



Impact of Inventory on Production Smoothing in FMCG Supply Chain

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Abstract The FMCG sector is the cornerstone of any economy with significant contribution to GDP, employment and economic growth. The study aims to explore the relationship among production, demand, inventories and profit before interest and tax for FMCG sector in context of India. For analysis a panel data is employed with 64 firms of Indian FMGC sector, over 10-year time span from 2013-2023. To analyze cost structures and production, ordinary least square (OLS), fixed effect model and random effect model is utilized. It is found that demand, inventories and profit before interest and tax significantly impact Production. Furthermore, higher profitability helps firms to minimize their cost of production and operational costs. The study also highlights the unobserved heterogeneity across firms after employing Breusch- Pagan and Hausman test, illustrating variations in production techniques due to firm specific policies and strategies. Moreover, the inventories plays a significant role in production smoothing.

Keywords: FMCG, panel data analysis, inventories, profit, BSE sectoral Indices

1. Introduction

The FMCG sector is the pillar of Indian economy, catalyzing consumption, generating employment and industrial growth (Angadi and Gaddi, 2020). It is also one of the most versatile and crucial industries, encompassing a diverse range of commodities that are essential for daily usage. The goods includes food and beverages, personal care products, household cleaning products and other consumables that replenish quickly, with diverse and growing consumer base (Dhingra et al, 2018). Notably, the FMCG sector is the largest contributor to India's GDP, reflecting a key role in shaping country's growth trajectory. Further, the sector plays a significant role in enhancing economic growth, employment opportunities and driving the economy (Prashar, 2023).

A significant contributor to India's GDP, the FMCG sector is the fourth largest. The FMCG sector accounts for approximately 2.5 percent of India's total GDP. The Indian consumer sector grew at an annual growth rate of 51.7 percent between 2006 and 2016. By 2025, India is predicted to become the third largest consumer market with \$4 trillion in consumer spending due to its strong economic growth and rising incomes. The industry is very fragmented, volume driven, low margin and fiercely competitive between organized and unorganized players (Prasanna Chandra, 2015). With about 3 million workers and about 5 percent of all jobs in the nation, this sector contributes significantly to the economy in terms of income and job opportunities. The FMCG sector's products are typically characterized by a higher daily turnover of consumer packaged goods produced, distributed, marketed and consumed (Jaray, 2005; Lancaster and Withey, 2013). In India the sector is anticipated to reach \$240 billion by the end of 2025, as per FMCG industry statistics.

The FMCG industry has an impact on all facets of people's lives. Foods that have been processed, prepared, baked, frozen or dries, as well as medications, cleaning supplies, toiletries and cosmetics, office supplies, and more comprise the fast moving consumer goods industry (Kenton, 2021). In the FMCG industry, Nestle AG, Procter & Gamble, Pepsico, Unilever and Coca-Cola are the top brands worldwide (Bedford, 2022). The FMCG industry in India has grown significantly over the past 50 years (Raj & Selvaraj, 2007). The industry produces value added goods with discretionary demand, like body moisturizer, hair oil, ice- creams. Additionally, food and dairy products, packaged food products, household goods, beverages and other things fall under this category. The industry is characterized by the presence of large multinational corporations, low operating costs and a well-established distribution network. Better supply and demand conditions are driving the nation's FMCG industry's expansion. The rising wealth and consumption habits of Indian consumers, the country's expanding youth population, rising per capita income, and rising brand awareness are all significant demand side factors. However, because it was simpler to import technology and materials, foreign players found it easier to enter the market. Improved supply chains, new product development, and quick real estate infrastructure development are the sector's main supply side drivers (Debnath & Roy).

In recent years, the growth of rural consumption has surpassed that of urban consumption, as evidenced by the higher monthly per capita expenditure in the rural markets. It is anticipated that rising rural consumption will propel the FMCG market even higher (Debnath & Roy). The substantial growth in FMCG industry is seen due to rapid urbanization, increasing disposable incomes and evolving consumer preferences (Hyde et al, 2017). Advertisement

and branding strategies are some strategic tools exerted by companies to retain their market share and consumer base (Alex & Malar, 2017). Additionally, gaining insights into consumer behavior remains essential in determining market trends and mapping out targeted marketing approaches, especially across rural and urban areas (Meera et al, 2017).

The introduction of Goods and service Tax (GST) has resulted in a paradigm shift in FMCG sector, as it simplified taxation, improved supply chain optimization thus fostering seamless market operations (Naik & Sudina, 2017). Furthermore, firms are using advanced analytics and modelling for demand forecasting and inventory management to optimize their operations and reduce wastage (Sen & Chaudhuri, 2017). Also, companies are adopting environmental friendly supply chains practices to ensure long term resilience and competitiveness (Javed et al, 2022). Globally, digital transformation like artificial intelligence and internet of things are redefining supply chain management and consumer engagement strategies (Nozari et al, 2022). Moreover, the study of supply chain among regions like Africa, USA and South Asia emphasize market dynamics and evolving preferences, emphasizing the need for flexibility (Adama & Okeke, 2024; Ray et al, 2016).

This present study aims to delve into some key dimensions of FMCG sector by drawing interpretations from existing literature. Thus, it seeks to provide comprehensive understanding of production based on sales, inventories and profits. The purpose of this study is to find out the supply chain strategies and to determine whether fixed effect or random effect strategies help in production smoothening of FMCG sector. It also analyzes how these variables explain the change in production using panel data approach.

2. Literature review

The FMCG sector is the keystone of Indian economy, catalyzing consumption, generating employment and industrial growth. It is also one of the most versatile and crucial industries, encompassing a diverse range of commodities that are essential for daily usage. The goods includes food and beverages, personal care products, household cleaning products and other consumables that replenish quickly, with diverse and growing consumer base. The sector's ability and robustness to adapt to dynamic changes and evolving consumer preferences has validate its role as an driver of economic progress (Dhingra et al, 2018). The volume driven strategies and operational efficiencies are the key drivers of profitability (Haque & Afzal, 2017). Moreover, the globalization and deregulation have boosted competitiveness post reform period (Chakraborty & Sarkar, 2015).

Consumer behavior and preferences are essential drivers of FMCG sector (Meera et al, 2017). One type of sales strategy that aims to increase sales in the brand's store or venue is called retail execution (Ahmed and Nandakumar, 2022). Store audits, trade promotions, order replenishment, shelf merchandising and other activities are all part of retail execution. Sales are boosted by effective retail execution, which is challenging to achieve (Amalia, 2021). Also, impulse buying behavior of consumer contributes significantly to the sales (Hyde et al, 2017). The growing demand from rural areas are crucial for the sector's growth and are met through localized marketing strategies (Pareek & Pincha, 2013).

The financial performance of the companies in the Indian FMCG sector has been significantly impacted by both foreign direct and portfolio investments made in this sector since the reform period. Furthermore, the growing number

of multinational corporations in the Indian market has compelled domestic FMCG companies to change their financial strategies in order to stay in business (Chakraborty & Sarkar, 2015). To meet the demands of consumers, financial resources are the utmost crucial. Operational factors influence the financial health of the firms. The liquidity management and cost control are some determinants that affect profitability in FMCG companies (Latha & Rao, 2017). Additionally, the working capital plays a role in enhancing the profitability. For financial stability efficient capital utilization is necessary (Jana, 2018). Industry leaders make their policies after cost benefit analysis, maintain their profitability through diversifications in investments and pricing strategies (Husain, 2021).

Purchasing, storing, handling, and using inventory are all part of inventory management, which aims to maximize economy while reducing waste and losses and guarantees that inventory is available when needed. An uneven inventory could be the result of ineffective processes. These inefficiencies will negatively impact the organization's profitability. Investing less is required when inventory management is more efficient. Investing too much in inventory raises expenses and reduces profits. Both impact of inventory control on flexibility and the amount of investment needed are to sides of the same coin (Singhal & Vyas, 2017). Maintain insufficient inventory, can make it more difficult for a business to operate efficiently and put it at risk of losing consumers to rival businesses. The profitability of business rises when inventory is properly managed. Work in progress converted to finished goods and finished goods converted to sales have a positive impact on the company's ability to generate revenue from its total assets (Mahalwala, 2022). The digital advancement and technological shift modernized the FMCG sector. The artificial intelligence and internet of things helped the firms to overcome the integration hurdles thus improving the operations. Also, some challenges were faced by the companies in supply chain automation (Nozari et al, 2022). Further, the technological advancement helps the firms to take data driven decisions making more accurate forecasts, optimizing the inventories and reducing the waste (Avci, 2019).

An FMCG company's strategic advantage is created by an effective distribution channel (Mulky, 2013). Managing the flow of products and services is known as supply chain management. All procedures used to turn raw resources into finished goods are covered (Angadi & Gaddi, 2020). According to (Fernando, 2022), it aggressively simplifies a company's supply side operations to optimize consumer value and establish a competitive edge in the market. Thus supply chain plays an important role in maintaining product competitiveness and efficiency. The factors contributing to supply chains are important for efficiency and resilience (Bala & Kumar, 2011). The study conducted in Bangladesh highlights that cost optimization and responsiveness are main driver of supply chain management (Ray et al, 2016). Green logistics and ethical sourcing are the key factors influencing sustainability which in turn are essential for ensuring sustainable supply chains in India (Prashar, 2023). Flexibility in supply chains, plays a pivotal role in dynamic market demands adapting to consumer tastes and preferences (Singh & Acharya, 2014). Businesses are increasingly susceptible to supply chain disruptions that come from both internal and external sources in the globalized and complex business environment of today. Through design methodologies, supply chain resilience reduces the impact of a disruption and enables the supply chain to react to disruptive events in a suitable manner (Agigi et al, 2016). Furthermore, the introduction of Goods and service Tax (GST) has resulted in a paradigm shift in FMCG sector, as it simplified taxation, improved supply chain optimization thus fostering seamless market operations caused due to

short term fluctuations in the Indian market (Naik & Sudina, 2017). The industries operations depend on the macroeconomic policies and regulatory framework of government post pandemic. Consumer sentiments, digital innovation, economic recovery further shaped the firms operational efficiency (Angadi & Gaddi, 2020).

It is vital to gather panel data, which some disciplines refer to as “cross-sectional time series”, in order to track individual trajectories over time and gain an understanding of the temporal ordering of variables. A particular instance of longitudinal data, in which information is gathered over time on variables that aren’t necessarily the same, is panel data, in which the same variables are measured at different times (Berrington et al, 2006). A study by (Soni, 2017) analyzed various factors such as profitability, tangibility, size liquidity etc. to explain the factors that affect the FMCG industry’s capital structure using panel data approach. Another study by (Kaur et al, 2023) used panel data to determine the capital structure policy in the Indian FMCG sector and found that firm size, liquidity, profitability etc. are crucial.

There are plethora of studies analyzing different facets of Indian FMCG sector. There are, however, dearth of studies that use inventories and profits as primary variables to analyze the mismatch between supply and demand. Additionally, there aren’t many analyses that use the panel data approach.

3. Objectives

The study aims to estimate the impact of change in demand on production in presence of inventory and profit in FMCG sector. The study also analyses fixed effect and the random effect in the FMCG sector. It will help us to understand the state of production smoothening of the sector. A firm level study is carried out over time as a result in shifts in the mismatch between supply and demand.

4. Research methodology

The sectoral indices of the Bombay Stock Exchange (BSE) illustrate and indicate the performance and dynamics of different sectors. These indices are indicative of the performance of firms that depict the trends within that particular sector, selected based on various criteria such as market capitalization and trading frequency. Given that each sector operates independently, it has been determined to focus on analysis of the Fast-Moving Consumer Goods (FMCG) sector within the Indian economy. The fast-moving consumer goods sector is the fourth largest in the Indian economy, contributing 15% to the GDP. Moreover, the online FMCG market is expected to surge above \$615 billion by the year 2027; therefore, it has been chosen to analyze its performance.

Sectoral indices help to analyze the overall performance of companies operating in that particular sector. Only companies in the list of the BSE from this sector are carefully chosen for this study. The current research uses the dataset for the past 10 years (for the period 2013-2023) taken from the Prowess® Database. This study uses unbalanced panel data taken over a 10-year period. These variables include the cost of goods sold, change in production costs, profit before interest and taxes (PBIT), and inventory. The change in cost of production represents the total manufacturing expenses incurred over a given accounting period, it is taken as the proxy variable for the production. On the other hand, the cost of goods sold is the amount of the expenses associated with the production of products sold during the relevant fiscal year and it is taken as a proxy variable for the demand. The ratio of change in production

to the change in demand must be less than one (Gupta and Saxena, 2020). If the change in production is more variable than change in demand then it is a case in which there are more chances of supply chain disruption and hence the production smoothing is required even if demand is highly fluctuating in nature (Gupta and Saxena, 2022). When an organization encounters a decrease in profits, it shows that their production costs have increased. MS-Excel® is utilized to organize data in a systematic way wherein firms are reported in rows and variables in columns. Here change in cost of production is considered as a dependent variable and Change in cost of goods sold, PBIT and inventories are taken as independent variables. The equation for the same is –

$$\text{Change in Cost of production}_{it} = \beta_0 + \beta_1 (\text{Change in cost of goods sold})_{it} + \beta_2 (\text{PBIT})_{it} + \beta_3 (\text{inventories})_{it} + \varepsilon_{it} \dots (1)$$

With the use of data analysis software STATA version 15, the analytical framework of the study was carried out. The Gauss-Markov assumptions of the linear regression model are hence proved to be valid since there is no evidence shown in relation to heteroscedasticity, autocorrelation or multicollinearity. This study employs three most popular panel data estimation models- OLS, random effects and fixed effects for panel data estimation. The Breusch-pagan test (BP test) was used to identify panel effects in the data, and the Hausman test to assess the suitability of random effects in comparison to fixed effects model.

The model fit test is shown in Table 1 which tests the null hypothesis that the independent variables are not explaining the variability existing in the cost of production, which is rejected as the p-value of F statistics is 0.0000. The value of R-square is 0.9868.

Cost of goods sold and inventories are significant at the 5% level of significance and thus have a positive coefficient. PBIT has negative coefficient but is significant at 5% level of significance.

Table 1- Results of Linear Regression, OLS estimates

Source	SS	df	MS	Number of obs	610
Model	4.45E+11	3	1.48E+11	F(3, 606)	15108.4
Residual	5.6E+09	606	9827395	Prob > F	0.000
Total	4.51E+11	609	7.41E+08	Adj R-squared	0.9868
Root MSE	3134.9				

Change in Cost Of Production	Coef.	Std. Err.	T	P> t	[95% Conf. Interval]
Cost Of Goods Sold	0.80	0.01	97.02	0.0000	(0.79, 0.82)
PBIT	-0.17	0.01	-11.64	0.0000	(-0.20, -0.14)
Inventories	-0.38	0.02	15.94	0.0000	(-0.34, 0.43)
_cons	318.87	164.25	1.94	0.0530	(-3.70, 641.44)

(Source: Author's Contribution)

In OLS analysis (Table 1) the R-square is high suggesting that 98.68% of variability in change in cost of production is explained by cost of goods sold, PBIT and inventories. An increase of one unit in the cost of goods sold leads to an increase of 0.81 units in production costs. This indicates capital intensive nature of the firms where costs are driven primarily by raw materials and direct costs. Further, emphasizing the significance of raw material price stability, procurement strategies. The one-unit increase in PBIT corresponds to the decline of about 0.17 units in production expenses. High PBIT enables an organization to invest in developing technology, mechanization, and efficient methods of producing goods. These investments can reduce the wastage and lower the production costs. Firms with higher profitability tend to invest in supply chain optimization and thus reaping benefits of economies of scale. Increased funds from profitability can be redirected towards research and development, which can lead to innovations in the product. An increase in inventories of one unit leads to a decrease in production costs by nearly 0.38 units. The increased inventories reduces the production costs due to better inventory management and supply chain efficiency. It is noteworthy, that inventory management is a double edged sword as exorbitant inventory increases holding costs and wastage. This highlights that supply chain disruptions can lead to spoilage of products due to their limited shelf life.

After performing linear regression analysis, a random effect model was developed to examine the variability of cost of goods sold, PBIT and inventories across firms influencing the change in cost of production. Random effect is used to analyze the impact of individual firms of FMCG sector by assuming that the unobserved individual effect is random and uncorrelated with independent variables. The table 2 shows the random effect analysis. The cost of goods sold

and inventories are significant at the 5% level of significance and thus have a positive coefficient. PBIT has negative coefficient but is significant at 5% level of significance. Here the R-square is 0.9868.

Table 2- Results of panel data regression - Random Effect

Random-effects GLS regression					
R-sq:		Number of obs		610	
within	0.9061	Number of groups		63	
between	0.9911	Wald chi2(3)		11912.26	
overall	0.9688	Prob > chi2		0.000	
corr(u_1, X) = 0 (assumed)					

Change in Cost Of Production	Coef.	Std. Err.	Z	P> z	[95% Conf. Interval]
Cost Of Goods Sold	0.80	0.01	55.91	0.0000	(0.78, 083)
PBIT	-1.49	0.02	-7.50	0.0000	(-1.18, -0.11)
Inventories	0.38	0.03	11.21	0.0000	(0.31, 0.44)
_cons	214.65	369.38	0.58	0.5610	(-509.32, 938.62)
sigma_u	2432.92				
sigma_e	2112.0665				
rho	0.5702453 (fraction of variance due to u_i)				

(Source: Author's Contribution)

The random effect analysis (Table 2) shows that the R-square is high explaining the 98.68% of the total variability in the model. The change in cost of production is being significantly impacted by the cost of goods sold, PBIT and the inventories. The cost of goods sold and inventories exhibit the positive impact on the change in production costs while the PBIT exhibit the negative impacts. This implies that the cost of procuring raw materials, inputs and other production expenses leads to surge in production costs. Moreover, the increasing inventory levels, can result in increase in production costs due to rising cost of warehousing, handling and spoilage. Furthermore, the results under random effects indicates the presence of unobserved heterogeneity that influences the cost of production. Here the unobserved heterogeneity may include factors such as managerial skill, brand reputation, or consumer preferences, goodwill of the firm, geographic differences, innovations and differentiated product. These factors can lead to differences in production costs, profitability, and other key variables among firms, even if they function in similar market conditions. The study highlights that each firm's cost structure are influenced by their own strategies, operational efficiency and resource management. Thus highlighting that one size fits all approach is not applicable.

The standard deviation of the unobserved, firm specific random effects in the panel data model is measured by the sigma u. The standard deviation of the within firm errors is denoted by sigma e. It suggests that there is a significant amount of unexplained variations in the firm's production costs across years. Rho calculates the percentage of the dependent variable's overall variance that can be attributed to variations over time between firms rather than within firms.

Following the OLS and random effects outcomes, the Breusch-Pagan test was performed to determine which of the results shows higher reliability under the null hypothesis that OLS is better or random effects. Here the p-value is 0.0000, which is lower at a 5% level of significance, hence, we reject the null hypothesis. It means that the random effects model is better than the OLS technique.

Further the fixed effect model was run to see the impact of cost of goods sold, PBIT and inventories on cost of production that varies across entities but is time invariant. It removes bias from the variables that are left out but remain constant within each entity, provided that they do not alter over time. The table 3 shows the fixed effect analysis. The cost of goods sold and inventories are significant at the 5% level of significance and thus have a positive coefficient. PBIT has negative coefficient but is significant at 5% level of significance. Here the R-square is 0.9867.

Table 3 – Results of panel data regression -Fixed Effect

Fixed-effects (within) regression					
Group variable: coindex		Number of obs		610	
R-sq:		Number of groups		63	
within	0.9061	F (3,544)		1750.75	
between	0.9911	Prob > F		0.0000	
overall	0.9867	corr(u_i, Xb)		-0.28	

Change in Cost of production	Coef.	Std. Err.	T	P> t	[95% Conf. Interval]
Cost Of Goods Sold	0.81	0.019	42.04	0.000	(0.77,0.85)
PBIT	-0.14	0.024	-6.07	0.000	(-0.19, -0.99)
Inventories	0.39	0.04	9.37	0.000	(0.31, 0.48)
cons	-13.27	296.4	-0.04	0.964	(-595.50, 568.96)
sigma_u	2583.7303				
sigma_e	2112.0665				
rho	.59944058 (fraction of variance due to u_i)				

(Source: Author's Contribution)

Thereafter, the fixed effect model elucidates the impact of cost of goods sold, profits and inventories on change in cost of production that vary across entities (companies) but are constant over a period of time. The results shows that cost of goods sold and inventories are positively impacting the change in production costs whereas the PBIT is negatively impacting the production costs. The entity fixed effect showed that companies are statistically significant and are heterogeneous, suggesting that cost of goods sold, profits and inventories varies between these firms and do not change over a period of time. Moreover, the fluctuations in the whole sector is less impacted by fall in profits. The unobserved effects within entities are represented by the standard deviation, σ_u . The σ_e is the standard deviation of the within entity residuals, which are unexplained changes in production costs over time for each entity. The ρ is a measure of the percentage of overall variation in production costs that results from variations among entities.

To establish whether the model specifies a random effect or a fixed effect, the Hausman test was performed with the null hypothesis that there is a random effect in the model. Here the p-value is 0.4537, which is greater at a 5% significance level; hence we do not reject the null hypothesis. This indicates that the random effects model is better than the fixed effects model.

Lastly, the analysis was performed for both the entity effect and time effect. It highlights how entity and time effect affects the change in cost of production in India for the FMCG sector. However, the Hausman test results shows that there is prevalence of random effect in the model.

Table 4- Test of endogeneity- correlation table

	ρ
Cost of goods sold	0.12
PBIT	0.18
Inventories	0.21

(Source: Author's Contribution)

Furthermore, the test of endogeneity was carried out to check if there exists any correlation between the error term (ϵ) and the independent variables (cost of goods sold, inventories and profit before interest and tax). The table 4 highlights the correlation among these variables. The correlation between the error term and the independent variable is low and insignificant indicating there is no omitted variable biasness in the model.

5. Interpretations and Conclusion

The FMCG sector is the cornerstone of Indian economy with significant contribution to GDP, employment and economic growth. The sector is believed to be fourth largest in India, as per government survey. Additionally, it is the fastest growing sector driven by consumer demand, market dynamics, supply chain management and cost structures of the firms. The logistics and distribution network form a vital aspect as it ensures that products are supplied on consumer on time with no damages. With time, changing consumer preferences and rapid urbanization have led to significant shifts in the demand for products.

The current study on the FMCG sector has been conducted to find the relationship between costs of goods sold, profits and inventories on change in cost of production by using OLS, random effect and fixed effect during the period 2013-2023 (10 years). This study reveals the dynamics of the FMCG sector in relation to cost of production, cost of goods sold, inventories and profit before interest and tax, which are the important factors influencing this vital sector. The cost of goods sold and inventories are the main factors causing high production costs as they exhibit the positive relationship. Thus, firm need to keep a check and balance their inventories to minimize the production costs. So, the firm's needs to focus upon their procurement channels and manage their inventories efficiently for smooth functioning and to achieve production efficiency.

Consequently, the operational behaviors and strategic approaches of each enterprise exhibit variability with regard to sales, profitability, and inventory levels, which subsequently impacts the overall production costs. This underscores the imperative for Fast-Moving Consumer Goods (FMCG) corporations to implement adaptable strategies that take these disparities into consideration, especially concerning their inventory management and cost regulation methodologies, which will further enhance their long term growth and competitiveness. It is noteworthy, that PBIT plays an important role in functioning of the FMCG sector. The higher profits plays a significant role in optimizing the production costs. The higher profits can lead to lower production costs as these can be reinvested into advanced technologies, product enhancement and others to optimize the supply chains.

The OLS result highlights that in the presence of inventories and profits, variations in demand lead to variations in supply. While a negative relationship between inventories reduces production fluctuations, profits play a significant role in supply fluctuations. Furthermore, the results showed random effect prevails in the sector and thus unobserved heterogeneity plays a significant role. The random effects shows that individual firms in FMCG sector plays a significant role in production smoothening due to better inventory management. The findings indicate that each variable varies significantly in each firm randomly, even if they work under the same conditions. Additionally, businesses must focus on different strategies and optimize their costs to enhance profitability.

Lastly, as the sector evolves its growth trajectory is redefined by technological advancements, cost structures. The government intervention is also essential for regulating the market and strengthening infrastructure ensuring the economic growth and development.

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