Chapter - 5

INVENTORY BEHAVIOUR MODEL

An attempt has been made here to examine the structural changes in the composition of inventory with a view to understand the behaviour of each inventory component and its influence on the behaviour of total inventory. For the purpose, the following identity equation, called Inventory Behaviour Model (IBM) has been developed and used :

$$TI = \sum_{t=1}^{n} T_i \qquad \ldots\ldots \quad (1)$$

Where,

TI = Total Inventory

Subscript,

t_1 = Raw Material Inventory

t_2 = Work-in-process Inventory

t_3 = Finished Goods Inventory

t_4 = Spares

To ascertain the factors responsible for change in the TI, the equation is modified as below :

$$\triangle TI = \triangle (W_{RM}+W_{WIP}+W_{FG} + W_S) \qquad \ldots\ldots \quad (2)$$

Where,

$\triangle$ indicates change

TI = Total Inventory

WRM = Weight of RM in total inventory

W_{WIP} = Weight of WIP in total inventory

W_{FG} = Weight of FG in total inventory

W_{S} = Weight of Spares in total inventory

The above model has an explanatory capability for changes over time in the level of inventory. The use of this model should not only enable us to pinpoint the extent and magnitude of each component's contribution to the changes in total inventory, but also should make it easier for bankers as well as industrial units to introduce necessary modification in their managerial strategy and its implementation for achieving the identified goals.

At the outset we have examined the behaviour of each major component of inventory during the period, both at the aggregate and sample level and then subsequently integrated them into the model to understand the relative influence of changes in individual components of inventory on the changes in the level of total inventory.

RM Component Analysis

Raw Materials constitute an important part of total inventory. Their behaviour in terms of change in their levels should generally effect the level of total inventory.[1] In the following table, therefore, the change in the level of Raw Materials inventory are analysed at the aggregate as well as sample level.

Table - 5.1 (A) Raw Material Inventory : Aggregate Level

Year	RM (Rs.Crs)	RM_I (%)		S (Rs. Crs)	S_I (%)		RM/S (%)
	1	2	3	4	5	6	7
1977-78	772.93	100.00	-	8589.41	100.00	-	8.99
1983-84	1777.36	229.96	100.00	21708.60	252.74	100.00	8.19
1984-85	1979.20	256.07	111.36	25571.66	297.71	117.80	7.74
1985-86	2334.65	302.06	131.35	29432.64	342.66	135.58	7.93
1986-87	2452.35	317.28	137.98	32190.61	374.77	148.29	7.62
1987-88	2616.61	338.54	147.22	35811.19	416.92	164.96	7.31

Table - 5.1 (B) Raw Material Inventory : Sample Level

Year	RM (Rs. lacs)	RM_I (%)	S (Rs. lacs)	S_I (%)	RM/S (%)
	1	2	3	4	5
1983-84	23124.21	100.00	281653.41	100.00	8.21
1984-85	23021.12	99.55	314542.68	111.68	7.32
1985-86	24324.41	105.19	340178.80	120.78	7.15
1986-87	34269.06	148.20	456149.43	161.95	7.59
1987-88	36715.18	158.77	501498.56	178.06	7.32

Source- (A) Financial performance of Companies, ICICI portfolio 1987-88 The Industrial Credit & Investment Corporation of India Ltd. Bombay, June 1989.

(B) Annual reports of the sample industries.

Explanations

1. RM = Raw material
   RM_I = Index of raw materials
2. S = Sales
   S_I = Index of sales

Findings

(1) The Raw Material to Sales ratio has been declining over the entire period which is a positive achievement.

(2) A comparison of the growth rates reveals that sales have recorded an increase of 63.38 per cent per annum while raw material inventory has risen by 47.71 per cent per annum, during the period. If we take 1983-84 as a base, the growth rate of the said variables have been 16.24 per cent and 11.81 per cent per annum, respectively. Thus, in this analysis also, the growth rate of raw material inventory has lagged behind that of sales at the aggregate level.

(3) In the sample units, the raw material inventory to sales ratio has shown the same characteristics as that at aggregate level. The growth rate of sales has been 19.52 per cent while for raw materials it has been 14.69 per cent per annum. Thus, considering the situational statistics or the incremental statistics in respect of this ratio the same pattern is confirmed.

In order to further reassure ourselves regarding the Raw Material Inventory Management Efficiency in industries at the aggregate level, we have calculated a ratio of the raw material inventory to the total raw materials consumed.

The following table contains the Raw Material Inventory Turnover Analysis.

Table - 5.2 Raw Material Inventory Turnover : Aggregate Level

Year	RM	TRMC	RMT
	1	2	3
1977-78	772.93	4612.12	5.97
1983-84	1777.36	11265.35	6.34
1984-85	1979.20	13242.64	6.69
1985-86	2334.65	15296.50	6.55
1986-87	2452.35	16274.83	6.64
1987-88	2616.61	17439.89	6.67

Source- Financial performance of companies, ICICI portfolio 1987-88. The Industrial Credit & Investment Corporation of India Ltd. Bombay -June 1989.

Explanations-

The turnover has been calculated as follow[2]

$$\frac{\text{Raw material consumed}}{\text{Raw material inventory}}$$

1. RM = Inventory of raw material
2. TRMC=Total raw material consumed
3. RMT= Raw material turnover.

The purpose of computing this ratio is to ascertain if the working capital is more than proportionately tied up in the raw materials.

Findings

(1) The highest Raw Material turnover has been 6.69 in 1984-85 and lowest, 5.97 in 1977-78.

(2) The Raw Material turnover ratio is higher than total inventory turnover ratio. It should be stressed that the increase in turnover ratio of raw material has not been sufficient enough to influence much, the total inventory turnover ratio. Still it is a good indication that industries have better controlled their raw material inventory, which was one of the main goals of NBLS.

Work-in-process

Work-in-process inventory is generally assumed to be a function of the technological process. However, a study made in India asserts that work-in-process inventory is not only a technologically determined factor but also a managerial factor and thus it can be reduced considerably through effective managerial decisions.[3]

The following tables show the changes in the work-in-process inventory at the aggregate and sample levels.

Table - 5.3 (A) Work-in-process Inventory : Aggregate Level

Year	WIP (Rs.Crs)	WIP_I (%)		S (Rs.Crs)	S_I (%)		WIP/S (%)
	1	2	3	4	5	6	7
1977-78	418.07	100.00	-	8589.41	100.00	-	4.86
1983-84	1060.93	253.77	100.00	21708.60	252.74	100.00	4.89
1984-85	1193.24	285.42	112.47	25571.66	297.71	177.88	4.66
1985-86	1314.94	314.53	123.94	29432.64	342.66	135.58	4.47
1986-87	1452.28	347.38	139.89	32190.61	374.77	148.29	4.51
1987-88	1559.72	373.08	147.01	35811.19	416.92	164.96	4.36

The growth index of work-in-process inventory is given in the following table.

Table - 5.3.(B) Work-in-process Inventory : Sample Level

Year	WIP (Rs.lacs)	WIP_I (%)	S (Rs.lacs)	S_I (%)	WIP/S (%)
	1	2	3	4	5
1983-84	12670.70	100.00	281653.41	100.00	4.50
1984.85	13537.19	106.84	314542.68	111.68	4.30
1985-86	14712.59	116.12	340178.80	120.78	4.32
1986-87	19799.41	156.26	456149.43	161.95	4.34
1987-88	21640.63	170.79	501498.56	178.06	4.31

Source- (A) Financial performance of Companies, ICICI portfolio 1987-88. The Industrial Credit & Investment Corporation of India Ltd. Bombay, June 1989

(B) Annual reports of the sample industries.

Explanations

1. WIP = Work-in-process
   WIP_I = Index of work-in-process
2. S = Sales
   S_I - Index of sales

Findings

(1) In absolute terms, at the aggregate level, work-in-process has registered an increase of 273.08 per cent between 1977-78 to 1987-88. But it has kept pace with the rising levels of sales which is clearly indicated by the work-in-process inventory to sales ratio, which is almost of the order of 4.36 per cent to 4.86 per cent which is confirmed by the growth rates of the two variables. Work-in-process inventory has increased by 54.62 per cent per annum and the growth rate of sales is 63.38 per cent per annum taking 1977-78 as the base year. If the base year is 1983-84 the growth rates are 11.75 per cent and 16.24 per cent per annum respectively.

(2) Taking Work-in-process/Sales ratio as an indicator of efficiency, we find that there is marginal decline in this ratio, which means a marginal increase in the WCME in terms of WIP inventory management. This factor, thus, should be marginally responsible in decreasing the total inventory level in the industries at the aggregate level.

(3) For sample industries, the ratio of Work-in-process to sales has almost shown a similar pattern over the

period under consideration, as was found at the aggregate level. But the growth rate of work-in-process inventory has been of the order of 17.70 per cent p.a. and that of Sales is 19.52 p.a. It can thus be concluded that there is some improvement in the management of WIP which has resulted in a slightly lowering of WIP in the terminating year compared to the base year.

Spares Component Analysis

Spares inventories are used in plant and machinaries. They are handled by slow moving and fast moving pattern of spares utilisation.[4] The following table depicts the position of spares at aggregate as well as sample level.

Table - 5.4 (A) Spares Inventory : Aggregate Level

Year	SP (Rs.Crs)	SP_I (%)		S (Rs.Crs)	S_I (%)		SP/S (%)
	1	2	3	4	5	6	7
1977-78	465.31	100.00	-	8599.41	100.00	-	5.42
1983-84	1119.51	240.60	100.00	21708.60	252.74	100.00	5.16
1984-85	1220.08	262.21	108.98	25571.66	297.71	117.80	4.77
1985-86	1384.08	297.46	123.63	29432.64	342.66	135.58	4.70
1986-87	1561.29	335.54	139.46	32190.61	374.77	148.29	4.85
1987-88	1777.27	381.96	158.75	35811.19	416.92	164.96	4.96

Table - 5.4 (B) Spares Inventory : Sample Level

Year	SP (Rs. lacs)	SP_I (%)	S (Rs. lacs)	S_I (%)	SP/S (%)
	1	2	3	4	5
1983-84	13840.51	100.00	281653.41	100.00	4.91
1984-85	15560.24	112.43	314542.68	111.68	4.95
1985-86	14704.93	106.25	340178.80	120.78	4.32
1986-87	21043.76	152.04	456149.43	161.95	4.61
1987-88	23344.71	168.67	501498.56	178.06	4.65

Source- (A) Financial performance of companies, ICICI portfolio 1987-88. The Industrial Credit & Investment Corporation of India Ltd. Bombay- June 1989.

(B) Annual reports of the sample industries.

Explanations

1. SP = Spares
2. SP_I = Index of spares
3. S = Sales
4. S_I = Index of sales

Findings

(1) At the aggregate level Inventory of Spares to Sales has been around 5 per cent during the period of analysis. The growth rate of spares per annum is 56.39 per cent and that for sales is 63.38 per cent p.a. taking 1977-78 as a base year. The growth rates have been 14.69 per cent and 16.24 per cent p.a. respectively taking

1983-84 as the base year for the two variables.

(2) The analysis of sample industry shows a comparatively lower ratio, with the only exception of the year 1983-84 in which the sample industry ratio has been higher. The industrial scenario of Gujarat has exeperienced a remarkable crisis of fuel and power severely as compared to the national scene of industry. At both the levels Stores inventory has recorded a smaller rate of growth as compared with that of sales.

Finished Goods Inventory

Finished goods inventory management is one of the most important strategic variables in the total inventory management.[5] It is worthwhile to relate the inventory management efficiency in terms of the finished goods inventory management efficiency, too. The following tables show the level of finished goods inventory at aggregate and sample levels.

Table - 5.5 (A) **Finished Goods Inventory : Aggregate Level**

Year	FG (Rs.Crs)	FG_I (%)		S (Rs.Crs)	S_I (%)		FG/S (%)
	1	2	3	4	5	6	7
1977-78	633.20	100.00	-	8589.41	100.00	-	7.37
1983-84	1665.61	263.05	100.00	21708.60	252.74	100.00	7.67
1984-85	1850.61	292.27	111.12	25571.66	297.71	117.80	7.24
1985-86	2392.54	377.85	143.64	29432.64	342.66	135.58	8.13
1986-87	2664.40	420.79	159.97	32190.61	374.77	148.29	8.28
1987-88	2794.62	434.25	165.08	35811.19	416.92	164.96	7.68

Table - 5.5 (B) **Finished Goods Inventory : Sample Level**

Year	FG (Rs.lacs)	FG_I (%)	S (Rs.lacs)	S_I (%)	FG/S (%)
	1	2	3	4	5
1983-84	19057.07	100.00	281653.41	100.00	6.77
1984-85	19620.68	102.96	314542.68	111.68	6.24
1985-86	22846.25	119.88	340178.80	120.78	6.72
1986-87	35006.86	183.69	456149.43	161.95	7.67
1987-88	34765.93	196.60	501498,56	178.06	7.47

Source- (A)Financial performance of companies, ICICI portfolio 1987-88. The Industrial Credit & Investment Corporation of India Ltd. Bombay -June 1989.

(B)Annual reports of the sample industries.

Explanations-

1. FG = Finished goods
2. FG_I = Index of finished goods
3. S = Sales
4. S_I = Index of sales

Findings

(1) At the aggregate level, the inventory of finished goods to sales has fluctuated around the mean figure of 7.73 per cent with deviations on positive side being 0.55 per cent and on negative side deviation being 0.36 per cent. Hence, the range is not symmetric. This is a positive feature. Looking at the variables in terms of their growth rates, the absolute growth rate is 66.85 per cent per annum for the period of 1983-84 to 1987-88 taking 1977-78 as a base year for finished goods inventory. The growth rate for Sales is 63.38 per cent per annum during the same period. Considering the growth rate for the period of five years taking 1983-84 as a base year, the annual growth rate of finished goods inventory has been 16.27 per cent and that in Sales is 16.24 per cent. Thus for the later period of five years too, the growth rate of finished goods has been higher than that of sales.

(2) The index of inventory of finished goods has risen to 434.25 in the year 1987-88, while that of sales to 416.93. On the face of it, it appears that inventory of finished goods has kept pace with sales. But if we look into the ratio between the two, there is stagnancy. It is evident that the marketing strategy has not been

efficient.

Thus, we can say, that during the post NBLP period, there has not been much of an improvement in management of Finished Goods Inventory and the NBLP has not been able to achieve its main goal ensuring a substantial reduction in the level of inventories in industries.

(3) At the sample level, the mean value of the ratio is 6.97 per cent, with a positive deviation being 0.69 per cent and the negative deviation 0.73 per cent. Hence, the range is constant and the fluctuations are marginal. If we look at the growth rates during this period, it is 24.15 per cent per annum for finished goods inventory and 19.22 per cent per annum for sales. Hence, it terms of the growth rate of the respective variables the conclusion emerges that the growth rate of the first exceeded that of the later, which is an indication of poor inventory management.

To make finished goods inventory management efficiency in industries at the aggregate level more clear, the ratio of finished goods inventory to cost of goods sold has been calculated. The following table depicts the finished goods inventory ratio at aggregate level.

Table - 5.6 **Finished Goods Turnover Ratio : Aggregate Level**

Year	CGS (Rs. Crs)	FGS (Rs.Crs)	CGS/FGS
	1	2	3
1977-78	7744.00	633.20	12.23
1983-84	19555.00	1665.61	11.74
1984-85	22995.25	1850.61	12.43
1985-86	26287.76	2392.54	10.99
1986-87	28925.20	2664.40	10.86
1987-88	32339.41	2749.62	11.76

Source- Financial performance of companies, ICICI portfolio 1987-88. The Industrial Credit & Investment Corporation of India Ltd. Bombay - June 1989

Explanations

1. CGS = Cost of goods sold
2. FGS = Finished goods stock
3. CGS/ FGS = $\frac{\text{Cost of goods sold}}{\text{Finished goods stock at cost}}$ 6

Where,

Cost of goods sold = Sales - profit.

Findings

This ratio measures the number of times finished goods inventory turnover in sales has been made, in a given period, say one year, in this case. The highest rate recorded is 12.43 in the year 1984-

85, which is closer to the rate in the year 1977-78, i.e. just after the implementation of the Tandon Study Group recommendations. The lowest rate recorded is 10.68 in the year 1986-87. This indicates that the finished goods turnover ratio has declined during the period of our study and it is further confirmed that in this area the impact of NBLP has not been favourable.

In order to find out the changes in the level of raw material inventory and finished goods inventory, we have calculated the stock size of both in terms of number of days. This measure should enable us to understand the impact of NBLS on the actual stock levels of two types of inventory. In this analysis a fall in the number of days holding indicates a decline in the level of inventory. It may be noted here, that we have not calculated the number of days of work-in-process because it is assured to be a technically governed factor. The following table gives information of inventory holding days at the aggregate level.

Table - 5.7 **Inventory holdings : Aggregate Level**

Year	RM Stock (No. of days)	FG Stock (No. of days)
	1	2
1977-78	69	25
1983-84	58	28
1984-85	55	26
1985-86	56	30
1986-87	55	30
1988-89	55	28

Source- Financial performance of companies, ICICI portfolio 1987-88. The Industrial Credit & Investment Corporation of India Ltd., Bombay - June 1989.

Findings

The table reveals that the raw material inventory levels have declined from 69 days holding to 55 days holding. We can, therefore, finally conclude that so far as the level of raw material inventory is concerned, the NBLP has been effective in achieving its goal of ensuring better inventory management in industries. But the picture is disappointing in terms of finished goods stock, where the inventory level has increased during the period.

Analysis of structural changes

It appears desirable to examine the changes in the share of components in total inventory levels, both at the aggregate level and at the sample level to evaluate the impact of NBLS on inventory levels. For that purpose we have decided to analyse the data on a two stage analytical frames. At the first stage the changes in the total inventory level and the major components thereof have been ascertained. At the second stage, an explanation to the change has been found out in terms of the relative behaviour of different major components.

These changes have been ascertained on the time points given below :

(1) Changes in the year 1983-84 over 1977-78 as a base year;

(2) Changes in the year 1987-88 over 1983-84 as a base year; and

(3) Changes in the year 1987-88 over 1977-78 as a base year.

The following table contains the required analysis for the relevant years.

Table - 5.8 **Inventory Components : Aggregate Level**

Year	Raw Material (Rs.Crs)	Work-in-Process (Rs.Crs)	Finished Goods & goods in transit (Rs.Crs)	Spares (Rs.Crs)	Total Inventory (Rs.Crs)
	1	2	3	4	5
1977-78	772.93 (33.78)	418.07 (18.25)	633.20 (27.65)	465.31 (20.32)	2289.51 (100.00)
1983-84	1777.36 (31.61)	1060.93 (19.87)	1665.61 (29.62)	1119.51 (19.90)	5623.41 (100.00)
1984-85	1979.20 (31.70)	1193.24 (19.11)	1850.61 (29.64)	1220.08 (19.55)	6243.13 (100.00)
1985-86	2334.65 (31.44)	1314.94 (17.71)	2392.54 (32.21)	1384.08 (18.64)	7426.21 (100.00)
1986-87	2452.35 (30.16)	1452.28 (17.86)	2664.40 (32.78)	1561.29 (19.20)	8130.32 (100.00)
1987-88	2616.61 (30.07)	1559.72 (17.92)	2749.62 (31.59)	1777.27 (20.42)	8703.22 (100.00)

Source- Financial performance of Companies, ICICI portfolio 1987-88. The Industrial Credit & Investment Corporation of India Ltd. Bombay -June 1989.

Explanation

Figures in the bracket shows percentage.

Findings

(1) The total inventory during period one changed from 2289 Crs. to 5623 Crs. Thus, the size of inventory

is more than doubled during the period. In the second period change in inventory was from 5623 Crs. to 8703.22 Crs., which was less than double. The overall change in absolute inventory was almost four times, in the third period. However, this four fold increase was consistent with increase in sales. But then, even in relation to sales as examined earlier, there has not been any reduction in the level of inventory, which is an indicator of the failure of th NBLP in this regard

(2) An analysis of the composition of inventory reveals that there has been a declline in the level of raw material inventory and very marginal decrease in W.I.P. However, the component responsible for the increase in total inventory has been finished goods inventory which has risen from 633 Crs. to 1666 Crs. during the first period. During the second period it has increased by one and a half times, and the overall increase is four and half times in the third period. The percentage of finished goods inventory has risen from 22.7 to 31.6 during the entire period covered by the study.

(3) The share of spares throughout the study period has remained constant. It was 20.32 per cent in the year 1977-78 and 20.42 in 1987-88. As recommended in NBLP it should be only of total inventory investment while

the scenario of stores and spares shows a marginal increase in the amount invested into it. The investment in spares is four times compared to the norms given in the NBLS. Thus, an excessive fund has been found to be blocked in this area of inventory with a resultant adverse impact on profitability of these enterprises.

Now to study the trend in the sample units of Gujarat State, we will analyse the changes in the structure of inventory.

Table - 5.9 **Inventory Components : Sample Level**

Year	Raw Material (Rs.lacs)	Work-in-Process (Rs.lacs)	Finished Goods & Goods in transit (Rs.lacs)	Stores (Rs.lacs)	Total Inventory (Rs. lacs)
	1	2	3	4	5
1983-84	23124.21 (33.00)	12670.70 (18.63)	19057.07 (28.02)	13840.51 (20.35)	68012.37 (100.00)
1984-85	23021.12 (32.09)	13537.19 (18.87)	19620.68 (27.35)	15560.24 (21.69)	71739.25 (100.00)
1985-86	24324.41 (31.76)	14712.59 (19.21)	22846.25 (29.83)	14704.93 (19.20)	76588.18 (100.00)
1986-87	34269.06 (31.12)	19799.41 (17.98)	35006.86 (31.79)	21043.76 (19.11)	110119.09 (100.00)
1987-88	36715.18 (30.81)	21640.63 (18.16)	37465.93 (31.44)	23344.71 (19.59)	119166.45 (100.00)

Source- Annual report of the sample industries.

Explanation

Figures in the bracket shows percentage.

Findings

(1) The total inventory changed from 68012 lacs in the year 1983-84 to 119167 in the year 1987-88, which is almost double. This increase is consistant with sales, which again supports the findings of aggregate level, that the NBLP has not succeeded in reducing the level of inventory.

(2) The Raw Material inventory has declined during the five year period, which is a positive feature. But reduction in work-in-process is not so significant. However finished goods inventory levels is showing an upward trend. It has increased from 19057 lacs in 1983-84 to 37466 lacs in 1987-88 i.e. almost doubled.

(3) Spares and stores inventory is showing similar trend at aggregate level. But at the same level it has declined marginally i.e. from 20.4 per cent to 19.6 per cent. But still investment in this area of inventory is much more higher than recommended by the NBLP.

Thus it can be inferred that the most important policy parameter in which much of the decision element is involved is the holding of 'finished goods' and 'stores and spares'. It appears that banks, while implementing a NBLS have not adequately attended to monitoring the level of these inventories.

It will be desirable at this stage to ascertain the relative influence of different inventory components on the changes in the total inventory. This exercise will provide an appropriate and effective technique to identify the strong and weak elements of inventory behaviour and can be used by industries as well as banks for different decision to maintain the optimum level of inventory.

Statistical Analysis of Inventory Behaviour

The inventory models propounded by operational researchers are based on the assumption of techno-economic background of the western world.[7] They do not take into account the crucial decision variables which lead to optimum inventory levels. For Indian industries, such sophisticated models are not applicable due to different techno-economic background under which they are operating and their internal system which do not yield necessary tools for sophisticated models, in the form of data, record, procedures and performance. It is an open secret that Indian industries have yet to go a long way in achieving the status of enlightened and professional scientific management.[8] On the basis of whatever system is prevailing, it is worthwhile to evolve inventory model commensurate with the prevailing conditions of Indian industries.

The relative significance of the contributory variables specified

should have impact in terms of appraising the financial requirements on realistic basis and scheduling as well as monitoring of the levels of bank advances for effective utilisation of the same. On the strength of the observations and findings stemming from the study, the model for inventory levels is specified as under.

The Model

This is a regression model. To impart a dynamic touch to the analysis, incremental quantums are taken as a ratios.

$$Y_{it} = ait + bX_1it + cX_2it + dX_3it + eX_4it$$

Where,

Y_{it} = level of inventory in i^{th} industry with respect to time t.

X_1 = Incremental inventory to working capital.

X_2 = Incremental inventory to work in process.

X_3 = Incremental inventory to finished goods.

X_4 = Incremental inventory to bank borrowings.

i = number of units.

t = time variable

a, b, c, d, and e are the co-efficients of the respective variables. The result is as under :

$$Y_{it} = \underset{(1.851)}{0.585} + \underset{(0.021)}{0.038}\, x_1 + \underset{(0.238)}{0.268}\, x_2 + \underset{(0.411)}{0.943}\, x_3 + \underset{(0.848)}{0.0345}\, x_4$$

R^2 = 0.798

Standard error of the estimate = 2.699

Standard error of the co-efficients = 0.357

Note Figures in the brackets show t value of the respective parameter.

In this model the contributory role of independent variables are quantified in terms of the estimated values of the parameters. The intercept part of this linear functional relationship is indicated by the first figure in the estimated function, i.e., 0.585. The relative significance of incremental inventory to working capital is almost 4 per cent, 27 per cent, 94 per cent and 35 per cent, that of work-in-process, finished goods and bank borrowings respectively. The explanatory value of the model is quite significant i.e. almost 80% of the variations in the level of inventory are attributable to these factors. The measure of standard error of the estimate speaks for the range of acceptability of statistical significance of the inference obtained, while the standard error of the co-efficient is indicative of the limits of variability in the estimated values of these co-efficients in various sample studies for their statistical significance and validity. The conclusion emerges that finished goods component of inventory has a significant role in inventory level and therefore, it may be used by the banks and industrial units as an important decision variable to monitor the requirements of inventory finance.

For identification and quantification of the contributory variables responsible for changing levels of inventory, the size of the industrial units covered and the level of their performance need not be overlooked. Hence, instead of a simple functional relationship obtained from the observed values of the variables in the sample data, indexing is necessary. For this purpose dynamic form of the model is specified[9] and tested as under for aggregate data.

$$Y_{it} = f(X_1it, X_2it, X_3it, X_4it)$$

To purge out the effect of size variables of the particular industry and to focus on the actual performances, the variables are expressed in incremental terms as done earlier. The rate of growth of inventory. is measured. Translog indices as developed by Thornquist are used[10], viz.,

$$I_y(t) = \frac{Y_t - Y_t-1}{Y_t-1}$$

This measures gives the indexing of each variable independently by applying it seperately on it. This is due to the fact that inventory is a perpetual phenomenon. Therefore, index form is a better approximation rather than discrete incremental figures for the same. The function is estimated in the following form for implementing linearity for the sake of simplicity of estimation in such a dynamic version in the form of indexing of the observed values of the variables.

$$\log Y = a + b \log X_1 t + C \log X_2 t + d_3 X$$

Where,

Y_{it} = translog growth rate in inventory

$X_1 t$ = incremental inventory to work-in-process, with respect to time t

$X_2 t$ = incremental inventory to finished goods with respect to time t

X_3 = Bank borrowings as dummy variable

This has been a slight methodological deviation as compared with the model analysed earlier. In this model three independent variables have been incorporated, leaving aside the first one, i.e., incremental inventory to working capital. This is due to the problem of co-relation between working capital and bank borrowings variable. Bank borrowings as revealed could not lend themselves for satisfactory quantitative analysis. Hence, it is taken up with the help of dummy variable technique.

The two run regression method was adopted. In the first run no dummy variable was included, while in the second run dummy variable is included. For statistical significance an explanatory value of the estimate $\bar{R}^2$ is used. The results are as under :

Results of the two run regression -

Item constant X_1 X_2 X_3

No. of dummy variables

$$Y_{it} = 5.7556\ X_1\ 0.3500\ X_2\ 0.1182$$
$$(1.701) \quad (0.371)$$
$$\bar{R}^2 = .77$$

Dummy variable included

$$Y_{it} = 6.2400\ X_1\ 0.3980\ X_2\ 0.5304\ X_3\ 0.4002$$
$$(0.738) \quad (0.901) \quad (2.437)$$
$$\bar{R}^2 = .91$$

Here, the value of the $\bar{R}^2$ is significant i.e., .77 per cent. The explanatory value of the model is enhanced more significantly, with the inclusion of the bank borrowings as an explanatory variable. If the banks have to play a prominent role in the provision of inventory finances, the assessment of the industrial inventory requirements should be based on the estimated values of the co-efficients in the trend function.

The independent variables specified in the model are very handy tools for appraisal of loan application as well as monitoring aspects of the flow of funds. Therefore, the lending policy of the bank leads to significant tempering in industrial inventory levels.

Several important conclusions have emerged from the analysis.

Findings

(1) The explanatory value of the variables under consideration is quite significant. Almost 80 per cent of the variations in the inventory levels are accounted for by these variables in the data. At the aggregate level the variables incorporated account for 91 per cent of the growth rates of inventory level.

(2) Ratio of work-in-process inventory being statistically significant establishes that the size of the industry and the technology of the industry have their distinct role in inventory levels. Hence, inventory management should accord due weightage to these factors.

(3) From among these variables finished goods are more influential in the inventory levels of the industries. Due to its statistical significance, it follows that this factor must be monitored carefully both by the industrial units and the banks.

(4) As established from the results of estimation, Bank borrowing is an important explanatory variable in varying levels of inventory.

(5) Ratio of inventory to working capital is also statistically significant. Therefore, it is one of the important

monitoring tools for inventory management. At the aggregate level, this ratio, due to the problem of serial co-relation, could not be highlighted.

H_2 **Inventory in Relation to Norms**

As pointed out earlier also, much stress has been laid on the inventory norms under the new bank lending system. Banks are expected to ensure that borrowal firms do not violate the condition of norms except under specified exceptional circumstances. In view of this essential stipulation of bank lending, it can be assumed that all the industries in India have maintained their inventory levels upto or below the prescribed norms. To empirically verify this assumption, the following hypothesis has been formulated and tested :

H_2 The level of inventories in all the industries is equal to or below the norms prescribed under the NBLS.

Under the NBLS, norms have been prescribed for fifteen different industries in resepect of three major components of inventory viz., Raw Materials & Consumable Stores, Work-in-process, and Finished Goods Stock. For the fourth component of inventory, i.e., Spares, it has been prescribed that their level should exceed 5 per cent of total inventory. In order to test the hypothesis, data of actual inventory levels has been compared with norms, taking a sample of six industrial units as given in the following table.

Table - 5.10 Comparison of Actual Inventories with Prescribed Norms

(in month)

Industry	RM			WIP			FG		
	A	Norm	x_1 D	A	Norm	x_2 D	A	Norm	x_3 D
	1	2	3	4	5	6	7	8	9
1. Textile	1.4	2	-(0.6)	1.1	0.75	+0.35	1.1	2.25	-1.15
2. Chemical	1.4	2.75	-1.35	0.4	0.25	+0.15	1.5	1.0	+0.5
3. Fertilizer	0.9	0.75	+0.15	0.3	N	UA	2.7	1.0	+1.7
4. Cement	3.3	1.33	+2.0	0.4	0.80	-0.10	0.4	1.0	-0.6
5. Automobile	2.4	2.25	-0.15	0.6	0.75	-0.15	0.8	2.0	-1.2
6, Machinery	2.5	2	+0.5	1.2	0.75	+0.45	0.8	2.5	-1.7

Explanations

To calculate the stock in terms of month the following formula has been used.

$$RM = \frac{RM \times 12}{\text{Cost of R.M. Consumed}}$$

$$WIP = \frac{WIP \times 12}{\text{Cost of production}}$$

Where

Cost of production = Net sales - (depreciation +selling cost)

Cost of sales = Net sales - profit

U.A. = Uncertain.

N = Negligible

The table reveals that :

(1) In Fertilizer industry the actual inventory levels in all the three components have been higher than the norms, while in Automobiles, all the three components show a lower stock level compared to the prescribed norms.

(2) In the remaining four industries, the deviations of actual inventory levels from the prescribed norms demonstrate a mixed pattern. For instance, compared to the RM Norms, the actual levels are lower in Textile and Chemicals and higher in the case of Cement and Machinery industries. In respect of WIP, the actual inventory levels are higher compared to Norms, in Textile, Chemical and Machinery industries and lower in one industry only viz., Cement. As against this, the Finished Goods inventory has been lower than the norms in three industries. viz., Textiles, Cement and Machinery, and higher in case of Chemicals only.

A review of the above observations makes it different to arrive at a decisive conclusion on the changes in the efficiency levels of industries in the field of adhereing to the financial discipline imposed by the New System of Bank Lending. It is also difficult to conclude that the efficiency of industries in the field of inventory management has really improved or declined.

For better understanding of the pattern of inventory behaviour and the deviations from the relevant norms prescribed under the NBLS with respect to the various components of inventory, we have identified two techniques for further analysis as given and applied below :

(1) **Point observation technique**

The above multidimensional table has six rows and three columns, depicting the deviations. Hence,the total number of observations on deviation is 18. Out of these 18 observations, 8 are positive and the remaining 10 are negative. Thus, deviations from norms are visible on all the 18 points, which indicates that at no point the actuals are equal to norms. Hence, the frequency distributions are shown in favour of negative side deviations. It may appear from this deviation that actual inventory holdings are lower than the norms in major number of point observations. But this is not an indication of better inventory management efficiency. It may be due to the prescription of norms being too high than the realistic requirements. Hence, probing into the behaviour pattern more closely becomes necessary at this juncture.

(2) **Standard deviation technique**

As a measure of dispersion it would be more appropriate to use as it avoids the problem of cross cancellation,

due to the opposite algebric signs of the values of deviations. To establish the aggregative degree of deviations from norms, the following formula of pooled standard deviation is applied :[12]

$$\sigma^2_{x_1\ x_2\ x_3} = \sqrt{\frac{n_1\ (x_1 - \bar{x}_1)\ .\ n_2(x_2 - \bar{x}_2)\ .\ n_3(x_3 - \bar{x}_3)}{n_1 .\ n_2 .\ n_3}}$$

Where,

σ^2 = pooled standard deviation

n_1 = number of observations on raw material

n_2 = number of observations on work-in-process

n_3 = number of observations on finished goods

x_1 = raw material

$\bar{x}_1$ = mean value of raw material

x_2 = work-in-process

$\bar{x}_2$ = mean value of work-in-process

x_3 = finished goods

$\bar{x}_3$ = mean value of finished goods

The Pooled Standard deviation is 85.27. Hence, it is established that industries have not been able to achieve the desired levels of efficiency in inventory management. Therefore, the hypothesis is rejected.

References

1. A. Morrison, 'Storage and Control of Stock : For Industry and Public Undertaking', Sir Isaac Pitman and Sons Ltd., London, 1967.

2. V. E. Ramamoorthy, 'Working Capital Management', Institute for Financial Management and Research, Madras, 1978.

3. Clenn A. Welsch and Robert N. Anthony, 'Fundamentals of Financial Accounting', Richard D. Irwin Inc., Illinois, 1981.

4. Love Stephen, 'Inventory Control', Mc Graw Hill Book Co., 1979.

5. H. Russel Beatty, 'Principles of Industrial Management', The Ronald Press, New York, 1951.

6. V. E. Ramamoorthy, Op. Cit.

7. Attila Chikan, 'The Economics and Management of Inventories' Part-I, Elsver Scientific Publishing Co., 1981.

8. Gupta L. C., 'The Changing Structure of Industrial Finance in India', Oxford University Press, London, 1975.

9. Hemlata Rao, 'Regional Disparities and Development in India' Ashish Publishing House, New Delhi, 1984.

10. Croxton and Cowndown, 'Indexing and Scheduling Methods', Quarterly Journal of Finance, University of Toronto, Canada, Dec. 1988.

11. S. Nagaratnam, 'Management Accounting : Financial Management and Holding Company Account', S. Chand and Co. Ltd., New Delhi, 1980.

12. Phelps Brown and Stanley, 'A Manual of Applied Statistics', Prentice Hall Publishing Co., N.J., 1989.