Inventory Model for Medium and Small Scale Enterprises

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Abstract: At the enterprise level, inventory holding assumes significance importance, as inventories represent an oversized proportion of the entire assets of the many issues. Proper control over inventories provides the management with flexibility in making purchases systematically rather than buying strictly according to the production schedule and hand to mouth supplies. The major drawback of internal control is to maximize profitableness by reconciliation investment price of materials against what's needed to sustain level operations. The purpose of this paper is to study the status of inventory holding the Medium and Scale Enterprises. An attempt is also made to test the optimality of inventory holding in these enterprises concerning the cost of sales by applying simple regression models For testing the optimality of inventory holding in relationship cost of sales, correlation coefficient, coefficient of determination (R-square), F-test through ANOVA, regression coefficients and their standard errors, values of t-statistics and their P-values have been computed. The analysis reveals that Medium and Light Engineering Central Public Enterprises could reduce the inventory holding in terms of the number of days of consumption, cost of production and cost of sales.

Keywords: Inventories, Medium, and Small Enterprises, Regression, ANOVA

1. Introduction

Inventory control deals with the acquisition, storage, handling and use of inventories, therefore, it needs to maintain the availability of the material when needed. Providing adequate cushion for contingencies account for the most economy and minimum wastage [1]. At the enterprise level, inventory holding assumes significance importance, as inventories represent an oversized proportion of the entire assets of the many issues [7].

It requires a substantial investment of capital besides involving the cost of storage and handling as well as the risk of damage, loss, and obsolescence [4]. To minimize costs and also to ensure that capital is not unnecessarily locked up, inventories must be efficiently managed. Errors in inventory management cannot be rectified, as it is the least liquid among all the current assets. The major drawback of internal control is to maximize profitableness by reconciliation investment price of materials against what's needed to sustain level operations [3]. Proper control over inventories provides the management with flexibility in making purchases

systematically rather than buying strictly according to the production schedule and hand to mouth supplies [3]. It also permits flexibility in production management and marketing. Through the production need not be geared to immediate sales, this does not warrant increasing the level of inventories indiscriminately.

Efficient management aims at increasing the level of inventories as long as the resulting economies and benefits exceed the total cost of holding such inventories and benefits exceed the total cost of holding such inventories [7].

Appropriate control over inventories affects the operational efficiency and profitability of the organization.

It also helps in achieving a higher return on investment by minimizing locked up working capital and also in improving the cash flow and liquidity position.

Inventory control should meet two opposing needs. Viz
1. Maintenance of an inventory of sufficient size and diversity for efficient operations and
2. Maintenance of financially favorable inventory.

Public Enterprises, of late, are subjected to the criticism that their economic performance is not satisfactory [2].

Among various issues affecting the performance of manufacturing concerns, inventory control is a major aspect.

2. Objectives the Paper

The purpose of this paper is to study the status of inventory holding the Medium and Scale Enterprises. An attempt is also made to test the optimality of inventory holding in these enterprises concerning the cost of sales by applying simple regression models. More precisely, the analysis enables to identify;

1. Whether the inventories of the undertakings moved in constant proportion to the cost of sales
2. Whether the inventory holding in the undertakings moved in square root relationship to cost of sales.
3. Whether the undertakings enjoyed economies of scale/suffered diseconomies of scale in respect of inventory holding.

3. Data and Methodology

Experience has given some idea of approximate limits within which inventories vis-à-vis the sales would move. This approximate limit suggests three possibilities. Firstly, inventories may move in constant ratio with their usage. Secondly, according to the established belief, with increasing consumption of sales, a relatively lesser volume of inventories are needed and under ideal conditions of effective management, inventories should move in square-foot relationship with their usage. The third alternative is that inventories increase in between these two extremes.

To assess the status of inventory holding, trends in all inventories, raw materials, work-in-progress, and finished goods in terms of cost of sales, consumption, cost of production and net sales respectively have been computed and presented in terms of several days. For testing the optimality of inventory holding in relationship cost of sales,

correlation coefficient, coefficient of determination (R-square), F-test through ANOVA, regression coefficients and their standard errors, values of t-statistics and their P-values have been computed.

To test the optimality of inventory holding, the following simple regression models have been applied to the time-series data of the sample undertaking:

1. $Y = a + bx$
2. $Y = A + bvx$
3. $Y = ax$

Where, Y= Inventories, a/a = intercept which indicates the level of safety stock.

b=regression coefficient, and X = cost of sales.

The value of a indicates the degree of economies of scale enjoyed/suffered by the undertakings. The values of coefficient a, b, a, a have been tested at 95 percent confidence level. For the present study, relevant data for the years 2008 -09 to 2017-18 have been obtained from various issues of Public Enterprises Survey-Annual Reports on the working of Industrial and Commercial Undertakings of the Central Government published by Government of India.

4. Inventory Behaviour – An Analysis

Trends in Inventories in Medium and Small Scale Enterprises:

To examine the trends in inventories in a sample enterprise, trends in all inventories, cost of sales, raw material, work in progress, finished goods have been computed and presented in Table 1. Trends values have been computed using the following formula:

$$\text{Trend Value} = \{(-)/\} \times 100$$

Where Value of inventories/ cost of sales of the previous year

Value of inventories/cost of sales of the current year

Table 1. Trends in Inventories in Medium and Light Engineering CPEPSs in India From 2008-2009 to 2017-2018 (Rs. In Crores/No. of days).

Year	Average Inventory	Cost of Sales	Inventory cost of sales	Raw materials cost of production	WIP: Cost of Production	Finished goods: Net sales
2008-2009	2253.66	4773.51	172	166	55	30
2009-2010	2323.83	4908.7 (3.11)	173 (2.83)	165	51	33
2010-2011	2258.25	5069.29 (-2.82)	163 (3.27)	161	47	32
2011-2012	2091.73	5444.19 (-7.37)	140 (7.40)	161	43	24
2012-2013	1897.29	5927.17 (-9.30)	117 (8.87)	141	39	20
2013-2014	1741.54	6383.14 (-8.21)	100 (7.70)	129	27	19
2014-2015	1949.84	6314.11 (12.00)	113 (-1.08)	130	28	62
2015-2016	2470.09	7776.70 (26.68)	116 (23.16)	122	30	58
2016-2017	2790.7	7920.89 (1.85)	129	121	17	70
2017-2018	2939.09	7955.62 (0.44)	135	128	7	72

Sources: Complied from Public Enterprises Survey – Annual Reports.
Figures in brackets indicate trends

From the table, it is clear that inventories increased by 3.11 per year in 2010-11 over 2009-10. From 2011-12 to 2013-2014, the level of inventories registered negative trends indicating improvement in inventory management. This trend could not persist in the rest of the study period. In 2015-16,

inventories have increased by 26.68 percent over the year 2014-15. However, in 2016-2017 and 2017-2018, there has been a significant decline in the cost of sales.

Analysis in respect of raw materials expresses in terms of several days consumption revealed that from 2008-2009 to

2011-2012 there has been an increase in the cost of sales ranging from 2.83 percent to 8.87 percent. In 2013-14 there has been some improvement and this improved further in 2014-15. However, in 2015-16, it has been as high as 23.16 percent. But in 2016-17 and 2017-18, there has been a significant decline in the cost of sale.

Analysis in respect of raw materials expressed in terms of several day's consumptions revealed that from 20018-09 to 2013-14, there has been a decline in the inventory level. However, this improvement could not be found in the rest of the years.

Analysis of work in progress and finished goods inventory revealed that on the whole, the management succeeded in reducing the level of work in progress in terms of the number of days of cost of production. However, the trend in finished goods inventory showed an increasing tendency as it has increased from 30 days in 20018-09 to 72 days in 2017-18.

Test of Optimality

To test the optimality of inventory holding concerning the cost of sales, simple regression models have been applied and the results have been presented in Tables 2-4.

Application of Regression Model –I: Y = a = bX

A simple regression model of y= a + bx has been applied to test the optimality of inventory holding. And the results are presented in Table 2.

Table 2. Regression Statstics Summary Results of Model I: y=a +bx.

Multiple R	0.568765
R Square	0.323494
Standard Error	33341.68
Observations	10

ANOVA					
	DF	SS	MS	F	Signif. F
Regression	1	4.25E +09	4.25E+09	3.82547	0.086205
Residual	8	8.89E+09	1.11E+09		
Total	9	1.31E+10			

t- Test				
	Coefficient	Std. Error	t-Statistic	p- value
Intercept	118971.6	56310.4	2.11E+00	0.06758
X	0.173176	0.088541	1.955881	0.086205

The value of R-Square is 0.323494. This value indicates that about 32 percent of the change in the level of inventories is due to the change in the sales level. Therefore about 67 percent of the change in inventory level is not in response to the change in sales but due to other considerations.

F-ratio (3. 82547) is not significant at 5 percent level of significance as its p-value (0.086205) is greater than 0.05. Thus, the relationship between inventories and sales is considered as an occurrence chance. Therefore, the variance due to regression with the unexplained variance is not significant.

The coefficient in respect of inventory intercept represents the level of safety stock. The results reveal that the policy matter concerning the maintenance of safety stock is not in proportion to the level of sales.

Further, the value of the coefficient in respect of sales is positive, which shows that the level of inventories is positively related to sales. However, t-values for intercept and sales coefficient indicated poor regression relationship. Thus the Excel summary Output in respect of Regression Statistics reveals that the inventories are not moving in a linear relationship to the sales.

APPLICATION OF MODEL –II; Y= a + bvX

Table 3. Regresion Statistics Summary Results OF Model I: y = a + bvX

Multiple R	0.542599
R- Square	0.294414
S. Error	34050.76

ANOVA					
	DF	SS	MS	F	Signif. F
Regression	1	0.016022	2.672392	0.005996	0.140742
Residual	8	0.047964	0.005996		
Total	9	0.063987			

t-Test				
	Coefficient	Std. Error	t-Statistic	p- value
Intercept	20021.05	113884.1	0.175802	0.864818
vX	263.2478	144.084	1.827043	0.105112

The results concerning the application of this model are presented in Table 3. The value of R-square is 0.294414. it reveals that about 29 percent of the variation in inventory is explained by the variation in sales. Thus a greater majority i.e. 71 percent of the variation in inventories is not explained by the variation in sales.

F-ratio (3.338088) is not significant at 5 percent level of significance as its p-value (0.105112) is greater than 0.05. Thus the relationship between inventories and sales is an occurrence by chance. Therefore, the variance due to regression with the unexplained variance (residual) is not significant.

The t-values concerning intercept and sales expressed in square root relationships are significant with their corresponding critical values. As such the variable inventories and sales are behaving independently.

The discussion based on the Excel Summary Output in respect of regression statistics reveals that the inventories are not moving in square root relationship to sales.

APPLICATION OF MODEL –III OR Log Y= LOGa +aLOGX

Table 4. Excel Summary Output of Model –III; y =aX$^\alpha$.

Regression Statistics	
Multiple R	0.500402
R Square	0.250402
S. Er	0.077431
Observations	10

ANOVA					
	DF	SS	MS	F	Signif. F
Regression	1	3.87E+09	3.87E+09	3.338088	0.105112
Residual	8	9.28E+09	1.16E+09		
Total	9	1.31E+10			

t- test					
	Coefficient	Std. Error	t- Statistic	t-Statistic	P-Value
Intercept	2.529625	1.729706	1.46E+00	0.18176	0.086205
Log X	(a)	4.88E-01	9.88E-02	1.634745	

The results concerning the application of this model are presented in Table 4.

Analysis of Excel Summary Output reveals that the value of R square (0.250402) fails to provide any meaningful evidence to believe the regression relationship between inventories and sales. Only 25 percent of the variation is explained by the regression relationship. Thus about 75 percent of the variation remains unexplained.

F-ratio, which explains the extent of the regression relationship with unexplained variance (residual) is not significant as its p-value (0.140742) is greater than 0.05. the coefficient in respect of intercept (a) and also log X (a) are positive and not significant. They indicate that the companies under consideration are suffering from diseconomies. Thus the t_0 values are also not significant. Therefore it may be concluded that there is no evidence to believe that the medium and light engineering industry enjoyed economies in respect of inventories.

5. Conclusion

The analysis reveals that Medium and Light Engineering Central Public Enterprises could reduce the inventory holding in terms of the number of days of consumption, cost of production and cost of sales.

The inventory holding of Medium and Light Engineering Enterprises did not move in constant proportion to sales. The inventory holding of the sample enterprises did not move in square root relationship to sales and the enterprises did not enjoy economies of scale in respect of inventory holding with sales.

Further, a detailed investigation of these trends revealed

1. Abnormal lead times.
2. Unscientific purchases/issuing decision
3. Heavy carrying costs,
4. Ineffective use of sales forecasting techniques,
5. Inadequate vendor rating, and
6. Lack of a strategic approach for inventory planning.

To improve the effectiveness of inventory management, it is high time for the public sector undertakings to reengineer the inventory management policies and practices with the help of Supply Chain Management/Just –In –time.

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