The relationship of operational practices improving inventory performance and the financial performance of the firm

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ABSTRACT

The study attempts to understand the relationship of inventory related operational practices and the financial performance of a firm. A sample of 179 manufacturing firms from western part of India is chosen and the data from financial reports from 2008 to 2018 was used to study the results. A regression-based model is developed and tested to establish the relationship. The study found that operational practices improving inventory management may not explain the financial performance. Improvement in inventory management has limited effect on financial performance as the measures used to evaluate financial performance are influenced by various factors other than operational practices

Keywords

Inventory management, operational practices, firm performance, regression analysis

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Introduction

Operational performance measurement is of paramount importance for the companies at upstream of supply chain and those need to focus more on economy of manufacturing than the revenue improvement. Multiple factors representing operational practices affecting company's operational as well as financial performance are studied in literature. Purchasing practices, supplier relations, quality management, Lean operations represent major part of operations practices the affect company performance. But among all, inventory management forms a major factor influencing the performance [1] as the impact of various other practices can improve inventory and the direct relationship with company's financial performance can be established.

The study aims at providing an econometric analysis of the financial measure representing those operational practices that improve inventory performance. The inventory management is influenced by supplier relations and the financial transactions involved in it [2]. This is reflected in the efficient use of credit available and calculated through the ability of firm to quickly convert to cash. The purchasing practices like make or buy decisions also impact the inventory performance [3]. A manufacturing firm can invest time and effort in those activities that are core competencies than involving in almost all manufacturing processes. Thus, outsourcing of a part of processes is preferred strategy and the expenses on the outsourced jobs may represent this strategy and impact on company's performance. Another operational practice affecting inventory performance is the dependence over imported materials. The share of expenses made over purchasing imported materials to the total material expenses represent such dependency which may impact cost and lead time of inventory.

The aforementioned measures are used for representing operational practices and their impact on company's performance is studied. Regression analysis is used to study the relationship of operational practices and firm performance of companies involved in manufacturing of engineered goods. It was found that inventory turnover has significant impact on firm performance whereas other variables are insignificant. The study also concludes that in establishing relationship of operational practices and firm performance, asset turnover is comparatively better measure than return on investment. The article is structured as follows. This section is followed by theory and hypotheses development. The next section then discusses the sample and the variables chosen for study. This is followed by the results of regression analysis and then discussion of the results. Finally, conclusion section summarizes the findings of the study.

Theory and Hypotheses

The literature on inventory management or evaluating inventory performance adopts two approaches. One, that approaches inventory management as an operational activity influencing operational performance and the other approaches inventory through the financial measurement lens and assesses the impact on financial performance. The operational practices as Lean, JIT, contract manufacturing, strategic sourcing, supplier management help in improving inventory performance. The efficient management of inventory through the aforementioned operational practices influence firm performance measured through operational and financial parameters.

The literature discusses impact of the operational practices improving inventory performance on the firm performance. Some significant relationships validated in literature are: strategic sourcing or purchasing practices affect firm performance [4] [5]; supplier management influencing firm performance [6]; Lean and JIT practices improving inventory performance and in turn improving firm

performance [7] [8]. Measurement and analysis of operational performance is a complex activity involving qualitative and quantitative measures [9]. The quantitative measures used are financial as well as non-financial measures. The financial measures representing the operational practices influencing inventory and firm performance are inventory turnover ratio [10], Cash conversion cycle [11], Outsourced manufacturing jobs, and import intensity. The financial measures of firm performance chosen from literature are Return on Assets (ROA) [12] and Asset turnover. The variables are studied simultaneously to assess the relationship which may not explain the causality.

The improvement in inventory management is reflected in improving the inventory turnover. Inventory performance is measured in terms of inventory turnover ratio. It has been found that the inventory turnover is directly related to financial performance of a firm [12]. The effect of this improvement is assumed to improve the financial performance of the company as well. The relationship of improved inventory turnover to that of improve ROA and return on assets is hypothesized as-

H1a : Inventory turnover has positive direct impact on ROA of the company

H1b : Inventory turnover has positive direct impact on Asset Turnover of the company

Cash conversion cycle is a measure of effective use of cash in the inventory system. It explains the number of days needed to convert purchased materials into sales. Lower the cash conversion cycle, better is the profitability of firm as the capital blocked in resources can be quickly released [11]. The impact of change in cash conversion cycle on the financial performance is hypothesized as-

H2a : Cash conversion cycle increases the ROA of the company decreases.

H2b : Cash conversion cycle increases the Asset Turnover of the company decreases.

The dependency of an organization on imported materials will lead to higher costs of materials as well as transport costs and higher lead times. The value engineering function helps the organizations in finding indigenous better materials to replace imported materials. The ratio of import materials expenses to the total material expenses is termed as Import intensity and its relationship with the financial performance measures is hypothesized as -

H3a : Higher Import intensity has negative impact on ROA of company

H3b: Higher Import intensity has negative impact on Asset Turnover of company

Outsourcing is seen as a strategy to focus on core competencies of a firm. Outsourcing helps in getting the jobs done with expertise and at economy. The expenses on outsourced manufacturing jobs may reduce inhouse inventory and improve financial performance measures. Hence it is hypothesized as-

H4a: Outsourcing expenses has direct positive impact on ROA of the company

H4b: Outsourcing expenses has direct positive impact on Asset turnover of the company

Sample and variables under study

The financial data for the variables under study was collected from Centre for Monitoring Indian Economy (CMIE) Prowess IQ database. The sample covers 179 large scale companies in manufacturing of engineered goods from western region of India. These companies are placed at a supply end of value chain and need to focus on cost and quality. As the cost of such goods affect the prices of final products, small savings at initial stages can reap significant benefits later. Operational performance in handling inventory in such industry affects the costs at considerable extent. In general, the manufacturing industry spends over 30% on inventory and specifically the engineering sector has about 55 to 60% of share in total cost.

The variables representing the performance of inventory are chosen from literature review. The data is gathered from CMIE database for the shortlisted 179 sample companies from 2007- 08 to 2017-18. There are various financial indicators expressing materials management practices and performance but the choice of variables should be such that these variables need not have significant correlation between them. As for model expressing higher explained variance, the independent variables should be sufficiently unique. The financial indicators and their definitions are presented here.

Inventory turnover: Most frequently reported financial indicator for inventory performance is “Inventory turnover” [13] [14] which is calculated as the ratio of cost of goods sold to average inventory. Average inventory is calculated as the simple arithmetic mean of opening and closing inventory.

Inventory turnover ratio (Inv_Turn) = (Cost of goods sold ÷ Average inventory)

Cash conversion cycle: It is a measure of efficiency of working capital. It is the number of days the working capital available for a firm. It is calculated as-

CCC = (Inventories/ COGS)* 365 + (Accounts receivables / Net sales)* 365 – (Accounts payables / COGS) * 365

Outsourced manufacturing jobs (Out_sour): Actual expenses on outsourcing of manufactured jobs expressed in Rs. Millions.

Import intensity (Imp_int): This measure is used to understand the share of expenses the import materials have in the total material expenses. It is the ratio of import materials expenses to the total material expenses.

The dependent variable of measuring firm performance is represented by two most common financial indicators in literature- Return on assets and Asset turnover.

Return on assets (ROA): It represents the ratio of net income to average total assets. The ratio depicts how the assets are used to generate income for the company. ROA is most frequently used measure of company performance in the operations literature. It represents management effectiveness.

Asset turnover (Asset Turn): Asset turnover is calculated as ratio of net sales and average total assets. As both the values in the ratio cannot be negative, the ratio takes only positive values. This ratio represents the efficiency of asset utilization in a company.

The data for the study is in the form financial indicators which are continuous variables. Hence to study the relationships, regression is used as data analysis technique.

The identified variables are tested for their multi-collinearity and then a regression-based model was proposed to test the hypotheses.

Results

The data for aforementioned variables is collected for a time period of 11 years and summarized for analysis. The summary of descriptive statistics of this data is presented in table I. The average inventory turnover ratio for the companies under study is 7.176 and the standard deviation is 5.745. The cash conversion cycle has an average of 62.24 days with standard deviation of 232.71 days. Among the dependent variables, ROA has an average of 0.0576with a standard deviation of 0.1012 and Asset turnover has a mean of 1.2961 with standard deviation of 0.6576.

TABLE I. DESCRIPTIVE STATISTICS OF VARIABLES FROM 2007-08 TO 2017-18

	Inv_Turn (Ratio)	**CCC** (days)	**Imp_int** (ratio)	**Out-Sour** (Rs. million)	**ROA** (Ratio)	**Asset_Turn** (Ratio)
Min.	0.810	-3474.88	0.0000	0.00	-0.5800	0.0000
Max.	78.840	3730.74	0.4900	7068.90	0.6500	5.0700
Mean	7.176	62.24	0.1490	129.89	0.0576	1.2961
Std. Dev.	5.745	232.71	0.2754	397.75	0.1012	0.6576
Variance	33.003	541544.00	0.0759	158202.61	0.0102	0.4324
Median	5.950	54.81	0.0500	23.80	0.0500	1.2600

Source: Secondary data from CMIE

A regression model representing and testing the relationship of independent variables namely, Inventory turnover ratio (inv_turn), Cash conversion cycle (CCC), Import intensity (imp_int), Outsourced manufacturing jobs (Out-sour) and dependent variables Return on Assets (ROA) and Asset Turnover ratio (Asset_Turn) is developed and tested for its significance. The literature review suggests two different models to be tested for two dependent variables. The study uses Microsoft Excel as an application for analysis of the regression model by using multiple regression method. The regression analysis which involves two or more independent variables is termed as multiple regression analysis. The most commonly used method is least squares method which provides a regression equation minimizing the sum of squared deviations between observed and estimated values of dependent variable and provides a best fit straight line regression equation [15].

The current study uses pooled ordinary least square (OLS) regression method as the values for the variable for the same companies were not varying over the years. The data was analysed to study the effects of independent variable on the dependent variables. The first dependent variable is ROA regressed upon independent variables inventory turnover (inv_turn), Cash conversion cycle (CCC), Import intensity (imp_int), Outsourced manufacturing jobs (Out_sour). The regression equation is formulated by using log linear model by taking the log on both the variables to reduce the dispersion range. So as to take log of some variables which had negative as well as zero as a value, those variables were added with a constant representing maximum value of the variable. These transformed variables are ROAPlus, CCCPlus, imp_intPlus, and out_souPlus replacing the earlier corresponding variables, ROA, CCC, imp_int, and out_sour. Taking logarithm of all the variable values the log linear model is written as a regression equation for testing.

A generalized form of model to be tested is written in equation form as follows-

$\log(ROAPlus) = \beta0 + \beta1\log(Inv\_turn) + \beta2(CCCPlus) + \beta3(Imp\_intPlus) + \beta4\,(Out\_sourPlus) + e$ ----- (model_A)

Where, $\beta0$ is Intercept constant;

$\beta1$, $\beta2$, $\beta3$, $\beta4$ are the regression coefficients of the independent variables respectively and 'e' signifies the error term.

This model is then tested with the help of OLS regression and the results are as shown in the subsequent tables. The model is first analysed with the help of scatter plot of residuals to fitted values. For a model to be fit, the scatter plot should depict random behavior of residuals. The scatter plot for model_A is as shown in Figure 1. The plot shows no specific pattern in the residuals. This represents a good model fit.

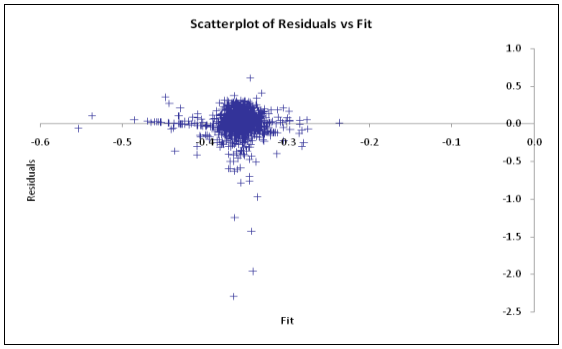

Figure 1. Residual scatter plot for model_A

The results of correlation among the variables are not significant except between inventory turnover and ROA. Also, the results of multicollinearity are tested by comparing the values of variance inflation factors (VIF). The VIF values of independent variables should be below 5 to confirm that there is no multicollinearity.

TABLE II. TEST OF MULTICOLLINEARITY MODEL_A

	VIF	**R-Square**
Constant		
Log(Inv_Turn)	1.011323	0.011196
Log(CCCPlus)	1.002138	0.002133
Log(imp_intPlus)	1.006234	0.006196
Log(out_sourPlus)	1.010816	0.0107

Table II lists the VIF values for the studied variables. It can be seen that for all the independent variables the VIF values are less than 5. So, here the authors confirmed that there exists no multicollinearity in the independent variables of the model.

Table III shows the results of regression equation in the form of regression coefficients, standard error, t-value and p-value.

TABLE III. REGRESSION TABLE SHOWING SIGNIFICANCE VALUES FOR MODEL_A

	Coefficient	**t-Value**	**p-Value**	**Hypothesis and result**
Constant	-2.53726	-2.66573	0.0078	***
Log(Inv_Turn)	0.02237	4.13969	< 0.0001	H_{1a} ***
Log(CCCPlus)	0.055371	1.26003	0.2079	H_{2a}
Log(imp_intPlus)	0.097629	0.94266	0.346	H_{3a}
Log(out_sourPlus)	0.171304	1.7155	0.0865	H_{4a}

*** Significant at p < 0.01

The results of regression coefficients show that only inventory turnover ratio is significant and affects positively to ROA. Other independent variables are not significant in the stated model. The outsourcing expenses show a weak direct relationship with ROA.

Table IV and V show the summary of the multiple regression for model_A. The R square value of the model is 0.0175 which means that the model is able to explain only 1.75 percent of variation.

TABLE IV. SUMMARY OF REGRESSION MODEL_A(ROA)

Multiple Regression for Log(ROAPlus)	**Multiple R**	**R-Square**	**Adjusted R-square**	**Std. Err. of Estimate**
	0.1322	0.0175	0.0146	0.17051112

TABLE V. ANOVA TABLE MODEL_A

ANOVA Table	**Degrees of Freedom**	**Sum of Squares**	**F**	**p-Value**
Explained	4	0.701394862	6.031109	< 0.0001
Unexplained	1357	39.45347525		

The model has F-value as 6.031(table V) and found to be significant at less than 1% level of significance. Though the model shows overall significance it does not explain the variation in the ROA based on the values of inventory turnover, Cash conversion cycle, import intensity and outsourcing expenses. The findings from this model coincide with the literature where it was observed that there are multiple factors than materials management which have impact on firm performance. As the dependent variable ROA is based on the input of net income, it will surely be affected by factors other than operational indices.

The regression equation with obtained regression coefficients is written as follows-

Log(ROAPlus) = - 2.53725719 + 0.02236985 Log(Inv_Turn) + 0.05537126 Log(CCCPlus) + 0.09762871 Log(imp_intPlus) + 0.17130417 Log(out_sourPlus)

The second model with dependent variable Asset Turnover is regressed upon independent variables inventory turnover (inv_turn), Cash conversion cycle (CCC), Import intensity (imp_int), Outsourced manufacturing jobs (Out_sour). A simple linear regression form of model is presented as-

Asset_Turn = β0 + β1 (Inv_turn) + β2 (CCC) + β3 (Imp_int) + β4 (Out_sour) + e ----- (model_B)

Where, β0 is Intercept constant; β1 , β2 , β3, β4 are the regression coefficients of the exogenous variables respectively and 'e' signifies the error term.

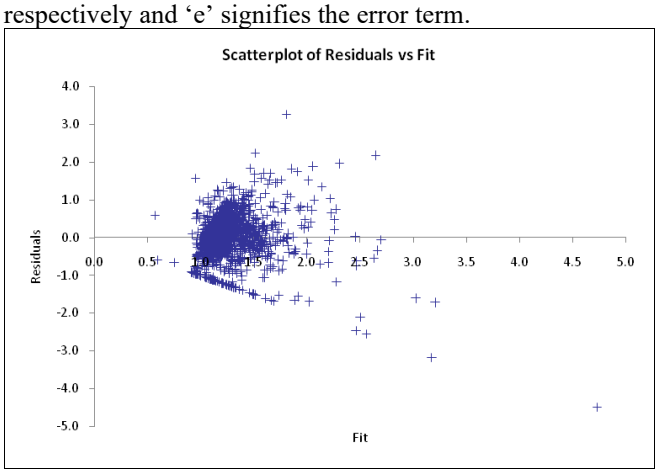

Figure II. Residual scatter plot for model_B

This model is then tested with the help of OLS regression and the results are shown in the subsequent tables. The model fit is first checked with the help of scatter plot of residuals to fitted values. The scatter plot for model_B is as shown in figure II. The plot shows no specific pattern in the residuals. This represents a good model fit.

The correlation of all exogenous and endogenous variables is checked and seen that the correlation between inventory turnover to asset turnover is significant, rest other correlation values are insignificant. The test of multicollinearity is used to check whether any two independent variables are highly correlated. The values for variance inflation factors (VIF) are well below 5 (table VI); which shows that there exist no multicollinearity in the independent variables.

TABLE VI. TEST OF MULTICOLLINEARITY MODEL_B

	VIF	**R-Square**
Constant		
Inv_Turn	1.026799	0.0261
CCC	1.014047	0.013852
Imp_int	1.016483	0.016216
Out-Sour	1.005784	0.00575

Thus , the residual scatter plot and multicollinearity test shows that the model is appropriate for testing. The regression model is run using linear OLS multiple regression.

Table VII shows the results of OLS regression equation in the form of regression coefficients, standard error, t-value and p-value.

TABLE VII. REGRESSION TABLE SHOWING SIGNIFICANCE VALUES FOR MODEL_B

	Coefficient	**t-Value**	**p-Value**	**Hypothesis and result**
Constant	0.963607	32.9854	< 0.0001	
Inv_Turn	0.047821	16.7681	< 0.0001	H_{1b} ***
CCC	-0.0001	-1.4888	0.1368	H_{2b}
Imp_int	-0.01651	-0.27895	0.7803	H_{3b}
Out-Sour	-1.3E-05	-0.32605	0.7444	H_{4b}

*** Significant at p < 0.01

The results of regression coefficients for model_B depict that only inventory turnover ratio is significant and affects positively to Asset Turnover. Other independent variables are not significant in the stated model_B.

Table VIII and IX show the summary of the multiple regression for model_B. The R square value of the model is 0.1796 which means that the model is able to explain about 18 percent of variation.

TABLE VIII. SUMMARY OF REGRESSION MODEL_B

Multiple Regression for Asset_Turn	**Multiple R**	**R-Square**	**Adjusted R-square**	**Std. Err. of Estimate**
	0.4238	0.1796	0.1772	0.59648

TABLE IX. ANOVA TABLE MODEL_B

ANOVA Table	**Degrees of Freedom**	**Sum of Squares**	**F**	**p-Value**
Explained	4	105.7129	74.28063	< 0.0001
Unexplained	1357	482.8056		

The model shows F-value as 74.28 (table IX) and found to be significant at less than 1% level of significance. Though the model shows overall significance, it does not explain the variation in the Asset turnover due to values of Cash conversion cycle, import intensity and outsourcing expenses.

The comparative analysis of both the models model_A and model_B shows that second model with Asset turnover as dependent variable explains the variation in the model better than model_A. Asset turnover uses revenue as the input as compared to net profit in ROA, hence the relationship of independent variables is better. To understand the performance of company by affecting operational indicators, asset turnover is a better indicator of company performance.

The regression equation for model_B is stated as follows-

Asset_Turn = 0.96360712 + 0.04782117 Inv_Turn - 0.00010416 CCC - 0.01651015 Imp_int - 0.00001329 Out-Sour

Discussion

The quantum of efforts put into improving efficiency of the operational processes if very high. An obvious effect assumed by the operational executives is that these practices influence the performance of the firm. But when this is compared with the financial data analysis, the results are not encouraging. A major reason behind lower impact of materials practices on financial performance may be impact of many external factors. The financial performance of a firm is affected by various factors other than operational efficiencies. Though the companies may generate localized cost efficiencies using better operational practices but the overall impact on financials is negligible.

The results of the regression show that only inventory turnover has a significant direct impact on return on assets. The values of ROA represent net income which may be affected by various external factors. Inventory is a small part of ROA and may affect marginally. Other independent variables have insignificant impact on ROA. It indicates that it is difficult to isolate the effect of inventory turnover on ROA which coincides with the past literature [7]. Though inventory turnover has a direct positive impact on ROA but the change affected is marginal. This result is supported by [12] which state that ROA is not a suitable measure to understand the impact of inventory management.

The results of the second model with Asset turnover as dependent variable show that there exists direct positive relation between inventory turnover and asset turnover. Other variables are insignificant for the model. As compared to model_A, this model has better explained variation. Though the model may not include all variables under study, it is a better model to test the performance effect of materials management on firm performance.

Conclusion

Operational practices improving inventory performance are at the core of manufacturing strategy of the companies involved in engineered goods. The financial measures representing the operational practices and performance are used to form a combined effect model. The literature on operational practices empirically validates the effect on firm performance but the financial performance perspective in operations literature is limited. The regression models discussed in the study concludes that inventory is at the core of operations management. Other financial parameters representing operational practices in financial statements like cash conversion cycle, share of imported materials expenses and expenses on outsourcing manufactured jobs have insignificant impact on firm performance. The regression models confirm that the improvement in operational practices like inventory management can bring small change to financial position of a company. The reported financials usually have to be targeted to the investors. So, evaluation of firm performance using

operational parameters can give a part of answer. Nonetheless, the study proposes that asset turnover is a better measure of firm performance to be used while dealing with operations management variables.

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