.385	-.491	-.598	1.000	-.004
Sizeta	-.100	.007	.022	-.081	-.037	-.046	-.003	-.037	-.004	1.000

Ramachandran & Jankiraman, 2009; Mohamad & Saad, 2010; Charitou et al., 2010; and Alipour, 2011) use CCC along with DTRDAYS, CTRDAYS AND INVDAYS.

With the objective of finding the relationship among the independent variables DTRDAYS, INVDAYS, CTRDAYS, CR, CLTOTA, ATR, FATOTA, GR, NWCL and SIZETA, a correlation is done. The correlation matrix is given in Table 2.

Out of 55 cells below the main diagonal, there are 12 correlation coefficients (shown in boldface letters) that are above 0.30 which are statistically significant and different from zero. The highest correlation coefficients belong to GR-CLTOTA (0.999); GR-ATR (0.918); CLTOTA – ATR (0.916).

The Kaiser-Meyer-Olkin test, a measure of sampling adequacy is found to be adequate with a value of 0.721; and the Bartlett test of sphericity rejected the null hypothesis that the correlation matrix was an identity matrix. Having satisfied the first step of the factor analysis, the next step, principal component of the variables are identified.

4.1 Initial Statistics

The factor solution should explain at least half of each original variable's variance, so the communality value for each variable should be 0.50 or higher. The communalities provide an index to the efficiency of the reduced set of variables. Table 3 shows the communalities of variables. Here all variables are having communality more than 0.5. High value of communality is for CLTOTA (0.978) and low value for SIZETA (0.580).

In order to group the information contained in the original variables, a smaller number of factors is extracted. The approaches based on eigen values, scree plot and percentage of variance accounted are used to determine the number of factors. Table 3 shows the variance explained by the factors. The resulting eigen values for only the first four common factors are greater than one. We reached the same conclusion using the Scree plot to determine the number of common factors.

The cumulative proportion of variance criteria can be met with four components to satisfy the criterion of explaining 60 per cent or more of the total variance. A four components solution would explain 80.160 per cent of the total variance.

4.2 Rotation and Interpretation of Factors

Variables are only checked for complex structure if there is more than one component in the solution. Variables that load on only one component are described as having simple structure. If a variable has complex structure, it should be removed from the analysis. NWCL is having a complex structure, so it is dropped from the analysis. Finally the variables DTRDAYS, INVDAYS, CTRDAYS, CR, CLTOTA, ATR, FATOTA, GR, and SIZETA are having communalities greater than 0.5 are incorporated in the analysis.

Table 4 shows the results of final rotated component matrix. Each variable is loaded on a single component,

Table3: Initial Statistics

Variable	*Communality*	*Component*	*Initial Eigen values*		
			Total	*% of Variance*	*Cumulative %*
DTRDAYS	.778	1	4.121	41.213	41.213
INVDAYS	.599	2	1.606	16.060	57.273
CTRDAYS	.785	3	1.267	12.665	69.938
CR	.814	4	1.022	10.222	80.160
CLTOTA	.978	5	.933	9.332	89.492
ATR	.898	6	.468	4.679	94.171
FATOTA	.894	7	.405	4.051	98.222
GR	.975	8	.125	1.254	99.476
NWCL	.715	9	$5.153E^{-02}$	.515	99.991
SIZETA	.580	10	$9.007E^{-04}$	$9.007E^{-03}$	100.000

Table 4: Final Rotated Component Matrix

	Component 1	2	3	4
DTRDAYS	-1.421E-02	.882	.111	-6.145E-02
INVDAYS	-9.448E-03	.108	1.709E-03	.901
CTRDAYS	1.547E-02	.867	-.101	.178
CR	-1.678E-02	-.126	.721	.326
CLTOTA	.984	2.447E-02	4.181E-03	-7.815E-03
ATR	.961	-4.232E-02	2.060E-02	-2.827E-02
FATOTA	.951	-3.033E-03	-7.285E-03	1.374E-02
GR	.983	2.525E-02	4.098E-03	-7.182E-03
SIZETA	-2.963E-02	-.134	-.743	.280

Table 5: Descriptive Statistics

	Mean	Median	Maximum	Minimum	Std. Deviation
DTRDAYS	65.4901652	51.258	3174.30000	.00000	90.00422350
INVDAYS	73.9695564	58.265	4584.75610	.00000	100.25935698
CTRDAYS	81.8266787	64.200	4610.60000	.00000	122.44118902
CR	3.7603181	2.2590	1080.00000	-1.27704	17.24285556
CLTOTA	.3084673	0.20820	144.21671	-.20059	1.9762531
ATR	1.2989697	1.0207	384.73556	.00000	5.28957382
FATOTA	.0351257	0.00052521	56.27060	-.00044	.76002211
GR	.3208367	0.21853	144.81582	.00000	1.99237892
SIZETA	5.1246486	5.0676	12.43420	-3.21888	1.71313243

thereby enhancing the interpretability of the factors.

The variables can be broadly classified in to four factors, viz, assets factor, policy factor, convertibility factor and operational factor.

The first factor has large weights for CLTOTA, ATR, FATOTA and GR. The above variables are classified as a factor relating to the total assets of the firms, while the second factor has high loading for DTRDAYS and CTRDAYS. This vector represents mainly the movements of debtors and creditors, the policies of the firm. The third factor has large weights for CR and SIZETA. This factor represents the ability of the firm to convert its assets in to cash, called as convertibility factor. The factor four has large weight for INVDAYS. So the fourth factor is related to the inventory conversion period of the firms. This is called as operational factor.

The model fitness is checked using 'Reproduced Correlation Matrix'. The difference between the observed correlations and the reproduced correlations as estimated from the factor matrix can be examined to determine the model fit. These differences are called residuals. In the matrix, only eight residuals are larger than 0.05, indicating an acceptable model fit.

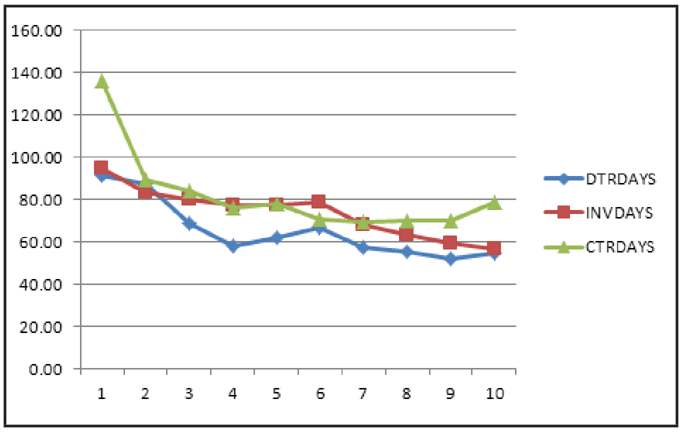
4.3 Descriptive Statistics

Descriptive statistics of the variables used is given in Table 5. The firm receives a payment on an average of 65.49days after the sales. It takes on average 73.96 days to convert the raw materials and sell the finished goods inventory and firms take on an average 81.83 days to pay purchases.

CR is the traditional measure of liquidity. It indicates the availability of current assets in rupees for every one rupee of current liability. The industry has a high liquidity with the average current ratio being 3.76. For manufacturing firms, the current liabilities are 30.85 of total assets. Sales are 1.3 times the total assets employed. Financial assets employed in the firm are only 3.5 per cent of the total assets. Debt as a percentage of total assets is given by gearing ratio. The debt is 32 per cent of the total assets employed in the firm. The size of the company is calculated as the logarithm of total assets, which is used as measure of solvency position.

Figure 1 gives the variation of mean DTRDAYS, mean INVDAYS and mean CTRDAYS with ROA deciles. The figure reveals that less credit period is given to the customers in comparison with the credit period availed for the purchases in all profitability deciles.

Figure 1: Mean DTRDAYS, INVDAYS and CTRDAYS V/s ROA deciles



The CTRDAYS is more for first profitability deciles. It justifies that less profitable firms has to wait longer to pay their bills. The firms with profitability of second to fifth deciles are having a purchase payment period equal to its inventory conversion period. This displays that the firms are giving the payment only after converting their purchase into sales. So, DTRDAYS is contributing mainly to the cash conversion cycle. In the sixth deciles, DTRDAYS and CTRDAYS are equal. That is the firms in the middle position of profitability are having equal creditors and debtors. From seventh to tenth deciles CTRDAYS is increasing consistently. INVDAYS and DTRDAYS are coming closer and become equal at tenth deciles. That firms having higher profitability deciles enjoying the credit period. This is also justifying that CTRDAYS is inversely related to profitability. Manufacturing firms required investments in debtors or inventories regardless of the profitability deciles. It is clear from the analysis of liquidity position of the firms. The current ratio is higher than the standard value (mean 3.76, median 2.26), gives the implication of carrying more current assets than current liability.

5. Conclusion

This paper identifies the salient variables of working capital management using factor analysis. The study has been conducted on manufacturing industries irrespective of business difference. The principal component analyses have identified the factors and are expected to assist the mangers to identify areas where they might improve financial performance of their operation. Interestingly the study finds CCC to be correlated with the other variables and eliminated. Finally, the variables are classified into four factors, assets factor, policy factor, convertibility factor, and operational factor, with a cumulative percentage variance of 82.977 percent. The assets factor is loaded with the variables CLTOTA, ATR, FATOTA, and GR. The policy factor is based upon the debtors and creditors policy of the firm, that is, DTRDAYS and CTRDAYS. The convertibility factor includes the variable CR and SIZETA, relates ability of the firm to convert its assets in to cash, called as convertibility factor. The operational factor is equipped with inventory conversion period, INVDAYS.

The above identified variables, representing the relevant four factors of the firm can be used for subsequent multivariate regression analysis.

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