# Behavioural Analysis Of Inventory Turnover

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**Abstract:** The study involves the econometric analysis of the inventory behavior by investing the inventory turnover. The investigation lies on the sample set of 302 top notching blue chip manufacturing firms in India for the period 2011- 2018. The analysis starts with the basic estimation of the inventory proportion in the total and current assets. Followed by the panel data analysis of the inventory turnover ratio through the explanatory variables of the inventory like gross margin, capital intensity and sales. Finally, the variance decomposition is carried out to find the dominating determinant of the inventory returns. The log linear models are used for the estimation and the results shows that the inventory turnover is inversely correlated with the gross margin and positively correlated with the capital intensity and sales surprise.The variance decomposition involves segregating and finding the proportion of variation in the inventory turnover due to the industry specific effect, firm specific effect and year to year effect. Also, the reaction of the inventory turnover due to changes in the investment intensity and sales growth rate was also observed. Finally, by decomposing the variance as per the components defined, the highest variability in inventory is accounted by the firm specific effect. The model is applicable for the various different analysis to find the determinants and track the behavior.

**Index Terms:** Inventory turnover ratio, gross margin, sales growth, capital intensity, correlation, fixed effect and variance decomposition,

## 1 INTRODUCTION

helps in fulfilling some sales orders, even if the supply of raw-materials have stopped. Such inefficient inventory policy of an organization may lead to have an adverse effect on the overall production of the firm. Inventory in a manufacturing firm not only holds the finished goods, but also includes raw materials and work-in-progress. Inventory management entail the management of stocks of raw inputs, products in- progress inventories, finished product stocks, equipment's, spares required for the machineries, production supplies and maintenance supplies in general. In a birds' eye view, inventory management comprises not only the physical stocks required to run the production process or to manufacture the end product but all types of inventories required to run the business such as store, human resource, transport facility and cash management, etc. The inventory policy of a manufacturing firm must be in way not only to cut the cost or investment in the inventories but also it should be in a way to generate income or at least to save the unnecessary fund block up in the inventories. Every manufacturing firm must have sufficient stock of raw materials in order to have the regular and uninterrupted supply of materials for the production schedule. If there arise a situation, the raw material is out of stock at any stage of production process then the whole production may come to a half. This may result in custom dissatisfaction as the goods cannot be delivered in time more over the fixed cost will continue to be incurred even if there is no production. Work-in-progress is the next stage of the processed raw material before the stage of finished goods which enables the smooth run of the production process run.In most of manufacturing concerns the work in progress inventories are considered as a due course outcome of the process which does not involve a separate system and it also This in turn will have a series effect on the sales, income and end up with the impact on the profitability of the firm. The inventory policy of the firm must be designed in a way to manage the fluctuating market changes to meet the demand and supply gap. Inventories can be managed at different levels from the raw materials to finished goods in general and it also includes many different aspects other than this like spares, equipment's, maintenance and ancillary spares, cleaning materials which may be projected as low cost inventories but as a whole it accounts for a considerable percentage in the inventory accounts of a manufacturing firm. One more important thing to be considered in inventory management is the surplus and obsolete stocks. This shows a severe effect on the return on investment obtained from the inventory. The surplus and obsolete stocks should be monitored carefully and system must be devised to reduce the surplus to at most possible level, this would in turn may reduce the obsolete stocks. Once the surplus and obsolete stocks crossed the considerable level then the firm may suffer due to lack of liquidity. This can be avoided by converting the obsolete stocks to cash through reuse, recycle, using as a substitute product or sending to scrap at least. This would prevent the loss in advance to an extent. So all divisions of the inventory must be controlled in all stages of the production process of a manufacturing firm. This could be facilitated by various inventory models to monitor and control the inventory at various stages. Manufacturing industry has developed as one of the high development areas in India. The 'Make in India' program is propelled to give worldwide representation to the Indian economy by making India on the world guide as a manufacturing centre. India is relied upon to turn into the fifth biggest manufacturing nation on the planet before the finish of year 2020. The Gross Value Added (GVA) at essential current costs from the manufacturing segment in India developed at a CAGR of 4.34 percent during FY12 and FY18 according to the subsequent development appraisals of yearly national pay distributed by the Government of India. During April-September 2018, GVA from manufacturing at current costs became 14.8 percent year-on-year to Rs 138.99 trillion (US$ 198.05 billion). Under the Make in India activity, the GOI intends to build the manufacturing part to the total national


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output (Gross Domestic Product) from 16 percent to 25 percent by 2022, and also targets to reach 100 million new initiations by 2022. The Indian manufacturing business environment keep on staying positive. India is an alluring center point for outside interests in the assembling area. A few cell phone, extravagance and vehicle brands, among others, have set up or are hoping to build up their assembling bases in the nation. The assembling part of India can possibly reach US$ 1 trillion by 2025 and India is relied upon to rank among the best three development economies and assembling goal of the world constantly 2020. The execution of the Goods and Services Tax (GST) will make India a typical market with a GDP of US$ 2.5 trillion alongside a populace of 1.32 billion individuals, which will be a major draw for financial specialists. With stimulus on creating mechanical hallways and savvy urban areas, the administration expects to guarantee all-encompassing improvement of the country. The halls would additionally help with incorporating, observing and building up a favourable situation for the mechanical improvement and will advance development rehearses in assembling. This study involves analysis of the inventory management in the manufacturing firms in India. The manufacturing firms which are included in the Nifty 500 list is selected for the analysis because nifty indexed production companies are the top notches in the field where the analysis would sound good as it require more attention towards the inventory management and may also follow a good inventory policy. The econometric analysis is used for the tracking the determinants of the inventory behavior.

## 2 LITERATURE REVIEW

Literature review is frequently found toward the start of research articles. This is on the grounds that the literature review shows the peruse where the examination network is up to in inquiring about that theme and features holes in the current research. The examination article at that point tends to those holes through new research. It's somewhat similar to discovering bits of a jigsaw confound and assembling them. When they are assembled, you can see unmistakably where the missing pieces are and what they may resemble. You would then be able to go searching for the missing pieces. Specialists direct a literature review to distinguish the territories of a point that have not yet been investigated in detail. They at that point proceed to do the exploration to fill the examination hole. This is the manner by which analysts add to the improvement of information on that theme. **Karen Yin. K, Hu Liu, Neil E. Johnson (2002)**in the paper “Markovian inventory policy with application to the paper industry” formulated a solution procedure using Markov inventory policy for inventory planning. It is used to apply to solve the problem of inventory control of the finished goods. It involves obtaining the state space of the Markov chain, designating the possible decisions and actions, calculating the transition probabilities, defining the cost structure and evaluating the cost function, and determining the optimal policy. The results shows that Markovain decision process model is proved to be better than the convention models, in particular for the high variability exhibiting systems. The MDP proposed in this paper is stated as a good alternative to make decision where the forecasting alone is not sufficient. **Buzacott and Zhang (2004):** “Inventory Management with Asset-Based Financing” attempts to incorporate asset-based financing into production decisions. Takes various assets and liabilities like cash, receivables, inventories, borrowings loan, compared to find the financing opportunities. Focused on how asset-based financing affects operations decisions and establish how a lending decision is made based on a firm’s assets monitored by its balance sheet and associated accounts. It is clear from the analysis that banks are better off using asset-based financing with appropriately chosen parameters, while retailers are able to enhance their cash return over what it would be if the retailers only used their own capital. **Boute. R. N., Marc R. Lambrecht, Olivier Lambrechts and Peter Sterckx (2007)**Researches the degree of inventories held by Belgian organizations at one minute in time in their paper “An Analysis of Inventory turnover in the Belgian manufacturing industry, Wholesale, Retail and the financial impact of the inventory reduction”. Shows the differences in inventory ratio between manufacturing industry among wholesale and retail which results that the sort of generation process is the most significant driver for work in process stock. The completed products stock proportion likewise contrasts altogether among industry divisions, however here the purposes behind the distinction are more enthusiastically to recognize. At last the stock proportion as essentially higher in retail than in wholesale. Relapse investigations incompletely bolster the speculation of a negative connection between stock proportion and budgetary execution however huge outcomes couldn't be gotten for all segments. The discrete production process prompts a high stock proportion. Conversely the proceed with creation process brings about a low stock proportion. **Koumanakos. D. P. (2008),**in the research paper "The Effect of inventory management on firm performance", measured inventory’s impact on the firms performance is carried out by measuring gross margin, net operating margin and inventory days. Initial results, reveal that the higher the level of inventories stocked (departing from lean operations) by a firm, the lower its rate of returns, obtained by cross-section linear regressions. Additional testes are conduced by the use of pseudo-likelihood ratio test which constitutes a more reliable tool, thus verifying the robustness of the linearity of the relationship. **Robert Obermaier (2012**) in an article “German Inventory to sales ratios1971–2005—An empirical analysis of business practice” Inventory holding always costs money but is not always bad, because inventories do have benefits as well. Inventory to sales ratio of the firm is fragmented and evaluated separately such as, raw material to sales ratio, work in progress to sales ratio and finished goods to sales to assess the inventory’s relation to the sales. Hence, the notion ‘‘less inventory is better’’ will not be true in all cases. Suggests that a good inventory policy necessarily deals with trade-off decisions. **Himanshu Choudhary and Gaurav Tripathi (2012)** in their paper "An examination of stock turnover and its effect on monetary execution in Indian sorted out retail industry" survey the operational proficiency of the organizations in the Indian composed retail industry, communicated as far as stock days, and to research the effect of the stock days on the key budgetary markers. Information was gathered from three retailers Pantaloon Retail (India) Ltd., Shopper's Stop Ltd. furthermore, Trent Ltd for the period 2000-2010.these organizations are chosen as they are considered as market pioneers because of high piece of the overall industry. Fixed effect model and ANOVA, used to check the essentialness of contrasts in the stock holding time of the case organizations. Further, for investigating money related effect of stock holding

period, relapse examination is utilized. The outcomes propose huge contrasts in the stock places of organizations under examination. A converse relationship is seen between stock days and the money related execution proportions viable which is somewhat bolstered by the relapse work. Curiously, critical outcomes couldn't be acquired for every one of the organizations under examination. The discoveries have strategy suggestions as the measures could be actualized for improving the stock position and in this manner the money related execution by the retailers. **WU.X AND SARAH M. RYAN, (2014),** "Joint optimization of asset and inventory management in a product–service system", uses and integrated model with an objective to reduce the total cost of the system by formulating the couplings between two subsystems. Also presents an algorithm to optimize the inventory management policy and replacement policy jointly. **Sebastian Steinkera, Mario Peschb and Kai Hoberga (2016)** "Inventory management under financial distress: an empirical analysis" analysed firms on the quarterly basis for their performance. It uses the inventory days and Altmans' Z score consisting of working capital asset ratio, retained earnings asset ratio, EBIT asset ratio, equity value and sales asset ratio. Altmans' Z score is used to find the distressed firms. Suggests that inventory reduction is positively correlated with extreme asset reductions and cost cutting strategies in turnaround situations, but we generally argue that short-term inventory reductions are valuable strategic options in times of severe financial distress. Inventory adjustments are promising turnaround options because they provide cash inflows and likely increase the efficiency of a distressed firm's supply chain. Distressed firms are advised to evaluate their inventory performance so that they can exploit these benefits, which may increase their odds of a business turnaround. **Elsayedn. K, HayamWahba (2016)** made a study on the topic "Reexamining the relationship between inventory management and firm performance: An organizational life cycle perspective", the organizational lifecycle is examined based on the Dividend, sales growth ratio, fixed asset ratio and age of the firm. Statistical tests like ANOVA and Kruskal wallis are carried out in accordance with ROA, ROE, inventory days, size and leverage of the firm.The results of this study demonstrate that the concept of organizational lifecycle has implications for inventory decisions, as organizational lifecycle may affect the relationship between inventory management and organization performance. It is believed that this is novel theoretical and empirical evidence that has significant implications for understanding of the inventory-performance literature. **Ambati (2016)**studied the components of inventory in selected companies and analyse the inventory conversion period in selected companies and explained in "Inventory Management in Paper Industry: A Comparative Study in SPML AND International paper" that inventories constitute about 50 to 60 per cent of current assets, the management of inventories is crucial for successful working capital management. Working Capital requirements are influenced by inventory holding. **Ndivhuwo Nemtajela & Charles Mbohwa (2017)** analysed "Relationship between inventory management and uncertain demand for fast moving consumer goods organisations" through the questionnaire method. The questionnaire involves collecting data with respect to demand and its impact on inventory system in the firms and the results insists that improper inventory management will result in unsatisfied demands, organisations will either have very high or very low on hand, and this will result in the decline of the organisation. Demand uncertainty have effects on inventory management by agreeing to the statement, there is a strong positive effect between these variables hence the higher the uncertainty on demand the more difficult and challenging of holding stock in an organisation. The organisations should consider implementation of effective demand and forecasting techniques. It is important to any organisation's success and growth to understand the calculations of safety stock in order to cover risk of stock-outs. **Gokhale. P. P, Megha B Kaloji (2018)** from their study named, "A Study on Inventory Management and Its Impact on Profitability in Foundry Industry at Belagavi, Karnataka" stated that the inventory management is practical field of accounting and production that covers the proficient and viable utilization of crude materials and extras which are expended in delivering the completed merchandise in assembling concern. A firm overlooking the administration of inventories will imperil its since quite a while ago run gainfulness and may bomb at last. The decrease in 'over the top' inventories conveys a good effect on an organization's benefit. **Rohitha Goonatilake & Sofia C. Maldonado (2018**) discussed the "Essentials of Novel Inventor Management Systems" where stated that a successful inventory management guided by the formulating of deterministic, stochastic, and probabilistic models is necessary in particular. Suggested the availability of continued growth of technology and modernized computerization of inventory data (and records) processing together with rapid growth in scientific inventory management systems will benefit all concerned, the general public, and more importantly, the manufacturers and retailers. **Atnafu. D and Assefa Balda(2018)**made a study on "The impact of inventory management practice on firms' competitiveness and organizational performance: Empirical evidence from micro and small enterprises in Ethiopia", This paper provides empirical justification for a framework that identifies five key dimensions of inventory management practices using the factor analysis and describes the relationship among inventory management practices, competitive advantage, and organizational performance on the basis of Tucker-Lewis Index. The results indicate that healthy competitive advantage and improved organizational performance can be obtained through higher levels of inventory management practices. In India the research on the inventory behaviour is carried out at different levels like (1) models for determining optimum inventory policies, (2) lot size optimization, (3) optimization of various specific management objectives, (4) models for optimizing highly specialized inventory situations, and (5) application of advanced mathematical theories to inventory problems. Still there remains many gaps to be filled for the models bridging the gap between theory and practice by the quantitative analysis of actual economic phenomena based on the concurrent development of theory and observation, related by appropriate methods of inference for the NIFTY 500 which represents the top 500 companies based on full market capitalisation and average daily turnover from the eligible universe for finding the areas and methods to enhance the firms inventory behaviour over a period. Inventories have generally been the most difficult asset to be managed both for merchandising and manufacturing firms. Inventory management incorporates purchasing, financing and selling policies which involves many conflicting functional objectives like minimizing the inventory level is contradictory to the goal of minimizing the probability of

inventory shortage as marketing manager desires to control the desirable inventory level, and also minimizing the total inventory cost, to attain optimization by overcoming the opportunity cost of overstocking and understocking.The inventory tracking and management is most import aspect to influence the purchasing, financing and selling policies of an organization. This study gives the brief information about the inventory behaviour ofmanufacturing firms indexed in Nifty 500 and analyses the inventory behaviour of the manufacturing companies of Nifty 500 index in India. This is aided by finding the factors that determine inventory behaviour and affect their performance using a large sample of Nifty indexed firms operating in the period 2011–2018 finding its variance of the inventory returns between the years across the firms, within the firms and among the segments involving a better treatment to give deep insight on the inventory behaviour.

## 3 DATA DESCRIPTION

TABLE 1

MANUFACTURING SECTORS AND NUMBER OF FIRMS IN THE SAMPLE

| SECTOR DESCRIPTION | ORIGINAL SAMPLE | FINAL SAMPLE |
|---|---|---|
| Automobile | 30 | 27 |
| Cement & cement products | 15 | 14 |
| Chemicals | 18 | 16 |
| Construction | 31 | 28 |
| Consumer goods | 75 | 62 |
| Energy | 35 | 29 |
| Fertilizers& pesticides | 10 | 10 |
| Financial services | 92 | 0 |
| Health care | 8 | 4 |
| Industrial manufacturing | 42 | 40 |
| IT | 27 | 0 |
| Media & entertainment | 12 | 0 |
| Metals | 20 | 19 |
| Paper | 1 | 1 |
| Pharma | 38 | 35 |
| Services | 27 | 0 |
| Telecom | 6 | 4 |
| Textiles | 13 | 13 |
| **TOTAL** | **500** | **302** |

The study analyses the financial data of a manufacturing firms operating over the years 2011–2018, where the secondary data are obtained from CMIE Prowess IQ, annual balance sheets and income statements of the companies. The Nifty 500 index comprises of 500 firms belonging to 18 sectors according to the industry classification code among which 14 are manufacturing and manufacturing related sectors selected for the study. Out of which many firms are excluded for several reasons firms belonging to service sector, media and entertainment, financial services, IT sector (mergers, acquisitions, bankruptcy, etc) and had missing data. Finally, obtained a balanced panel dataset of 302 firms under analysis are shown in Table 1. Considering our models are log linear, zero values in the variables cannot be used as denominators or in logarithms. So, all the zero values is replaced with small non zero number but this may create outliers. Presence of outliers may cause problems in estimation like ratios, so winsorization of the data is followed. The following variables are used for the estimation process of the study using the above described data.

Inventory turnover ratio (ITR) at year (T), is the ratio of the difference between the cost of goods sold (CGS) to inventories (INV) at year (T):

$$ITR_T = \frac{CGS_T - Depreciation_T}{INV_T}$$

The relation between the cost of goods sold and inventory can be explained, in the initial period inventory plus net purchases represents the goods available for the sale. The value/ cost of these goods are accounted in the balance sheet. Once these inventories are sold, then cost of goods sold flows into the income statement. So, before sales the cost of goods will be recorded as future expenses in the balance sheet and as already realized cost in the income statement.

Capital Intensity (CI) at year (T), is the ratio of the net fixed asset (NFA) to the inventories (INV) plus net fixed asset (NFA) at year (T):

$$CI_T = \frac{NFA_T}{NFA_T + INV_T}$$

Gross margin (GM) at year (T), is the ratio of the difference between the sales at year (T) and the cost of goods sold (CGS) at T to the sales at year (T):

$$GM_T = \frac{Sales_T - CGS_T}{Sales_T}$$

Introducing a new variable sales surprise (SS) which is an explanatory variable for the inventory turnover. Sales surprise is the ratio of the actual sales to the anticipated sales. The anticipated sales is not publicly available, we calculate the anticipated sales from the historical sales data. For the sales forecast we use Holt's Linear Exponential Smoothing method. The sales forecast for the year T is

$$\text{Sales forecast}_T = \text{Level}_T + \text{Trend}_T$$

Where, $\text{Level}_T = \alpha * \text{sales}_T + (1-\alpha)(\text{Level}_{T-1} + \text{Trend}_{T-1})$

$\text{Trend}_T = \beta(\text{Level}_T - \text{Level}_{T-1}) + (1-\beta)\text{Trend}_{T-1}$

$\alpha, \beta \{\alpha, \beta \in [0, 1]\}$ are constants. The sales surprise (SS) is obtained from,

$$SS_T = \frac{Sales_T}{\text{Sales forecast}_T}$$

Sales forecast rely on the historical data, so there is a possibility that our estimate may not correspond to the manager's estimate as the information available to us not as with the managers. Using SS as the explanatory variable for the inventory turnover in the model is considerable. So, we opt for sales growth rate (sales surprise proxy). The sales growth rate can be estimated as,

$$\text{Sales growth rate } SGR_T = \frac{Sales_T - Sales_{T-1}}{Sales_{T-1}}$$

The sales growth rate is adjusted to avoid the negative values as follows,

$$SGR_T = \frac{Sales_T}{Sales_{T-1}}$$

The impact of the sales growth rate changes to the inventory turnover in sales – decline region and sales increased region is tested by introducing a new variable, CENSGR. It takes values as follows;

$$CENSGR_T = \begin{cases} 0, & \text{if } \log SGR < 0 \\ \log SGR_T, & \text{if } \log SGR > 0 \end{cases}$$

The two regions of the sales growth ration (SGR) can be distinguished by considering the variables SGR and CENSGR.

1. Sales decline region, where $\log SGR_T < 0 \rightarrow SGR_T < 1 \rightarrow Sales_T < Sales_{T-1}$
2. Sales increased region, where $\log SGR_T > 0 \rightarrow SGR_T > 1 \rightarrow Sales_T > Sales_{T-1}$

TABLE 2

MEAN, MEDIAN AND STANDARD DEVIATION OF COMPONENTS OF CURRENT ASSETS BY SECTOR

| Industry | Inventories to total asset | | | Inventories to current assets | | | cash & cash equivalents to CA | | | Receivables to current assets | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.D | Median | Mean | S.D | Median | Mean | S.D | Median | Mean | S.D | Median |
| 1 | 0.119 | 0.116 | 0.057 | 0.291 | 0.134 | 0.292 | 0.099 | 0.127 | 0.046 | 0.343 | 0.152 | 0.357 |
| 2 | 0.076 | 0.022 | 0.074 | 0.245 | 0.432 | 0.099 | 0.138 | 0.141 | 0.075 | 0.020 | 0.096 | 0.009 |
| 3 | 0.118 | 0.063 | 0.111 | 0.582 | 0.345 | 0.581 | 0.063 | 0.085 | 0.036 | 0.024 | 0.078 | 0.022 |
| 4 | 0.176 | 0.168 | 0.154 | 8.261 | 16.748 | 3.103 | 0.141 | 0.213 | 0.047 | 0.320 | 1.557 | 0.380 |
| 5 | 0.219 | 0.142 | 0.190 | 1.753 | 5.656 | 0.457 | 0.132 | 0.157 | 0.061 | 0.012 | 0.018 | 0.002 |
| 6 | 0.071 | 0.092 | 0.026 | 0.492 | 1.095 | 0.182 | 0.243 | 0.224 | 0.185 | 0.020 | 0.588 | 0.010 |
| 7 | 0.147 | 0.062 | 0.148 | 1.335 | 0.891 | 1.174 | 0.057 | 0.090 | 0.023 | 0.015 | 0.101 | 0.033 |
| 8 | 0.028 | 0.019 | 0.027 | 0.650 | 0.635 | 0.328 | 0.101 | 0.095 | 0.081 | 0.016 | 0.049 | 0.003 |
| 9 | 0.160 | 0.094 | 0.143 | 1.858 | 2.319 | 1.012 | 0.132 | 0.161 | 0.060 | 0.033 | 0.433 | 0.018 |
| 10 | 0.106 | 0.079 | 0.090 | 0.566 | 0.943 | 0.274 | 0.213 | 0.338 | 0.056 | 0.021 | 0.022 | 0.010 |
| 11 | 0.085 | 0.014 | 0.083 | 0.115 | 0.091 | 0.080 | 0.650 | 0.071 | 0.032 | 0.016 | 0.040 | 0.010 |
| 12 | 0.125 | 0.116 | 0.064 | 0.909 | 1.036 | 0.601 | 0.168 | 0.205 | 0.074 | 0.004 | 0.018 | 0.001 |
| 13 | 0.047 | 0.043 | 0.027 | 2.401 | 3.685 | 0.999 | 0.053 | 0.041 | 0.044 | 0.058 | 0.233 | 0.025 |
| 14 | 0.242 | 0.132 | 0.192 | 1.128 | 1.593 | 0.468 | 0.057 | 0.053 | 0.038 | 0.060 | 0.188 | 0.017 |

Table 2 shows the summary of inventories and other components in accordance with the total and current assets. For the Indian blue-chip companies, inventories represent on average 12.3% of the total assets and 47% of the currents assets. Remaining of the current assets are accounted by cash & cash equivalents and accounts receivables. Cash& cash equivalents shows up 16% of the currents assets and receivables represents 6%.

TABLE 3

DESCRIPTIVE STATISTICS FOR INVENTORY TURNOVER RATIO, CAPITAL INTENSITY AND GROSS MARGIN.

| Industry | Capital Intencity (CI) | | | Gross Margin (GM) | | | Inventory Turnover Ratio(ITR) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.D | Median | Mean | S.D | Median | Mean | S.D | Median |
| 1 | 0.720 | 0.101 | 0.733 | 0.217 | 0.469 | 0.253 | 10.478 | 13.728 | 7.371 |
| 2 | 0.840 | 0.062 | 0.852 | 0.487 | 0.085 | 0.512 | 4.747 | 1.984 | 3.99 |
| 3 | 0.737 | 0.135 | 0.751 | 0.303 | 0.074 | 0.290 | 6.098 | 2.756 | 5.365 |
| 4 | 0.417 | 0.316 | 0.427 | 0.294 | 0.189 | 0.294 | 50.368 | 303.597 | 3.717 |
| 5 | 0.525 | 0.214 | 0.561 | 0.325 | 0.177 | 0.319 | 6.433 | 8.615 | 4.248 |
| 6 | 0.836 | 0.193 | 0.932 | 0.323 | 0.195 | 0.282 | 17.76 | 40.533 | 8.666 |
| 7 | 0.611 | 0.170 | 0.633 | 0.238 | 0.122 | 0.245 | 5.263 | 3.459 | 4.208 |
| 8 | 0.908 | 0.042 | 0.900 | 0.358 | 0.193 | 0.377 | 27.366 | 30.603 | 10.983 |
| 9 | 0.564 | 0.181 | 0.595 | 0.26 | 0.080 | 0.263 | 5.351 | 3.209 | 4.783 |
| 10 | 0.736 | 0.157 | 0.762 | 0.334 | 0.183 | 0.285 | 4.847 | 3.820 | 3.534 |
| 11 | 0.861 | 0.038 | 0.871 | 0.292 | 0.051 | 0.287 | 5.402 | 0.692 | 5.236 |
| 12 | 0.637 | 0.163 | 0.663 | 0.364 | 0.103 | 0.368 | 2.994 | 2.800 | 3.440 |
| 13 | 0.798 | 0.232 | 0.880 | 0.227 | 0.131 | 0.243 | 2647.09 | 6732.86 | 8.853 |
| 14 | 0.532 | 0.243 | 0.574 | 0.279 | 0.136 | 0.258 | 3.132 | 1.459 | 3.250 |

The descriptive statistics of ITR, CI and GM by the industry is shown in Table 3. The inventory turnover ratio ranges from 2.99 for pharma sector to 50.37 for the construction sector. But exceptionally high inventory turnover ratio is observed for telecom sector because of the inventory nature.

TABLE 4

THE CORRELATION MATRIX OF THE VARIABLES

| | *ITR* | *GM* | *CI* | *SS* | *SGR* |
|---|---|---|---|---|---|
| ITR | 1 | | | | |
| GM | -0.01869 | 1 | | | |
| CI | 0.078201 | 0.057684 | 1 | | |
| SS | -0.00549 | 0.02541 | -0.02702 | 1 | |
| SGR | -0.0019 | -0.00503 | 0.000506 | -0.00622 | 1 |

Table 4 shows the correlation among the variables used in the model. The variables are inventory turnover ratio, gross margin, capital intensity, sales surprise and sales growth rate. The inventory turnover ratio is inversely correlated with the gross margin, sales surprise and sales growth rate

# 4 ECONOMETRIC ANALYSIS

To track the behavioural performance of the inventory, the log linear model is used to analyse the models. The model is as follows,

$$\log ITR_T = F_f + C_T + b_{1,i} \log GM_{ifT} + b_{2,i} \log CI_{ifT} + b_{3,i} \log SS_{ifT} + E_{ifT} \quad (1)$$

where f represents the firm, i represents the industry to which the firm belongs and T represents the year. The dependents variable log $ITR_T$ represents the log of inventory turnover ratio of the firm f of the industry I at the year T. The independent variables are log GM, log CI and log SS represents the log of gross margin, capital intensity and sales surprise of the firm f of the industry i at the year T. The error term $E_{ifT}$is the disturbances that vary across the firms, $F_f$, $C_T$refers the unobservable effects of the firm, where $F_f$ varies across firms but constant over time and $C_T$varies over time but constant across the firms. The parameter bi refers the coefficient of estimation which vary among the industries. The above model (1) is tested to find the statistical significance using the regression analysis.

$$\log ITR_T = F_f + C_T + b_1 \log GM_{ifT} + b_2 \log CI_{ifT} + b_3 \log SS_{ifT} + E_{ifT} \quad (2)$$

F- test is carried out for each of the explanatory variables to test the null hypothesis of the parameters.

There is a chance of multicollinearity between the gross margin and the capital intensity, as the functions of the cost of goods sold and the inventories. So, having the dependent variable as log ITR in the model (1) and (2) we can restructure the model to have dependent variable as log INV and the cost of goods sold [log CGS] as independent variable representing the model (3)

$$\log INV_{ifT} = F_f + C_T + b_{1,i} \log GM_{ifT} + b_{2,i} \log CI_{ifT} + b_{3,i} \log SS_{ifT} + b_{4,i} \log CGS_{ifT} + E_{ifT} \quad (3)$$

The model (1) and (2) are estimated by using the sales surprise variable, but we use an alternative forecast variable for sales surprise. Sales growth rate SGR is used instead of the sales surprise SS for addressing the differences in the forecasted sales data with that of the manager's data.

$$\log ITR_T = F_f + C_T + b_1 \log GM_{ifT} + b_2 \log CI_{ifT} + b_3 \log SGR_{ifT} + b_4 CENSGR_{ifT} + E_{ifT} \quad (4)$$

The independent variables are correlated with the firm-specific effects in our data set. Thus, fixed effects estimation is more appropriate than random effects estimation because if the true model has individual-specific effects correlated with the regressors, then a random effect process yields inconsistent estimates (Mundlak, 1978).

TABLE 5

PERIODIC FIXED AND CROSS SECTION EFFECTS SIGNIFICANCE TEST

| Model 2 | | | |
|---|---|---|---|
| **Effects test** | **Statistics** | **df** | **Prob.** |
| period F | 1.85118 | (111,2297) | 0.000 |
| period Chi -square | 206.650389 | 111 | 0.000 |
| cross-section F | 31.85631 | (3,2297) | 0.000 |
| cross-section Chi-square | 15.365682 | 3 | 0.0015 |

The Hausman test is used find the presence of the fixed effects. The test statistics leads to the rejection of the null hypothesis which means, the firm specific effects are uncorrelated with the independent variables and ensuring the

presence of fixed effects. The true model is tested for the significance. The coefficients of the cross-section dummies are equal to zero (Table 5). With F- statistics 31.85 with 3, 2297 degree of freedom, so reject the null hypothesis.

TABLE 6

EXPLANATORY VARIABLES OF EQUALITY TESTS

| Model 1 | F-statistics | df | Prob. |
|---|---|---|---|
| log SS | 2.006588 | (132399) | 0.017 |
| log GM | 16.305 | (132401) | 0.000 |
| log CI | 64.08713 | (132402) | 0.000 |

At the Table 6 the equality between the coefficients for each of the variables across the industry is presented using the F – statistics value. The null hypothesis is rejected for all the three variables. The variance decomposition analysis is used by considering Ff, CT as random effects rather than fixed effects. This is because the individual effects are treated as fixed and different, no way of getting meaningful estimates unless having large set of data. We view that time, firm specific and industry specific effects as random variable which may differ from firm to firm, from time to time and from industry to industry.

## 5 RESULTS

The estimated results are presented in the Table 7 – Table 12. The table 7 and 8 shows the estimates from the model (1) and (2).

TABLE 7

COEFFICIENT ESTIMATION OF MODEL (1)

| Model 1 Dependent variable : log ITR | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Industry | log GM | | | log SS | | | log CI | | |
| | Coef. | Std. Er | p value | Coef. | Std. Er | p Value | Coef. | Std. Er | p Value |
| 1 | -0.529 | 0.136 | 0.000 | 1.235 | 0.348 | 0.000 | -0.109 | 0.126 | 0.385 |
| 2 | -1.114 | 0.169 | 0.000 | -0.162 | 0.089 | 0.071 | 1.218 | 0.437 | 0.006 |
| 3 | -0.044 | 0.143 | 0.760 | -0.097 | 0.098 | 0.325 | 0.948 | 0.173 | 0.000 |
| 4 | -1.423 | 0.131 | 0.000 | -0.121 | 0.110 | 0.276 | 0.967 | 0.056 | 0.000 |
| 5 | -0.474 | 0.049 | 0.000 | 0.059 | 0.065 | 0.367 | 0.502 | 0.049 | 0.000 |
| 6 | -0.948 | 0.090 | 0.000 | 0.108 | 0.127 | 0.396 | 0.963 | 0.205 | 0.000 |
| 7 | 0.014 | 0.169 | 0.935 | 0.182 | 0.152 | 0.234 | 0.796 | 0.175 | 0.000 |
| 8 | -0.564 | 0.095 | 0.000 | 0.157 | 0.158 | 0.329 | 9.212 | 1.755 | 0.000 |
| 9 | -0.168 | 0.077 | 0.029 | -0.253 | 0.046 | 0.000 | 1.212 | 0.063 | 0.000 |
| 10 | 0.010 | 0.084 | 0.901 | -0.063 | 0.085 | 0.463 | 1.111 | 0.167 | 0.000 |
| 11 | 0.601 | 0.388 | 0.196 | 0.422 | 0.319 | 0.256 | 0.963 | 1.660 | 0.593 |
| 12 | -0.601 | 0.084 | 0.469 | 0.104 | 0.064 | 0.102 | 0.217 | 0.076 | 0.005 |
| 13 | 0.250 | 0.668 | 0.711 | -0.970 | 0.561 | 0.095 | 2.983 | 1.311 | 0.031 |
| 14 | -0.027 | 0.112 | 0.811 | -0.358 | 0.112 | 0.002 | 0.699 | 0.084 | 0.000 |

### 1. Inventory turnover ratio is inversely correlated with gross margin

Out of 14 industries under study, 10 industry's coefficient of gross margin in model (1) is negative. Among those 10 industries having negative coefficient, six are statistically significant ($p < 0.001$). The industries with the positive coefficient of gross margin are statistically insignificant. The gross margin coefficient margin lies between the range -0.02 and 0.2 and the negative elasticity of gross margin coefficient is between -0.02 and -0.9. This negative correlation shows that the firms must trade off the gross margin with the inventory turnover to obtain returns from the inventory investments. If the inventory turnover is lower than the targeted given gross margin level, then it is an alarm for the management of the inefficiency.

### 2. Inventory turnover ratio is positively correlated with sales surprise

Out of 14 industries under study, 7 industry's coefficient of sales surprise in model (1) is negative. Among those 7 industries having negative coefficient, six industries are statistically insignificant ($p > 0.001$). The industries with the positive coefficient of sales surprise, except one all are statistically insignificant. When the sales surprise ratio is low, it reduces the inventory turnover resulting in overbought situation unless the overstocked condition is corrected. This lowers the gross margin further reduces the inventory turnover. If the situation prevailing is understocking, where the sales surprise is high further increasing the inventory turnover.

### 3. Inventory turnover ratio is positively correlated with capital intensity

The coefficient of capital intensity in model (1) is found to be positive for thirteen industries out of fourteen. Among the 13 industries having positive coefficient, nine industries are statistically significant. The industry with negative coefficient is statistically insignificant. The healthcare industry is having relatively highest coefficient of capital intensity than other industries (Table 7). This shows the importance of investments in that industry. The healthcare industry may experience increased inventory availability in relation with the reduced stock outs, where they can carry less buffer stocks. Thus, lower the inventory level lower investment in inventory and higher the inventory turnover. Despite the safety stocks holding, inaccurate forecast may shows impacts like opportunity cost, out of pocket, loss of customer good will and reduced performance at inventory level.

TABLE 8

COEFFICIENT ESTIMATION OF MODEL (2)

| Model 2 Dependent variable: log ITR | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Industry | log GM | | | log CI | | | log SGR | | |
| | Coef. | Std. Er | p Value | Coef. | Std. Er | p Value | Coef. | Std. Er | p Value |
| 1 | -0.533 | 0.137 | 0.000 | 1.214 | 0.349 | 0.001 | 0.014 | 0.134 | 0.915 |
| 2 | -1.104 | 0.173 | 0.000 | 1.404 | 0.434 | 0.002 | 0.046 | 0.236 | 0.844 |
| 3 | -0.025 | 0.143 | 0.862 | 0.924 | 0.171 | 0.000 | 0.270 | 0.229 | 0.241 |
| 4 | -1.327 | 0.128 | 0.000 | 0.963 | 0.057 | 0.000 | 0.226 | 0.251 | 0.369 |
| 5 | -0.477 | 0.048 | 0.000 | 0.513 | 0.049 | 0.000 | 0.335 | 0.173 | 0.053 |
| 6 | -0.932 | 0.089 | 0.000 | 0.957 | 0.205 | 0.000 | -0.206 | 0.332 | 0.535 |
| 7 | 0.108 | 0.171 | 0.529 | 0.837 | 0.173 | 0.000 | 0.172 | 0.310 | 0.581 |
| 8 | -0.515 | 0.082 | 0.000 | 9.410 | 1.552 | 0.000 | -1.409 | 0.474 | 0.006 |
| 9 | -0.184 | 0.081 | 0.024 | 1.210 | 0.066 | 0.000 | 0.122 | 0.122 | 0.318 |
| 10 | 0.043 | 0.082 | 0.602 | 1.107 | 0.161 | 0.000 | 0.405 | 0.130 | 0.002 |
| 11 | 0.189 | 0.440 | 0.689 | -0.533 | 1.473 | 0.736 | -0.275 | 1.296 | 0.842 |
| 12 | -0.082 | 0.084 | 0.331 | 0.202 | 0.076 | 0.009 | 0.254 | 0.148 | 0.087 |
| 13 | 0.168 | 0.709 | 0.815 | 3.281 | 1.400 | 0.027 | 0.106 | 1471.000 | 0.943 |
| 14 | -0.200 | 0.108 | 0.851 | 0.819 | 0.078 | 0.000 | 0.971 | 0.236 | 0.000 |

The model (2) (Table 8) is the obtained by restructuring the model (1) by replacing the sales surprise with sales growth rate which results in slight variation with the results of the model (1). The inventory turnover is inversely correlated with gross margin and statistically significant. The impact of capital intensity on inventory turnover ratio is positive and statistically significant. The impact on inventory turnover due to the sales growth rate is positive as per the coefficient estimation of model (2) (Table 8).

TABLE 9
COEFFICIENT ESTIMATION OF MODEL (3)

| Model 3 | Dependent variable | | | log INV | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Industry | log GM | | | log CI | | | log SGR | | | log CGS | | |
| | Coef. | Std. Er | p Value | Coef. | Std. Er | p Value | Coef. | Std. Er | p Value | Coef. | Std. Er | p Value |
| 1 | -0.008 | 0.123 | 0.947 | -1.628 | 0.240 | 0.000 | -0.013 | 0.091 | 0.888 | 0.928 | 0.029 | 0.000 |
| 2 | 0.952 | 0.168 | 0.000 | -1.264 | 0.420 | 0.003 | -0.085 | 0.228 | 0.710 | 1.081 | 0.034 | 0.000 |
| 3 | 0.002 | 0.145 | 0.988 | -0.918 | 0.184 | 0.000 | -0.199 | 0.234 | 0.397 | 1.063 | 0.050 | 0.000 |
| 4 | 0.915 | 0.141 | 0.000 | -0.879 | 0.055 | 0.000 | -0.210 | 0.236 | 0.928 | 0.698 | 0.060 | 0.000 |
| 5 | 0.431 | 0.048 | 0.000 | -0.576 | 0.049 | 0.000 | -0.304 | 0.169 | 0.072 | 0.887 | 0.025 | 0.000 |
| 6 | 0.669 | 0.088 | 0.000 | -1.183 | 0.176 | 0.000 | 0.187 | 0.280 | 0.504 | 1.088 | 0.031 | 0.000 |
| 7 | -0.305 | 0.137 | 0.029 | -0.813 | 0.135 | 0.000 | -0.284 | 0.242 | 0.246 | 0.623 | 0.057 | 0.000 |
| 8 | 0.657 | 0.079 | 0.000 | -7.879 | 1.339 | 0.000 | 1.477 | 0.386 | 0.001 | 1.142 | 0.037 | 0.000 |
| 9 | 0.161 | 0.081 | 0.048 | -1.269 | 0.070 | 0.000 | -0.109 | 0.119 | 0.361 | 0.954 | 0.034 | 0.000 |
| 10 | 0.121 | 0.720 | 0.093 | -1.598 | 0.142 | 0.000 | -0.484 | 0.108 | 0.000 | 1.207 | 0.026 | 0.000 |
| 11 | -0.853 | 0.534 | 0.208 | -1.511 | 1.627 | 0.422 | -0.480 | 1.136 | 0.701 | 1.740 | 0.418 | 0.025 |
| 12 | 0.181 | 0.078 | 0.020 | -0.196 | 0.069 | 0.005 | -0.176 | 0.134 | 0.189 | 1.190 | 0.024 | 0.000 |
| 13 | -0.002 | 0.305 | 0.995 | -1.290 | 0.630 | 0.051 | -0.013 | 0.632 | 0.984 | -0.786 | 0.156 | 0.000 |
| 14 | 0.009 | 0.120 | 0.939 | -0.634 | 0.109 | 0.000 | -0.962 | 0.244 | 0.000 | 0.759 | 0.058 | 0.000 |

| Model 3 | Dependent variable | | | log INV | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Industry | log GM | | | log SS | | | log CI | | | log CGS | | |
| | Coef. | Std. Er | p Value | Coef. | Std. Er | p Value | Coef. | Std. Er | p Value | Coef. | Std. Er | p Value |
| 1 | -0.008 | 0.124 | 0.947 | -0.004 | 0.088 | 0.961 | -1.625 | 0.239 | 0.000 | 0.928 | 0.030 | 0.000 |
| 2 | 0.971 | 0.161 | 0.000 | 0.240 | 0.088 | 0.007 | -0.979 | 0.417 | 0.021 | 1.106 | 0.034 | 0.000 |
| 3 | 0.036 | 0.143 | 0.803 | 0.224 | 0.112 | 0.047 | -0.899 | 0.181 | 0.000 | 1.125 | 0.055 | 0.000 |
| 4 | 1.012 | 0.149 | 0.000 | 0.063 | 0.105 | 0.551 | -0.899 | 0.056 | 0.000 | 0.723 | 0.061 | 0.000 |
| 5 | 0.423 | 0.048 | 0.000 | -0.095 | 0.064 | 0.141 | -0.567 | 0.049 | 0.000 | 0.881 | 0.025 | 0.000 |
| 6 | 0.686 | 0.088 | 0.000 | -0.109 | 0.107 | 0.310 | -1.189 | 0.176 | 0.000 | 1.088 | 0.031 | 0.000 |
| 7 | -0.213 | 0.137 | 0.124 | -0.103 | 0.120 | 0.396 | -0.792 | 0.138 | 0.000 | 0.633 | 0.058 | 0.000 |
| 8 | 0.674 | 0.098 | 0.000 | -0.026 | 0.149 | 0.863 | -7.616 | 1.702 | 0.000 | 1.132 | 0.048 | 0.000 |
| 9 | 0.179 | 0.077 | 0.021 | 0.250 | 0.047 | 0.000 | -1.224 | 0.067 | 0.000 | 1.013 | 0.034 | 0.000 |
| 10 | 0.166 | 0.075 | 0.028 | 0.196 | 0.073 | 0.009 | -1.591 | 0.148 | 0.000 | 1.212 | 0.028 | 0.000 |
| 11 | -0.710 | 0.374 | 0.153 | 0.599 | 0.853 | 0.533 | -1.444 | 1.557 | 0.422 | 2.377 | 1.069 | 0.113 |
| 12 | 0.187 | 0.079 | 0.018 | 0.057 | 0.061 | 0.355 | -0.196 | 0.070 | 0.005 | 1.199 | 0.025 | 0.000 |
| 13 | 0.075 | 0.276 | 0.788 | -0.625 | 0.267 | 0.027 | -1.237 | 0.562 | 0.037 | -0.977 | 0.163 | 0.000 |
| 14 | 0.102 | 0.128 | 0.430 | 0.426 | 0.141 | 0.003 | -0.637 | 0.113 | 0.000 | 0.871 | 0.073 | 0.000 |

The table 9 consists the coefficient estimation of the model (3). The results interpretation of the model (3) coefficient is same as the model (1) and (2). The new independent variables are introduced in the model (3). The new variables are log CGS and the dependent variable in the log INV. It is the log the inventories of the firm at the year T.

TABLE 10

COEFFICIENT ESTIMATION OF MODEL (4)

| Model 4 | Dependent variable | | log ITR | |
|---|---|---|---|---|
| Independent variables | coefficients | Std. Er | t-Stat | Prob. |
| log GM | -0.677 | 0.021 | -20.228 | 0.000 |
| log CI | 0.863 | 0.025 | 34.056 | 0.000 |
| log SGR | 0.694 | 0.163 | 4.254 | 0.000 |
| CENSGR | -0.712 | 0.203 | -3.509 | 0.000 |

In Table 10 shows the estimation of model (4). The log SGR coefficient in the Table 10, shows the impact on the inventory turnover due to the sales growth rate. It is positive and statistically significant. The coefficient of SGR is 0.694, this refers that SGR accounts for 69.4% changes in the inventory turnover. In depth, 1% change in SGR results in the 69.4% changes in the inventory turnover. Similarly, the changes in the capital intensity impacts inventory turnover by 86%. In table 11 shows the variance decomposition with respect to variation across the firms, across industry and between years. The table 11 gives the estimation of variance observed across the firms, across industries and between years. It also gives the proportion of variance accounted by them in the total variance. The industry and firm effects are positive and significant. The proportion of the variance accounted across the firms is 83. 50% and across the industries is 17.10%. The contribution of the year to year variation effect id very less of 0.2%.

TABLE 11

VARIANCE DECOMPOSITION ESTIMATION

| **Model 5** | **Dependent variable: log ITR** | |
|---|---|---|
| **Independent variables** | **coefficients** | **Std. Er** |
| Intercept | -0.545 | 0.01 |
| | | |
| **variance** | **Estimates** | **Std. Er** |
| variance between years | 0.308 | 0.081 |
| variance across industries | 2.07 | 0.584 |
| variance across firms | 0.011 | 0.002 |
| | | |
| **Proportion of variance** | | |
| variance between years | 0.20% | |
| variance across industries | 17.10% | |
| variance across firms | 83.50% | |

## 6 CONCLUSION

This paper attempts to explain the determinants of the inventory turnover. This study was conducted with the sample of financial data of 302 firms in India for the period 2011 – 2018. From the panel data analysis, it is found that the inventory turnover ratio is negatively correlated with the gross margin and positively correlated with the sales surprise and capital intensity. The inventory reacts more to the changes in the sales. To deeply record the proportion of variance due to the industry effects, firm effects and year to year effects. The highest variability is due to the firms effect. Moreover, the impact on the inventory turnover due to the industry specific effect must also be considered as it accounts for a considerable percentage of variation as the determinants of inventory turnover. The inventory performance behaviour can be improved by using the results obtained. This will be helpful in finding the methods of improvement and the areas of applications. This study will be helpful for the managers' to make financial decisions based on the inventory. In particular it accounts for the inventory investment decision as the capital intensity holds higher variation proportion of the inventory returns. This model is flexible enough to be used for the analysis of longer periodic series data, or introduce many new variables. This improvement flexibility makes the model reliable and applicable in various aspects of financial and operational management.

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