



PANEL DATA ANALYSIS ON RETAIL INVENTORY PRODUCTIVITY¹

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Abstract

Inventory is one of the most dynamic current assets in the retail industry due to its variability with time and across firms. The organized retail sector is in its nascent stage in India. This study tries to find out the important variable(s) that affect(s) inventory productivity in three selected Indian retail companies namely Pantaloon Retail India Limited, Trent limited and Shopper's Stop respectively. The gross margin return on investment (GMROI) has been regressed on inventory turnover, gross margin, size of the firm (last year sales), and capital intensity. Balanced panel data is used for conducting the analysis. The results indicate that all variables have a positive and significant impact on GMROI.

Keywords: Inventory, Inventory management, Panel data, Retail, Productivity analysis

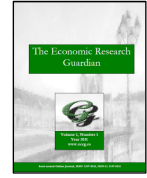
JEL classification: C33, G31, L81

1. Introduction

Inventory is the one of the most important elements of working capital management for any industry. Inventory consists of raw material; work in process and finished goods. The significance of managing inventory is a major concern in the modern management. A lot of studies have been conducted in this area in the past. The main strategy of any manufacturer and the seller in this era would be low cost or low price without compromising on the return i.e. margin. A manufacturer must manage the inventory in an efficient manner for achieving this low cost.

Inventory management means managing the inventory efficiently and effectively for ensuring the smooth flow of production and sales. Efficient management of inventory will ensure that there is no under or over investment in inventory. Just-In- Time, EOQ, ABC are the some of the tools that are used by the manufactures for managing the inventory. A manufacturer can use any of the available tools to manage the inventory but success can be achieved only with their effective implementation.

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Inventory productivity analysis will indicate how well an organization is managing its inventory. Productivity is indicating the return on investment. It depends on a lot of factors like gross margin, inventory turnover, the growth rate, size of the firm, location of the retail firm, the capital intensity, managerial efficiency and the macroeconomic factors etc. It is also influenced by working capital and the supply chain management.

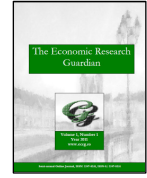
In retail sector, there is only one type of inventory namely finished products of different companies. Every retail organization will charge a fixed margin to the products and sell. Thus, the revenue of the retailer mainly depends on the inventory turnover. The more the retailer can turn over the inventory the more profit he will get.

In India, the organized retail sector is in its nascent stage and it is expected to grow tremendously in the coming years (KPMG, March 2009). However, in spite of these positive projections, some of the Indian retailers are not performing well and some of them have even become bankrupt. Thus, inventory management is very important in retail business because of its peculiar nature.

Improper management of inventory is one of the main reasons behind failures of some retail companies. Inventory is influenced by a number of factors, some of them are internal and some of them are external to the organizations. Thus, to entail an efficient inventory management system, the impact of these factors on inventory needs to be studied and analyzed. Hence, to understand more deeply about these factors, this study intends to analyze the factors affecting the inventory productivity of selected listed retail companies in India.

2. Literature review

Chen, Frank and Wu (2005) have studied about what is happening to the inventory level over a period of time. Is it reducing? What are reasons for the reduction in the inventory? It also checked whether the reduction of inventory is having any impact on the performance of the stock. The authors have found that inventory has reduced considerably over a period of time. Firms that were having abnormally high inventory showed a poor long term stock returns. Firms that were having low inventory showed ordinary returns. But the firms having an average inventory had shown good stock returns. Singh (2008) tried to resolve some of the queries related to the reduction of inventory cost in an Indian tractor manufacturing company. The main objective of the study was to suggest a suitable inventory control system to reduce the inventory cost and the safety stock level of the company. The author has come up with a new method combining ABC and XYZ for giving a minimum total inventory cost. Singh (2008) finds out the effects of inventory on working capital with the help of various ratios. It was conducted on two Indian fertilizer companies. The author compared the efficiency of inventory management between the two companies. The study also found that there is a significant relationship between inventory and working capital. Grablowsky (1984) highlighted the importance of inventory management. The author has compared the inventory management practices of small and large firms through a survey. It also mentioned the various tools generally used by small and large firms for managing the inventory. Finally the author has concluded that small business firms should also use some efficient (modern) inventory management techniques for better results. Guar, Fisher and Raman (2005) have measured the



performance of American retail firms regressing inventory turnover on gross margin, capital intensity, sales surprise (the ratio of actual sales to the expected sales). The model they had used was panel data fixed effect model. The authors found that capital intensity and sales surprise have shown a positive impact on inventory turnover. Gross margin has shown a negative impact on inventory turnover. Guar and Kesavan (2008) study is an extension of the study cited above. Further, it analyzed the impact of two additional variables i.e., firm size and sales growth rate on the inventory performance and the overall performance of the firms. The main purpose of the study was to found out the various factors that could affect the positive or negative relations with respect to size and sales growth rate with inventory turnover and provide evidence regarding the existence of economies of scale and scope in retailing as well as the effect of growth rate of firms on their inventory turnover performance. The variables in this study are statistically significant.

From the above literature has the following limitation like Chen, Frank and Wu (2005) concentrated only on analyzing the trend of inventory and check whether abnormal inventory contributed to long term stock returns. Singh (2008) took two Indian fertilizer companies to study the significance of inventory on working capital by using a Chi-square test. A t-test was more appropriate test for this purpose. Grablowsky (1984) has done only a descriptive analysis of the responses. Guar, Fisher and Raman (2005) studied the correlation of inventory turnover with gross margin, capital intensity and the sales surprise. For the estimation of parameters in the model, they have used MLE method by arguing that data may have first order auto correlation and heteroscedasticity, but they have not tested the data for the same.

Substantial work has been not done in retailing in Indian context. Presently, the organized retailing is growing and expected to have a significant growth in future (KPMG, March 2009). It is an extension of the study done by Guar, Fisher and Raman (2005) in Indian context with the inclusion of more variables and appropriate statistical tools.

GMROI is one of the most important tools used for analyzing the inventory productivity in the retail sector. It shows the return from each rupee investment in inventory. At the same time, it also shows the degree of inventory turnover and return on investment in inventory. In this study, gross margin return on investment has been used as an indicator of efficient inventory management.

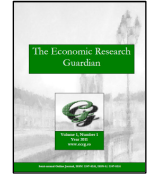
3. Methodology

3.1. Data description

The CMIE (Center for Monitoring Indian Economy) database has been used for collecting the financial data of public- listed Indian retail firms for 11 years ranging from 1999-2009. The data has been drawn from their annual income statement and balance sheet. The criteria used for selection of the companies' are:

- I) BSE listed retail companies and
- II) Data available for ten years continuously.

A total of seven companies are listed in BSE but the data is available only for three companies.



1. Pantaloon Retail India Limited: Pantaloon is one of the biggest retail chains with its presence across the country. It is having a wide network and operating under different names for different segments. Big Bazaar, Central, Future Bazaar, Brand Factory, Pantaloon, e zone, Home town are some of the stores operating under Pantaloon Retail India Limited.
2. Shoppers' stop: Shoppers stop is operating in major cities of India. It is mainly concentrating on apparels and accessories of ladies and gents.
3. Trent Limited: Tata enterprise is operating in most of the cities in India under the brand names of Westside, Landmark, Star bazaar and Trent. It deals with apparels, books, music CDs, footwear and leather items.

Based on the literature review, the following are the five variables that have been used in this study:

- I. Gross margin return on investment (GMROI) = $\text{Gross margin} / \text{Average inventory}$
- II. Gross margin, GM = $(\text{Sales} - \text{Cost of goods sold}) / \text{Sales}$
- III. Inventory turnover, IT = $\text{Cost of goods sold} / \text{Average inventory}$
- IV. Size of the firm, SZ = Last year sales
- V. Capital intensity, CI = $\text{Net fixed assets} / \text{Total assets}$

3.2. Formulation of hypothesis

Inventory turnover, (IT): Inventory turnover indicates the volume of sales happening in a year and the direction of performance. It measures how many times the inventory has turned to sales in a particular time period. High inventory turnover means the firm is getting more profit. Thus, the following hypothesis has been framed.

Hypothesis 1: Inventory turnover is positively correlated with gross margin return on investment.

Gross Margin, (GM): Gross Margin indicates the per unit margin of each item. It varies in terms of product and category. A product may have a high margin but low volume of sales whereas another product may have low margin but high volume of sales. Thus, gross margin is dependent on the total inventory in the store and its movement (i.e., inventory turnover). The literature review indicates a negative correlation between gross margin and inventory turnover. Higher inventory results in higher profit. Thus, the following hypothesis has been framed.

Hypothesis 2: Gross Margin is positively correlated to inventory turnover.

Capital Intensity, (CI): Capital Intensity is the long term investment made by retail companies in the form of opening new stores, latest technology, etc. An increase in capital investment is likely to result in higher inventory turnover. Hence the hypothesis will be:

Hypothesis 3: Higher Capital intensity increases inventory turnover.

Size of the firm, (SZ): Size of the firm can be measured on various parameters such as total assets, net assets; sales etc. Size denotes last year sales in this study. Assets have been avoided as the increase in total or net assets are already a part of capital intensity. Last year's sales are a good indicator to



predict current year's demand. Hence, last year's sales form the basis for current year's inventory. The higher the volume of sales, the faster is the inventory turnover expected.

Hypothesis 4: Inventory turnover of a firm has positive impact on size

3.3. Model

Data type: A balanced panel data has been used for the analysis. The data set that contains observations on different objects studied over a period of time is called panel data. It is the combination of cross-sectional data and time series data. The same time period is available for all cross-sections in balanced panel data

Model specification: The Panel Least Square method has been used to test the hypotheses

$$GMROI_{it} = F_i + C_t + b_1 IT_{it} + b_2 GM_{it} + b_3 SZ_{it} + b_4 CI_{it} + U_{it} \quad (1)$$

Here i is representing the firm and t is the time;

F_i is the firm specific fixed effect for firm i ;

C_t is the year specific fixed effect for the year t ;

b_1, b_2, b_3, b_4 are the coefficients of $IT_{it}, GM_{it}, SZ_{it}, CI_{it}$ respectively;

U_{it} indicate the error term for the observations of firm i in the year t ;

$GMROI_{it}$ is gross margin return on investment of firm i in the year t ;

GM_{it} gross margin of firm i in the year t ;

SZ_{it} size of the firm i in the year t ;

CI_{it} is the capital intensity of firm i in the year.

Firm specific fixed effects, F_i : Inventory productivity is also affected by many variables that are not included in this study such as location of the firm managerial efficiency, marketing strategy, accounting policies etc. The presence of these variables may create inconsistent estimates. Thus, for minimizing the effects of these omitted variables, the study is using firm specific control variables. There are two types of control variables: fixed effects and random effects. In this study, fixed effects variable have been used because random effects requires more number of cross-sections and it is possible to compare average inventory productivity across the firm over the period of time by fixed effects.

Year specific fixed effects, C_t : This variable takes care of the dynamics of macroeconomic variables such as interest rate, price level, inflation etc and enables the study to be conducted over a period of time.



4. Result and findings

4.1. Descriptive statistics analysis

Table 1 - Result of descriptive statistics

	CI	GM	GMROI	IT'
Mean	0.316451	0.406471	0.001928	4.176758
Median	0.291635	0.313037	0.000646	3.423193
Maximum	0.719889	1.196434	0.019614	8.859893
Minimum	0.121812	0.233211	2.32E-05	-1.083607
Std. Dev.	0.1585	0.209532	0.003918	2.19499
Skewness	0.850114	2.247478	3.525417	0.120956
Kurtosis	3.082178	8.231081	15.49509	2.886448
Jarque-Bera	3.621906	59.46103	257.3019	0.08927
Probability	0.163498	0	0	0.956347

It is evident from the table that std.dev. Of 'IT' is highest (2.88) among the set of the variables. GMROI is showing the lowest standard deviation. CI and IT' are normally distributed.

Table 2 - Result of covariance matrix

Variables	C	CI	IT'	SZ	GM
C	2.11E-06	-8.82E-07	-2.51E-07	6.59E-13	-1.92E-06
CI	-8.82E-07	1.30E-06	6.48E-08	9.85E-12	3.75E-07
IT'	-2.51E-07	6.48E-08	3.28E-08	-6.56E-13	2.37E-07
SZ	6.59E-13	9.85E-12	-6.56E-13	4.79E-16	-8.45E-12
GM	-1.92E-06	3.75E-07	2.37E-07	-8.45E-12	2.10E-06

Covariance matrix shows that the variables don not have high correlation. It implies that the possibility of multicollinearity does not exist.



4.2 Panel data regression (least square)

Using the panel least square method, the overall model has found to be statistically significant. All variables are having positive and significant impact on GMROI. Gross margin has highest impact on GMROI and size has the lowest impact on dependent variable.

Table 3 - Panel least square with fixed and random effects

Panel data models : dependent variable GMROI					
Independent variables	Model. 1	Model. 2	Model .3	Model. 4	Model. 5
	RE	FE	CS FE	Two Way FE	CS FE and P RE
IT	0.000379*** (5.050432)	0.000453*** (5.880308)	0.000475 (1.497167)	0.000615*** (3.393523)	0.000547*** (3.609463)
GM	0.023197*** (22.98908)	0.022894*** (21.40986)	0.027966*** (10.85477)	0.025876*** (17.83939)	0.027809*** (22.91207)
SZ	3.23E-08* (1.860131)	1.33E-07*** (5.369458)	-4.14E-08 (1.498515)	6.22E-08** 2.839700	-2.87E-08* (-2.049259)
CI	0.006940*** (7.457559)	0.007432*** (6.596370)	9.56E-05 (0.055122)	0.003784*** (3.324362)	0.000680 (0.790318)
constant	-0.011441*** (-12.23739)	-0.012289*** (-12.21731)	-0.011247*** (-4.369785)	-0.012667*** (-8.724286)	-0.011731*** (-9.591402)
Model summary					
R ²	0.889834	.988126	0.963543	0.995566	0.967896
F- test	50.48260***	102.4245***	101.3130***	209.5805***	115.5700***
Hausman test	129.075625***				70.863350***
Fixed effect-test		14.716737***	23.250639***	30.351978***	20.608583***
Companies included	3	3	3	3	3
Total panel observation	30	30	30	30	30
Notes: 1. The Hausman test has χ^2 distribution and tests the null hypothesis that unobservable individual effects are not correlated with the explanatory variables, against the null hypothesis of correlation between unobservable individual effects and the explanatory variables.					
2. The F test has normal distribution N(0,1) and tests the null hypothesis of insignificance as a whole of the estimated parameters, against the alternative hypothesis of significance as a whole of the estimated parameters.					
3. ***, **, and *denote significance at 1, 5 and 10 % level of significance respectively					
4. RE, FE, CS, P denotes Random effects , Fixed effects, Cross section, Period respectively					
Source: Authors calculation					



The study is unable to test the cross section random effect because random effect estimation requires number of cross section should be greater than number of coefficients for between estimators for estimate random effect. High R square in all the models shows that model have enough explanatory power and which is evident from The F- test of model fitness. Fixed effect F-test shows that cross sections as well as period specific fixed effect are significant.

In table 3 results of constant is negatively and GM is positively significant at one percent irrespective of the model. The result of Model 1 and Model 5 Hausman test show that fixed effect model is appropriate for the analysis. IT is positively significant at one percentage in all the case except Model 3. SZ is showing different result in different models for example: Model 1, Model 2 and Model 4 it is positively significant at 10%, 1% and 5% respectively, in case of Model 3 it is not showing significance and for Model 5 it negatively significant at 1%. CI is positively significant at 1% except Model 3 and Model 5 both cases it not showing significance. From the above result is evident that Model 4 is giving the best estimator comparing the other models.

5. Conclusion

This study is an attempt to look at the inventory productivity of selected retail companies. Inventory productivity cannot provide an accurate analysis of the performance of a firm but it will indicate the direction of the company's performance. The management of inventory is most important irrespective of small and large companies. The inventory productivity analysis highlighted that the productivity of inventory is dependent on several variables such as inventory turnover capital intensity, gross margin, size of the firm etc. Hence, efficient management of inventory requires an understanding of these variables and their effect.

The study can be extended by adding more number of companies, years and variables as well as different countries. Primary data can be also used to cross check and validate the study.

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