
Internet of Things – Panacea for the Bullwhip Effect

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Keywords:

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Bullwhip effect,
supply chain,
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Abstract

The Indian retail industry is at a critical stage of evolution. The industry is undergoing a metamorphosis and interesting outcomes may be witnessed in the future. The share of organized retail in India's total retail trade is a miniscule. The Global Research Development Index (GRDI) has rated India as the hottest destination for foreign investments in the retail sector.

One of the biggest challenges that retailers face is the debilitating impact of the bullwhip effect (BWE). BWE refers to the exaggeration and over amplification of consumer demand as one moves up the supply chain. It must be noted that the base level of demand is less important to retail operations compared to fluctuations in demand.

Internet of Things is a network of physical objects that can communicate to each other through sensor technology and the Machine-to-Machine (M2M) communication. IoT is a game changer for the retail industry that affords greater insights and tools for business transformation. When integrated with big data, business analytics and cloud computing, IoT has the potential to overcome the BWE, which is the biggest meltdown, factor in the retail world.

This paper seeks to understand the impact of IoT in mitigating the effects of the bullwhip effect.

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Introduction

India is reckoned a very attractive destination for FDI in retail industry on account of many factors, forces and features. Growing urbanization, increasing purchasing power of the middle classes and a marked change in consumer tastes and preferences are cited as the chief reasons for this marketplace attractiveness. As demonstrated by Exhibit 3, the personal disposable income of Indians has registered a significant growth. Further, AT Kearney's Global Retail Report 2015 (Exhibit4) states that Indian consumption is increasingly oriented to brand consciousness especially of the global genre. The sheer market size of India coupled with the fact that India is recording the highest growth rate globally in its GDP is making it a fertile destination for FDI in retail sector.

Internet of Things

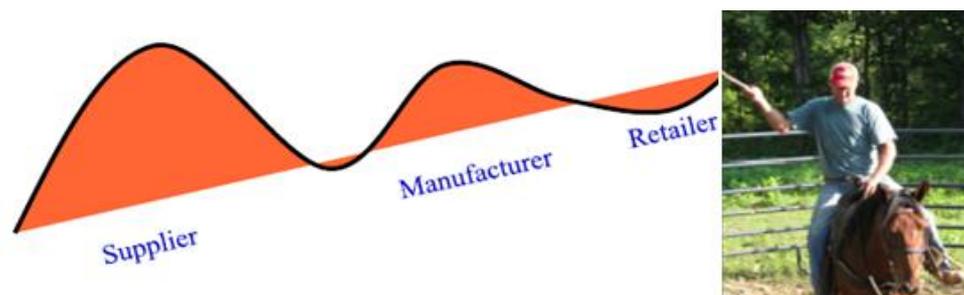
The Internet of Things (IoT) is the network of physical objects that contain embedded technology to communicate and sense or interact with each other. Basically, IoT establishes connectivity between the objects in the physical world and the computer networks. This connectivity enables computer systems and software controlling tangible physical objects like industrial equipment, electricity distribution networks, and others. The end result is greater accuracy, efficiency and enhanced productivity in day to day operations.

According to Gartner Inc., around 4.1 billion objects would stay connected in 2015 (30% more than 2014) and will reach 50 billion by 2020. These devices would go beyond PCs, smart phones, tablets and include objects like alarm clocks to air coolers to washing machines to cars and almost every machine. Basically IoT is poised to create a virtual network of objects – both human and non-human that will generate and use data.

Introduction to BWE

The Bullwhip Effect (BWE) refers to the exaggeration and over amplification of consumer demand as one move up the supply chain. Historically, Procter and Gamble is credited with usage of this term for the first time. It must be noted that the base level of demand is less important to retail operations compared to fluctuations in demand. For the sake of simplicity, we adopt the RWDP model of the supply chain. RWDP stands for Retailers, Wholesalers, Distributors and Producers. BWE implies that a 4% increase in consumer demand as it is projected on the RWDP chain gets exaggerated to a more than proportionate increase in consumer demand at the level of the producer. This demand exaggeration results in accumulation of inventory. Unsold inventory at any point on the RWDP chain is financially debilitating. Similarly, dilution of demand forecast will result in an unsavoury position of declaring a stock out which will have the effect of consumers shifting loyalties and losing confidence in the retailer. Excess inventory causes increase in operating costs and reduction in profitability.

In the recent past, a concerted effort has been made to make forays into the semi-urban and rural areas of the country. The very nature of this market expansion gives rise to the BWE. In India, there is a paucity of secondary data that places a premium on collection of primary data. Inferences drawn from primary data can be subjective and susceptible to varied interpretation.



Source: utdallas.edu/~metin

Review of Literature

Much of the literature scanned was focussing attention on the study of the BWE at an international level. Internet of Things is a technology that is evolving in recent times and integration of this technology to the study of the BWE has not been addressed by research thus far. Papers published by pioneering authors like Padmanabhan, Lee and Wang and a few others examine the BWE and suggest econometric models to study the dynamics of BWE. Literature in India on this subject is sparse. There is a study on a retail outfit in Maharashtra where conclusions are based on interactions had with the store managers. Another interesting study tries to create a BWEWI ie. BWE weighted index. However, this weighted index is highly location and goods specific.

This paper is different from the rest of the literature because it focusses attention on parameters to identify the evidence of BWE in the Indian retail industry. Moreover, the technological choices opened up by the Internet of Things are factored into this study. Supportive data has been obtained from highly reputed reports like the KPMG Retail report, T Kearney's GRDI report, Retail Association of India and the Indian Retail reports.

Causes of BWE

There are many reasons for the bullwhip effect to manifest. *Firstly*, the time duration that a retailer places an order on the supplier plays an important role in the strength of the BWE. This is termed as order batching. Orders can be placed on the supplier quarterly, monthly, fortnightly or weekly. A quarterly order will have a higher safety margin of ordering compared to a monthly order. Thereby, BWE is more manifest in a quarterly order and less manifest in orders of shorter duration. *Secondly*, lack of information about the customer at various layers of the supply chain gives rise to BWE. Paucity of information can arise out of reluctance to share information between the various players on the supply chain. Lack of transparency and false security in confidentiality of information is an important ingredient in the existence of BWE. *Thirdly*, the rationing game that retailers indulge in products whose supply is less than demand for it distorts demand forecasting. When a product is in short supply, producers tend to ration the orders received from various retailers. This makes the retailers exaggerate their orders to be on the right side of the rationed quantity. *Fourthly*, discounts received on bulk orders and the attendant transport economies exacerbate the bullwhip effect. It is well known that price varies according to the size of the order. Higher the size of the order lesser is the price as demonstrated by the fact that B2B pricing is lesser than B2C pricing. Procurement managers are prone to pad up an order only to enjoy bulk order discounts. Unfortunately, this short term gain is more than offset by the debilitating impact of piling inventory and carrying costs.

Evidence of BWE

a) Interest Coverage Ratio: According to the Investopedia website, interest coverage ratio shows how easily a company can pay interest on outstanding debt. The lower the ratio, the more the company is burdened by debt and vice-versa. An interest coverage ratio below 1 indicates the company is unable to generate sufficient revenues to meet interest expenses. Exhibit 1 demonstrates that the interest coverage ratio of Indian retail outfits has been steadily declining since 2010 and stands at 0.94 in 2015. Further the quantum debt as a ratio to owners own funds has been on the decline. This shows the adverse credit worthiness of the retail companies.

b) Inventory Turnover Ratio: One of the key indicators to the vital financial health of a retail operator is the agility and speed with which the inventory is turned over. Absence of BWE would point to a higher rate of inventory turnover as there is no exaggeration in stocking patterns. Exhibit 1 shows that inventory turnover has declined from 5.06 in 2010 to 2.94 in 2015. This fall is statistically significant and indicates the pervasiveness of the BWE. Exhibit 2 also demonstrates the fact that inventory turnover in India has been between 3 to 14 times while it is around 18 times globally.

c) Operating Profit Margin Vs. Net Profit Margin: Presence of BWE and excess accumulation of inventory places a burden on working capital requirements and mounting debt servicing burden. Exhibit 1 clearly shows a dismal record in comparing these two ratios. In the year 2015, while the operating profit margin was 10.79 the net operating margin was barely 0.71. This demonstrates the high working capital requirements of the retail outfits and the entailing interest burden. The working capital cycle has hit an all time high of 111.36 days in 2015 as per Exhibit 1. Inefficient management of the supply chain is a important cause in increasing the working capital cycle.

d) High Logistics Costs: According to Exhibit 2, the logistics costs as a percentage of total prices are 10% in India as compared to 5% globally. When costs of supply chain logistics are high, there is a tendency to lump demand to get better product price from the producers and also lower transport costs. This condition by itself manifests in the experience of the BWE. Fleet footedness and dexterity in operations is critical to eliminate the debilitating impact of BWE.

Deployment of IOT in controlling BWE

There are many uses of IoT in ushering in a new era of retailing that would witness the emergence of a smart supply chain management, customer engagement and proactive maintenance and built in fault eliminating mechanisms. All this will have the effect of better demand management and elimination of the Bull Whip effect. The following are some of the areas that would make IoT contribute in this direction:

- a. **Customer engagement-** Understanding the digital exhaust and digital footprint of the customer is going to be critical to customer engagement in the future. Predictive intelligence will aid retail outfits in making personalized and customized product offerings to the customer. IoT enables a complete scanning of consumer behaviour within a matter of seconds. Smart vending machines (SVMs) are coming into existence and are going to be equipped with sensors, bar code readers, and payment options. For example, a coffee vending machine will be smart enough to recognise the customers and suggest the flavour that he likes. Customer interactions will also include features like gifting to family and friends through the social networks. Thereby customer demand and forecasting his future

requirements will become more predictable as demand mapping will be highly accurate, precise and timely.

- b. **Smartsupply chain** – With the advent of IoT and sensor technologies, the traditional supply chain can be made smart to meet the challenges posed by the digital era. Innovations in Radio Frequency Identification Device (RFID) and RFID based smart shelves can identify goods replenishment, items nearing expiry date, misplaced visual merchandising and such others. Alerts can be directly sent to warehouses and manufacturers during times of stock outs or low stocks. Factors like holidays, festivals and social sentiments can be factored into smart inventory decisions. A combination of smart supply chain logistics, inventory management and fleet movement will redefine engagement of customers.

Vendor managed inventory (VMI) will ensure optimal deployment of stocks that will eliminate both stock outs and inventory accumulation. Machine to machine (M2M) communication will be ushered in by IoT through sensor technology. Computer systems at the vendor's premises can directly communicate and obtain intelligence from the computer systems at the premises of the retailer. Any scope or element of human error will be obfuscated.

According to Juniper research, retailers using the IoT to generate an 'ecosystem' are poised to gain market advantage and truly capitalise on the opportunity. Apart from RFID, Bluetooth Beacons ensures smarter tracking of customer footfalls and channelling data to the smart phones of customers.

Noted author Steffen Sorrell states "Retailers such as Zara and Target are already taking advantage of the benefits offered by RFID asset tracking. Meanwhile, the Beacon industry is expanding rapidly, used as a method to provide consumers with contextually relevant information in conjunction with their smart phone will enormously enhance the in-store experience."

- c. **Minimising Downtime:** M2M communication will pave the way for early fault diagnosis, fault servicing and rapid communication of potential problems in a proactive manner. Dysfunctional lighting, air conditioning, point of sale apparatus, bar code readers and others are issues that one encounters while dealing with retailers. These issues have the potential to dilute the in-store experience of the customers and adversely impact their chances of continued engagement with the retail organization. It is well known that customer retention is less expensive than customer acquisition. IoT will ensure minimum downtime of infrastructure that would result in greater customer satisfaction. Proactive fault diagnosis and self healing are typical of M2M communication.

Conclusion

Retail operations involve many checks and balances. Two developments need to be considered while assessing the future of brick and mortar retailing in India. Firstly, increasing focus is being placed on expansion of operations into the tier 2 and tier 3 cities. Lack of secondary data and infrastructural bottlenecks in these cities make the impact of BWE more acute. Secondly, retailing in India is facing intense competition from e-commerce outfits like Amazon, Flipkart and others. This places high stress on the operating profits and profit margins. When the profit spread is getting squeezed, finding solutions to the BWE assume paramount importance. Cost minimization is going to be as important as profit maximization.

Thankfully, a revolutionary new technology in the form of IoT is fast evolving and embracing every facet of retailing. Technology offers solutions to the many problems plaguing the retail industry. Comprehensive deployment of the positive features of this technology goes a long way in mitigating the erosive effects of BWE.

Future Retail		Previous Years >				
Key Financial Ratios						
		Mar '15	Mar '14	Dec '12	Jun '11	Jun '10
Investment Valuation Ratios						
Face Value		2.00	2.00	2.00	2.00	2.00
Dividend Per Share		0.60	0.60	1.10	0.90	0.80
Operating Profit Per Share (Rs)		26.94	44.90	33.52	19.30	29.13
Net Operating Profit Per Share (Rs)		249.68	499.93	301.74	188.95	306.42
Free Reserves Per Share (Rs)		--	--	--	--	118.33
Bonus In Equity Capital		3.85	6.88	6.88	7.34	7.71
Profitability Ratios						
Operating Profit Margin(%)		10.79	8.98	11.10	10.21	9.50
Profit Before Interest And Tax Margin(%)		5.81	5.47	6.62	6.62	6.91
Gross Profit Margin(%)		5.83	5.48	6.64	6.64	6.94
Cash Profit Margin(%)		4.69	3.24	4.68	5.41	4.50
Adjusted Cash Margin(%)		4.69	3.24	4.68	5.41	4.50
Net Profit Margin(%)		0.71	0.02	3.91	1.86	2.84
Adjusted Net Profit Margin(%)		0.71	0.02	3.89	1.86	2.83
Return On Capital Employed(%)		6.70	7.57	7.53	6.00	11.12
Return On Net Worth(%)		1.43	0.08	8.22	2.82	6.99
Adjusted Return on Net Worth(%)		-0.51	-0.85	0.50	2.82	4.82
Return on Assets Excluding Revaluations		124.93	140.41	143.47	125.06	124.61
Return on Assets Including Revaluations		124.93	140.41	143.47	125.06	124.61
Return on Long Term Funds(%)		7.64	8.95	8.23	6.92	13.12
Liquidity And Solvency Ratios						
Current Ratio		1.14	1.02	1.22	1.03	1.13
Quick Ratio		0.84	0.84	0.81	0.49	0.65
Debt Equity Ratio		0.81	1.69	0.96	0.73	0.54
Long Term Debt Equity Ratio		0.59	1.28	0.80	0.54	0.37
Debt Coverage Ratios						
Interest Cover		0.94	0.96	1.07	1.66	1.84
Total Debt to Owners Fund		0.81	1.69	0.96	0.73	0.54
Financial Charges Coverage Ratio		1.71	1.54	1.75	2.51	2.08
Financial Charges Coverage Ratio Post Tax		1.88	1.59	2.27	2.28	2.14
Management Efficiency Ratios						
Inventory Turnover Ratio		2.94	3.72	3.26	2.33	5.06
Debtors Turnover Ratio		29.05	48.34	40.73	27.19	42.00
Investments Turnover Ratio		2.94	3.72	3.26	2.33	5.06

http://www.moneycontrol.com/stocks/company_info/print_main.php

1/15/2016 Future Retail | Key Financial Ratios > Retail > Key Financial Ratios of Future Retail - BSE: 523574, NSE: FRI

Fixed Assets Turnover Ratio	1.91	2.51	2.59	2.50	4.46
Total Assets Turnover Ratio	1.13	1.36	1.09	0.88	1.52
Asset Turnover Ratio	1.14	1.52	1.23	0.92	1.36
Average Raw Material Holding	--	--	--	--	46.57
Average Finished Goods Held	--	--	--	--	79.20
Number of Days In Working Capital	111.36	90.34	95.89	94.97	59.42
Profit & Loss Account Ratios					
Material Cost Composition	75.62	73.60	69.27	76.65	52.33
Imported Composition of Raw Materials Consumed	1.97	0.36	2.38	6.31	9.67
Selling Distribution Cost Composition	--	--	--	--	8.59
Expenses as Composition of Total Sales	0.68	0.76	1.21	1.13	0.96
Cash Flow Indicator Ratios					
Dividend Payout Ratio Net Profit	33.70	497.15	9.34	26.44	9.53
Dividend Payout Ratio Cash Profit	4.25	3.43	4.36	9.08	5.01
Earning Retention Ratio	194.36	150.16	-53.30	73.56	86.17
Cash Earning Retention Ratio	94.87	96.29	92.23	90.92	94.01
AdjustedCash Flow Times	8.64	14.62	9.76	8.66	4.85
	Mar '15	Mar '14	Dec '12	Jun '11	Jun '10
Earnings Per Share	1.79	0.12	11.80	3.53	8.71
Book Value	124.93	140.41	143.47	125.06	124.61

Source : Dion Global Solutions Limited

Exhibit 1: Financial Ratios of Indian Retail Outfits

Indian Retail vs. Global Retail				
	Logistics cost as % of price	Inventory turns	Stock-out percent	Shrinkage percent
Indian Retailers	Approximately 10	3 to 14	5 to 15	3.1
Global Retailers	5	Average 18	Below 5	Average 1

Improving supply chain and logistics will enable retailers in India to significantly enhance overall competitiveness and successfully deploy growth initiatives

Exhibit 2: Indian Retail Vs. Global Retail Source: Resurgent India

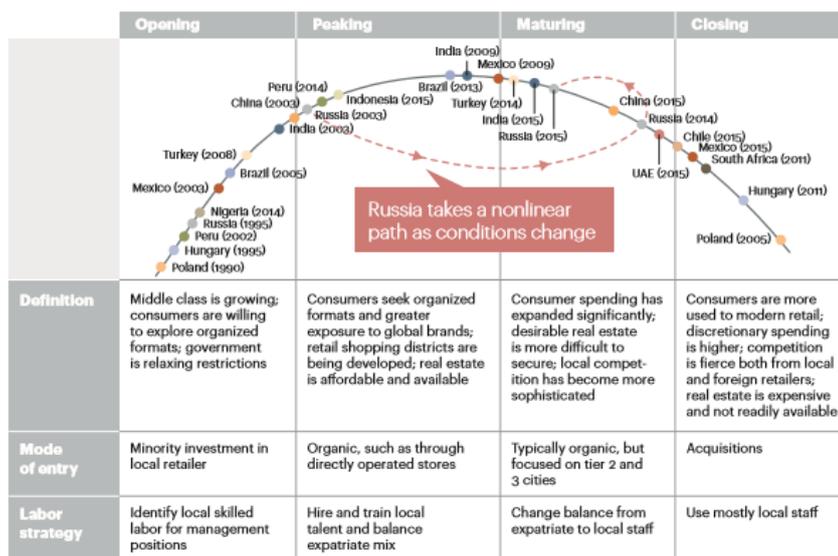
India's personal disposable income (PDI) growth comparison with other emerging markets



Source: Euromonitor Estimates

Exhibit 3: Personal Disposable Income

The GRDI window of opportunity



Source: A.T. Kearney analysis

Exhibit 4: The GRDI Window of Opportunity

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