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Contents

Focus

An Empirical Analysis of Total Factor Productivity in Food and Beverage Sector

SHEENA CHHABRA AND RAVI KIRAN

Food and beverages account for a substantial part of Indian consumption, over 30 per cent compared to other emerging markets. India's food processing industry is ranked fifth in terms of production, consumption, export and expected growth. The total factor productivity has varied over a decade within the range of 0.8 to 0.96. TFP is positive depicting that the sector is a growing sector of the economy. While analysing the predictors of total factor productivity, the total emoluments have a positive significant association with total factor productivity.

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Introduction

Food and beverage is indispensable to human life and health and its role is mounting in economic growth of the nation. Food and beverages account for a substantial part of Indian consumption (over 30 per cent) compared to other emerging markets (Brazil at 17 per cent and China at 25 per cent). The increase in consumption is due to rising income levels and decreasing food prices.

This industry operates at different levels, i.e. unorganised businesses owned by a family member or entire family and organised businesses in the form of a company operated at local/national/global level. The industry contributes to both economic and social values. The revenues generated by this industry flows to:

- Farmers involved in raw material production
- Local food processing or manufacturing capital investment
- Both direct and indirect labour
- Government in the form of taxes
- Investors in the form of dividends

According to KPMG report, majority of the respondents believe that company's revenue is expected to increase in the coming year. The key drivers of revenue generation are product innovations and adding new customers.

According to ASA & Associates LLP report, India is the world's second largest producer of food after China. India's food processing industry is ranked fifth in terms of production, consumption, export and expected growth. While developed nations continue to be the large markets for beverages, both manufacturing bases and consumption bases are shifting to developing nations like India and China. The Confederation of Indian Industry (CII) has estimated that food processing sector can attract an

investment of US$33 billion in coming 10 years. The food processing sector is expected to grow with a CAGR of 10 per cent by 2015.

The popularity of food industry is not surprising as it is the top-ranked industry (according to Annual Survey of Industries, 2011–12) with 16.03 per cent of total factories. With globalisation, a number of foreign brands like McDonalds, KFC, and Pizza Hut, etc., have become household names and Indian brands like Bikanervala foods, MTR ready-to-eat food, etc., have found shelf-space in the US and Europe retail market. The rising per capita income in domestic food market leads to growing demand for processed and convenience foods.

Current Scenario

The sector has seen a tremendous growth with a double digit growth rate. The non-alcoholic beverage sector accounts for more than 1 per cent of India's GDP and its share in the GDP is rising. The sector is performing better than other manufacturing sectors. Unlike China and Brazil, India is not a part of the global production network in the agro-processing sector. According to Global Strategic Business Report entitled 'Dried Fruit and Edible Nuts: A Global Strategic Business Report', Asia-Pacific being the largest market worldwide is growing at a compound annual growth rate (CAGR) of 5.3 per cent for dry fruits and 6.5 per cent for edible nuts. There has been a transition during 1994 to 2000; many reforms took place after the new economic policy, which led to the growth of food and beverage sector.

Review of Literature

The consumption pattern of the individuals has changed in the post-liberalized era. The key drivers to this change are socio-economic environment, urbanization, trade policies, increased affordability, increase in supermarkets, long product shelf life, low price, improved marketing strategies, etc. (Kearney, 2010). In the recent decades, about 50 per cent of the world's population lives in urban environments and the proportion of the world's population employed in agriculture have declined (Parfitt et al., 2010). People belonging to medium socio-economic level purchase street foods frequently (14.7 per cent) whereas those belonging to high socio-economic level (13.2 per cent) purchase fast foods often (Steyn, Labadarios & Nel, 2011). With low prices and rich food supply, there occurs a nutrition transition in economies like China (Popkin, 2002).

Steyn, Labadarios, and Nel (2011) found that the street food and fast food consumption is more in all territories of South Africa. The street food consumption was highest in Limpopo Province (20.6 per cent) followed by North West (19.9 per cent) but least in Northern Cape (1.8 per cent), whereas the fast food consumption was highest in Gauteng (14.7 per cent) followed by Limpopo (7.5 per cent) but lowest in North West (1.5 per cent). It has also been found that employed people were frequent buyers of fast food indicating the effect of westernization of diet.

While comparing the volume of sales for two big giants of beverage industry viz. Coca Cola and PepsiCo, Kleiman, Ng, and Popkin (2012) revealed that for Coca Cola, the volume per capita sold between 2000 and 2010 increased from 0.9 to 5.7 ml/day for bottled water, 1.3 to 2.2 ml/day for fruit/vegetable juice, and 0.4 to 1.1 ml/day for energy drinks whereas for PepsiCo; it increased to 2.7 from 0.3 ml/day for bottled water, 0.9 to 1.3 ml/day for fruit/vegetable juice, and 0.1 to 1.8 ml/day for energy drinks. During 2000 to 2010, the daily per capita volume sales of soft drinks in emerging economies like Brazil and China have increased 269 per cent and 147 per cent for Coca Cola and PepsiCo, respectively.

The increased demand of food items has provided employment to a huge number of individuals. In European Union, about 3.8 million people were employed in this sector in 2005, out of which more than 5,00,000 people were working in Germany and the UK alone (Hamann, 2007). The East European economies like Poland, Hungary, Czech Republic, Slovenia, and Slovakia employ over 800,000 in this sector. But, an increase in productivity has reduced the employment rate. There has been a decline in employment opportunities for unskilled and semi-skilled workers in Europe (Simpson & Stalker, 2004).

With gender equality, there is a rise in the number of women entrepreneurs. VanderBrug (2013) discussed that women-owned businesses in the organized sector represent approximately 37 per cent of enterprises globally. Since women are engaged in household activities for majority of their time thus they prefer to be a part of food and beverage industry either in an organized manner or in unorganized manner. A higher percentage (41 per cent) of women engage themselves in the food, beverages (and tobacco) manufacturing sector (Eurostat, 2006). Tambunan (2009) revealed that there has been an increase in the women entrepreneurs in Indonesia since the 1980s during the new order era (1966–1998) when the country achieved rapid economic growth leading to rapid increase in per capita. About 29 per cent of total Small and Medium

Enterprise (SMEs) in the manufacturing sector are operated by women. It has been found that there is a decline in the rate of women entrepreneurs in Small Enterprise (SEs) than in Medium Enterprises (MEs).

Majority of the crops are produced by small farmers with limited resources and technology. Growers generally focus on production activities with diminutive attention to post-harvest and marketing activities that are undertaken by middlemen and traders. Their major markets include unorganized traditional wholesale markets, though many supply to the supermarkets and fast food chains. With inadequate financial resources and low returns from agricultural production, these farmers do not invest in new technologies or improve yields through increasing inputs to production (Mittal, 2007). Supermarkets being the principal intermediary between farmers and consumers play a vital role in food and beverage industry. Supermarkets are the main vehicle for delivering all kinds of food items for the growing middle classes and the urban poor in all types of economies (Reardon et al., 2007). With change in lifestyle, people prefer staple and packaged food as their prices are lower in supermarkets than in traditional retail outlet (Igumbor et al., 2012). Weatherspoon and Reardon (2003) highlighted that healthy food items cost more in supermarkets than in small shops when compared with less healthy foods.

In techno-savvy environment, it has been reported that the advancement of biotechnology in food industry is a factor that led to severe competition and an urge for quality assurance as some events came out in food supply chain, including the application of biotechnology in agricultural products and food processing (Brannback & Wiklund, 2001; Hagen, 2002). In food and beverage sector, the responsibility and traceability of food ingredients, handling process, preservation and labelling have become more important. They are important for organisations entering the European market, because TTA (traceability, transparency, and assurance) protocols have been launched. As customers are not willing to compromise on quality of the product, it has been examined that the supply chains of food and beverages are under increased competition and regulatory pressure to develop and maintain knowledge management systems for quality assurance (Hagen, 2002). It has been examined that the post-harvest loss in developing economies like India, Indonesia, Iran, and Korea, etc., is more than 20 per cent because of lack of improved infrastructure but this percentage is between 2 to 23 for US (Parfitt et al., 2010).

Sporleder (2001) revealed that the competition among various firms in food industry has been changed from tangible assets to value added and wealth creation through KM. The knowledge management system of a firm includes brands, reputations, and customer and supplier relationship. Alavi and Leidner (2001) believe that application of knowledge is more important than knowledge itself, which helps a firm to have a competitive edge over another firm. Kwahk, Kim, and Chan (2007) agreed with Alavi, they suggested that application of knowledge at top-level business strategies influence the organizational performance more than KM in transactions processing. Their study showed that a decision support loop is useful for a beverage company.

Globalization has improved the trade of agricultural and food products across borders. The attainment of new Member States within Europe has made accessibility easier for agricultural supplies as well as new consumers. The comprehensive food chain has also increased competition within the sector, driven by food retailers who influence both consumers and suppliers (European Foundation for the Improvement of Living and Working Conditions, 2004).

Objectives of the Study

I. To find out the labour, capital and total factor productivity of food and beverage sector in post-liberalized era (2001–12).

II. To study the growth rate of output in food and beverage sector in post-liberalized era (2001–12).

III. To identify the predictors of total factor productivity.

Hypothesis

H_1: There is a significant growth of output in food and beverage sector in post-liberalized era (2001–12).

H_2: There is a positive association between total factor productivity and its predictors like level of output, Total emoluments, number of factories, capital to labour ratio and capital per factory.

Research Methodology

The sample for the study consist of number of factories, labour employed, Total Emoluments, Total output, Net value added, Fixed capital and Depreciation during 2001 to 2012. The data has been collected from Ministry of Statistics and Programme Implementation, Government of India.

The growth rate, labour productivity, and capital productivity have been calculated as productivity provides an insight into the efficiency of the industries. The total factor productivity is calculated using following equation:

$$\Delta \log TFP(t) = \Delta \log V(t) - \{[(S_L(t) + S_L(t-1))/2] \Delta \log L(t) + [((1-S_L)(t))] + (1- S_L)(t-1))/2] \Delta \log K(t)\}$$

Where V, L, K, TFP, and S_L indicate value added, labour, capital, total factor productivity, and share of labour income in value added respectively.

To identify the predictors of total factor productivity, TFP is a function of few factors.

$$TFP = f(O, TE, F, K/L)$$

Where O, TE, F, K/L indicate level of output, total emoluments, number of factories and capital to labour ratio.

The relationship of productivity growth with all the aforementioned variables can be represented by an equation of the form:

$$Y = f(X_1, X_2, X_3, X_4, X_5)$$

Where X_1 is output growth;

X_2 is total emoluments;

X_3 is number of factories;

X_4 is capital labour ratio;

X_5 is capital per factory.

Analysis and Interpretation

The labour, capital and total factor productivity are calculated to understand the pattern of food and beverage sector.

As depicted in Table 1, the labour and capital productivity has increased every year from 2001 to 2012 but capital productivity is more than labour productivity for each year. The total factor productivity is positive and is increasing with time. Thus there is technical progress in this sector.

While analysing the predictors of total factor productivity, the total emoluments have a positive significant association with total factor productivity. The other variables, level of output, number of factories and capital to labour ratio, capital per factory are insignificant.

Table 1: Labour, Capital and Total Factor Productivity

Year	GVA	Labour	Fixed Capital	TFP	LP	CP	Growth(g)
2001–02	1968344	1009033	3390701	–	1.048334478	0.963831849	
2002–03	1998809	1008865	3762747	0.807385	1.049458111	0.958218613	0.797234
2003–04	1969948	1005538	3741169	0.787083	1.048656595	0.957621747	0.789109
2004–05	2214823	1056053	4138787	0.791135	1.05339809	0.958963388	0.816483
2005–06	2769860	1092482	4535666	0.841831	1.066912191	0.967824125	0.887102
2006–07	3972090	1142956	5745985	0.932374	1.089301243	0.976278035	0.935596
2007–08	4059128	1178602	6833484	0.938817	1.088458754	0.96690252	0.916941
2008–09	3706995	1133327	6812392	0.895065	1.085007692	0.961325034	0.886868
2009–10	4323203	1163712	8406328	0.878672	1.093962188	0.958293557	0.894254
2010–11	5554372	1199767	10128769	0.909837	1.109479757	0.962755036	0.939819
2011–12	6817386	1276477	12261853	0.9698	1.119162028	0.96403524	

Note: Where GVA = NVA + Depreciation
LP = Log(GVA) / log (Labour)
CP = Log (GVA) / log (Capital)
Growth = [Δlog GVA(t) – Δlog GVA(t–1)] / 2
Source: Author's own.

Total factor productivity is positively related to all the variables such as Total Output, Total Emoluments, Factories, Capital to labour ratio and Capital per factory. Regression coefficient for Total Emoluments and Capital to labour ratio are statistically significant but the coefficient for capital to labour ratio is very small. Out of the total variation in total factor productivity, 88 per cent is explained by the model.

Further, step-wise regression has been conducted which revealed that the total emolument is a significant determinant of total factor productivity. The capital to labour ratio has been excluded because of its multi-collinearity

Table 2: Predictors of Total Factor Productivity

Summary Output (Total factor productivity)					
Regression Statistics					
R	0.941				
R Square	0.886				
Adjusted R Square	0.744				
Standard Error	0.03305				
Observations	10				
ANOVA					
	Df	*SS*	*MS*	*F*	*Significance F*
Regression	5	0.034	0.007	6.235	0.050
Residual	4	.004	.001		
Total	9	.038			
	Standardized Coefficients	*Standard Error*	*t Stat*	Sig.	
Intercept		0.049	13.433	.000	
1. Total Output	0.563	0. 002	1.775	0.151	
2. Total Emoluments	0.490	0.004	3.969	0.002	
3. Factories	0.941	0.005	1.806	0.145	
4. Capital to labour ratio	0.772	0.011	2.695	0.050	
5. Capital per factory	0.152	0.003	0.381	0.722	

Note: Regression equation for food and beverages sector is:
$y = 0.563x_1 + 0.490\ x_2^* + 0.941\ x_3 + 0.772\ x_4^* + 0.152\ x_5$
t = (1.775) (3.969) (1.806) (2.695) (0.381)
$R^2 = 0.886$
Source: Author's own.

Table 3: Step-wise Analysis of Total Factor Productivity

Summary Output (Total factor productivity)					
Regression Statistics					
R	0.751				
R Square	0. 564				
Adjusted R Square	0.509				
Standard Error	0.04576				
ANOVA					
	Df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.022	0.022	10.349	0.012
Residual	8	0.017	0.002		
Total	9	0.038			
Excluded Variables					
	Beta In	*t*	*Sig.*	*Partial Correlation*	*Collinearity Statistics*
1. Total Output	0.222	0.586	0.576	0.216	0.414
2. Factories	–0.246	–0.736	0.486	–0.268	0.519
3. Capital to labour ratio	0.422	1.357	0.217	0.456	0.509
4. Capital per factory	0.119	0.446	0.669	0.166	0.858

with other factors. The model explains 56 per cent variations in total factor productivity.

Conclusion

Food and beverage is one of the growing sector of Indian economy. The sector is performing better than other manufacturing sectors. Globalization and technological advancement are contributing towards the growth of this sector. There is an increase in the labour and capital productivity during the last decade. The sector has grown with a growth rate from 0.79 to 0.93. The result of the study highlights that the contributing factor towards the total factor productivity is the total emoluments.

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Excellence is a continuous process and not an accident.

—A. P. J. Abdul Kalam

Productivity Improvement Through Design And Manufacturing of Special Purpose CNC Duplex Milling Machine For Cam Follower Lever

DHANANJAY V. PATIL & JAYDEEP S. BAGI

In today's competitive industrial scenario, increasing the productivity of the manufacturing process with machine tools used is a measure of concerned. This paper discusses the design and manufacturing of special purpose CNC duplex milling machine for the manufacturing of Cam Follower Lever. The newly developed machine tool helps to achieve substantial improvements in term of reduction of cycle time and an increase in production rate. These improvements are reflected in saving in the manufacturing cost per component.

Dhananjay V. Patil is affiliated to the Department of Mechanical Engineering, Sanjeevan Engineering & Technology Institute, Panhala, Kolhapur; and Prof (Dr.) Jaydeep S. Bagi is affiliated to Department of Production Engineering, Kolhapur Institute of Technology, Kolhapur.

1. Present Theories and Practices

In ABC Enterprises, the traditional method of machining involves metal removal using conventional setup of duplex milling machine with two face-milling cutters machining the component Cam Follower Lever from either side to mill the faces. The process involves manual loading & unloading of the component. In this setup dedicated drives for each cutter with 2 hp motor power are provided. After manual loading of component the machining cycle starts with hydraulic feed mechanism. The current feed rate is 0.01 mm/tooth. Once the machining is complete, the cross table quickly retracts. Then the finished component is manually unloaded. The setup utilizes a hydraulic power pack, running on 1 hp motor for feed mechanism. The total output of the machine is 440 components per shift. This is the first operation performed on the component which is a bottle neck operation.

The output does not fulfill the demand of the succeeding machine; hence to balance the line, increasing the output of present machine is important.

1.1 Component Description

The constructional details of component Cam Follower Lever are shown in Figure 1. The component 3056566 has a as-cast width of 40 mm. After both side face milling operation (i.e. Face C and Face D) the required width is 34.65 +/- 0.09 mm and surface finish (Ra value) less than 125 μin. For duplex milling operation they use SPKN1203 EDL and EDR Carbide inserts in milling cutter.

2. Problem Background

At present, ABC enterprises is using Duplex milling machine for both side face milling of a component Cam Follower Lever. The loading & unloading of lever is

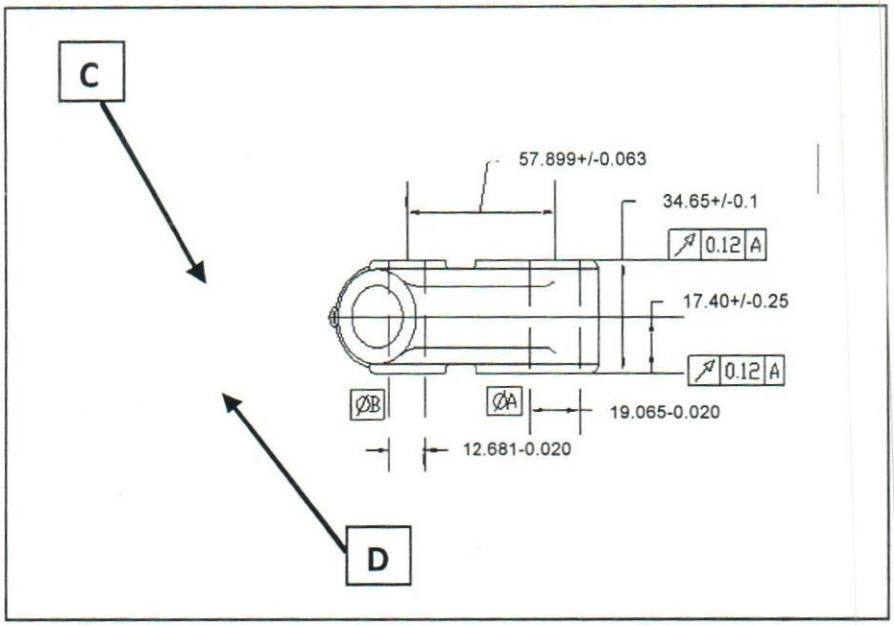

Figure 1: Constructional details of C.F.L. 3056566.

performed manually. The total cycle time includes loading & unloading of one job along with machining time. Machining parameters like spindle speed, feed rate, cycle time are fixed & cannot be adjusted which affects the overall output of the machine & hampers the productivity of the machine.

The present Duplex milling machine has a 60 sec. cycle time to finish the both side face milling operation of Cam Follower Lever. To manufacture the finished component the different operations which need to be performed which is shown in figure 2. The ABC is running

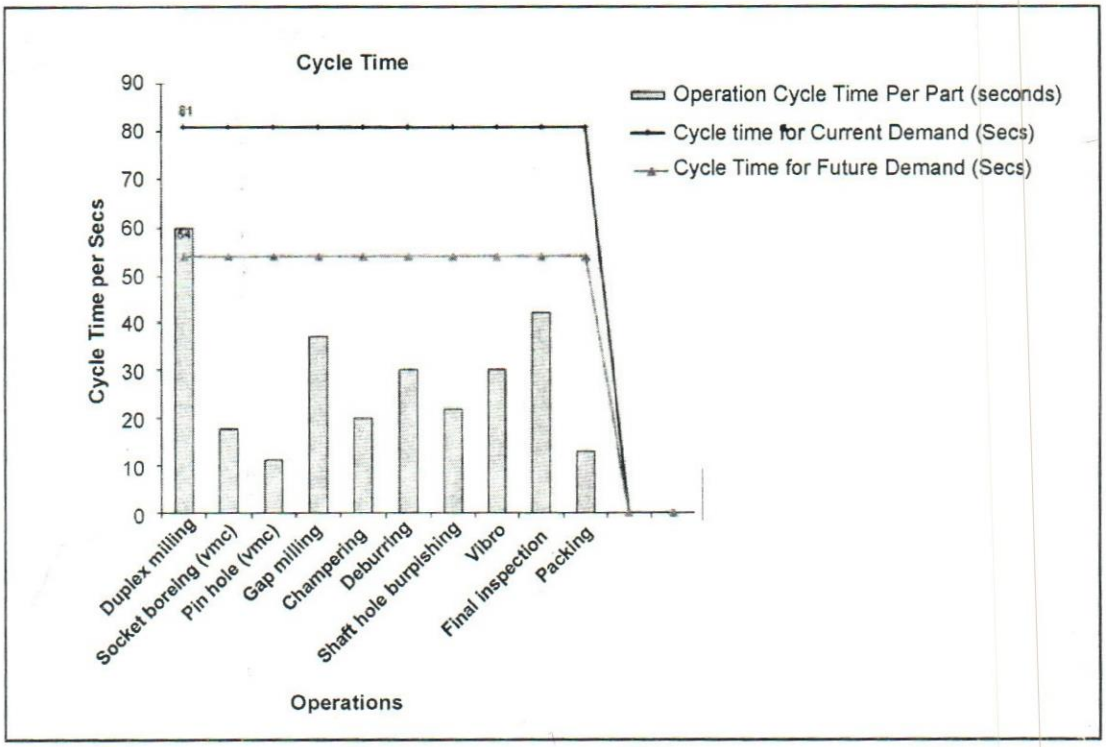

Figure 2: Graph of Operations Vs Cycle time

in two shifts of 12 hours each and output is 880 components/day with rejection. The current demand of Cam Follower Lever is 800 components/day. To fulfill the current demand 81 sec. cycle time is required for each operation which is under control as shown in Figure 2. The future demand of customer is 1200 components / day and to achieve this, it is required that all operations have a 54 sec cycle time.

From Figure 2 it is understood that, there is problem with the duplex milling operation cycle time. It has a 60 sec. cycle time and due to dedicated type of drive there is no scope for optimization of cycle time. There is one more constraint for less output: ABC enterprises depends upon the supplier for Cam Follower Lever casting. The supplier provides Cam Follower Lever 1000 parts a batch. The owner of ABC enterprises told that the demand of customer may increase up to 2000 components /day in the future, so they have started their own foundry which has eliminated the problem of shortage of casting. Cycle time of Duplex milling machine is above the line of cycle time for future demand as shown in Figure 2.

To overcome the problems discussed, we studied the machining time of Cam Follower Lever on old machines. We took 10 successive readings to know the loading time, cutting time, unloading time, and cleaning time. Following Table 1 shows the cycle time for Cam Follower Lever and

Table 1: Cycle time for Cam Follower Lever 3056566.

Ob. No.	Loading Time, Sec	Cutting Time, Sec	Unloading Time, Sec	Cleaning Time, Sec	Total Time, Sec
1	8	42	7	3	60
2	7	43	7	3	60
3	7	43	8	2	60
4	8	41	8	2	59
5	7	41	7	3	58
6	8	41	8	4	61
7	7	41	7	3	59
8	8	42	7	3	60
9	7	41	7	4	59
10	8	41	8	4	61
Avg.	**7.6**	**41.4**	**7.4**	**3.2**	**59.6≈60**

Fig. 3 shows details of cycle time of Cam Follower Lever 3056566.

So, it is proposed to Design and Manufacture a CNC Duplex Milling Machine for manufacture of Cam Follower Lever which eliminates the mentioned problems. The idea behind this is that while the first component is being machine, the second component must be loaded which will eliminate the loading-unloading time and cleaning time (18 secs). Remaining cutting time can be reduced by

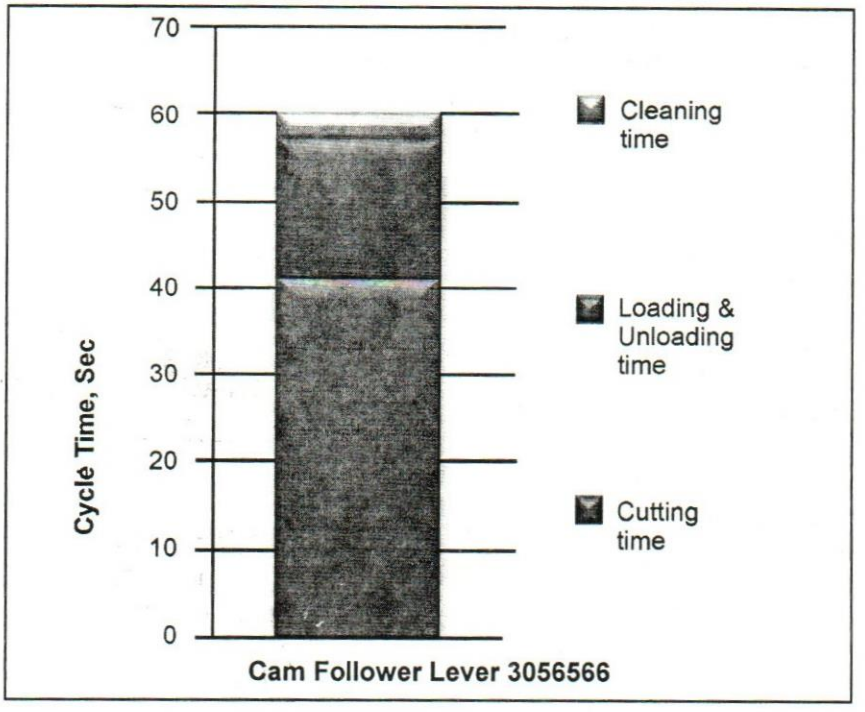

Figure 3: Details of cycle time of 3056566.

improving machining parameters. Hence cycle time may be reduced from 60 secs to 30 secs approximately.

3. Research Problem statement

To design & manufacture a CNC duplex milling machine for the manufacturing of Cam Follower Lever.

4. Research Objectives

1. To reduce the manufacturing cycle time per component.
2. To increase the production rate for the component.
3. To reduce the manufacturing cost per component.
4. To increase the overall productivity of the manufacturing process.

5. Methodology

5.1 Alternative Logical Design

Design is undoubtedly a creative process. Many people mistakenly attribute this creativity to a flair for design in certain persons who become successful designers. In fact the engineer with a flair for a design is, as a rule, a man with a logical decision-making ability by which he explores all possible solutions to a given problem and arrives at an optimal after carefully analyzing all the alternatives [7]. We proposed different logical design alternative mechanisms for 'CNC Duplex Milling Machine'.

We considered following criteria such as Cutting down machining time, cutting down non-productive time (i.e. loading, Fixture cleaning and unloading time), Accuracy, Cost of manufacturing, Simplicity of design, safety and convenience of control, Operator fatigue, human ergonomics etc. Testing the alternatives with decided criteria, evaluating them and then selecting the best for implementation is the key.

5.2 Single plate indexing

The Figure 4 shows single plate indexing mechanism. First the component is loaded at position 1 with hydraulic clamping and fed against the milling cutter. At the same time the second component is loaded at position 2 and clamped hydraulically. When the milling operation on the

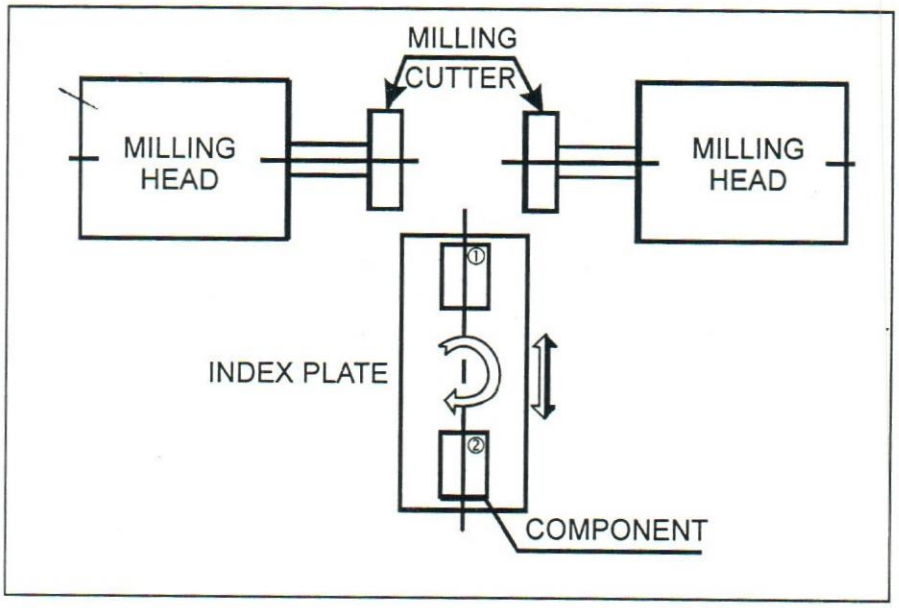

Figure 4: Single Plate indexing

first component is finished, the index plate retracts and indexes through 180°. Then the second component is fed against the milling cutter; at the same time unloading of component, cleaning of fixture and loading of new component can be done. In this case loading and unloading time becomes zero, accurate machining due to less moving parts, Simple design, one axis drive reduces cost, no fatigue to operator, and is safe to operate and control. The only disadvantage is that, during machining, the next component is loaded on a moving index plate.

After discussion with ABC enterprises about various design alternative mechanisms, we selected the single plate index mechanism and set the target up to 30 sec cycle time (i.e. 2000 components/day).

6. Design consideration

Sr. No.	ENTITIES	
1	Diameter of cutter (D) = 125mm	[1]
2	Cutting Speed (V) = 160 m/min.	[1]
3	Revolution per minute (n) , We know, $v = \pi Dn/1000$ $\therefore n = \frac{V * 1000}{\pi D} = \frac{160 * 1000}{\pi 125} = 407.44$ rpm	[1]
4	Feed per tooth (S_z) = 0.05mm , Number of tooth (z) = 10 . Feed per minute (S_m) = Sz . z . n = 0.05 * 10 * 407.44 = 203.72 mm/min.	[1]
5	Depth of Cut (t) = 3.25 mm, Width of Cut (b) = 80 mm.	[1]
6	Metal removal rate (Q) $= \frac{b.t.S.m.}{1000} = \frac{80 * 3.25 * 203.72}{1000} = 52.97$ cm^3/min.	[1]
7	Approach Angle, x = 45°	[1]
8	Avg. chip thickness (a_s) = $\frac{57.3 * Sz * \sin x(\cos \psi 1 - \cos \psi 2)}{\psi s} = \frac{57.3 * 0.05 * \sin 45 (\cos 37 - \cos 143)}{106°} = 0.023$mm.	[1]
10	Unit power, U = 0.030 kw/cm^3/min. ------- (S.G. Iron, 160 BHN) Correction factor for flank wear, K_h = 1.5 ---------- (flank wear = 0.4mm, as = 0.1 mm, BHN = 125) Radial rake angle, γ = -5 degree Correction factor for radial rake angle, $K\gamma$ = 1.21 Power at spindle (N) = U . K_h. $K\gamma$. Q = 0.03 *1.5 * 1.21 * 52.97 = 2.884 Kw.	[1]
11	Efficiency of transmission, E = 85% = 0.85	[1,2]
12	Power of the motor (Nel)= N/E = 2.884/0.85 = 3.315Kw = 3.315/0.75 = 4.42 HP ≅ 5 Hp [1]	
13	Tangential cutting force, P_z = 110.313 Kgf = 110.313 * 9.80665 N = 1081.80 N Torque at Spindle, Ts = 172.303 Nm. P_x = Axial component of tangential force = 594.99 N P_y = Radial component of tangential force = 378.63 N.	[1,8]
14	Selected Diameter for the Spindle. d = 60 mm. Single-row Taper Roller Bearing No. 30212 is selected : Inner diameter = 60 mm, outer diameter =110mm, Bearing Width = 23.75 mm.	[3,4,5]
15	Timing Belt Drive Selection for milling Head, Drive summary Belt: 390 H 300, Driver pulley: 18 H 300, Driven pulley: 60 H 300,Center distance: 232.135 mm. Timing Belt Drive Selection for Servomotor, Drive summary Belt: 330H 300, Driver pulley: 14 H 300, Driven pulley: 42 H 300, Center distance: 234.45 mm.	[8,9]
16	Selection of Turret : Model- BTP100, Center height, mm =100+0.1, No. Of indexing positions = 8, Version = STD, Total indexing time for adjacent station = 0.6 Sec, Inertia of tool disc and tooling max, kg.m^2 = 3, Weight of tool disc & tooling max. kg =100.	[10]
17	Selection of LM-Guideways : Model : HGH 30HA, Basic Dynamic load rating (KN) = 47.27, Basic static load rating (KN) = 69.16,Static rated moment (KN-m): MR=0.88,MP=0.92,MY=0.92. Selection of Ball Screw : FSI Type , Model : 32-10T4, Nominal dia. = 32mm, lead size =10mm,Ball dia.= 6.350mm Ball Screw Support : Model No. BK 25,BF 25, Ball screw shaft OD (mm) = 32/36, Shaft support portion OD = $25^{-0.005,-0.004}$, Screw thread = M18 x 1.5, Length of screw,(mm) = 9.	
18	Selection of Servomotor : Servo Motor Model : HF-KE73 (B), Servo amplifier model : MR-E-70A/AG, Power Facility Capacity (KVA) : 1.3, Rated output (W) : 750, Rated Torque (N-m) :2.4, Max. torque (N-m) : 7.2, Max. Speed (r/min) : 4500, Speed/ position detector: Incremental encoder (resolution/servo motor rotation: 16384p/ rev.).	
19	Hydraulic Power Pack : Piston diameter = 65 mm, Piston rod diameter = 30mm, Flow rate requirements = 5 lpm, Cylinder = 65mm bore dia., Rod = 30 mm direction 90° RH, Pump = Gear Pump: model: PG0A200-420, Electric Motor : 1Hp, 1440 rpm, Flange mounted, induction motor, Pressure relief valve : DPRS06K100-04, Direction Control Valve : DSG 01-3C60-A240, Rotary Union[11] : 1100 series: Pressure PSI 725, Speed rpm 60 max., Shaft Threads : 3/8', Capacity of Oil reservoir = 40 lits., Pipe = 10mm. Hydraulic Oil = SAE Grade No 68	

7. Stress Analysis Using FEA Technique

For complex model analysis generally numerical methods are used. FEA is one of the numerical methods used to solve complex mathematical problems. The entire solution domain must be discretized into simply shaped sub domain called as elements. ANSYS software is used for the analysis of the CNC duplex milling machine model, which is based on the FEA method.

7.1 Steps in finite element analysis

7.1.1 3D modeling of CNC Duplex Milling Machine

Complicated shape models cannot be created easily but it's easy to develop 3D of complicated shapes by using the modeling software's such as PRO-E, CATIA etc. To create a 3D model of CNC duplex machine with all intricate geometric details PRO-E software is used.

7.1.2 Meshing of the 3D model of CNC Duplex Milling Machine

In simple term meshing means connecting elements with each other. Elements are the building blocks of the finite element analysis. Meshing and analysis is carried out by using ANSYS 13.0 software. Meshing is an important step in FEA analysis. The meshing is adequately done to obtain the accurate results with computations. Model is meshed by using Solid 185 element tetra meshing and with 10 element size. Total 929285 elements and 203523 nodes are created after meshing. When we reduce the element size, better accuracy is obtained but simultaneously the computational time increases tremendously.

7.1.3 Material properties assigned

After completion of meshing, material properties are assigned to meshed model. These properties are listed in Table 2.

Table 2: Material Properties of machine parts

Sr. No.	Part Name	Material	Modulus of Elasticity, E N/Mm²	Poisson's Ratio
1	Duplex Bed	M.S, Fabrication	$2.060 * 10^5$	0.3
2	Sliding Base	M.S, Fabrication	$2.060 * 10^5$	0.3
3	Sliding Plate	CI	$1.000 * 10^5$	0.23
4	Indexing Plate	M.S	$2.080 * 10^5$	0.3
5	Fixture Bracket	M.S	$2.080 * 10^5$	0.3
6	Resting V	M.S, carbide pads	$2.080 * 10^5$	0.3
7	Vertical Resting V	M.S	$2.080 * 10^5$	0.3
8	Motor bracket	M.S	$2.080 * 10^5$	0.3
9	Servo motor bracket	M.S	$2.080 * 10^5$	0.3
10	Spindle	M.S	$2.080 * 10^5$	0.3
11	Motor pulley	SAE 8620	$2.000 * 10^5$	0.3
12	Spindle pulley	M.S	$2.080 * 10^5$	0.3
13	Ball screw pulley	M.S	$2.080 * 10^5$	0.3
14	Servo motor pulley	M.S	$2.080 * 10^5$	0.3

7.1.4 Loading and Boundary Conditions

After completion of meshing of the model and assigning the material properties loading in terms of forces is applied. Following forces are acting on the machine while in operation.

1. Px-594.99 N Axial force towards spindle.
2. Pz-1081.80 N Tangential cutting force
3. Py-378.63 N Feed force.

After application of the loading conditions boundary constraining is applied to the model. The all degree freedom of the model is fixed at the bottom and the forces are applied on the model.

7.2 Results

After applying material properties and boundary conditions, analysis is carried out by the ANSYS solver. ANSYS solver formulates the governing structural stress strain equations for each and every element and the formulated governing

equations are solved for deformation. With this governing equation other quantities such as stresses, strains can be calculated. Stress patterns are observed by using post processing tool. Principal stresses, von-mises stresses are the logical checks for CNC Duplex milling machine model analysis. After every analysis these logical checks have been cross checked. After application of the load the maximum deflection found is limited up to 40 microns only and maximum stress developed in the component is 6.2294 N/mm^2 in localized areas. From this it is clear that the component will get less deformation during the operation and the maximum value of stress is less than the material yield strength hence the total assembly is very safe for actual working.

7.3 The Manufacturing Process

The total manufacturing process is elaborated as follows:

1. The full proof planning of all activities related to designing, manufacturing, assembly, inspection and testing of machine as per design and Customer Requirement. Also critical planning is done to meet the customer delivery time.
2. The procuring of all raw materials as specified in drawing and as per customer requirement.
3. The procuring of all standard bought-outs such as Power pack, Servo motor, motors, LM-Guide ways, Spindle housing, Programmable logic controller etc.
4. The manufacturing different custom designed components such as Main base, Slide base, Slide plate, Index Plate, Fixture bracket, motor Bracket, cylinder Plate, Pulley etc. are done by appropriate manufacturing process.
5. All the components and mating parts dimensions are verified and confirmed according to the drawing specification.

8. The Assembly Process

Initially the machine foundation base is fabricated, and then the base is heat treated to relieve internal stress caused due to welding process. This also helps to improve the machinablity of base. Then the foundation base is milled on Planno-miller to create surface for mounting the components like housing. Then scrapping is performed on the required surfaces and accuracy achieved is 15 microns. The assembly of Duplex milling machine consist of milling head sub-assembly, bed and slide sub-assembly and fixture sub-assembly.

The milling head assembly consists of fitting of Quill, Spindle, Bearing etc. in the housing. Milling head assembly is a brought out part. It is purchased from Precision Engineering, Bangalore. The adjustable quill is used to support the spindle. Surface roughness ranges from 5 to 6 microns on the surface of the quill. The clearance between adjustable quill and housing is kept 10-12 microns. Taper roller bearings support the spindle and neutralize the effect of radial and axial forces. Various types of combinations of mounting are used but most commonly used is back to back mounting on spindle. In between two bearings spacers are used to accommodate with length differences. Worm gears are connected with quill and housing as per the drawings. Scrapping of milling head housing base is carried out up to 10 microns. Spindles that are hardened and are having out and that have to be removed as it will affect the accuracy in machining operations. The run out measured by placing the spindle between the centers and with the help of dial gauge is 5 microns. If there is out, it is removed by placing spindle in the vice and tightening. During installation of this sub-assembly care should be taken to maintain co-axiality of both shafts.

After scrapping the main base, hole marking is done with the help of scriber. It is then marked by a colour marker so that it can be easily identified. Center punch is carried out correctly on marks and 3 mm drill centering is made followed by 7, 10, 12 mm drills. After this, tapping of M12 x 1.75 mm H- type is done. Scrapping of top and bottom of bed is carried out up to 10-15 microns. Drilling of 12 mm holes is as per drawing. Then the bed is kept on main base perpendicular to spindle axis and tightened.

On the top surface of bed LM-Guide ways are kept following guidelines provided in the catalogue. Check perpendicularity of LM-guides ways with spindle axis i.e. 10 microns and tightened and LM-blocks connected with guideways. Then BTP 100 turret is kept inside the main base which is connected with slide plate and slide plate with LM blocks. This is followed by checking the perpendicularity of slide plate with spindle axis using dial gauge which is 10 micron.

The fixture brackets are connected with the index plate and vertical resting Vee with fixture bracket as per drawing. The fixture bracket with resting Vee on slide plate and hydraulic cylinders clamped with fixture bracket through cylinder plate. Servomotor 2.4 Nm at 300 rpm attached to base at back side using servo bracket. Recirculating ball screw attached with slide plate, which

is supported on bearings. Other end of ball screw connected with servomotor through timing pulleys and timing belts. This drive assembly feeds the component against milling head to perform face milling operation. Milling motors are connected with adjustable motor brackets. Milling cutters were bolted to spindle by maintaining perfectly perpendicular 10 microns to the slide. All electrical connections & hydraulic connection to respective cylinder & power pack are then made as per the requirements. Then all controls are given to PLC unit. The machine is safe guarded by outside frame.

9. Design of Experiment

9.1 Purpose of study

The Taguchi parameter design stage is the primary design applied in the study, and the purpose of this study is to efficiently determine the optimal face milling parameters to achieve the smallest surface roughness value for a SG Iron parts under varying conditions. The questions that this study will address include the following:

What are the relationships between the controllable factors (in the study: spindle speed, feed rate, and depth of cut) and the response factor (surface roughness)?

What are the optimal conditions of the milling parameters for surface roughness?

9.2 Experimental design

9.2.1 Orthogonal array and experimental factors

The first step in the Taguchi method is to select a proper orthogonal array. The standardized Taguchi-based experimental design, a $L_9(3^3)$ orthogonal array is used in this study. This basic design makes use of up to three control factors, with three levels for Spindle speed, feed rate and Depth of Cut. A total of nine experimental runs must be conducted, using the combination of levels for each control factor (A–C) as indicated in Table 3.

Table 3: The basic Taguchi $L_9(3^3)$ orthogonal array

Run	Control Factors & Levels			Run	Control Factors & Levels		
	A	B	C		A	B	C
1	1	1	1	6	2	3	1
2	1	2	2	7	3	1	3
3	1	3	3	8	3	2	1
4	2	1	2	9	3	3	2
5	2	2	3	-	-	-	-

The selected parameters are listed in Table 4 along with their applicable codes and values for use in the Taguchi parameter design study. The response variable is the dependent variable. The control factors are the basic controlled parameters used in a milling operation. The spindle speeds were selected from within the range of parameters for finishing milling of SG iron. Depth of cut was selected as per width requirement of workpiece after face milling operation. The feed rates were slightly lower than normally used for milling SG iron workpiece, in consideration of safety concerns.

Table 4: Parameters, Codes and level values used for orthogonal array.

Parameter	Code	Level 1	Level 2	Level 3
Control Factors				
Spindle speed, rpm (m/min)	A	360 (140)	410 (160)	460 (180)
Feed rate, mm/tooth	B	0.05	0.075	0.1
Depth of Cut , mm	C	2.63	2.68	2.72
Response Variable				
Surface roughness, Ra (μ)	—	—	—	—

9.2.2 Experimental set-up and procedure

After the orthogonal array has been selected, the second step in Taguchi parameter design is running the experiment. This experiment was conducted using the hardware listed as follows:

- CNC Duplex milling machine.
- Surface roughness measurement device: Federal Pocketsurf Stylus Profilometer
- (measures *Ra* in μ ; stylus travel 0.1 in. /2.54 mm).
- Cutting tool inserts: SPKN1203 coated carbide inserts (Ingersoll Cutting Tools).
- Tool holder: Vidia V40SPF 12-insert mill with 125mm cut diameter (for above inserts).
- Surface table: polished granite surface for more stable and accurate surface roughness measurements.
- Microsoft Excel and Minitab software packages for charting data and statistical analysis.

The 9 experiments were cut in a random sequence to better eliminate any other invisible factors that might also contribute to the surface roughness. A simple NC

program was written with different cutting conditions specified to have the milling of both face of workpiece. After each cut, the surface roughness was measured on the surface table with the stylus profilometer. Two fixed spots on each milled surface, one in the left and the other on the right, were used to measure the surface roughness of the cut, and the mean of the two readings was recorded in the orthogonal array.

9.3 Result and Analysis

Table 5: Complete orthogonal array.

Sr. No.	Coded Factor			Uncoded/Actual Factor			Response variabla (Ra)μ	S/N Ratio
	A	B	C	Speed	Feed	DoC		
1	1	1	1	140	0.05	2.63	2.08	-6.36127
2	1	2	2	140	0.075	2.68	2.12	-6.52672
3	1	3	3	140	0.1	2.72	2.43	-7.71213
4	2	1	2	160	0.05	2.68	2.083	-6.37379
5	2	2	3	160	0.075	2.72	2.129	-6.56351
6	2	3	1	160	0.1	2.63	2.133	-6.57982
7	3	1	3	180	0.05	2.72	2.098	-6.43611
8	3	2	1	180	0.075	2.63	2.451	-7.78687
9	3	3	2	180	0.1	2.68	2.459	-7.81517

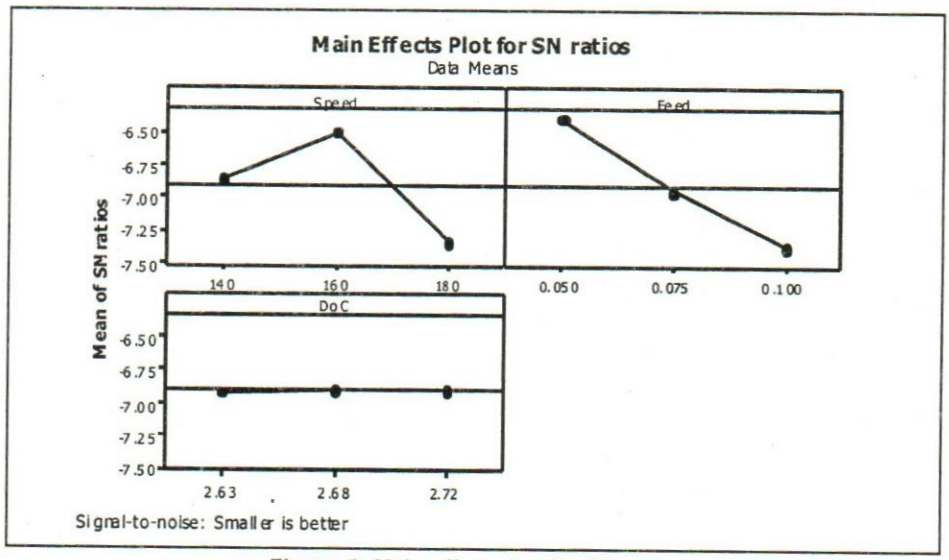

Figure 5. Main effect plot for SN ratio.

Table 6: Response Table for Signal to Noise Ratios Smaller is better

Level	Speed	Feed	DoC
1	-6.867	-6.390	-6.909
2	-6.506	-6.959	-6.905
3	-7.346	-7.369	-6.904
Delta	0.840	0.979	0.005
Rank	2	1	3

Table 7: Analysis of Variance for SN ratios

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Speed	2	1.06627	1.06627	0.533135	1.18	0.459
Feed	2	1.44922	1.44922	0.724609	1.60	0.384
DoC	2	0.00005	0.00005	0.000024	0.00	1.000
Residual Error	2	0.90515	0.90515	0.452576		
Total	8	3.42069				

The different values of S/N ratio between maximum and minimum are shown in Table 5. The feed rate and the cutting speed are two factors that have the highest difference between values, 0.979 and 0.840 respectively. Based on the Taguchi prediction that the larger difference between values of S/N ratio will have a more significant effect on surface roughness (Ra). Thus, it can be concluded that increasing the feed rate will increase the Ra significantly and also cutting speed. The results of data analysis of S/N ratio for Ra values, which are calculated by Taguchi method, are shown in Table 7. (where DF is degree of freedom, F variance ratio, and P significant factor). Thus, it is seen in Fig. 5 and Table 6 that the second level of cutting speed, the first level of feed rate and the third level depth of cut are higher. Consequently, the optimum cutting conditions are one with the largest S/N ratio which is -6.36127 therefore optimal cutting conditions are speed 140 m/min, feed 0.05 mm/tooth and depth of cut 2.63 mm.

9.4 Confirmation run

After the optimal levels of all the control factors were identified, the last step in Taguchi parameter design is conducting the confirmation run .The combination of the optimal levels of all the factors should produce the optimal magnitude of surface roughness (the smallest *R*a). This conclusion must be further supported through the confirmation runs. Fifteen samples were cut under the optimal parameter set-up in the study for the purpose of confirmation run. The optimal levels for the controllable factors were spindle speed 140 m/min, feed 0.05mm/tooth, depth of cut 2.63 mm. Table 8 shows the results of the confirmation run.

Table 8: The results of the confirmation run

Sample	Ra (μ)	Width (mm)	Sample	Ra (μ)	Width (mm)	Sample	Ra (μ)	Width (mm)
1	2.080	34.67	6	2.083	34.68	11	2.083	34.68
2	2.081	34.67	7	2.083	34.68	12	2.083	34.68
3	2.080	34.68	8	2.084	34.67	13	2.082	34.69
4	2.082	34.69	9	2.084	34.68	14	2.084	34.68
5	2.082	34.67	10	2.084	34.69	15	2.083	34.68

Compared with the experiment results in Table 8 the mean surface roughness of the 15 confirmation samples 2.082 ì (i.e. 81.97 ìin) and width of Lever 34.68 mm which was very close to required values. Therefore, the confirmation run indicated that the selection of the optimal levels for all the parameters produced the best surface roughness with required dimensional accuracy of the component. The cycle time measured with the help of stop watch for this machining operation is approximately 26 seconds including loading, machining, unloading and cleaning.

10. Costing Summary Sheet

Table 9: Total Cost

Sr. No.	Description	Cost (Rs.)
1	Raw Material	1,10,510
2	Bought Out Parts	6,68,820
3	Fabrication Cost	15,995
4	Machining Cost	90,530
5	Pattern Cost	2,500
5	Sheet metal	3,000
6	Labour Cost	65,000
7	Machine Painting	8,000
8	Transportation	10,000
9	Miscellaneous	10,000
	Total Cost (Rs.)	9,84,355

10.1 Estimate reduction Cost per component

10.1.1. For CNC Duplex milling machine.

A. Standing expenditure / fixed expenditure

1. Rent of machine – considering both the machine occupies the same space.
2. Working life in hours

Assuming machine will run for 7 years, 2 shifts = 39,312 working hours

Weight of machine = 1.5 ton
Material of machine = cast iron = 1,500 * 65
∴ Scrap Value = Rs. 97,500/-
Depreciation of Machine = 9,84,355 – 97,500
=8,86,855
=8,86,855/39,312
= Rs. 22.56 per hour

Administration charges

Supervisor, Manager, other than worker
= Rs. 9,000 per month = 9,000/468 = Rs. 19.23 /hr
Insurance charge (2%) = 9,84,355*0.02
=19,687.1 per year

Working hrs/year = 468 * 12 (month) = 5,616

Insurance charges per hour = 19,687.1 /5,616
= Rs. 3.51 / hr.

Common light = 2,000 / month = 2,000 / 468
= Rs. 4.27 /hr.

B. Variable expenses

1. Motor of Machine = 10 H.P = 7.5 Kw
= 7.5 * 7.5 = Rs. 56.25 / hr.

2. Tooling cost

Milling Inserts = (180*20) + 450 = Rs. 4050

Replacement of insert after every 4,000 components

Cost of Milling Inserts (B) = 4,050 /4,000
= Rs. 1.0125 / job * 18 = Rs. 18.225 / hr

∴ Cost of Tooling = 18.225/hr.

3. Other consumables = 6 months period of change

= 40 litres * Rs. 150 = Rs. 6,000

No. of working hours = 26*18*6 = 2,808
= 6,000/2,808 = Rs. 2.14 / hr.

Machine hour rate of CNC Duplex Milling Machine

= Fixed charge + variable charge

= (22.56+19.23+3.51+4.27) + (56.25+18.225+2.14)

= 49.56 + 76.615

= Rs. 126.19 / hr

For one component

= 126.19 / No. of components per hour.....(1246 component per shift)

= 126.19 / 138 component per hour

= Rs. 0.91 per component

10.1.2. For Duplex Milling Machine

A. Standing expenditures / fixed expenditures

1. Rent of Machine – considering both the machines occupy the same space
2. Working life in hours

Assuming machine will run for 7 years, 2 shifts
= 39,312 working hours.

Weight of Machine = 1.5 tons

Material of Machine = Cast Iron = 1,500 * 65

∴ Scrap Value = Rs. 97,500 / -

Depreciation of Machine = 6,00,000 – 97,500
= 5,02,500

= 5,02,500/39,312 = Rs. 12.78 / hr

Administration charge = 5,02,500 / 39,312
= Rs. 19.23 ...From I

Insurance charge (2%) = 6,00,000 * 0.02
= Rs. 12,000 / year

Working hour per year = 468 * 12 = 5,616

Insurance charge per hour = 12,000 / 5,616
= Rs. 214 per hour

Common light = 2,000 / month = 2,000 / 468
= Rs. 4.28 /hr.

C. Variable expenses

1. Motor of Machine = 5 H.P = 3.75 Kw
= 3.75 * 7.5= Rs. 28.13 / hr.
2. Tooling cost

Milling Inserts = (180*7) + 450 = Rs. 2,970 /-

Replacement of insert after every 4,000 components

Cost of Milling Inserts (B) = 2,970 /4,000
= Rs. 0.7425 / job * 18
= Rs. 13.37 / hr.

∴ Cost of Tooling = 13.37/ hr.

3. Other consumables = 6 months period of change = 40 litres * Rs. 150 = Rs. 6,000 No. of working hours = 26*18*6 = 2,808
= 6,000/2,880
= Rs. 2.14 / hr

Machine hour rate of Duplex Milling Machine

= Fixed charge + variable charge

= (12.78+19.23+2.14+4.28) + (28.13+13.37+2.14)

= 38.43 + 43.64 = 82.07

For one component = 82.07 / 48
= Rs. 1.71

The difference between CNC Duplex milling machine and Duplex Milling Machine can be said as saving in cost per component,

= 1.71 – 0.91 = 0.80

= Rs. 0.80 per component

11. Results & Conclusion

Here are the results:

Table 10: Comparative Statement

Method	Previous Method On Old Machine	Improved Method On Newly Developed Machine
Non Productive Time [Sec]	18 Sec	0 Sec
Machine Parameters	Milling Motor : 2 hp 2Nos, Feed: 0.01 mm/tooth using Hydraulic drive of 1 hp motor, Speed: 125 rpm, No. of Inserts: 7/cutter, No indexing mechanism, Manual Clamping.	Milling Motor : 5 hp 2Nos, Feed: 0.05 mm/tooth using Recirculating ball screw & 1 hp servomotor, Speed: 360 rpm, No. of Inserts: 10/cutter, Turret indexing mechanism (BTP 100), Hydraulic Clamping.
Machining Time / Component	60 Sec	26 Sec
No. Of Jobs / Shift	440	1246
Labour Required	1 Skilled	1 Unskilled

1. The Reduction in cycle time achieved = **56.66 %**
2. The Improvement in Production rate achieved = **64.69 %**
3. The Reduction in manufacturing cost achieved = **Rs. 0.80 per component**

Thus, from the above it is concluded that the newly developed CNC Duplex milling machine has delivered a substantial inerease in productivity of the manufacturing process under study.

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In short, intelligence, considered in what seems to be its original feature, is the faculty of manufacturing artificial objects, especially tools to make tools, and of indefinitely urging the manufacture. — ***Henri Bergson***

Focus

Indian Hometech Industry: A Trade Perspective

ASIYA CHAUDHARY

The use of textile in industry for specific purposes like human protection from extreme situations are called that are used in high-tech products and processes.

Of the twelve segments of technical textiles, this paper explores the hometech industry which comprises of the textile components used in the domestic environment, interior decoration and furnishing. Though this industry is still in its nascent stage, the production of various Hometech products is continuously swelling due to an evergrowing consumption. This has also boosted imports from different countries, particularly China. It is observed that the exports have also been growing in the past decade. This paper goes on to investigate statistically whether the increase in exports & imports is significant or not, in the context of change in international trade of Indian Hometech Industry with the world in general and with USA and China in particular between 2002-12.

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Introduction

Generally, the textile industry is considered as an industry fulfilling clothing requirements of human beings for protection and to improve aesthetic sense. This sector is known as *traditional textile or general textile*. On the other hand, use of textile in industry for specific purposes associated with human protection from extreme situations, for example waterproof jackets, filters, fire proof seats etc., are called *technical textile, industrial textile, and functional textile*.

The core technical textiles comprise of specially designed and engineered textiles that are used in high-tech products and processes, or even more technically these qualify due to the following criteria (by IMACS):

- Products that have high-tech end-use application; and
- Products that require advanced manufacturing technology.

Of the twelve segments of Technical Textiles, this paper explores the Hometech Industry. Hometech segment comprises of the textile components used in the domestic environment, interior decoration and furniture, carpeting, protection against the sun, cushion materials, fire proofing, floor and wall coverings, textile reinforced structures/fittings, filter products for vacuum cleaners, etc. They are made of both natural and synthetic fibers that kill dust mites in bedding, repel dirt and contain antimicrobial qualities (http://technotex.gov.in/hometech.html). While the basic functions remain unchanged, Hometech makes such products more complex, multifunctional and even more intelligent by adding various functional properties.

Though this industry is still in its nascent stage, the production of various Hometech products is continuously swelling due to an ever-growing consumption. This has also boosted imports from different countries especially

China. It is observed that the exports have also been growing in the past decade. The paper goes onto investigate statistically whether the increase in exports & imports issignificant or not.

Hometech Industry

In the past years the Hometech industry has been witnessing tremendous growth. It is the third largest segment. At a global level, it has contributed about 7 percent of the share (David Rigby Associates, 2010), whereas in India it has accounted for about 6 percent of the total technical textile market in 2004, growingto 12 percent in 2011. (Report of the Expert Committee on Technical Textiles (2004), Vol. 1, Ministry of Textiles, Government of India, New Delhi. p.111)

The products covered under Hometech are as given below:-

1. Fiberfil
2. Carpetbackingcloth (Jute & Synthetic)
3. Stuff toys
4. Blinds
5. HVAC filters
6. Filtercloth for vacuum cleaners
7. Mattress and pillow components
8. Non-woven wipes
9. Mosquito nets
10. Furniture fabrics

IMACS has prepared a list of Hometech products classified as core technical textiles based on the above criteria (Final Report on Baseline Survey of the Technical Textile industry in India (2009), March, Office of the Textile Commissioner).

As per CRISIL Research's estimate, the Hometech industry in India stood at around Rs. 75 billion in 2010-11, with furniture fabric being the largest segment, accounting for a 38 percent share of the industry. In future, the growth in this segment shall be driven by an increase in the number of addressable households and a simultaneous increase in household income levels. The fastest growing products under the Hometech segment over the next 3 years would be stuffed toys and HAVAC filters (CRISIL CRB (2012), Sector Focus: Textiles, **http://crisil.com/pdf/research/CRISIL-Research-cust-bulletin_jan12.pdf** pp. 1-2.).

Hometech Textiles: Global Overview

The markets for most traditional Hometech products are fairly mature in Western economies. However, as disposable incomes have increased and the relatively wealthy middle classes have grown in number in many developing countries, the growth in the market for hometech has already accelerated. This has in turn promoted the expansion of local manufacturing both for the finished products and for the supporting Hometech supply chains.

India and China have demonstrated the highest growth rates of Hometech over recent years and are forecasted to continue to grow at about 5% per annum in the short term and shall be further boosted. This has lead to increased trade opportunities for low-cost suppliers into the more developed markets, and has also created opportunities for established manufacturers in the West to expand their export business into the developing markets. Further, it has led to increased investment in this industry.

Table 1 exhibits the global market size of Hometech textiles from the year 2000 to 2012, which was estimated by David Rigby Associates, International Consultants, who are the only agency following technical textiles.

Table 1: Global market size of Hometech textiles (2000-12)

Years	Volume (000 tonnes)	value (US $ million)
2000	2186	6750
2005	2499	7622
2007	2634	8086
2010	2853	8778
2012	3009.1	9006.3
CAGR (%)	2.7	2.66

Source: David Rigby Associates. (2010). Technical Textiles and Non wovens: World marketforecasts to 2010. RetrievedFebruary 4, 2012, fromhttp://www.fibre2fashion.com/industry-article/pdffiles/Technical-Textiles-and-Nonwovens.pdf. p.8.

The increase in the market size also reflects the increase in the consumption levels of the Hometech products. Table 2 shows the rise in end-use consumption of Hometech textiles in various regions like North America, South America, Western Europe, Eastern Europe, South Asia, North East Asia, South East Asia and the rest of the World. It gives an analysis of Hometech by region from year 1995 to 2010 with CAGR (%). The world consumption of Hometech from year 1995 to 2010 has increased significantly.

Table 2: World Hometech consumption, 1995-2010, by region in volume terms (000 tonnes)

Region	Year												CAGR (%)		
	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	95-00	00-05	05-10
North America	801.8	903.6	911.9	917.4	950.4	983.6	1018.9	1040.2	1057.8	1075.2	1092.4	1109.9	2.4	2.4	1.7
South America	53.3	66	67.3	68.8	72.5	76.7	80.9	85.5	90.1	95	99.9	105.1	4.4	4.2	5.4
Western Europe	553.1	675.9	692	703.4	719.3	738.7	758.7	774.8	791	807.1	823	839.3	4.1	2.3	2
Eastern Europe	35.6	40.5	42.2	44.2	46.5	48.9	51.4	54.8	58.3	62	65.9	70.1	2.6	4.9	6.4
South Asia	34.8	50.4	53.6	57.1	61.6	66.4	71.4	77.2	83.4	89.9	96.8	104.2	7.7	7.2	7.9
North East Asia	234.8	284.3	289	293	303.3	314.6	326.7	338.5	351.5	365.1	379.2	394.1	3.9	2.8	3.8
South East Asia	28.8	37.5	38.8	40.3	43	45.8	49	52.3	55.9	59.7	63.6	67.7	5.4	5.5	6.7
Rest of the World	121.3	127.7	129.3	131.5	134.6	138.1	141.6	145.5	149.5	153.7	158.1	162.8	1	2.1	2.8
Total	1863.6	2185.9	2224	2255.7	2331.2	2412.7	2498.6	2568.7	2637.6	2707.7	2778.9	2853.1	3.2	2.7	2.7

Source: David Rigby Associates. (Personal Communication, 2003).HOMETECH: Technical components for Furniture, interior textiles and floor covering.

The major consumers of the Hometech products are America, followed by Britain and Asia. Over 42.58% of consumption was found in North and South America followed by Western and Eastern Europe with a share of 32.2% and South Asia, North East Asia and South East Asia, together representing a share of 20%, while rest of the world constitutes a share of 5.7% only (David Rigby Associates, 2003).

Review of Literature

The researcher, after critically examining various published and unpublished works related to the study undertaken, estimated the existing research gap. Following is the list of published work which helped the researcher to find the research gap and work further to bridge that gap.

Patel, Milin (2012) reviewed in the paper "Technical Textiles in India" that the technical textile industry in India is said to be its initial stage as it contributes only 3% of total consumption. But, it would be wrong to say that India's technical textile industry is still sleeping.

Nemoz (2001) in a presentation on "Applications and markets of Technical Textiles: Actual situation and Trends" discussed the steps of designing of a technical textile products, end users of Technical Textiles and four main classes of functions for technical textile such as mechanical functions, exchange functions, functionalities for living beings and protective functions.

Chaudhary, Asiya and Shahid, Nazneen (2011) in their paper entitled" Technical textiles industry in India: Special reference to Hometech Industry", attempted to suggest that the government has to get more active and participate in the promotion of the sector.

Malik, Tanveer, *et.al* (2012) discussed in their paper "Mosquito Repellent Textiles: An Overview" that to ensure our security and safety from future hazards, we need to equally develop the technology for our protection.

Chaudhary, Asiya and Shahid, Nazneen (2011) in their paper entitled" Technical textiles industry in India: Special reference to Hometech Industry", attempted to suggest that the government has to get more active and participate in the promotion of the sector Adding that without its intervention at a broader scale things cannot be sorted out.

Not much work has been done on this segment. The review of literature reveals a gap in so far as there is no study is specific in dealing with the Hometech segment of the Technical textiles in India. Nor does any work reviewed

tried to examine the trade of the Hometech industry in India in the international market, especially in comparison with USA and China. The present study is an earnest attempt in the direction of bridging this gap.

Objective of the Research

1. To identify the key trade variables of the Hometech industry;
2. To analyse the trends of trade variables i.e Production, Import, Export and Trade balance of the industry with the rest of the world;
3. To analyse the trends of the trade variables i.e Import and Export of Hometech industry with special reference to USA and China in particular;
4. To validate the hypotheses framed on trade variables of the industry with the world and specifically with USA and China;

Hypotheses of The Research

HO1: There is no significant difference in the value of export and import of hometech products of India with the rest of the world from 2002 to 2012.

HO2: There is no significant difference in the value of Export & Import of hometech product of India with USA

HO3: There is no significant difference in the value of Export & Import of Hometech product of India with China

Approach & Methodology

A quantitative, descriptive approach is adopted in this study. The data and information collected during course of the study is obtained from secondary sources which are given as under:

1. Database of Ministry of Textiles of India;
2. Database of Ministry of Commerce & Industry of India;
3. Federation of Indian Chambers of Commerce and Industry (FICCI), New Delhi;
4. The Associated Chambers of Commerce and Industry of India (ASSOCHAM), New Delhi;

The data required for the study is obtained mainly from the prospectus, pamphlets, various websites and annual reports of various institutions and organizations.

The data is analyzed with the help of Statistical Package for the Social Sciences (SPSS). To validate the hypothesis and analyze the data collected from various sources, appropriate statistical tools have been applied. Percentage, standard deviation, and Paired sample T-test have been applied to analyse the data.

Period of The Study

The data is collected from 2002-2012 from various sources as mentioned above.

Results and Discussion

- In India the Hometech industry has shown a substantial improvement. There has been an increase in the demand and consumption (Table 2) of the Hometech products in the country. This in turn has given a boost to the production and imports to meet the demand. Improvement in the production has lead to improvement in exports of the industry products. This can be judged by the data represented in Table 3, which details the production, import, export and trade balance of Hometech industry in India with the rest of the world from 2002-03 to 2011-12.
- In Table 3, we observe that the exports grew up sharply from 146.52 Cr. in 2002-03 to 3299.54 Cr. in 2011-12. In terms of rate of growth there was a big jump from 2002-03 to 2003-04 i.e. by 953.04% but gradually this slowed down. It can be seen that in some of the year's growth was even negative but in the last years it went up by 29.86%.
- Similarly, there is a big leap in the imports (Table 3) in the first two years where it has gone up by 135.63% in the year 2003-04 from the year 2002-03. Though imports grew in the later years consistently but from 2010 to 2012 there was a substantial increase by 41.97 %. On the other hand on analyzing the trade balance of the industry it is found that though it was positive in the former years, this later remained negative continuously in the last six years. It may be due to the fact that figures of imports always remain higher than exports. Value-wise around 13% of the total consumption is imported. As per volume, 67% of HVAC filters consumed are imported whereas the value-wise import of non-woven wipes is 80% of the total consumption. Majority of imports are from Germany and Netherland (HVAC filters) and China. Majority of wipes are imported from China and Singapore.
- In order to determine the variation in the value of export and import of hometech products since 2002 with the rest of the world, paired sample t-test is used. Table 4 shows the Mean value and Standard Deviation of Indias export of hometech product to

Table 3: Production, Export, Import and Trade balance and their growth (%) from 2002 to 2012

YEARS	Production (Values in Rs. Cr.)	Production Growth (%)	Export (Values in Rs. Cr.)	Export Growth (%)	Import (values in Rs. Cr.)	Import Growth (%)	Trade Balance (Values in Rs. Cr.)	Trade balance growth (%)
2002-03	883.39		146.52		165.52		-19	
2003-04	1029.72	16.56	1542.91	953.04	390.01	135.63	1152.9	-6167.89
2004-05	1199.77	16.51	2015.85	30.65	529.17	35.68	1486.68	28.95
2005-06	1397.89	16.51	1106.69	-45.10	782.16	47.81	324.53	-78.17
2006-07	1628.74	16.51	2578.16	132.96	1070.02	36.80	1508.14	364.72
2007-08	5025.00	208.52	2712.05	5.19	1346.22	25.81	1365.83	-9.44
2008-09	3797.52	-24.43	2294.63	-15.39	1732.84	28.72	561.79	-58.87
2009-10	4321.10	13.79	2114.83	-7.84	1825.32	5.34	289.51	-48.47
2010-11	4844.68	12.12	2540.84	20.14	2444.82	33.94	96.02	-66.83
2011-12	7831.00	61.64	3299.54	29.86	3470.80	41.97	-171.26	-278.36

Source: (1) Production Data from 2002-03 to 2007-08: Ministry of Textiles. (2006). Report of the working group on Textiles & Jute industry for the Eleventh Five year plan (2007-12). New Delhi: Ministry of Textiles, Government of India. p. cxvi.
(2) Production Data for the years 2007-08 and 2011-12: Ministry of Textiles. (2011). Report of the working group on Textiles & Jute industry for twelfth five year plan (2012-17), Chapter 16. New Delhi: Ministry of Textiles, Government of India. p. 265.
(3) Production Data for the years 2008-09, 2009-10 and 2010-11 have been calculated by the researcher using interpolation.
(4) Export and Import: Government of India, Ministry of Commerce and Industry, Department of Commerce, Country – wise Export Import Data Bank.

Table 4: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Export	2035.2020	10	903.86642	285.82766
	Import	1375.6880	10	1025.31844	324.23416
Pair 2	Export	2035.2020	10	903.86642	285.82766
	TB	659.5140	10	656.03532	207.45658
Pair 3	Import	1375.6880	10	1025.31844	324.23416
	TB	659.5140	10	656.03532	207.45658

the rest of the world (Mean = 2035.2020, Std.Deviation=903.86642) and Indias import of hometech product from the rest of the world (Mean = 1375.6880, Std. Deviation = 1025.31844). The mean value of exports is comparatively more than the mean value of imports. Further in Table 5, on applying the paired sample t-test, the t-value is 3.179 and significant value (2 tailed) is 0.011 which is less than 0.05 (95% CI), which implies that the variation in Indias export and import of hometech product with the rest of the world is statistically significant. Hence, the null hypothesis (HO1) that there is no significant difference in the value of export and import of hometech products since 2002 with the rest of the world is rejected and the alternate is accepted. Therefore, t may be concluded that there is a significant difference in the value of export and import of hometech product since 2002 with the rest of the world. It is also observed that the exports of Hometech products have been much more than imports.

Table 5: Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	export - import	659.51400	656.03532	207.45658	190.21460	1128.81340	3.179	9	.011
Pair 2	export - TB	1375.68800	1025.31844	324.23416	642.21937	2109.15663	4.243	9	.002
Pair 3	import - TB	716.17400	1465.04130	463.28674	-331.85341	1764.20141	1.546	9	.157

Table 6: Indian Hometech Export and Import with USA

Years	Export	Growth (%)	Imports	Growth (%)
2002-03	3,691.17		508.07	
2003-04	56,222.54	1423.16	2,009.41	295.50
2004-05	66,386.00	18.08	2,394.92	19.19
2005-06	87,254.60	31.44	2,485.71	3.79
2006-07	67,685.88	-22.43	3,052.50	22.80
2007-08	66,054.29	-2.41	3,840.44	25.81
2008-09	49,290.91	-25.38	7,755.16	101.93
2009-10	33,582.32	-31.87	10,010.12	29.08
2010-11	50,129.28	49.27	8,803.31	-12.06
2011-12	58,881.54	17.46	12,151.46	38.03
Total	539,178.53		53,011.10	

Source: Government of India, Ministry of Commerce and Industry, Department of Commerce, Country - wise Export Import Data Bank.

- After studying the Indian Hometech trade with the world in general, later, data was tested to analyse Indian Hometech trade with USA in particular i.e. to verify the second hypothesis that there is no significant difference in the value of export of hometech product between India and USA. Table 7 demonstrates that the Mean value and Standard Deviation of India's export of hometech product to USA (Mean = 53917.8530, Std.Deviation = 22621.54898) and India's import of hometech product from USA (Mean = 5301.1100, Std. Deviation = 4010.54969). India's export of hometech product to USA has the highest Standard Deviation of 22621.54898. This confirms a positive increment in India's export of hometech product to USA as compared to import. Further Table 8 shows the t-value which is 6.647 and significant value (2 tailed) is 0.000 which is less than 0.05 (95% CI), it implies that the variation in India's export and import of hometech product with USA is statistically significant. Hence, the null hypothesis is rejected and alternate hypothesis that there exists a significant difference in the value of export and import of hometech product between India and USA stands accepted. Hence, it may be concluded that Indian Hometech exports to USA are significantly higher than what it imports from her.

Table 7: Paired Samples Statistics between Indian Hometech Export and Import with USA

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	EXPUSA	53917.8530	10	22621.54898	7153.56190
	IMPUSA	5301.1100	10	4010.54969	1268.24717

Table 8: Paired Samples Test between Indian Hometech Export and Import with USA

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	EXPUSA - IMPUSA	48616.74300	23128.58231	7313.89992	32071.55192	65161.93408	6.647	9	.000

Table 9: Indian Hometech Export and Import with China

Years	Export	Growth (%)	Imports	Growth (%)
2002-03	324.98		2,985.93	
2003-04	303.24	-6.69	10,421.08	249.01
2004-05	2,281.05	652.23	18,997.98	82.30
2005-06	497.88	-78.17	41,699.13	119.49
2006-07	5,651.36	1035.08	61,869.95	48.37
2007-08	2,029.28	-64.09	78,998.86	27.69
2008-09	1,185.03	-41.60	106,901.75	35.32
2009-10	608.46	-48.65	115,640.52	8.17
2010-11	1,000.13	64.37	159,878.13	38.25
2011-12	2,039.47	103.92	241,660.97	51.15
Total	15920.88		839,054.30	

Source: Government of India, Ministry of Commerce and Industry, Department of Commerce, Country - wise Export Import Data Bank.

- The next analysis is to study Indian Hometech trade with China in particular i.e. to verify the third hypothesis that there is no significant difference in the value of Export & Import of Hometech product

Table 10: Paired Samples Statistics between Indian Hometech Export and Import with Chin

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	EXPUSA	1592.0880	10	1608.70075	508.71584
	IMPUSA	83905.4300	10	75015.93092	23722.12025

between India and China. Table 10 demonstrates the Mean value and Standard Deviation of India's export of hometech product to China (Mean = 1592.0880, Std. Deviation = 1608.70075) and India's import of hometech product from China (Mean = 83905.4300, Std. Deviation = 75015.93092). India's import of hometech product from China has the highest Standard Deviation of 75015.93092. This confirms a positive change in the value of imports of hometech products between India and China in comparison to exports. Further Table 11 calculates the t-value which is 3.475 and significant value (2 tailed) is 0.007 which is less than 0.05 (95% CI), it implies that the difference in India's export and import of hometech product to and from China is statistically significant. Hence, the null hypothesis is rejected and alternate hypothesis that there exist a significant difference in the value of export and import of hometech product between India and China stands accepted. Hence, it may be concluded that Indian Hometech imports from China are significantly higher than what it exports to the country.

As per the reports of the base line survey, the exports in the Hometech segment are not very significant; value-wise around 6% of the production is exported. Fiberfil, which exports 9% of its production volume and furniture fabrics, which exports about 14% of its production value are the only products with significant export. The key export markets are the US and Argentina (Final Report on Baseline Survey of the Technical Textile industry in India (2009), March, Office of the Textile Commissioner http://technotex.gov.in/Revised_Final_ Report_ Baseline_ Survey_

Table 11: Paired Samples Test between Indian Hometech Export and Import with China

		Paired Differences			Paired Samples Test		t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	EXPUSA - IMPUSA	-82313.34200	74896.60677	23684.38664	-135891.14689	-28735.53711	-3.475	9	.007

of_Technical_Textile% 20industry_in_ India.pdf, pp. 381-420.) In the past decade the imports from China has substantially increased. The increase has been sharper since 2007-08 onwards (Table 9). Whereas on the other hand not much fluctuation or rather improvement can be observed in imports from USA (Government of India, Ministry of Commerce and Industry). This indicates that for Indian Hometech importers China is better in terms of trade and price.

Conclusion

On the basis of the conclusions drawn statistically, we find that Indian Hometech industry is exporting significantly to USA markets and importing heavily from China.

This implies that our market for exporters is concentrated in USA. Too many eggs in one basket may prove fatal. That implies that Indian Hometech exporters would suffer largely if the USA market gets disturbed. For example, the impact of recession or slowdown in USA gave a drastic blow to our exporters. For this it may be recommended that markets must be further explored and diversified. More stable and consistent markets must be captured; to cater new markets, there is a requirement of not only continuous innovation process and product differentiation but it becomes important to understand the macro business environment of that country also.

Since the Indian industry is dominated by small-scale Hometech firms, it can optimally cater small orders initially. In order to negotiate better in new markets it also becomes important for sellers to thoroughly understand and follow,' Supply chain management. This will surely facilitate in

grappling more share in the market. The exporters, by providing qualitative services, after sales services, discount and festive offers, most reasonable/competitive prices, etc. can create and later increase loyalty of their customers. Once moving in this direction, things can be handled more profitably with better chunk of the diversified market throughout the globe.

Considering the global scenario, for Indian Hometech industry its major marketplaces are US and Europe. But, India to be the market leader needs to surpass China, which is its biggest competitor as well as exporter. Too much concentration/dependence on any country for its imports might prove fatal for any industry. It is found by interviewing importers, that most of the raw material for Hometech products are either imported or purchased from well established, large scale manufacturers, mostly from China. The industry is heavily dependent on imports of spare parts that cannot be manufactured here. Indian Hometech industry is technologically backward and therefore cannot produce technical products. On the other hand whatever that can be produced is very costly. China exports at very competitive prices. To produce at low cost, the industry needs to strengthen its 'Research and Development' segment. Presently the India Hometech industry is spending huge amount on importing technology & spare parts that cannot be developed here. This heavily adds to the cost of production. Once investment is done in R&D, much outflow of capital can be saved and at the same time dependency on foreign suppliers will be reduced. Business people and investors must be promoted and encouraged by the government through various promotional schemes e.g. tax holidays/concessions, SEZ, FTZ, etc., to produce the inputs which are imported after paying high prices. If such items are manufactured here, it will significantly help the buyers to reduce their costs.

To conclude, the industry has immense potential for development and expansion in the near future. Earlier, the industry's growth was quite submissive in overall participation in the world textile market. But today, this industry has a very contemporary outlook, with many effective strategic policies to compete the global market. By summing it all, India is now completely geared up and is propelling towards humongous growth of the overall industry.

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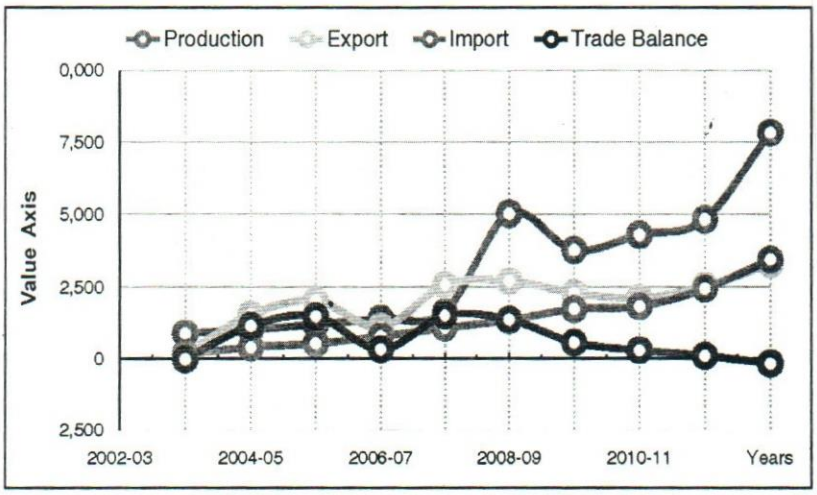
There is nothing so useless as doing efficiently that which should not be done at all.

—Peter F. Drucker

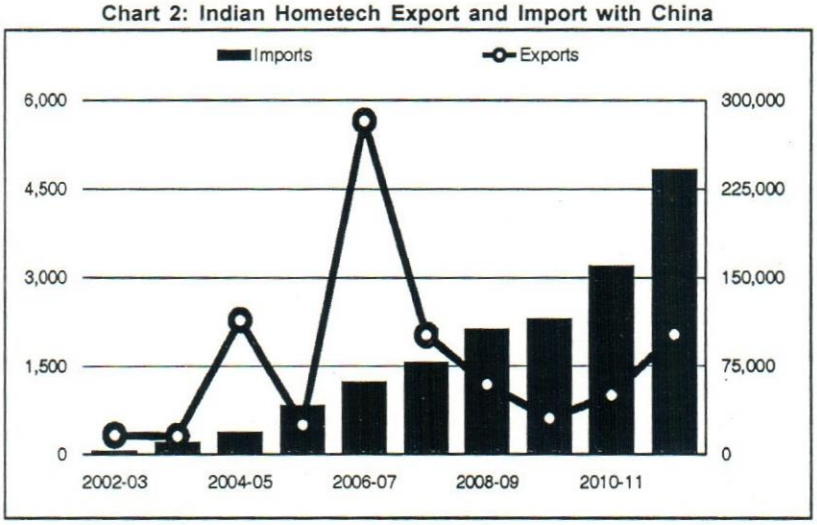
APPENDIX

Chart 1: Production, Export, Import and Trade balance of Hometech industry (2002-12)



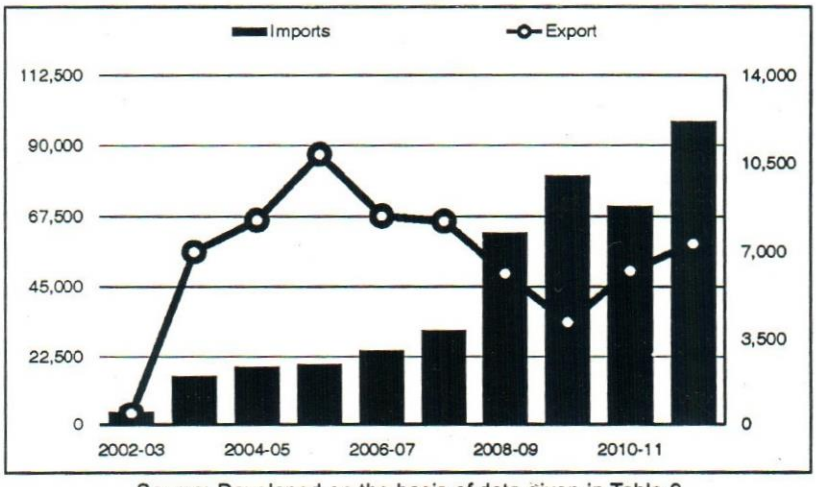
Source: Developed on the basis of data given in Table 1.

Chart 2: Indian Hometech Export and Import with China



Source: Developed on the basis of data given in Table 6.

Chart 3: Indian Hometech Export and Import with USA



Source: Developed on the basis of data given in Table 9.

Focus

Export Performance of India's Small-Scale Manufacturing Industries under Globalization

UMA SANKARAN

India is one of the developing countries that has undertaken a series of institutional interventions towards developing a vibrant Small Scale Industries (SSI) sector. However, the business environment has changed drastically since 1990s, with the initiation of market-oriented reforms that led to intense competition resulting in the removal of protective barriers for the SSIs. Under the new environment of heightened competition, the SSIs sustainability in terms of production, exports and employment depends upon their competitiveness. This paper examines the international competitiveness of India's SSI manufacturing sector through an exploratory analysis of its export performance under globalization.

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Introduction

In India, Micro, Small and Medium Enterprises (MSMEs[1]) contribute about 8 per cent of the GDP of country, about 45 per cent of the manufactured output and about 40 per cent of exports (Annual Report of MSMEs, 2010-11). For many decades, global business was considered to be the domain of large and multinational enterprises. However, increasingly there is a realization that small-scale firms are playing an important role in international business. In particular, even with the pressure of globalization pulls and pushes, the small-firms are surviving in the international market (Mtigwe, 2006). Small-Scale Industries (SSIs) have rapidly expanded their business to international markets and have used international diversification as an important strategic option to achieve growth (Masum and Fernandez, 2008). For developing countries, integration into the global economy through economic liberalization was seen as an important way to overcome poverty and inequality. Essential to this process is the development of a vibrant private sector, in which SSIs play a central part (Raynard and Forstater, 2002).

India is a pioneer in assigning a strategic role to SSIs in its industrialization process and development (Subrahmanian, 1995). Government policies have played an important role in ensuring a level playing field between small and large-scale industries, which provided a protective environment to the SSIs. There were notable efforts viz. quantitative restrictions on a number of products manufactured by the SSIs, tariff exemption and preferential treatment in government purchases and so forth, for promoting of SSIs primarily with a view to generate employment. However, the business environment has

[1]At the outset, it needs to be mentioned that micro and medium enterprises have been introduced in India under MSMEs Development Act, 2006. However, this study is only on the SSIs manufacturing sector, which will be discussed in detail.

changed drastically since the 1990s with the initiation of market-oriented reforms that has led to heightened market competition in SSIs inter alia by removal of all protective barriers. In the current context of a liberalizing economy that is, attempting to industrialize within the spaces provided by a world capitalist system, export of manufactured goods is the key to industrial transformation (Morris et al., 2001). This attempt is important for countries like India, which are characterized by resource scarcity and surplus labour. If small firms have to continue well in terms of production, exports and employment in the globalized competitive environment, they have to be competitive (Subrahamanya et al. 2002 and Bhavani, 2002). It is the relationship among the small firms and with the rest of the world that create environment for survival and successful operation of the small industry (Subrahmanian and Pillai, 1994). The primary objective of the SSI policies during the nineties would be to impart more vitality and growth-impetus to the sector to enable it to contribute to the economy, particularly in terms of growth of output, employment, and exports (Joseph and Sankaran, 2014). The plan recognizes that the achievement ambit of these laudable objectives in a globalised context is possible only through enhancing international competitiveness. Hence, the important question is how are they placed in the globalized era? Although, the importance of SSIs to participate in the export market highlighted, except few studies on SSIs export performance (for instance, Morris et al., 2001; Das and Pradhan, 2009 and Subrahmanya, 2011), majority of the empirical studies in India focused on analyzing the structure and performances of smaller units (Sandesara, 1993; Subramanian and Pillai 1994; Subrahmanya, 2004 among others). It is due to sparse research on the external oriented performances of SSIs that this study has been conducted.

Data

The study used various issues of Annual Reports published by the Ministry of MSMEs, Government of India. Hence, the period of analysis depends upon the availability of data. For the disaggregated analysis the study used large unit level data set of Third Census of SSIs (2001-02) and Fourth Census of MSMEs (2006-07)[2]. This is the only data set provides information on SSIs exports. Third and Fourth Censuses follows different definitions of SSIs[3]. To make the Fourth Census data consistent with the Third census, from the former dataset, we have extracted only the manufacturing enterprises with investment in plant and machinery up to 100 lakhs. Further, third census covered only direct exporters, hence, we do not include indirect exporters from the Fourth census. However, the exporters who are using both direct as well as indirect channels to exports have been included.

SSI Policies

The 'New Economic Policy' in July 1991 showed a sign of paradigm shift from centralized planning and regulatory regime to market-oriented economy. Though liberalization ends the protective measures for SSIs, there are policies introduced to promote competitiveness by addressing the basic concerns of the sector, namely, technology, finance, and marketing. In case of strategies attempt to promote exports, SSIs has been accorded as a high priority in India. For instance, Market Development Assistance (MDA) scheme, which is currently operated by the Ministry of Commerce to encourage exporters (including MSME exporters) to access and develop overseas markets. The scheme offers funding for participation in international fairs/ exhibitions, study tours abroad, trade delegations, publicity. Similarly, there are other schemes like ISO 9000/ ISO 14001/ HACCP certifications, Training Programme in Packaging for Exports introduced by the Ministry to encourage small-exporters[4]. The success of any policy can be judged on the basis of the achievement of its objectives. In this context, the primary objective of the policies mentioned here is to improve the competitiveness of MSMEs both domestically and globally. A measure of success of globalization forces winning over the MSMEs is clearly the performance of exports (Das, 2008). Hence,

[2] Though the Census covers both registered (under District Industries Centre) and unregistered SSIs, the study focuses only registered SSIs.

[3]Third census defines SSI as an industrial undertaking in which the investment in fixed assets in plant and machinery, whether held on ownership terms, or on lease, or by hire purchase, does not exceed Rs. 10 Million as on 31.3.2001. Fourth census defines, a micro enterprise, where investment in plant and machinery does not exceed twenty-five lakh rupees. A small enterprise, where the investment in plant and machinery is more than twenty five lakh rupees but does not exceed five crore rupees and a medium enterprise, where the investment in plant and machinery is more than five crore rupees but does not exceed ten crore rupees.

[4]For details see dcmsme.gov.in

Table 1: Growth Rate and Share of Exports of Small Scale Industries

(Value in US$ billion)

Year	India's Total Exports	Exports from SSIs	Percentage Share	Growth Rate
1990-91	18.15	5.39	29.68	
1991-92	18.00	5.67	31.52	5.32
1992-93	17.52	5.80	33.12	2.29
1993-94	22.24	8.07	36.28	39.05
1994-95	26.33	9.26	35.16	14.74
1995-96	31.79	10.90	34.29	17.77
1996-97	33.47	11.06	33.03	1.40
1997-98	35.01	11.96	34.16	8.16
1998-99	33.22	11.64	35.05	-2.64
1999-2000	36.82	12.51	33.97	7.44
2000-01	44.56	15.28	34.29	22.15
2001-02	43.83	14.94	34.09	-2.22
2002-03	52.72	17.77	33.71	18.98
2003-04	63.84	21.25	33.28	19.56
2004-05	83.54	27.69	33.15	30.31
2005-06	103.09	33.93	32.92	22.55
2006-07	126.26	40.31	31.92	18.78
2007-08	162.98	50.20	30.80	24.54

Source: Various issues of Annual Report, Ministry of MSME

Note: The data for the period up to 2005-06 is SSIs. Subsequent to 2005-06, data with reference to MSMEs are being compiled.

the next section measures the competitiveness of SSIs using export performance as an indicator.

Export Performance of SSIs

Table 1 provides the export performance of the SSI sector. If the available data is any indication, though the share of SSI exports in total exports has gone up steadily over the years, the performance in relative terms lagged behind the economy as a whole during globalization. The share of SSI exports in India's exports has increased from 29.68 per cent in 1990-91 to 33.12 per cent in 1992-93. After reaching the level of 36 per cent in 1993-94 it declined to 33 per cent in 1996-97 and then hovered around 33 per cent still 2004-05. Then, SSIs share in India's export has reduced to around 30 per cent in 2007-08. Further, SSI production which is diverted into export market or export intensity has increased from 12 per cent to 25 per in 1993-94 (Figure 1). This is the period when the share of exports of SSIs in India's exports was also increased. Then, followed by the ups and downs, the export intensity has reached the level of 30 per cent in 2005-06 and had a fall in 2007-08. Though the share of exports of SSI in total exports has increased over the years, the growth rates of exports reveals that there have been massive fluctuations over the period. The growth rate of exports has reached the peak of 39 per cent in 1993-94 and then reduced to 24 per cent in 2007-08. From this table, it can be noted that,

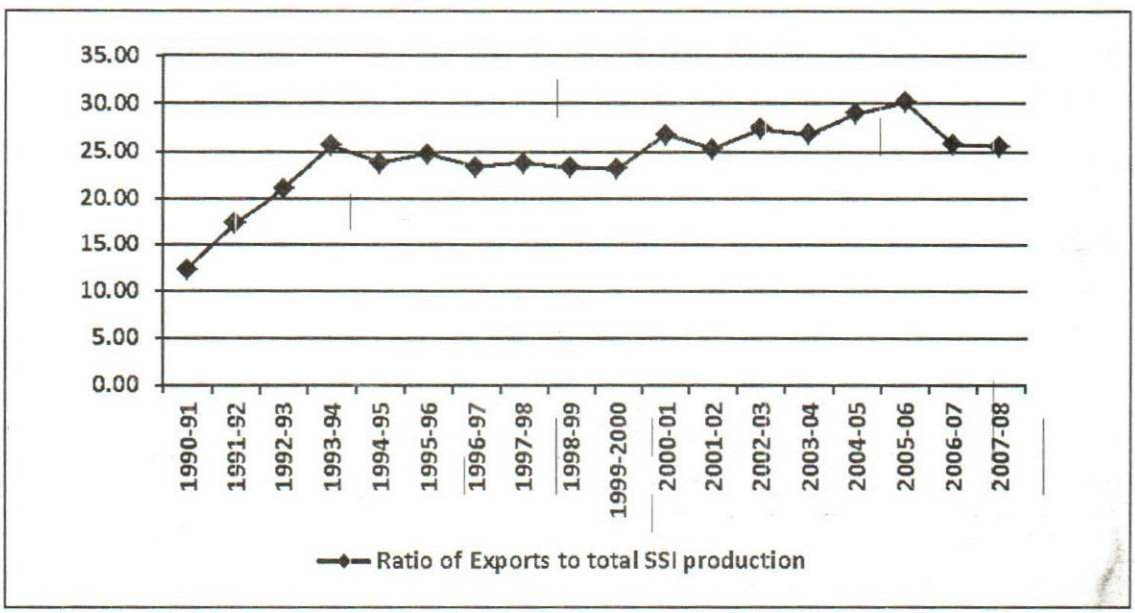

Figure 1: Percentage Share of exports in the production of small scale sector

Source: Same as Table 1

Table 2: Compound annual growth rate in the selected indicators of SSI sector (percentage)

Period	No. of Units	Employment	Fixed Investment	Production [a]	Exports from SSI [b]
1990-91 to 1999-2000	4.07	4.19	-5.18	2.31	9.81
2000-01 to 2012-13	13.61	13.24	17.96	15.44	18.52
1990-91 to 2012-13	9.17	9.03	7.05	8.87	14.03

Source: Same as Table 1.

[a] Growth rate of production is for the period 1990-91 to 2010-11.

[b] Growth rate of export is for the period 1990-91 to 2007-08.

Note: The values of 2007-08 to 2012-13 are projected data.

over the years, there has been a stagnation of MSMEs share of exports in total exports and it is reflected in the reduction of growth of exports.

Table 2 displays the annual growth rate for the key indicators of SSI sector. It is evident that, compared to the period of 1990-2000, 2000-13 showed higher growth in all the selected indicators. Growth of number of units in the SSI has increased from 4.07 per cent per annum during the first period to 13.61 per cent during the second period. When it comes to production and employment, the growth was from 2.31 to 15.44 per cent[5] and 4.19 to 3.96 per cent respectively during the two periods considered. Fixed investment of SSIs showed drastic growth from -5.18 to around 18 per cent during 1990-2013. It is interesting to note that the export growth of SSIs has doubled from 9.81 per cent in 1990-2000 to 18.52 per cent in 2007-08[6]. This table highlights the faster growth of SSIs probably because of the definitional changes, in terms of investment brought about by the MSMEs Act, expanded the scope of the sector earlier known as SSIs. On the other hand, the increased competition due to economic reforms and access to export markets in the liberalized regime possibly encouraged SSIs to improve their performances, as expected before liberalization. However, Saluja (2004) raised the suspicion about the quality of annual data on key parameters, such as number of units, production, and employment, at the all-India level published by the Development Commissioner (DCMSMEs). This is because the data published by DC is based on a mere two per cent of the sample of working units and over time, this percentage has gone down. On the other hand, Development Commissioner of MSME reported exports undertaken by the SSIs through Export Promotion Councils (EPCs), hence, this is data is expected to be reliable. Hence, the limited availability of the information from the annual reports and not for the standard years restricts the disaggregated analysis as well as making hard to conclude about SSIs performances. Hence, hereafter the study uses unit level data of Third and Fourth Census of SSIs.

Table 3: Exporting and Non-Exporting SSIs: Major Characteristics (2001-02 & 2006-07)

	Share of units (%)	K/L	O/L (Rs.[7])	O/K (Rs.)	Employment share (%)	Employment per unit[8]	Output per unit
2001-02							
Exporting	0.78	2.54	9.80	3.86	4.43	32.46	318.23
Non-Exporting	99.22	1.52	3.22	2.12	95.57	5.51	17.74
2006-07							
Exporting	2.46	3.35	8.87	2.65	6.79	15.34	136.06
Non-Exporting	97.54	2.90	4.66	1.60	93.21	5.30	24.71

[5]As noted in the table the period of the growth was 1990-2000 to 2010-11. In the recent annual report production information does not available.

[6]After this year the data does not available.

[7]All the values, which are mentioned in terms of rupees, are deflated using industry wise WPI at 1996-97 prices.

[8]Employment per unit is measured as total employment divided by number of units.

Table 3 reveals that the majority of the registered SSI units are domestic oriented or non-exporting and the exporting units share is incredibly meager in both 2001-02 and 2006-07. The share of registered SSI exporting units has increased from 0.78 per cent in 2001-02 to 2.46 per cent in 2006-07. However, we could observe a significant difference between exporting and non-exporting units in terms of selected performance indicators. For instance, the capital intensity (K/L) of exporting units has increased from 2.54 in 2001-02 to 3.35 in 2006-07. However, capital and labour productivity of exporting units has decreased from 9.8, 3.86 in 2001-02 to 8.87, 2.65 in 2006-07 respectively. Though in both years capital and labour productivity of exporting units is higher than non-exporting units, the reduction of both indicators in 2006-07 in the former units indicates the deteriorating of the quality of labours. In both years, the employment share of exporting units is largely lower than non-exporting units; still it increased from 4.43 to 6.79 per cent in exporting units. However, employment per unit, which can be considered as an indicator of size of the unit, of exporting enterprises (32.46), is around five times higher than non-exporting units (5.51) in 2001-02. Employment per unit in exporting units has decreased to 15.34 in 2006-07 yet around five times higher than non-exporting units. Similarly, output per unit of exporting units is also decreased in this period but remarkably higher than non-exporting units. This reveals that, though, the number of exporting units is meager their performance, in terms of labour productivity, capital productivity and size of operation is significantly higher than non-exporting units. This result parallels Morris et al. (2001) finding that exporting firms are significantly more efficient than non-exporting firms.

Industry Classification

The need for upgrading technology was emphasized in the literature to evolve SSIs into modern medium and large-scale enterprises to withstand international competition. This meant that in order to maintain or improve their market position, enterprises have to undertake reconfiguration in production that involves new technologies, efficient scales of operations and new products (Bhavani, 2011). Hence, technology is one of the important factors in determining exports. Further, firms belonging to the high technology intensity industries are presumed to have technological competency compared to firms in the low technology intensity industries. Hence, the export performance of SSIs is expected to vary across these industry groups. Therefore, after examining the overall trends and patterns of SSIs, here we explore the trends and patterns of SSIs based on technology intensity of the industries. The overall trends and patterns can provides the general picture about the manufacturing sector of SSIs, however, it fails to explain industry specific variations. Taking this into consideration, the present study attempts to explore the export performance of SSIs at the disaggregated level across different technology industry groups. However, Census of SSI does not have information about small firm's technology. In this context, classification of manufacturing industries according to technology intensity by OECD (2011)[9] was found to be useful. Using this classification the study divided SSI industries into low-tech, medium low-tech, medium high-tech and high-tech.

Table 4 presents the share of exporting and non-exporting units at the 2-digit industry level[10]. As noted earlier the share of SSI exporting units has increased from 0.78 in 2001-02 to 2.46 in 2006-07. During the same period, within technology groups, share of exporting units in low-tech industries has increased from 0.66 per cent to 2.3 per cent. Similarly, in case of medium low-tech, medium high-tech and high-tech industries share of exporting units has almost doubled in 2006-07. However, an analysis based simply on share of exporting units tend to conceal more than what is revealed; hence, we presented the industry-wise the share of exports and export intensity of the exporting units. In 2001-02, the major share of exports is from low-tech industries (71.87 per cent) and in 2006-07 also the trend is continued (67.76 per cent). The share of exports from medium high-tech is increased to 11.53 per cent in 2006-07 from around 9 per cent in 2001-02. The share of exports in medium low-tech and high-tech industries in 2006-07 is almost as same as in 2001-02. As noted above, the number of exporting units has almost doubled in all the industry groups; however, it was not reflected in their share of exports. This result indicates that, in 2006-07, though there is a negligible share of exports shifted to medium high-tech industries, low-tech SSIs are the dominant exporters.

According to Orser et al. (2008), export intensity reflects the degree to which firms internationalize their operations and is measured as the ratio of export revenue in total sales. Both third and fourth censuses do not have the sales information. Hence, the paper measured export

[9]For detail see http://www.oecd.org/sti/ind/48350231.pdf

[10]List of industries covered by the study and their names are given in Appendix A.3.1.

Table 4: Industrywise distribution of exports and export intensity (2001-02 & 2006-07)

	2001-02				2006-07			
Nic2Digit	Share of exporting units (%)	Share of non-exporting units (%)	Export Intensity	Export share (%)	Share of exporting units (%)	Share of non-exporting units (%)	Export intensity	Export share (%)
15	0.55	99.45	0.60	19.64	0.99	99.01	0.43	9.06
16	0.53	99.47	0.27	1.10	1.15	98.85	0.27	0.18
17	1.13	98.87	0.60	16.16	7.66	92.34	0.73	16.83
18	1.31	98.69	0.70	16.73	1.83	98.17	0.84	24.84
19	0.94	99.06	0.83	11.08	2.47	97.53	0.77	8.73
20	0.32	99.68	0.45	0.60	1.02	98.98	0.48	0.68
21	0.74	99.26	0.32	0.35	2.41	97.59	0.29	0.38
22	0.38	99.62	0.17	0.16	0.63	99.37	0.41	0.49
36	0.41	99.59	0.61	6.06	2.06	97.94	0.87	6.56
Low-tech	**0.66**	**99.34**	**0.63**	**71.87**	**2.30**	**97.70**	**0.70**	**67.76**
351	1.55	98.45	0.01	0.00	2.50	97.50	0.40	0.00
23	0.60	99.40	0.23	0.08	1.97	98.03	0.24	0.06
25	0.88	99.12	0.28	2.20	3.81	96.19	0.33	2.88
26	0.52	99.48	0.32	2.23	1.94	98.06	0.45	2.71
27	1.23	98.77	0.40	2.89	3.14	96.86	0.39	1.63
28	0.83	99.17	0.42	8.71	1.64	98.36	0.49	9.68
Medium low-tech	**0.79**	**99.21**	**0.37**	**16.11**	**2.12**	**97.88**	**0.44**	**16.96**
24 excl. 2423	1.44	98.56	0.39	4.14	2.16	97.84	0.43	5.05
29	1.03	98.97	0.22	1.72	2.21	97.79	0.26	2.65
31	0.91	99.09	0.27	1.47	2.16	97.84	0.29	1.32
34	1.31	98.69	0.35	0.74	2.17	97.83	0.07	0.69
352+359	1.25	98.75	0.25	0.51	11.10	88.90	0.48	1.83
Medium high-tech	**1.17**	**98.83**	**0.31**	**8.57**	**2.95**	**97.05**	**0.29**	**11.53**
2423	2.70	97.30	0.27	2.17	3.45	96.55	0.38	1.71
30	1.05	98.95	0.03	0.02	22.37	77.63	0.65	0.09
32	1.25	98.75	0.18	0.56	1.65	98.35	0.13	0.51
33	2.23	97.77	0.28	0.60	5.78	94.22	0.22	1.44
353	7.14	92.86	0.92	0.10	1.57	98.43	-	-
High-tech	**2.14**	**97.86**	**0.25**	**3.45**	**5.76**	**94.24**	**0.25**	**3.75**
Total	**0.78**	**99.22**	**0.50**	**100.00**	**2.46**	**97.54**	**0.52**	**100.00**

intensity as the ratio of Value of Exports to the Gross Output. Overall, manufacturing industries showed a small increase in export intensity from 0.50 units in 2001-02 to 0.52 in 2006-07. This increase in export intensity was mainly contributed by low-tech and medium low-tech industries. The medium high-tech industries export intensity showed slight decrease from 0.31 to 0.29 units during 2001 to 2007 and in these years, the export intensity of high-tech industries did not change. Once again the results revealed that, in terms of export share and intensity low-tech industries are the major exporters. However, it is evident that there is considerable variation in export performance across industries within different technology groups. First of all, the study found that within different technology group of industries, the share of exports and export intensity is contributed by few industries. For

instance, though in both years low-tech industries were found to be main exporters, within them the major share of exports was concentrated in Food and beverages (NIC-15), Textiles (NIC-17), Wearing Apparel (NIC-18), Tanning and dressing of leather (NIC-19), industries. Textiles (NIC-17) is considered to be one of the important industries in terms of their employment generation. The share of exporting units in this industry has increased from 1.13 per cent in 2001-02 to 7.66 per cent in 2006-07. During the same period, the export intensity of this industry has increased from 0.6 to 0.73 units; however, the share of exports remains the same. Wearing Apparel (NIC-18) is the industry showed an increase of the share of exports from around 17 to 25 per cent between the years 2001 and 2007. During the same period, though the exporting units increased slightly in this industry, the export intensity increased from 0.7 to 0.84 units. The share of exports and intensity has reduced in Food and Beverages (NIC -15) and Tanning and dressing of leather (NIC-19) industries. As noted above, medium high-tech industries are the group showed increased share of exports during 2001-07. Within this group the share of exports in Chemicals and Chemical products (NIC-24)[11], Machinery and equipment (29), and Railroad equipment and transport equipment, n.e.c. (352+359) industries has increased in 2006-07; these three industries together contribute around 10 percentage of the export share. In particular, the share of exporting units of Railroad equipment and transport equipment, n.e.c. (352+359) industry has increased to 11 per cent in 2006-07 from 1.25 per cent in 2001-02. Further, during this period, the export intensity of this industry has almost doubled. However, this is not the same case in all industries within medium high-tech group. For instance, the share of exports and export intensity in Motor vehicles, trailers & semi-trailers (NIC-34) industry has reduced in 2006-07.

It is interesting to look at exports from SSIs high-tech group of industries. Within this group, one particular industry, which is Office, accounting and computing machinery (NIC-30), showed a dramatic increase in terms of share of exporting units (from 1.05 to 22.37 per cent between 2001-07), export intensity (from 0.03 to 0.65). The export share of this industry increased meagerly from 0.02 to 0.09 per cent. Ultimately, our analysis showed that, though to some extent there was a diversification in the share of exports from low-tech industries to medium high-tech industries, the major share of export is concentrated in low-tech industries. Hence, the meager number of exporting units and their concentration in low-tech industries in turn indicates the lack of competitiveness and diversification of the SSIs. This further raised the question of impact of policies/schemes introduced by GOI to enhance SSIs competitiveness via making the availability of capital credit, improve technology and encourage them to participate in the international market. However, looking at the share across industries may not reveal about the growth performance of these industries. Hence, the

Table 5: Industry-wise Average Annual Compound Growth Rate (2001-02 to 2006-07) of Number of Exporting Units and the Value of Exports

NIC 2-digit	Growth rate of exports	Growth rate of exporting units	Export intensity growth
15	-1.79	15.61	-5.46
16	-17.00	27.93	0.23
17	12.47	51.06	3.33
18	19.32	38.70	3.15
19	7.38	13.03	-1.12
20	14.02	22.55	1.22
21	13.52	25.85	-1.55
22	35.14	10.14	15.45
36	13.21	33.79	6.05
Low-tech	**10.63**	**33.35**	**1.75**
351	9.47	24.18	80.56
23	6.45	12.71	0.71
25	16.83	27.74	2.89
26	15.41	22.78	5.92
27	1.52	12.70	-0.16
28	13.71	13.28	2.49
Medium low-tech	**12.68**	**17.78**	**2.64**
24 excl 2423	15.45	11.24	1.55
29	20.11	24.56	2.83
31	9.78	27.23	1.24
34	10.37	5.92	-22.92
352+359	38.32	79.11	11.37
Medium High-tech	**17.38**	**26.52**	**-0.86**
2423	7.30	0.74	5.36
30	46.08	119.77	64.78
32	10.07	35.90	-5.71
33	29.13	39.18	-4.19
High-tech	**13.81**	**38.62**	**0.09**
Total	**11.74**	**28.62**	**0.73**

[11]This excludes Manufacture of pharmaceuticals, medicinal chemicals and botanical products (NIC-2423).

following table provides the growth of exports of different industries.

From Table 5 it can be noted that the overall growth of value of export and exporting units is around 12 and 29 per cent per annum respectively between 2001-02 and 2006-07. During the same period, the growth rate of export intensity is merely 0.73 per cent per annum. Within different technology groups, the overall growth rate of exports is high in medium high-tech industries (17.38 per cent per annum) as compared to other groups. High-tech industries ranks first in terms of growth rate of exporting units (around 39 per cent) and positioned second in terms of export growth (13.81 per cent); still very slow growth rate of export intensity (0.09 per cent per annum). Followed by, the growth rate of exporting units of low-tech industries is 33.35 per cent. However, the growth of exporting units has not accompanied by the growth rate of exports (around 11 per cent). In case of medium low-tech industries, with 18 per cent growth rate of exporting units attained 13 per cent growth rate of exports. Overall, the growth of value of exports is high in medium high-tech and high-tech industries; however, the growth rate of export intensity is relatively high in low-tech and medium low-tech industries.

All industries show growth of exporting units. Further, except a few industries in the low-tech group, the growth of export in all other industries is positive but this is not the case in the export intensity growth. Among all the industries the growth rate of value of export, exporting units and export intensity is significantly high in office, accounting and computing machinery (NIC-30) industry during 2001-07. This industry falls in high-tech group and the analysis shows the dynamic nature of this industry in terms of export growth. This reveals that this industry is the major contributor to the growth of export in high-tech industry[12]. Followed by, within high-tech group Radio, television and communication equipment (NIC-32) and Medical, precision and optical equipment (NIC-33) industry's export growth are 10 and 29 per cent per annum respectively during 2001-07; still the export intensity of these industries is negative. This reveals that, though these industries growing in terms of exports, output diverted to exports is decreasing in these industries.

Within medium high-tech group, Railroad equipment and transport equipment, n.e.c. (352+359) industry positioned top in terms of the growth of exporting units (79.11 per cent), export (38.32 per cent) and export intensity (11.37 per cent). This industry alone contributes to the major export performance in this group. In this group, almost all the industries showed growth of exports and export intensity, except Motor vehicles, trailers & semi-trailers (NIC-34). Similar results can be obtained in medium low-tech industries, i.e., all the industries within this group showed growth of exports and export intensity, except, Basic metals. Within medium low-tech industries, in terms of growth rate of export intensity, building and repairing of ships and boats (around 81 per cent[13]) (NIC-351) positioned first, yet, the growth of exports in this industry is relatively lower compared to other industries. Further, the share of exports of this industry is almost nil (Table 4).

As noted already, within a low-tech industry group major share of exports is concentrated in four industries. Within them, the growth rate of exporting units, exports and export intensity is relatively high in Textiles (NIC-17) and Wearing Apparel (NIC-18). Apart from this, another one industry showed relatively high growth in terms of exporting units, exports and export intensity is publishing, printing and reproduction recorded media (NIC-22)[14]. This result indicates that even in the year 2006-07 the export potential is high in India's textile oriented products.

The following observations can be made out of the analysis done so far. The analysis shows that the growth of exporting units unaccompanied the growth of exports in certain industries. Further, the important contributor of export is low-tech industries in both 2001-02 and 2006-07. The industries that are historically known for exports are the ones that continue to be have a major share of exports, for instance, textile oriented products. It can also observe the relatively higher growth rate of exports and

[12]Both Censuses provides A Standard Industrial Commodity Classification (ASICC) codes at the 5-digit level. Hence, we have used these codes to identify the major contributor for the export performance of this (Office, accounting and machinery NIC-300) industry. It has been found that, in 2001-02, the exports of this industry concentrated only in computer/parts/peripherals n.e.c. However, in 2006-07, this industry started exporting some of the new products like UPS, solid state (ASICC-77554), Xerox/photocopier/reprographic machine (77727), Domestic and office electrical equipment (77789), computer based system (78305) and computer media (78306) among others. In 2006-07, within this industry 92 per cent of the exports are computer based systems products. Followed by, Xerox/photocopier/repro graphic machine share of exports is 6.19 per cent. This reveals that the export potential of Office accounting and machinery industry is concentrated in few product lines.

[13] The export intensity of Building and repairing of ships and boats (NIC-351) has increased from 0.01 to 0.4 during 2001-02 to 2006-07.

[14]Within publishing, the growth of exports is mainly from the publishing of newspapers, journals and periodicals (NIC-2212). Due to space constraint the disaggregate analysis results are not provided here.

exporting units in medium high-tech and high-tech industries, but concentrated in certain products. This reveals that though SSIs started exporting high-tech industrial products their export potential concentrated in a few products lines.

Concluding observations

The following observations can be made out of the analysis done so far. The descriptive analysis reveals that, overall the major share of registered SSI units are non-exporting and the exporting units share is incredibly meager both in 2001-02 and 2006-07. Though the number of exporting units is meager their performance, in terms of labour productivity, capital productivity and size of operation is significantly higher than non-exporting units. Further, though little diversification of share of exports from low-tech to medium high-tech industries can be observed, the major share of exporting units and exports are concentrated in low-tech industries. The relatively high growth rate of exports and exporting units in medium-high tech and high-tech industries showed concentration in certain products. This indicates that though SSIs started exporting high-tech industrial products their export potential concentrated in a few product lines. Further, these

Appendix Table A.1: List of Industries

NIC-98 CODE	Industries Name
15	Food and Beverages
16	Tobacco products
17	Textiles
18	Wearing Apparel
19	Tanning and dressing of leather
20	Wood products
21	Paper and paper products
22	Publishing, printing and reproduction recorded media
23	Coke, refined petrol
24 excl 2423	Chemicals and chemical products (excluding 2423)
2423	pharmaceuticals, medicinal chemicals and botanical products
25	Rubber and plastics
26	Other non-metallic mineral products
27	Basic metals
28	Fabricated metal products
29	Machinery and equipment
30	Office, accounting and computing machinery
31	Electrical machinery
32	Radio, television and communication equipment
33	Medical, precision & optical instruments
34	Motor vehicles, trailers & semi-trailers
351	Building and repairing of ships and boats
352+359	Railroad equipment and transport equipment, n.e.c.
36	Furniture; manufacturing n.e.c.

Source: National Industrial Classification-98 (NIC-98), Central Statistical Organisation.

results point towards the lack of competitiveness of Indian SSIs in the export market, which in turn raises the question of success of policies introduced to improve their competitiveness.

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Winners make a habit of manufacturing their own positive expectations in advance of the event.

—Brian Taky

Focus

Globalization and Industrial Development in Developing Countries: Evidence from India's Automobile Industry

JATINDER SINGH & MANINDER DEEP CHEEMA

The objective of this paper is to analyze the impact of the changing economic environment on the structure and development of the automobile industry in India since 1991. This study, using various concentration indices and growth measures, has shown that the policy changes do influence the structure and contribute to the growth of the industry. However, the impact of liberalization policies differs across sub-sectors of the industry, with the passenger vehicles segment witnessing a consistently high growth and greater restructuring as compared to others segments of the industry. Thus, besides liberalization policy, sector-specific factors remain critical in determining the outcomes for any sector.

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Context of the study

This paper aims to understand the impact of the growing economic integration of India with the world market on the structure and development of the automobile industry. Though the process of liberalization began in India in the early years of 1980s, a paradigm shift in its industrial policy from a highly controlled to decontrolled regime was noticed in early 1991. The automobile industry has witnessed substantial policy changes as part of liberalization policy of 1991 (Narayanan, 1998; Singh, 2014).

Subsequently, this industry has witnessed one of the most successful and dynamic cases of liberal economic policy as it has experienced a consistent high growth in the post-reform period (Mani, 2011; Kale, 2012). The position of the automobile industry strengthened in the world market, and India is now recognized as the second largest producer of two-wheelers (only after China), the fourth largest manufacturer of commercial vehicles and the sixth largest car producer (Nag, 2011; SIAM, 2013; Gopalan, 2013).

Currently this industry is considered as one of the most globalized industries in India. The extent of economic integration of this industry is visible: First, India's automobile industry received a large volume of direct foreign investment. Foreign investment received by it in 2004 stood at Rs. 6342.5 million and that figure increased to Rs. 59,797.7 million in 2012 (Singh, 2009; GOI, 2013). Almost all the leading international firms (namely Suzuki Motors, Toyota, Mitsubishi, Mazda, Nissan; General Motors, Fiat automobiles, Mercedes-Benz, Honda, Ford, Hyundai; Skoda, Volkswagon, Renault, Nissan, BMW, Audi etc.) have started production activities in India over the last two

and a half decades. Second, export intensity of the automobile industry increased from 3.5 per cent in 2001-02 to 13 per cent in 2009-10 (Singh, 2014).

Given the growing importance of this industry, the Government of India has accorded special attention to the development of this industry. It is clear from the fact that Government prepared a special policy dealing with the development of automobile industry in 2002 (i.e. Auto Policy 2002) (GOI, 2002). Furthermore, in 2006 the Government brought up a vision document for the automobile industry known as the Automotive Mission Plan (2006-16). The Automotive Mission Plan is a ten-year vision document wherein emphasis was placed on developing India "—— as the destination of choice in Asia for the design and manufacture of automobiles and automotive components. The output of India's automotive sector will be USD 145 billion, contributing to more than 10 per cent of India's Gross Domestic Product and providing employment to 25 million persons additionally by 2016" (GOI, 2006).

Special attention from the Government was warranted as this is a sector with deep forward and backward linkages with other key sectors of the economy (such as rubber, plastics, glass, steel and iron) and it has emerged as a prime engine of economic growth in India (GOI, 2010). The contribution of automotive industry to gross domestic product has increased from 2.77 per cent in 1992-93 to 4.14 per cent in 2008-09 (GOI, 2010).

In response to the rapid growth and dynamic development, this industry has received a considerable attention from the scholars as well over the last two decades (Mohanty, Sahu and Pari, 1994; D'Costa, 1995; Kathuria, 1996; Narayanan, 1998; Tyabji, 2000; Sagar and Chandra, 2004; Singh, 2004, 2007; Ranawat and Tiwari, 2009; Mani, 2011; Kale, 2012). These studies have analyzed the various issues such as technology development, competitiveness, export performance etc. In general these studies argue that the changing policy environment contributed to the development of the industry. These studies did not give credence to factors other than the changing economic environment behind the success of the industry.

Globalization and industrial development: Analytical understanding

Globalization refers to a process of integrating nations economically, politically and culturally through a systematical reduction in barriers intrade and international investment, along with an expansion of communication facilities and scientific infrastructure. It influences the development process of nations by generating various threats and opportunities for the firms in emerging economies (Gorodnichenko, Svejnar and Terrel, 2009). It brings opportunities by assuring the access to modern technology and large global market. It poses threat to the survival of inefficient firms by increasing supply of low cost imported products as well as by intensifying competition between domestic and foreign firms. Accordingly, manufacturers in emerging countries like India are forced to innovate in order to ensure their stay in the market under changing economic conditions. But the long-term effects of these threats and opportunities on the industrial development of the host country is not automatic and unambiguous, as it is affected by a number of firm-specific, industry specific and country specific factors (Singh, 2009; Singh, Joseph and Vinoj, 2011).

Firm specific factors include both tangible and intangible capabilities that manufacturers have developed over time. If domestic firms are equipped with advanced technology capabilities and other intangible assets (marketing and organizational skills), then in the wake of growing economic integration it is very likely that these firms will upgrade their technology base in order to successfully face the challenge posed by the globalization. In this process, the manufacturing capabilities of the host country would expand and further it is expected that the domestic firms would increase their participation in the international market. In a globalized world, the market size is not constrained by the domestic size of the economy. Thus, a competitive firm can grow by supplying product to the international consumers at competitive prices (Kumar and Joseph, 2007). Contrary to this, if manufacturing firms in the domestic market are lacking in terms of modern technology capability and other intangible assets, then domestic firms may get crowded out from the market under liberal trade and investment regime as technology gap between domestic firms and international firms is very high. In this case, any efforts of domestic firms may not bring them to the level that they can compete with international firms. In this process, the host country may lose domestic manufacturing capabilities as indigenous firms will go out of business.

The above discussion clearly states that the influence of growing economic integration on the industrial development and structure of the country is ambiguous. It may promote or ruin the industrial sector of the host country. Given this understanding, we conduct an empirical analysis

which is intended to understand further the influence of globalization on the structure and development of Indian automobile industry.

Data sources and methods used

Data Sources

To analyze empirically the aforesaid objective, data has been collected from different secondary sources. The primary data sources include the annual publications of the Society of Indian Automobile Manufacturers (SIAM); Automotive Component Manufacturers Association of India (ACMA); and the annual reports and special documents related to automobile industry released by Department of Heavy Industry, Ministry of Heavy Industries and Public Enterprises, Government of India.

Data related to production, sales both for the industry and sub-segments were collected from the *Statistical Profile of Indian Automobile Industry* and *Profile of the Indian Automobile Industry* - two are annual publications of the SIAM. Furthermore, we collected data relating to the production of vehicles and components from the *Automotive Industry of India: Facts and Figures* (various issues) published by the ACMA. To supplement information collected from SIAM and ACMA publications, we used annual reports as well as document on Automotive Mission Plan 2006-2016 released by Ministry of Heavy Industries and Public Enterprises, Government of India.

Methodology

To draw some meaningful analysis from the available information, we perform analysis both at the aggregate and disaggregated levels. At the aggregate level, we examined the performance of the automobile industry as a whole that informs about changes experienced by the industry under different policy regimes. The aggregate analysis fails to highlights the sub-segment specific features. The automobile industry produces various types of vehicles such as two wheelers, three wheelers, commercial vehicles (light, medium and heavy commercial vehicles), and passenger vehicles. The nature of the markets and the impact of policy changes may not be same in each segment of the automobile industry. For example, cars and other passenger carriage vehicles are meant for personal use, and commercial vehicles are meant for commercial purpose (transport of final goods and raw material). The overall study (taking all segments together such as two-wheelers, three wheelers, passenger cars and commercial vehicles) of automobile industry may produce misleading results. In this study, the analysis is confined to four wheelers segment only as this segment has witnessed more dynamic changes in the post reform period. The four-wheelers segment is further sub-divided into three groups: (i) passenger vehicles (comprised passenger cars, utility vehicles and multi-purpose vehicles); (ii) light commercial vehicles and (iii) heavy commercial vehicles (buses and trucks).

To understand the changes in the structure of the industry, we use measures like *Concentration Index,* Herfindahl–Hirschman Index *etc.* The empirical findings from these indicators will help to understand the structural changes witnessed overtime.

Concentration Ratio is a measure to analyze the trends in industrial concentration. Concentration ratios are usually used to show the extent of market control of the larger firms in the industry. Value of this index lies between zero and one. Value closer to zero indicates competitive market situation and near to one indicates oligopolistic market structure. Symbolically,

$$CR_n = \sum_{i=0}^{n} S_i / S$$

$$CR_n = \sum_{i=0}^{n} P_i 0d \leq CR_n d \leq 1$$

Here,

CR_n = N-firm concentration ratio

N = 4

S = Total product sales

S_i = Sales of i^{th} firm

P_i = Sales Share of i^{th} firm in total product sales

Herfindahl-Hirschman Index (HHI): it is defined as the sum of squares of the market shares of firms within the industry. It is better as compared to concentration index as it takes into account all the firms operating in the industry. Value of HHI lies between one and zero. Value moving from zero to one generally indicates a decrease in competition and an increase in market power and vice versa.

Symbolically, $H = \sum_{i=1}^{N} s_i^2$

Where, H is Herfindahl–Hirschman Index

S_i is the market share of i^{th} firm in the industry and N is the number of firms in the industry.

Empirical analysis

In this section, an attempt is made to understand the changing structure and subsequent development observed

by the automobile industry in the post reform period. Before providing empirical results, it would be useful to understand the dynamic role played by the policy environment involved around this industry since the early years of India's independence. This industry was strictly regulated through series of policies initiated in the 1950s and 1960s till the middle of 1980s with primary aim to develop an indigenous automobile industry. The review of policy environment from historical perspective is significant as the performance of industrial sector under particular policy environment cannot be appreciated in isolation from what it was before.

Evolution of the Indian automobile industry: A brief review

The production of manufacturing of automobiles started with the entry of General Motors and Ford Motors in the late 1920s. General Motors and Ford Motors entered in India in 1928 and 1930 respectively. But these two manufacturers started assembling of cars and trucks based on the imports of components and parts from USA in the form of completely knocked down (CKD) kits (Venkataramani, 1990; Kathuria, 1996). Further, two indigenous firms entered in the industry in the early 1940s. Birla group established Hindustan Motors Limited (HML) in 1942 and Walch and Hirachand group established Premier Automobiles Limited (PAL) in 1944 (Venkataramani, 1990; Kathuria, 1996). Initially, these companies also offered import-intensive products due to intense competition from subsidiaries of foreign firms. Thus, the process of indigenization remained slow till India attained independence (Hindustan Motors Limited, 1996; Pingle, 1999). The process of development of indigenous automobile industry started only after the attainment of independence.

With India's Independence, the Government of India announced a series of policies. The policy measures were drafted to discourage pure assembling and to encourage indigenous manufacturing of automobiles in the country. For this, first in 1949, the Government announced an automobile policy wherein a ban was imposed on the imports of completely built vehicles in 1949 in order to eliminate intense competition posed by the imported vehicles. But the Government allowed assembling of vehicles based on imported CKD kits. Second, in 1952 the Government took another major step towards the establishment of domestic automobile industry and appointed a Tariff Commission to outline the clear approach for the development of indigenous automobile industry in India. This was important as 12 automobile manufacturers were supplying motor vehicles in the early 1950s and most of them were assemblers of automotive products (Narayana, 1989). The commission advised the Government to permit only those firms to continue manufacturing activities in India which have a long term progressive manufacturing programme. The firms which failed to submit manufacturing plan were advised to terminate their operations within three years. Accordingly General Motors and Ford Motors closed down their production plant in the 1956 as these two were not willing to start indigenous production of components and other parts.

Initially only two firms (HML and PAL) got approval for continuing their manufacturing activities as they had prepared long term manufacturing programme and later three other firms (Standard Motor Products India Ltd. (SMPIL), Automobile Products of India Ltd. (APIL) and Ashok Motors Ltd) were allowed to enter as they outlined their indigenization programme. Except SMPIL and Ashok Leyland, all others were producing both cars and commercial vehicles[1]. In 1955, Mahindra and Mahindra (M&M) also implemented progressive manufacturing programme for the Willy jeep. Further, in 1961 government licensed M&M to produce a jeep-truck, with common engine, transmission and front and rear axles. Company introduced a one-ton-payload truck in 1965 and stopped production of the jeep truck. Tata Engineering and Locomotives Co. Ltd. (Telco) collaborated with Daimler-Benz for manufacturing 3 to 5 ton diesel commercial vehicles and the manufacturing of components in the same year (1955).

In 1956, the Government revised the Industrial Policy Resolution (IPR) 1948 in view to incorporate the then recent policy development in the industrial sector and announced IPR 1956. However, the IPR 1956 did not classify the automobile industry under schedule A and B. The development of the automobile industry was left for the private sector. Before the effective implementation of IPR 1956, the Indian economy witnessed a balance of payment crisis. Due to the foreign exchange crisis in 1956-57, the Government reduced the allocation to the industrial sector including automobile industry. As a result, firms were forced to increase indigenization as limited foreign exchange resources did not allow them to import most of the components which they were importing earlier. Due to this, the production of automobiles got adversely affected and

[1]SMPIL was submitted only a car manufacturing programme and Ashok Leyland for commercial vehicle.

quality of motor vehicles deteriorated along with rise in prices (Pingle, 1999; Ranawat and Tiwari, 2009). Thus, the Government appointed a committed under L K Jha to inquire into the issues related to rising prices and deterioration in the quality of vehicles. The commission advised the Government to develop a separate auto component industry in India in order to improve the quality and reduce the cost of production. In response to the recommendation, the Government encouraged the entry of component producers and exclusively reserved 60 to 80 components for the small scale units in 1965.

Another significant policy change had been noticed in 1973 when the global economy experienced the first oil crisis. It led to the division of the Indian automobile industry into two categories (a) luxury (passenger car) (b) non-luxury (rest of the industry). Government decided to improve technology and promote growth of non-luxury segment and ignored luxury segment. It was so because the passenger car was considered as a wasteful luxury used by the elite section of the population. On the other hand, the development of commercial vehicles was considered important as it contributes to the economic development by ensuring smooth supply of goods including raw materials for industrial production. Accordingly, the commercial vehicles segment was added to the 'Appendix-1' list in 1973. The tightening regulatory environment around the passenger car industry adversely affected its development and growth (Narayana, 1989; Singh, 2014) whereas the commercial vehicles and other segments witnessed rapid growth. Another distinguishing character of the automobile industry was that the industry was piled up with excess demand which gets reflected in huge waiting list. Thus, in 1970s a buyer had to wait for more than two years to get a new car and the vehicles offered by manufacturers were obsolete in terms of technology (Kathuria, 1996).

Given the unsatisfactory performance of automobile industry till the 1980s, the Government of India made an attempt to modernize the industry. For this, the Government announced a number of relaxations in the policies implemented during the 1950s. The important changes in the industrial policy in the 1980s included broad-banding scheme, capacity re-endorsement, easing of the restrictions on the imports of raw material, components and capital goods (Narayanan, 1998). The most significant changes were involved with regard to foreign investment policy wherein manufacturers were allowed to form collaborations with foreign firms. Accordingly, a large number of foreign firms signed joint ventures with domestic firms (D'Costa, 1995). All these restrictions were aimed to improve the competitiveness of this industry by upgrading the technology.

The process of economic liberalization was initiated in the 1980s and further launched in full swing in the early years of 1990s on account of severe balance of payment crisis. To deal with the crisis, India approached the International Monetary Fund (IMF). Though the IMF sanctioned a loan but also imposed a number of conditions which led to the change in the policy environment. The IMF mainly directed the Government to eliminate restrictions on the entry and operations of foreign firms, reduce the size of public sector, allow imports of raw material and other parts etc. Accordingly, the Government abolished restrictions on the entry and eased the operation of foreign firms in the country, allowed imports of capital and components, eliminated the condition of local content requirement etc. (Pingle, 1999). In continuation of the 1991 changes, the government extended foreign participation up to 100 per cent in the automobile industry in the early years of 2000. As a result of this, a large number of foreign firms made entry in the industry. The most important ones include General Motors, Fiat, Mercedes-Benz, Honda, Ford, Hyundai and Daewoo, Suzuki, Skoda, Toyota, Volkswagon, Renault, Nissan, BMW etc. Accordingly, the production of vehicles (passenger vehicles, commercial vehicles, 2-wheelers and 3-wheelers) increased significantly after 1990-91. Production of vehicles jumped from around 2 million in 1990-91 to more than 20 million in 2011-12 (Figure 1).

The changing policy environment would not only have added to volume of production but it is expected to have caused change in the industrial market structure as large international firms made entry in the industry. Given this, we are analyzing the influence of growing economic integration on the structure and growth of the industry.

Structure of the industry

In this section, we are analyzing the impact of policy changes witnessed in the 1990s and afterwards on the structure of three segments of the automobile industry: (i) passenger vehicles; (ii) heavy commercial vehicles and (iii) light commercial vehicles. These three segments have been selected because: (i) till late in the 1980s the structure of these segments were more like an oligopoly as few firms were dominating in the market and (ii) a large number of foreign firms made entry after 1990s (especially true for passenger vehicles segment).

Table 1: Trends in market structure and share of passenger vehicle sector firms, 1990-91 to 2010-11

	1990-91	1995-96	2000-01	2005-06	2010-11
Indices	**Market Structure**				
N-Firms Concentration Ratio	1.00	0.95	0.88	0.86	0.80
HHI	0.38	0.47	0.34	0.24	0.24
Firms	**Share in Passenger Vehicle Sector (in %)**				
MUL	56.04	66.81	54.07	43.69	42.63
PAL	19.58	7.38	0.00	0.00	0.00
M&M	12.49	14.10	8.82	6.69	6.21
HML	11.48	6.73	4.37	1.15	0.33
Hyundai	0.00	0.00	13.50	19.89	19.90
TELCO	0.00	2.52	11.84	16.06	10.79
Daewoo Motors India Ltd	0.00	2.20	0.00	0.00	0.00
Ford	0.00	0.00	0.84	2.07	3.77
General Motors	0.00	0.00	1.29	2.34	3.63
Toyota Kirloskar	0.00	0.00	3.94	3.44	2.81
Nissan Motor India Pvt	0.00	0.00	0.00	0.00	2.51
Honda Siel Cars	0.00	0.00	0.41	3.16	2.02
Volkswagen India Pvt Ltd	0.00	0.00	0.00	0.00	1.79
PAL-Peugeot Ltd	0.00	0.00	0.00	0.00	1.37
Skoda	0.00	0.00	0.00	0.75	0.79
Fiat	0.00	0.00	0.00	0.05	0.73
Force Motors Ltd	0.00	0.00	0.00	0.56	0.30
BMW India Ltd	0.00	0.00	0.00	0.00	0.19
Mercedes Benz	0.00	0.25	0.14	0.14	0.19
International Cars & Motors Ltd	0.00	0.00	0.00	0.00	0.02
Bajaj Tempo	0.00	0.00	0.78	0.00	0.00
Sipani	0.41	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00

Source: ACMA, Automotive Industry of India: Facts and figures (Various issues); SIAM, Statistical Profile of Indian Automobile Industry.
Note: MUL = Maruti Udyog Limited[2]; PAL = Premier Automobiles Limited; M&M = Mahindra and Mahindra; HML = Hindustan Motors Limited; Telco = Tata Engineering and Locomotives Co. Ltd.

From Table 1 it can be seen that the structure of the industry has changed after the 1991 reform programme. The change in the structure of the industry is measured by using two indices (HHI and N-firm concentration ratio). The change in the structure of passenger vehicle segment is manifested as the value of HHI and N-firm concentration ratio observed downward trends. For instance, the value of HHI declined from 0.47 in 1995-96 to 0.24 in 2010-11. The significant fall in the value of HHI suggests that the market concentration has declined. Alternatively, the competition has increased in the reference period. This is further supported by the falling value of concentration index. The value of concentration index declined from 1 to 0.8 during 1990-91 to 2010-11. The decline in value of concentration ratio implies that in 1990-91 four leading firms were serving whole market (100 per cent) and in 2010-11 the share of top four firms declined to 80 per cent (Table 1). In other words, the dominance of four leading firms has weakened in the reference period.

To understand the changes in the market position of the passenger vehicles firms, we have also estimated the

[2]In 2007, MUL renamed as Maruti Suzuki India Limited.

market share of selected firms (table 1). It is worth pointing out that market shares of almost all the firms have declined in the reference period. It is interesting to highlight that the market share of the MUL (market leader) has declined from 66.81 per cent in 1995-96 to 42.63 per cent in 2010-11. The decline in market share of MUL in two periods is more than 24 per cent. Similarly, the market share of other leading firms such as PAL, M&M and HML declined from 56.04 per cent, 12.49 per cent and 11.48 per cent, respectively, in 1990-91 to 0 per cent, 6.21 per cent and 0.36 per cent, respectively, in 2010-11 (Table 1). The downfall in the market position is mainly attributed to the new entrants in the industry in the liberal investment regime. The new entrants (Hyundai, Telco, General Motors, Ford etc.) supplied a variety of technologically advanced passenger vehicles to the manufacturers at competitive prices and gained the market position. The major gainers in the passenger vehicles segment include Hyundai and Telco. The market share of Hyundai and Telco was zero in 1990-91 which increased to around 20 per cent and 11 per cent in 2010-11 (Table 1). Due to the entry of Hyundai and Telco, the leadership of MUL got challenged as these two manufacturers started offering close substitutes of MUL passenger vehicles. The reshuffle in the market position of market leaders itself implies that the competition has been intensified under the liberal policy regime.

Table 2 presents the changes in market structure and the market share of leading firms in the light commercial vehicles segment. The number suggests that the market structure of the LCVs sector changed in the period under consideration. Unlike the changes witnessed in the passenger vehicles segment, the market concentration in the industry has increased overtime. The increase in market concentration is evident both from rising value of HHI and concentration index. The value of concentration index rose from 0.78 in 1990-91 to 0.94 in 2010-11. The increase in value of concentration implies that the market has moved away from competition. Alternatively, the emerging market structure is more of an oligopoly as the market position of top four firms has strengthened overtime. This inference is further supported by the rising value of HHI which almost doubled during 1990-91 to 2010-11 (Table 2). The value of HHI increased from 0.22 in 1990-91 to 0.43 in 2010-11.

Table 2: Trends in market structure and share of LCV sector firms, 1990-91 to 2010-11

	1990-91	1995-96	2000-01	2005-06	2010-11
Indices			**Market Structure**		
N-Firms Concentration Ratio	0.78	0.89	0.94	0.96	0.94
HHI	0.22	0.41	0.43	0.46	0.43
Firms			**Share in LCV Sector (in %)**		
TELCO	34.29	59.65	62.81	63.10	58.60
Bajaj Tempo	28.26	21.66	5.11	0.00	0.00
M&M	6.84	3.58	9.56	23.84	28.39
Force Motors	0.00	0.00	0.00	4.35	4.24
Mahindra Navistar Automotives Ltd	0.00	0.00	0.00	0.00	2.58
Swaraj Mazda	6.49	3.48	8.19	0.00	0.00
Eicher Motors*	8.35	4.57	13.34	4.74	2.49
Mahindra Nissan	5.53	0.00	0.00	0.00	0.00
Piaggio Vehicles	0.00	0.00	0.00	0.00	2.24
M&M Ltd., Zahirabad	0.00	1.62	0.00	0.00	0.00
Daewoo Motors India Ltd	7.47	1.58	0.00	0.00	0.00
SML Isuzu Ltd	0.00	0.00	0.00	3.25	1.12
Ashok Leyland Ltd	1.23	1.81	0.99	0.52	0.25
HML	1.55	2.06	0.00	0.20	0.08
	100.00	100.00	100.00	100.00	100.00

Source: Same as Table 1.
Note: * includes VECVs-Eicher.

The analysis of market share also indicates that the dominance of few firms in the LCVs industry has increased in the reference period. During the reference period, the market share of some firms declined drastically whereas other firms have gained at the expense of losers (Table 2). The firms which have strengthened their market position were Telco and M&M. The share of Telco and M&M rose from 34.29 per cent and 6.84 per cent, respectively, in 1990-91 to 58.68 per cent and 28.29 per cent in 2010-11. On the other hand, Bajaj Tempo, Swaraj Mazda, Daewoo Motors and Eicher Motors are the major losers in the reference period (Table, 2). The consolidating position of limited number of firms implies that the market structure has transformed into an oligopoly wherein a few firms are serving whole market. These developments corroborate our previous argument that the market structure of LCVs sector moved away from competition as market position of few firms leading firms further consolidated over time.

Why has it happened?

To understand the growing concentration in the LCVs segment, it is important to understand the changes witnessed by this sector during the 1980s. In the LCVs, four new firms made entry during 1980s in the form of joint ventures. Four Indian firms signed joint ventures (financial and technical) with Japanese firms in the light commercial vehicles segment: Toyota (Japan) formed a joint venture with Delhi Cloth Mills (India); Mazda (Japan) with Swaraj (India); Nissan (Japan) with Allwyn (India) and Mitsubishi (Japan) with Eicher (India). Entry of new firms with access to Japanese technology led to introduction of a variety of new vehicles in the LCVs sector. Initially, these firms gained market that led to increase in competition in the LCVs sector (Kathuria, 1996; Narayanan, 1998).

The situation changed as Telco made entry in this sector in the middle of the 1980s. Given the strength and long experience in commercial vehicles segment, Telco launched light commercial vehicle which was not only advanced in terms of technology but also price competitive (Narayanan, 1998). Telco's price competitiveness lay in her indigenous manufacturing capacity as the firm has successfully developed a number of commercial vehicles using 100 per cent local content (Agarwal, 1987). On the other hand, the joint ventures between Japanese and Indian firms were new in the industry and hence they launched products using high import content. Due to high import content, they failed to compete effectively with Telco products. Most of these joint ventures finally disappeared from the light commercial vehicles segment especially after the middle of the 1990s (Table 2).

As illustrated in Table 2 the market share of Swaraj Mazda, Eicher, Daewoo declined from 6.49 per cent, 8.35 per cent and 7.47 per cent, respectively, in 1990-91 to 0 (zero) per cent, 2.49 per cent and 0 (zero) per cent, respectively, in 2011-12 (Table, 2). Correspondingly the market share of Telco and M&M increased from 34.29 per cent and 6.84 per cent, respectively, in 1990-91 to 58.60 per cent and 28.39 per cent in 2011-12. The increase in the market position of two indigenous firms (Telco and M&M) is mainly attributed to their technology base which these firms have developed overtime. The technological strength of Telco is evident as this firm have spent huge on technology development and also established an Engineering Research Centre (ERC) in 1966 at Pune (Venugopal, 2001). Apart from this explanation, there are some other reasons which are discussed while analyzing the growth of this sector later in this paper.

Table 3 outlines the trends in market structure of the heavy commercial vehicle sector and the changes witnessed in the market share of selected firms. In general, it is worth to point that the market structure of this industry did not witness any significant change during 1990s whereas some changes were noticed during 2000s (Table 3). It is evident as the value of concentration index and HHI remained more or less the same. The value of concentration ratio remained 1 in 1990s whereas a marginal downfall was noticed in the 2000s. Similarly, the value of HHI also declined during 2000s. Thought industry witnessed downfall during 2000s, but market structure remained more of an oligopoly as leading 4 firms were continuously serving more than 95 per cent market (Table 3).

Another interesting point which comes from the analysis of the market share is that the position of market leaders did not change. Telco remained on top and Ashok Leyland maintained second position during the reference period (1990-91 to 2010-11). Irrespective of Telco's dominance in the industry, the market share of this firm declined from 71.54 per cent in 1990-91 to 62 per cent in 2000-01 and further stood at 58 per cent in 2010-11 (Table 4). The decline in the market share of Telco led to the gain in the market position of new entrants. Among new entrants which gained market during the reference period were Eicher Motors, SML Isuzu Ltd and Asia Motor Works Ltd.

Telco maintained its top position both in case of LCVs and HCVs segments (Tables 2 and 3), even in the phase of open investment regime. This would have happened because of its leadership (or management) (for detail related to management issues, see Ray and Ray, 2011;

Table 3: Trends in market structure and share of HCV sector firms, 1990-91 to 2010-11

	1990-91	1995-96	2000-01	2005-06	2010-11
Indices	**Market Structure**				
N-Firms Concentration Ratio	1.00	1.00	1.00	0.99	0.97
HHI	0.59	0.60	0.53	0.45	0.42
Firms	**Share in HCV Sector (in %)**				
TELCO	71.54	72.23	62.26	59.92	58.09
Ashok Leyland Ltd	27.94	27.41	37.58	29.27	27.39
HML	0.52	0.36	0.15	0.00	0.00
Eicher Motors*	0.00	0.00	0.00	7.39	9.21
SML Isuzu Ltd	0.00	0.00	0.00	2.90	2.41
Volvo Buses India Pvt	0.00	0.00	0.00	0.46	0.48
Kamaz Vectra Motors	0.00	0.00	0.00	0.06	0.00
Asia Motor Works Ltd	0.00	0.00	0.00	0.00	1.91
Mahindra Navistar Automotives Ltd	0.00	0.00	0.00	0.00	0.45
Daimler India CVs Pvt Ltd	0.00	0.00	0.00	0.00	0.06
JCBL Ltd	0.00	0.00	0.00	0.00	0.02
Total	100.00	100.00	100.00	100.00	100.00

Source: Same as Table 1.
Note: * includes VECVs-Eicher.

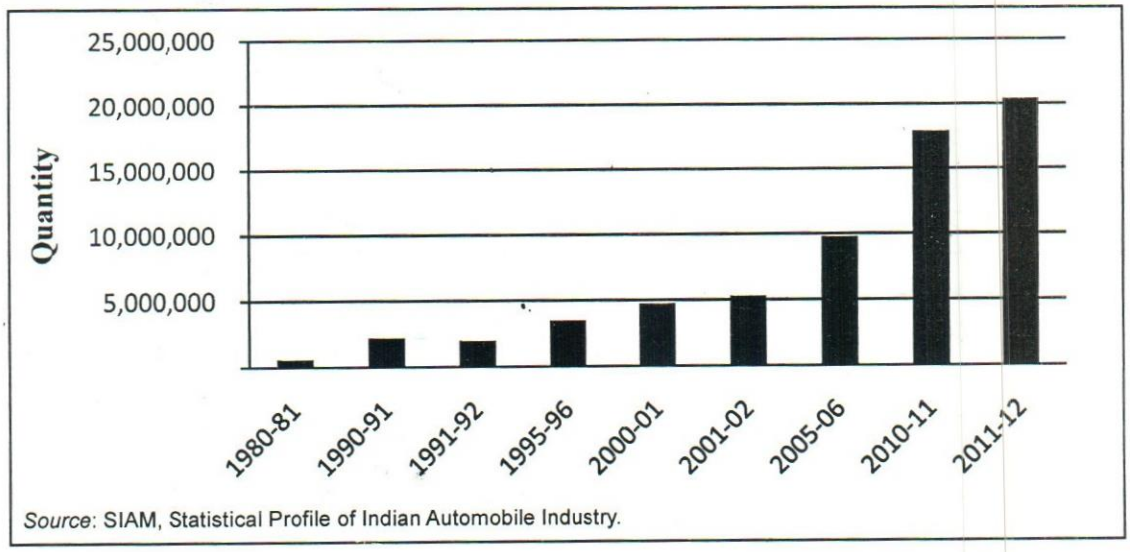
Becker-Ritterspach and Bruche, 2012) and long term vision of the firm (Kathuria, 1996; Venugopal, 2001; among many other). These factors are reflected in the decision to establish an Engineering Research Centre (ERC) in 1966 at Pune when no Indian firm gave importance to design and develop new products. Accordingly, the establishment of the ERC added to the absorption capacity of the firm to exploit imported technology on the one hand and also created the base for indigenous design and product development (Venugopal, 2001). Due to its technological strength, this firm successfully maintained it stop position in the market.

From the above discussion, it is worth pointing that the market structure of the automobile industry has witnessed significant change in the post reform period. However, the changes experienced by different sub-segments such as LCVs, HCVs and passenger vehicles are not uniform. The passenger vehicles segment witnessed a major restructuring and moved away from concentration to competition during the reference period. On the other hand, the structure in the LCVs and HCVs segments also observed changes but the dominance of few firms continued. Why is it that different sub-segments responded differently? Partly, we have discussed the varied response of different sub-segments in the same industry to the liberal policy regime. Further, in the following section we will analyze the growth and development of the industry to facilitate us in understanding the difference in the emerging market structure.

Growth of the automobile industry

This section analyses the trends in growth and production of the industry as a whole as well as its sub-sectors in the post reform period. For this, we have analyzed growth in production as well as changes in the production of the automobile industry and its sub-sectors.

Figure 1 indicates the volume of production of automobiles in India from1980-81 and 2011-12. Till the middle of the 1980s the production was less than 1 million whereas in 2011-12 per annum it crossed 20 million. But a sharp jump in production of the automobile industry has been witnessed since the mid-1990s (Figure 1). For instance, the average production of automobiles in India was 2.5 million during 1991-92 to 1995-96 and it reached to 7.4 million during 2001-02 to 2005-06 and finally stood at 12.9 million during 2006-07 to 2010-11 (Table 5). The change in production volume is more than 6 times in the period under consideration. It was the period when Indian economy experienced a number of changes in the regulatory environment. Accordingly, the number of new



Source: SIAM, Statistical Profile of Indian Automobile Industry.

Figure 1: Production of automobile vehicles in India, 1980-81 to 2011-12 (in nos.)

firms including foreign firms started production in India as industry demand grew rapidly in this phase (Table 4). The compound annual growth of the automobile production was 9.93 per cent during 1991-92 to 2000-01 which increased to 14.45 per cent in the following decade (2001-02 to 2010-11).

Table 4: Category-wise Production and CGPA trends, 1991-92 to 2010-11

	PVs	LCVs	HCVs	Total Vehicles
Time period	Compound Annual Growth Rate (CAGR)			
1991-92 to 1995-96	20.09	24.62	9.72	14.66
1996-97 to 2000-01	4.39	-6.92	-12.75	4.55
2001-02 to 2005-06	18.24	27.13	22.70	16.33
2006-07 to 2010-11	17.92	15.96	4.02	12.82
1991-92 to 2000-01	13.88	1.95	-0.17	9.93
2001-02 to 2010-11	18.07	22.49	15.16	14.45
Number of Vehicles (5-Year Average)				
1991-92 to 1995-96	277964.6	80821	92520	2504583.2
1996-97 to 2000-01	584813.4	66118.2	106157	4364611
2001-02 to 2005-06	980279.6	113709	163496.2	7408580.4
2006-07 to 2010-11	2047233.4	285798	275242.2	12948343.8
2011-12	3146069	544335	384801	20382026

Source: Same as Table 1.
Note: PVs = Passenger Vehicles; LCVs = Light Commercial Vehicles; HCVs = Heavy Commercial Vehicles.

The large expansion in the production was not equally shared among different sub-segments of the industry (Table 4). The considerable variation in the growth across segments would have probably contributed to the varying nature of changes in the structure of PVs, LCVs and HCVs segments under the liberal economic environment. For instance, the growth of the PVs segment not only remained positive but also increased consistently in the reference period. The compound annual growth of the PVs segment was 13.88 per cent during 1991-92 to 2000-01 and it increased to 18.07 per cent in 2001-02 to 20010-2 (Table 4). On the other hand, the growth of other two segments (LCVs and HCVs) remained not only slow during 1990s but also turned as negative in case of HCVs, but the growth of these segments (LCVs and HCVs) became significantly high after 2000. The growth of LCVs and HCVs was 1.95 per cent and -0.17 per cent, respectively, during 1990s and it increased to 15.16 per cent and 14.45 per cent in the following decade (2001-02 to 20010-2) (Table 4).

The increase in the production in the automobile industry is probably attributed to mainly two developments witnessed under the reform period which has direct implications for the demand of the industry. First, this was the phase (2002-03 to 2007-08) when Indian economy experienced the highest ever growth rate (around 9 per cent) (Nagraj, 2013). The high growth raised the income of households, which appears in terms of rising income of

middle class population. According to NCAER (National Council of Applied Economic Research) estimates, the share of middle class households (middle + upper middle income group) in the total population increased from 8.48 per cent in 1985-86 to 18.35 per cent in 1996-97 and further to 31.56 in 2009-10 (Singh, 2014). According to NCAER, based on 2001-02 prices, the income of middle class households varied between 2 to 10 lakhs per annum[3]. The growing size of income of households would have obviously contributed to the demand of automobiles in general and the passenger vehicles in particular. It is so because the middle class households are more aspirants and want to enjoy luxurious life as their income increases. Thus, the change in income adds to the demand of luxury goods as these households have already fulfilled the basic necessities of life. It is evident as passenger vehicles segment grew at significantly higher rate as compared to other segments as well as industry as a whole (Table 4). On the other hand, the rising income may not have directly affected the demand for commercial vehicles as these vehicles are used for transfer of final goods to the market and raw materials to industry. Thus, it is clear that the demand for commercial vehicles is not directly related to consumer disposal income. In addition, the slow growth of commercial vehicles segments could partly be attributed to the emergence of alternate means of transfer of goods (railway network expanded in the country) during the last couple of decades.

Second, credit facility for consumer durables also increased at an exponential rate after the middle of the 1990s (Chandrasekhar, 2011). The easy availability of credit would have obviously contributed to the growth of the industry. Numbers suggest that around 75 per cent of the value of passenger vehicles is financed by credit offered by the banking system in India in the recent years (India Brand Equity Foundation, 2010 and Singh, 2014).

The difference in the growth of sub-segments provides significant explanation to the varying nature of emerging market structure of different sub-segments (PVs, LCVs and HCVs) in the post reform period. As noticed above, the PVs segment grew at rapid pace in the reference period. It implies that the demand for PVs segment increased significantly under the reform period. Due to high growth of this segment, a large number of foreign firms made their entry in the PVs industry. The important ones include General Motors, Ford India, Fiat, Suzuki, Hyundai, Skoda, Mercedes-Benz, BMW, Toyota, Nissan etc. The large entry of new firms added to the competition as every new entrant wanted to exploit rapidly growing market of passenger vehicles in India. In this process, both the new entrants and existing ones intensively introduced new varietiesof passenger cars and multi utility vehicles especially after 2000 in order to gain market share. This led to the restructuring of the passenger vehicles industry. On the other hand, the slow growth of LCVs and HCVs did not provide much incentive for new entrants to enter in the industry. Due to slow growth, some firms which earlier entered in the LCVs and HCVs segments diversified their product line and entered in the passenger vehicles segment. For instance, Daewoo, Telco etc were manufacturing commercial vehicles till the early years of 1990s and later entered into the PVs segment.

Concluding Remarks

The objective of this paper is to understand the impact of growing economic integration of India with the world market on the structure and development of the India's automobile industry. These developments are analyzed against the backdrop of neo-liberal reform programme initiated in the early 1990s. This industry was subjected to significant policy changes as a part of economic liberalization of the 1990s (Narayanan, 1998). The industry was tightly regulated through a series of regulatory instruments implemented in the 1950s and 1960s in order to promote indigenization. The policy instruments used to regulate the industry were protection, capacity licensing, restrictions on foreign collaboration, price controls, the reservation of certain components and parts for small scale units, etc. These measures continuously regulated the development of the industry till the middle of the 1980s. Accordingly, the regulatory measures not only influenced the growth and development by restricting the volume of production but also influenced the structure of the industry by limiting the number of manufacturers in the industry. How has the liberal policy regime influenced the structure and development of the industry is the main issue addressed in this paper.

The empirical analysis performed in this paper highlights that the policy changes witnessed in the early years of 1990s significantly influenced the growth and structure of the industry during the last couple of decades. However, the changes observed are not uniform across the sub-segments. The analysis of the structure of the industry indicates that the PVs segment was subjected to significant restructuring since the middle of the 1990s.

[3] Based on 2009-10 prices, the income of these households varied between 3.5 lakh to 17 lakh (NCAER).

It is evident as value of both the indices (HHI and N-firm concentration) has declined on the one hand and the ranking of the manufacturers in terms of market shares of market leaders also changed. Contrary to the experience of PVs, the concentration in case of LCVs and HCVs did not decline even in the phase of liberal investment regime. The structure is more like an oligopoly as a few leading firms are serving more than 80 per cent of market demand.

Similarly, the growth trends also varied across the selected sub-sectors. The PVs industry experienced rapid and consistent growth over the reference period whereas the growth of LCVs and HCVs not only remained slow but also turned negative in case of HCVs in the 1990s. But after 2000, the growth of these two segments increased significantly. The difference in the growth performance could be the major underlying factor behind the varying performance across sub-sectors. Due to high growth of PVs sector, a number of new foreign and domestic firms made entry in the industry and some existing firms in the commercial vehicles segments also diversified. A huge entry of firms mainly aimed at exploiting rapidly growing market. To exploit the market, new entrants as well as old firms launched a variety of new passenger cars and utility vehicles in order to get foothold in the market. In this process, the concentration in the industry has declined and the market has converted into competitive one. On the other hand, the slow growth of LCVs and HCVs did not provide much incentive for new firms to enter. Though some firms entered in the industry, but they failed to get desired share because of strong capabilities of old established firms (Telco, Bajaj Tempo and Ashok Leyland).

With this understanding, it can be argued that the liberal economic environment is not a sufficient condition to bring about the required changes and promote the development of the industrial sector in general. The firm specific factors are equally important in shaping the long run growth trends and structure of the industry. It is evident from the varying response of sub-segments within the same industry under the same policy regime. It is suggested that, besides the liberalization policy, sector- specific factors remain critical in determining the outcomes for any sector.

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One machine can do the work of fifty ordinary men. No machine can do the work of one extraordinary man.

—Elbert Hubbard

Focus

Growth and Productivity of the Food Processing Sector: An Assessment of the Organised Segment

H K VARSHNEY AND D INDRAKUMAR

The food processing industry is the vital link between the two core sectors of the economy viz., agriculture and industry. In an era of globalised and competitive economic conditions the agriculture sector needs to have forward linkages with the industrial sectors. The food processing industry ranks fifth in size in the country, representing 1.5 per cent of the total GDP and 9.3 per cent of manufacturing GDP in 2009-10. The industry employed 5.48 million people in 2009-10. This sector as a whole proved to be a job loosing sector, but an organised component of the sector exhibited an overall growth. Organised sector employed just one-third of the total employment in the sector but contributed two-thirds of the GVA by the sector. Labour productivity of the organised sector has nearly doubled during 1994-95 to 2009-10 and increased with an average rate of growth of 3.4 per cent per annum.

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Background

The reform process in India has infused enormous competitiveness among organisations, thereby mounting pressure on them to adapt suitable strategy for their survival. In the changed economic platform, market access is governed not merely by the volume of products but more importantly by their quality and price competitiveness. The unorganised sector, which constitutes a significant proportion of the economy is characterised by low level of productivity. Thus, a disaggregated analysis of productivity in the organised and unorganised sectors would be useful for evolving policies relating to investment and employment.

Productivity plays a key role in determining competitiveness of the sector. Hence, estimation of productivity is vital in understanding the relative performance of the sector. Labour and capital are the major factor inputs to estimate productivity levels of any sector/ industry. In the present circumstances, it becomes important to know the changes in sectoral productivity over a period of time. From the change in sectoral productivity, one can know how productivity is changing in different sectors. This may also give an idea about the sectors which have more scope to employ the surplus labour and the sectors which require additional investments. It is in this context, that present paper aims to analyse the productivity trends in food processing sector.

Profile of the Sector

Food processing sector is crucial to the economy as it provides employment to about 5.48 million people (1.62 million in the organised and 3.86 million in the unorganised sector) in 2009-10. The sector is a vital link between the two pillars of the Indian economy, namely, Industry and Agriculture. A vibrant agrarian and rural economy requires establishing forward linkages in the form of food processing

industries. It has been realized that food processing industries have a crucial role to play in value addition to agriculture, to increase the shelf life and also in the reduction of post-harvest losses.

This sector is one among the heterogeneous sectors of manufacturing. It covers a spectrum of products from sub-sector comprising agriculture, horticulture, plantation, animal husbandry and fisheries. The processed food industry is divided into the following broad segments:

i. Primary processing: processing of food with low level of technology which includes products such as fruits and vegetables, packed milk, unbranded edible oil, milled rice, flour, tea, coffee, pulses and salt, etc., sold in packed or non-packed forms.

ii. Secondary processing: processing that provides value addition to food by more sophisticated technology which includes products such as processed fruits and vegetables, juice and jams, pickles, processed dairy products, processed poultry and marine products, confectionary, chocolates, alcohol and beverages, etc.

The data on food processing sector, provided by different agencies is classified under NIC-15 under the heading 'food products and beverages'.

Essentially, the food industry involves the commercial movement of food from "field to fork". Food processing industries are one of the fastest growing segments in manufacturing in 2010-11 contributing 27 per cent to average industrial growth, i.e., more than three times its weight in the Index of Industrial Production (IIP) (GoI, 2011). With 16 per cent of world population and 12 per cent of world's food production, India is today one of the largest producers and consumers of food in the world. Indians spend approximately 49 per cent in rural areas and 38.5 per cent in urban areas of their total spending on food. But food processing levels in the country are substantially lower than most developing and developed countries.

Only 6 per cent of the food produced in India is properly processed which is much lower than in China (40 per cent) and in Malaysia (80 per cent) (FICCI, 2011). A proper planning based on demand and supply of labour is required at for the sector to reach better employment (ILO, 1998). Currently, no systematic and scientific data pertaining to the food processing sector based on harmonised concepts, definitions and classifications is available (MOFPI, 2012). However, more than 70 per cent of the industry output in volume terms and 50 per cent in value terms are from unorganised and small players of the sector. Despite this food processing industry ranks fifth in size of the industrial category in the country. The sector contributes 1.5 per cent to the total GDP and 9.3 per cent to the manufacturing GDP in 2009-10 (CSO, 2011).

The food processing sector comprises of organized as well as unorganized industries. While data on industries in the organized sector is made available on a fairly regular basis by the Central Statistical Organisation (CSO) through its annual publication 'Annual Survey of Industries (Factory Sector)', the data on industries in the unorganized sector is not available in that manner. National Sample Surveys organization (NSSO) through its quinquennial surveys on Employment and Unemployment provides information for the total economy as well as for the organized and unorganized sectors. But the definitions adopted for organized sector by ASI and NSSO are different. Moreover, due to lack of reliable data on the operation of unorganized industries, data for unorganized sector is obtained by subtracting the organized sector data (available from ASI) from the total data (available from NSSO). The unorganized sector employs about two-third of the total employment in food processing sector but it contributes only one-third of the total value addition by the sector. In this scenario, an analysis of the productivity of the food processing industries in organized sector has been undertaken in this paper.

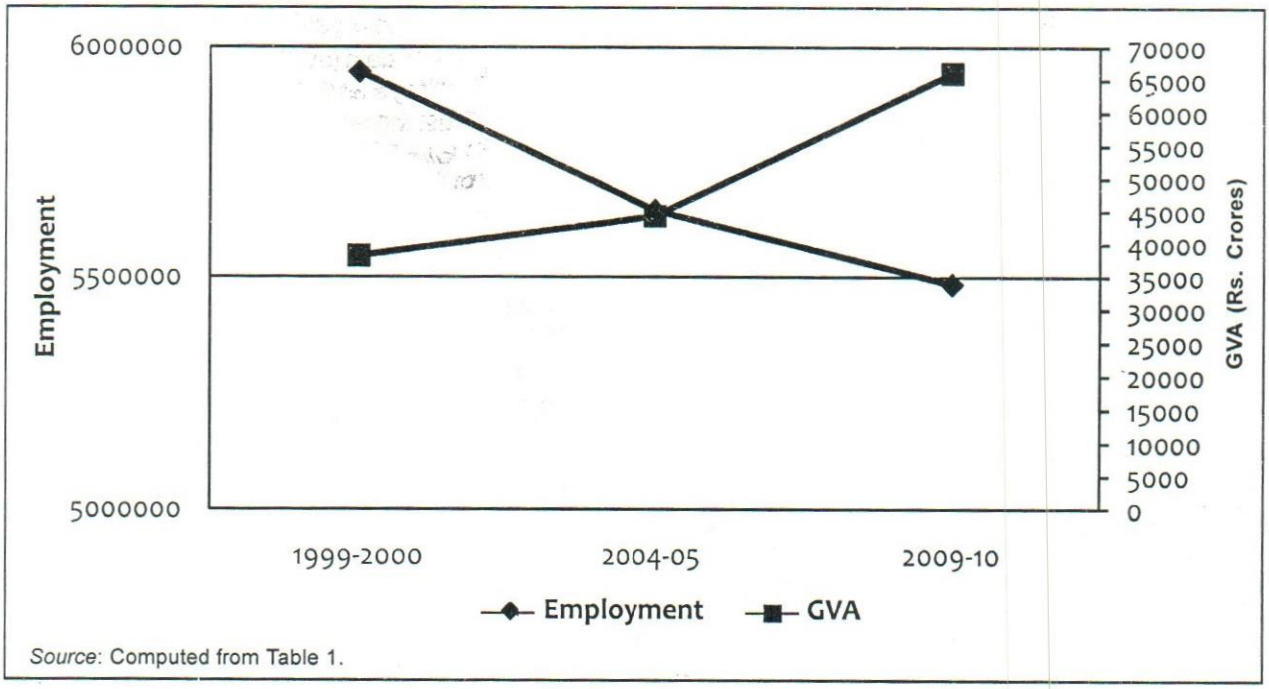
Table 1 chart 1 describes the degree of structural change that is taking place in respect to employment and GVA in total manufacturing and food processing industries as shown by NSS data for the decade 1999-2000 to 2009-10. The sector employed 5.48 million persons in 2009-10, constituting 10.8 per cent of the total employment in the manufacturing sector and 1.2 per cent of the total workforce in the economy. However, employment in this sector has declined by about 0.47 million during the last decade. The loss of employment was more visible in the first half of the decade (1999-2000 to 2004-05) as compared to the second half of the decade (2004-05 to 2009-10).

It is worth mentioning that the growth rate of employment in the manufacturing sector rose by 1.42 per cent per annum during the decade but in the case of food products and beverages, the employment reduced by a rate of (-) 0.81 per cent per annum (employment rose by 4.83 per cent per annum in the first half and declined by 1.87 per cent per annum in the second half). As a result of loss in employment, the share of food products & beverages in the manufacturing sector employment has also declined from 13.5 per cent in 1999-2000 to 10.8 per cent in 2009-10.

Table 1: Employment and GVA trend in Food and Beverage, 1999-2000 to 2009-10

Sector	Year and Employment (in millions)		
	1999-2000	2004-05	2009-10
Food and Beverages	5.95	5.65	5.48
Manufacturing	44.05	55.77	50.74
Total Economy	396.76	457.47	460.21
% share in manufacturing	13.50	10.12	10.81
% share in Total economy	1.50	1.24	1.19
GVA (Rs. Crores)			
Food and Beverages	38252	44355	66078
Manufacturing	331758	453225	713428
Total Economy	2143129	2971464	4493743
% share in manufacturing	11.53	9.79	9.26
% share in Total economy	1.78	1.49	1.47

Source: (i) NSSO Reports on Employment and Unemployment for 1999-2000, 2004-05 and 2009-10.
(ii) National Accounts Statistics from CSO for different periods for data on GVA.



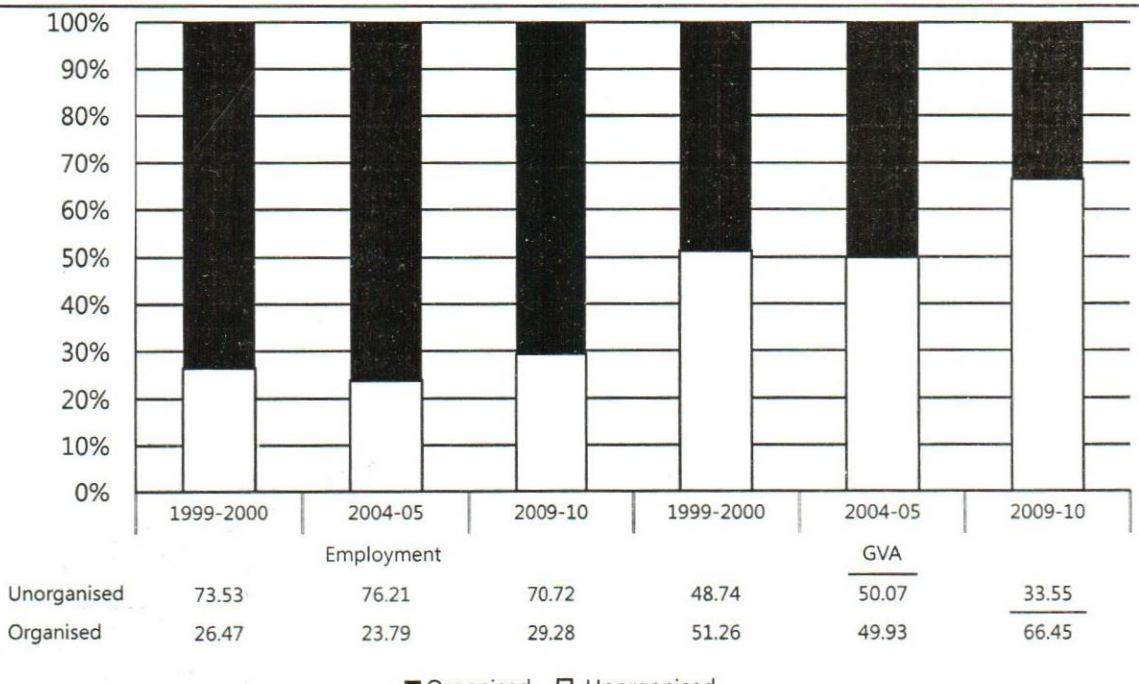
Source: Computed from Table 1.

Chart 1. Growth of Employment and GVA in Food Processing Sector

The distribution of organized and unorganized segment of employment and GVA is given in Chart 2. It is very clear from the data that both employment and GVA for organized segment has registered appositive growth over the years. In case of employment, share of organized segment is slightly less than that of the GVA. The GVA share in organised segment has registered significant growth over the years it was 51.26 per cent in 1999-2000 to 66.45 per cent in 2009-10. However, the employment increased to 29.28 per cent from 26.47 per cent in 1999-2000. There was a little increase in the organised share of employment during the last decade.

Food Processing Industries in Organised Sector

The scenario for the period from 1994-95 to 2009-10 has been reviewed and the data for four points of time i.e., 1994-95, 1999-00, 2004-05 and 2009-10 has been taken from relevant issues of Annual Survey of Industries (Factory



Source: NSSO Employment and Unemployment Reports for 1999-2000, 2004-05 and 2009-10 for Total employment, Annual Survey of Industries for Organised Employment for the same period and GVA for both organised and unorganized from CSO data on same period. Unorganized employment as a residual of organized from the total.

Chart 2. Organised and Unorganised Share of Employment and GVA

Sector) and has been converted at constant (1993-94) prices (see Annexure Table A1). The performance of food processing industries has been compared with the total manufacturing sector. A cursory look at the data reveals that the period 1999-2000 to 2004-05 was not favourable for food processing as well as total manufacture sector.

Growth of Food Processing Sector

Growth rate analysis of the food processing sector presented in Table 2 shows that the sector has been growing constantly since 1994-95. The data highlights that during the period 1994-95 to 2009-10, food processing

Table 2: Growth Rates of selected characteristics in Organised Food Processing and Total Manufacturing Sector

Economic Indicators'	CAGR (%)							
	Food Processing Sector				Total Manufacturing Sector			
	1994-95 to 1999-2000	1999-2000 to 2004-05	2004-05 to 2009-10	1994-95 to 2009-10	1994-95 to 1999-00	1999-2000 to 2004-05	2004-05 to 2009-10	1994-95 to 2009-10
1. Number of factories	4.24	1.16	1.62	2.33	1.35	0.72	3.10	1.72
2. Employment								
a) Total persons engaged	2.62	-0.07	3.64	2.05	-2.40	0.68	6.88	1.65
b) Workers	2.82	0.28	3.72	2.26	-2.06	0.99	6.77	1.84
c) Employees	1.95	-1.29	3.37	1.33		-0.40	7.28	1.04
3. Fixed Capital	14.64	0.29	13.12	9.15	2.32	-0.19	15.22	5.57
4. Invested Capital	12.24	0.21	12.19	8.06	2.53	0.78	14.43	5.74
5. Input	12.62	1.78	10.83	8.30	7.06	8.31	11.42	8.92
6. Output	12.19	1.24	11.02	8.04	6.08	7.64	11.41	8.35
7. Gross Value Added	9.56	-2.61	12.55	6.29	2.82	4.96	11.34	6.31

Source: Computed from Annexure Table A1

sector on an average exhibited a positive growth trend. However, during 1999-2000 to 2004-05, there was either a marginal growth or a declining trend. Though, average growth in total manufacturing sector was also positive for all characteristics, this growth was less than the food processing sector. Declining trend in many of the characteristics was observed during the first two sub-periods, i.e., 1994-95 to 1999-2000 and 1999-2000 and 2004-05. Another salient feature of the data is that growth in output, GVA and wages/salaries was substantially higher as compared to the growth in Number of factories and number of workers/employees.

An analysis of change in major characteristics based on data provided in Tables 3, 4, and 5 is presented in following paragraphs.

The number of workers and number of employees engaged in food processing sector reported a declining trend during 1994-95 to 2009-10. However, the recent sub-period reported to substantial growth. It is worth mentioning that

Table 3: Growth in Selected Technical coefficients in Food Processing and Total Manufacturing Sector

Technical Ratios	Food Processing Sector				Total Manufacturing Sector			
	1994-95 to 1999-2000	1999-2000 to 2004-05	2004-05 to 2009-10	1994-95 to 2009-10	1994-95 to 1999-2000	1999-2000 to 2004-05	2004-05 to 2009-10	1994-95 to 2009-10
Fixed cap per factory	9.97	-0.86	11.32	6.67	0.96	-0.90	11.75	3.79
GVA per factory	5.10	-3.72	10.76	3.87	1.44	4.21	7.99	4.51
Worker per factory	-1.37	-0.87	2.07	-0.07	-3.37	0.27	3.56	0.11
Employee per factory	-1.56	-1.21	1.99	-0.27	-3.70	-0.04	3.67	-0.07
GVA per person	6.76	-2.54	8.59	4.15	5.34	4.25	4.17	4.59
Output/Input	-0.39	-0.53	0.17	-0.25	-0.92	-0.62	-0.01	-0.52
Output per factory	7.62	0.08	9.25	5.58	4.67	6.87	8.05	6.52
Output per worker	0.73	8.33	-0.01	2.95	5.56	1.41	2.89	3.27
Output per employee	0.47	8.82	-0.12	2.98	5.40	1.63	2.56	3.18
GVA/Invested Capital	-2.39	-2.81	0.32	-1.64	0.28	4.14	-2.70	0.54
GVA per worker	6.56	-2.88	8.51	3.94	4.98	3.92	4.28	4.39
GVA per employee	7.47	-1.34	8.88	4.90	6.51	5.38	3.79	5.22
GVA per person	6.7648	-2.54251	8.590694	4.15466	5.340915	4.251218	4.1728	4.586958

Source: Computed from Annexure Table A1.

all the factors under consideration exhibited an accelerating trend over the entire period except the decelerating trend during 1999-2000 to 2004-05. In general, the rate of growth for different parameters was higher during the period 2004-05 to 2009-10 as compared to the period 1994-95 to 1999-2000. The highest rate of growth was reported by Fixed Capital during 1994-95 to 2009-10 (Table 3).

As a result of different rates of growth in food processing industries and total manufacturing, the share of various characteristics of food processing industries in total manufacturing has changed over time. The share of various characteristics of food processing industries in total manufacturing sector is presented in Table 4. In general there was fluctuating trend was observed for major economic indicators of food and beverages industries in manufacturing component. Up to 2004-05 majority of the indicators shows an increasing trend.

Number of Factories

The number of factories in food processing sector have increased from 19449 in 1994-05 to 27480 in 2009-10 i.e., increased at the compounded annual rate of 2.33 per cent. This rate of growth is much higher than that for the total manufacturing sector (1.72 per cent per year). However, further analysis reveals that the rates of growth in number of factories vary in different sub-periods. In the period 1994-95 to 1999-2000 the growth was much higher (4.24 per cent per annum) as compared to other sub-periods (1.16 per cent and 1.62 per cent per annum respectively during 1999-2000 to 2004-05 and 2004-05 to 2009-10). It is interesting to note that except during the period 2004-05 to 2009-10, the rate of increase in total manufacturing industries was less than the rate of increase in food processing industries (Annexure Table A1).

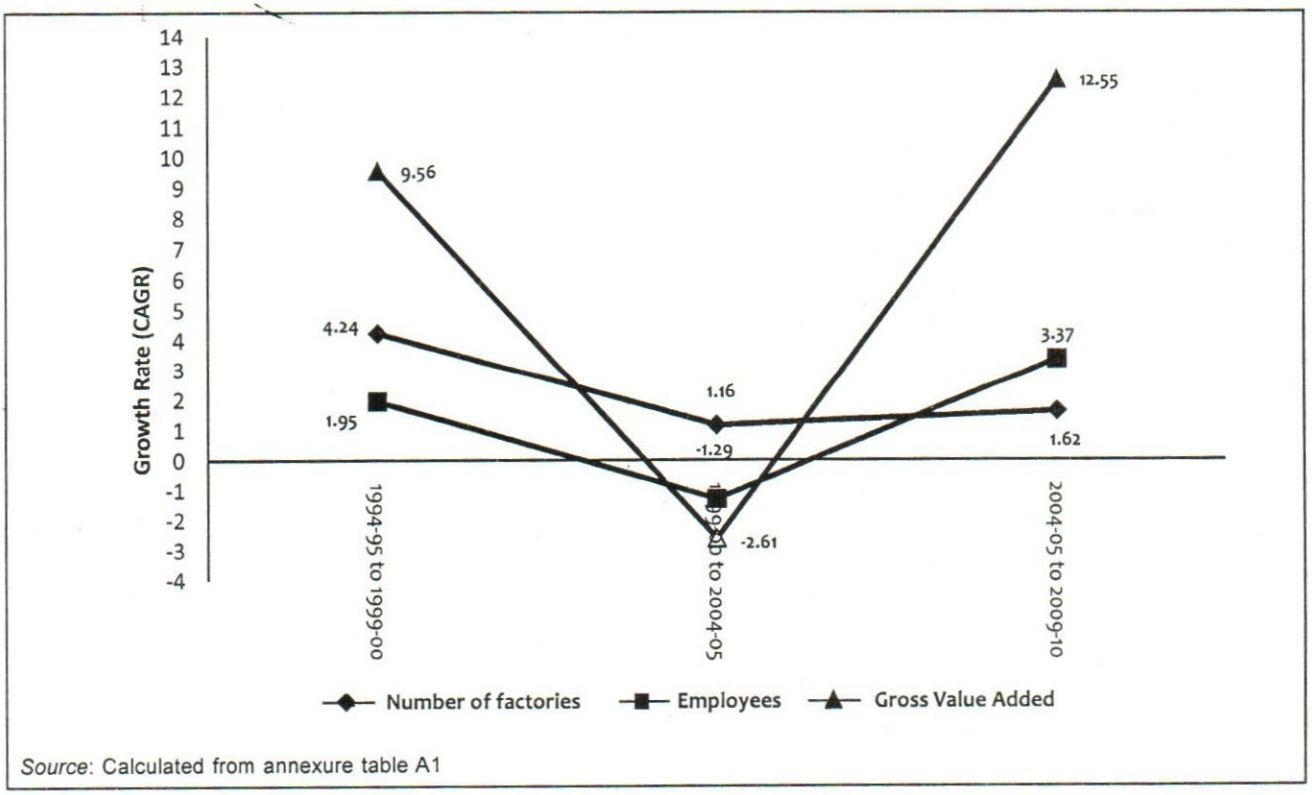
Table 4: Share of food processing sector in total manufacturing sector

Economic Indicators	Share of Food Processing in Total Manufacturing			
	1994-95	1999-2000	2004-05	2009-10
1. Number of factories	15.81	18.20	18.60	17.30
2. Employment				
a) Total persons engaged	12.83	16.49	15.89	13.62
b) Workers	13.00	16.58	16.00	13.84
c) Employees	12.31	16.18	15.47	12.85
3. Fixed Capital	4.46	7.87	8.07	7.36
4. Invested Capital	7.24	11.39	11.07	10.03
5. Input	14.16	18.23	13.36	13.01
6. Output	12.54	16.59	12.21	12.00
7. Gross Value Added	7.57	10.40	7.15	7.55

Source: Computed from Annexure Table A1

An increasing trend in the number of factories in food processing sector as compared to total manufacturing sector may be attributed to various incentives announced by the Ministry of Food Processing Industries, Government of India.

However, due to the variable rate of growth in number of factories between different periods in both food processing sector and total manufacturing sector, the share of food processing sector in the total manufacturing has been changing. This share increased from 15.8 per cent in 1994-95 to 18.2 per cent in 1999-2000, then to 18.6 per cent in 2004-05 but declined to 17.3 per cent in 2009-10. The overall all trend of the number of factories, employees and GVA is shown in the following chart (chart 3).



Source: Calculated from annexure table A1

Chart 3. Growth Rates of Number of Factories, Employees and Gross Value Added in Organised Food Processing. Industries

Employment

(a) Workers

As against about nine lakh workers in 1994-95, the number of workers in food processing sector increased to about 12.6 lakh in 2009-10. This is in contrast to a decline in workforce in food processing as a whole, covering organized and unorganized sectors. The number of workers increased at the compounded annual growth rate of 2.26 per cent during 1994-95 to 2009-10. This is higher than the rate of increase (1.84 per cent) witnessed by number of workers in total manufacturing sector over the same period. The increase in number of workers witnessed a fluctuating trend: during 1994-95 to 1999-00, the rate of increase was 2.82 per cent which dropped to just 0.28 per cent during 1999-2000 to 2004-05 and increased to 3.72 per cent during 2004-05 to 2009-10. It is interesting to note that number of workers in total manufacture sector, which declined by 2 per cent during 1994-95 to 1999-00 and increased by just 1 per cent during 1999-00 to 2004-05, increased significantly by 6.77 per cent during 2004-05 to 2009-10 (Table 4).

Though the employment grew in food processing units, the share of workers in food processing units to the total manufacturing witnessed a fluctuating trend. The share of workers engaged in food processing industries to the total workers in manufacturing sector increased from 13 per cent in 1994-95 to 16 per cent in 2004-05 but again declined to 13.84 per cent in 2009-10. Thus, above analysis points out that food processing sector is losing its labour intensive character.

(b) Employees

In addition to workers, there are a number of other persons employed in the industry. These include managers, engineers, technicians, supervisors, etc. They are the high level manpower in the officer grade. While highly technological industry may require more number of employees, traditional labour intensive industry may require lesser number of employees. The unpaid family workers are also included in this category. The difference in the number of total persons engaged and the workers provide the number of such employees/persons.

In the food processing sector, the growth in the number of employees is less than the growth in number of workers during 1994-95 to 2009-10. A similar pattern has been observed in the case of total manufacturing sector which indicate that both food processing industries as well as total manufacturing sector are becoming more technological oriented. It is interesting to note that the share of employees in food processing sector to that in the total manufacturing is less than the share of ratio of workers. Further analysis indicates that there is a marginal increase in the number of workers per employee and this is true for both food processing and total manufacturing sector (Table 4).

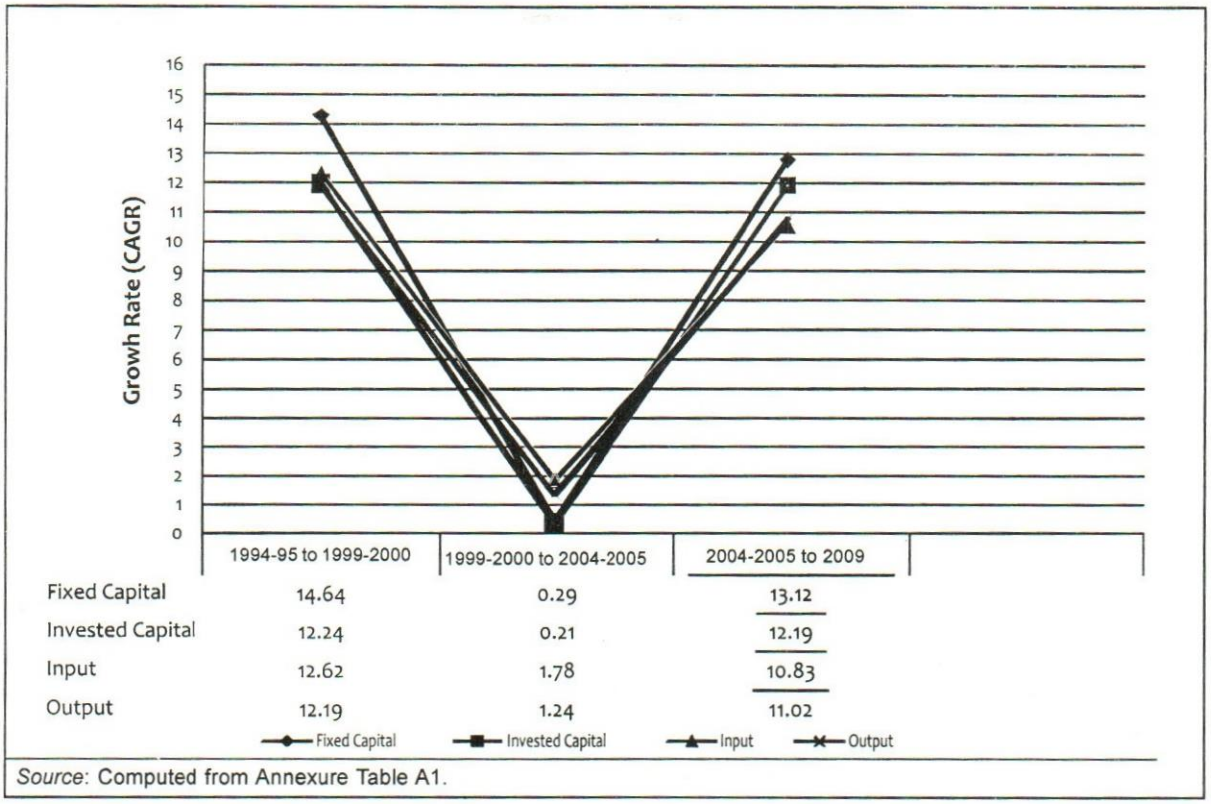
Gross Value Added (GVA)

GVA measures the contribution of each sector or industry to the total economy. It measures the productivity of the economy and is a headline measure used to monitor economic performance. Value addition by the food processing industries as well as by total manufacturing in the country has grown at a very significant rate during the period under reference. During the 15 years period under reference, the rate of growth in GVA by food processing sector and the manufacturing as a whole was almost similar (6 per cent per annum) but analysis of different sub-periods depicts a different picture as they exhibited a fluctuating trend. During 1994-95 to 1999-00, GVA by food processing sector increased by 9.6 per cent as against just 2.8 per cent by total manufacturing. During 1999-00 to 2004-05, GVA by food processing sector declined by 2.6 per cent per annum while GVA in total manufacturing grew by about 5 per cent per cent during the same period. In the third sub-period i.e., 2004-05 to 2009-10, GVA in both food processing and total manufacturing accelerated by almost 12 per cent annum. However, the contribution of food processing industries in total manufacturing in terms of gross value added increased from 7.6 per cent in 1994-95 to 10.4 per cent in 19992000 but declined to 7.2 per cent in 2004-05 and increased marginally to 7.6 per cent in 2009-10 (see Table 4).

The general trend of the other economic indicators is shown in chart 4.

Invested Capital

The total capital invested in food processing industries has increased at a compound annual growth rate of 8.06 per cent during 1994-95 to 2009-10. The corresponding increase in total manufacturing was 5.74 per cent during the same period. The growth in capital investment has shown fluctuating trends during this period. In the case of food processing industries, the rate of growth was 12.24 per cent per annum during 1994-95 to 1999-2000 but declined sharply to just 0.21 per cent per annum during 1999-2000 to 2004-05 and again grew by 12.19 per cent per annum during 2004-05 to 2009-10. Total manufacturing



Source: Computed from Annexure Table A1.

Chart 4. Growth Rates of Number Fixed, Invested Capitals and Input & Output in Organised Food Processing Industries

sector behaved in exactly the similar manner, though the rates vary. This increase during 2004-05 to 2009-10 may be a result of foreign direct investment (FDI) which has increased since 2005-06.

The share of capital investment in food processing industries to the total manufacturing sector after increasing from 7.24 per cent in 1999-2000, remained between 10 to 11 per cent during the remaining period (see Table 4).

Fixed Capital

The Fixed Capital Invested in food processing sector was almost half of the invested capital and the growth pattern was similar to that followed by invested capital. The fixed capital in food processing industries has increased by 9.15 per cent per annum during 1994-95 to 2009-10. Except during 1999-2000 to 2004-05, the rate of growth in fixed capital remained 13 to 14 per cent per annum.

The proportion of fixed capital invested in food processing industries to that total fixed capital invested in manufacturing has increased from 4.46 per cent in 1994-95 to 7.36 per cent in 2009-10. The share of fixed capital to total capital invested in food processing industries has increased from 44.1 per cent in 1994-95 to 51.3 per cent in 2009-10 (see Table 4).

This investment pattern indicates that food processing sector is becoming more capital intensive and more capital is being used for plant and machinery.

Input

The cost of input in food processing sector has increased on an average by 8.3 per cent per annum. The rate of growth was highest (12.62 per cent) during 1994-95 to 1999-2000 and was least (1.78 per cent) during 1999-2000 to 2004-05. The corresponding rate of growth in total manufacturing industries during 1994-95 to 2009-10 was 8.92 per cent per annum. Though, this rate of growth is higher than the food processing sector, the rate of growth in total manufacturing in different sub-periods is higher than the corresponding rates in food processing sector. However, the share of food processing sector in total manufacturing in terms of input has declined from 14.16 per cent in 1994-95 to 13.01 per cent in 2009-10 (see Table 4).

Output

During the period 1994-95 to 2009-10, the output of the food processing industries increased by 8.04 per cent per annum. The growth during 1999-2000 to 2004-05 was only 1.2 per cent per annum as against nearly 12 per cent in

other sub-periods. Total manufacturing sector followed the same pattern and grew by 8.35 per cent during the entire period and there was consistent increase: 6.1 per cent, 7.6 per cent and 11.4 per cent per annum during 1994-95 to 1999-2000, 1999-2000 to 2004-05 and 2004-05 to 2009-10 respectively. However, share of output of food processing industries in the total output of manufacturing sector remained to about 12 per cent except in 1999-2000 when it grew to 16.6 per cent. This rate of growth was 0.25 per cent less than the rate of input during the same period (see Table 4).

Analysis of Technical Ratios:

Workers per Factory

Though food processing sector is considered to be labour intensive, the workers per factory in the sector were less as compared to total manufacturing sector. There were 47 workers per factory in food processing sector in 1994-95 as compared to 57 in total manufacturing. The growth in number of factories in food processing sector was identical to the growth of workers in the sector; as a result, the workers per factory remained almost constant during the period 1994-95 to 2009-10. A similar trend has been observed in the case of total manufacturing sector. The workers per factory in both the sectors - food processing and total manufacturing - declined in 1999-2000 and 2004-05 and again increased in 2009-10. The decline in workers per factory over the time indicates that industries are using advanced technology which requires fewer workers.

Employees per Factory

The data suggests that organized manufacturing units are providing more employment per factory in 2009-10 as compared to 1994-95. This is in contrast to the scenario in food processing sector where number of employees per factory has remained almost constant. This indicates that in food processing sector, employment (workers as well as employees) are not increasing at the same pace as the number of factories. In other words, the food processing industries are becoming capital intensive (as is evident from the data on fixed capital per factory).

Fixed Capital per Factory

In the food processing industries, the fixed capital per factory has increased from Rs. 56.56 lakh in 1994-95 to Rs. 148.94 lakh in 2009-10. In total manufacturing sector, this ratio increased from Rs. 200.45 lakh to Rs. 350.16 lakh over the same period. While fixed capital per factory in food processing sector tripled during 1884-95 to 2009-10, the ratio in the case of total manufacturing increased by 1.5 times. In 1994-95, the fixed capital per factory in total manufacturing was almost four times the fixed capital per factory in food processing sector which is nearly double in 2009-10. Though, the number of factories in food processing sector increased at a faster pace than the number of factories in the total manufacturing sector, the rate of growth in fixed capital in food processing sector was higher than that in total manufacturing industries. This scenario highlights that food processing sector is becoming

Table 5: Selected Technical Coefficients for Food Processing and Total Manufacturing Sector

Technical Ratios	Unit	Food Processing Sector				Total Manufacturing			
		1994-95	1999-00	2004-05	2009-10	1994-95	1999-00	2004-05	2009-10
Fixed cap per factory	Rs. Lakh	56.56	90.96	87.12	148.94	200.45	210.23	200.90	350.16
GVA per factory	Rs. Lakh	43.96	56.37	46.62	77.70	91.83	98.65	121.23	178.06
Worker per factory	Number	47	43	42	46	57	48	48	58
Employees per factory	Number	14	13	11	12	18	14	14	17
Persons per factory	Number	61	56	53	58	75	62	62	74
Output/Input	Number	1.17	1.15	1.12	1.13	1.33	1.27	1.23	1.23
Output per factory	Rs. Lakh	296.57	428.19	429.97	669.23	373.97	469.75	654.91	964.67
Output per worker	Rupees	636466	659995	984469	983956	1032642	1353152	1451075	1673497
output per employee	Rupees	487088	498558	760848	756150	812052	1056334	1145134	1299637
GVA/Invested Capital	Number	0.34	0.30	0.26	0.27	0.33	0.33	0.41	0.36
GVA per worker	Rupees	94341	129592	111974	168479	162062	206638	250492	308904
GVA per employee	Rupees	307625	440922	412205	630616	500489	685889	891467	1073832
GVA per person	Rupees	72199	100155	88054	132957	122421	158797	195546	239895

Source: Computed fro Annexure Table A1

more capital intensive as compared to the total manufacturing sector, and losing its labour intensive character as observed earlier.

Gross Value Added per Factory

The GVA per factory in manufacturing sector was double to that in food processing sector in 1994-95 but by 2009-10, GVA per factory in manufacturing became 2.25 times to that in food processing sector. The GVA per factory in the case of food processing sector increased from 43.96 lakh in 1994-95 to 77.7 lakh in 2009-10, i.e., witnessing a compounded annual growth of 3.87 per cent as against 4.51 per cent in the case of total manufacturing sector over the same period. It is worth mentioning that the rate of growth in gross value added was same in both food processing and the total manufacturing during the period under reference. Moreover, the share of GVA by food processing sector in the GVA by manufacturing sector remained almost constant throughout the period. Thus, it is the growth in number of factories in food processing sector that restricted the GVA per factory in food processing sector.

Invested Capital per employee

The capital invested per employee has also increased from Rs. 480 in 1999-2000 to Rs. 1200 in 2009-10. It has almost doubled in the second half of the decade.

Efficiency

The efficiency of an industry or a sector is defined as the ratio measure of the size of output to the size of input and is generally expressed in per centage terms. Both input and output are measured in same units and hence efficiency is unit less. The efficiency of the food processing sector decreased from 1.17 in 1994-95 to 1.15 in 1999-2000 and further to 1.12 in 2004-05 and experienced a marginal increase of 0.01 in 2009-10. There was an average annual decline of 0.25 per cent during 1994-95 to 2009-10. However, after a deceleration of 0.39 per cent and 0.53 per cent per annum during the first two sub-periods, it has increased by 0.17 per cent per annum during the last sub-period.

It is observed that efficiency in food processing sector has always remained less than the total manufacturing, though it also exhibited a declining trend. The average annual deceleration of efficiency in total manufacturing was of the order of 0.52 per cent; much more than that in food processing sector. As in the case of food processing sector, the rate of decline of efficiency in total manufacturing was significant initially (0.92 per cent and 0.62 per cent per annum) and remained stable in the third sub-period.

However the efficiency of food and beverages industry is less than the total manufacturing component. Highly labour intensive in nature, highly depend on agriculture etc may be the factors cause for low efficiency in food and beverages sector. There was decline in the efficiency of both food industries and all manufacturing industries during the reference period.

Productivity

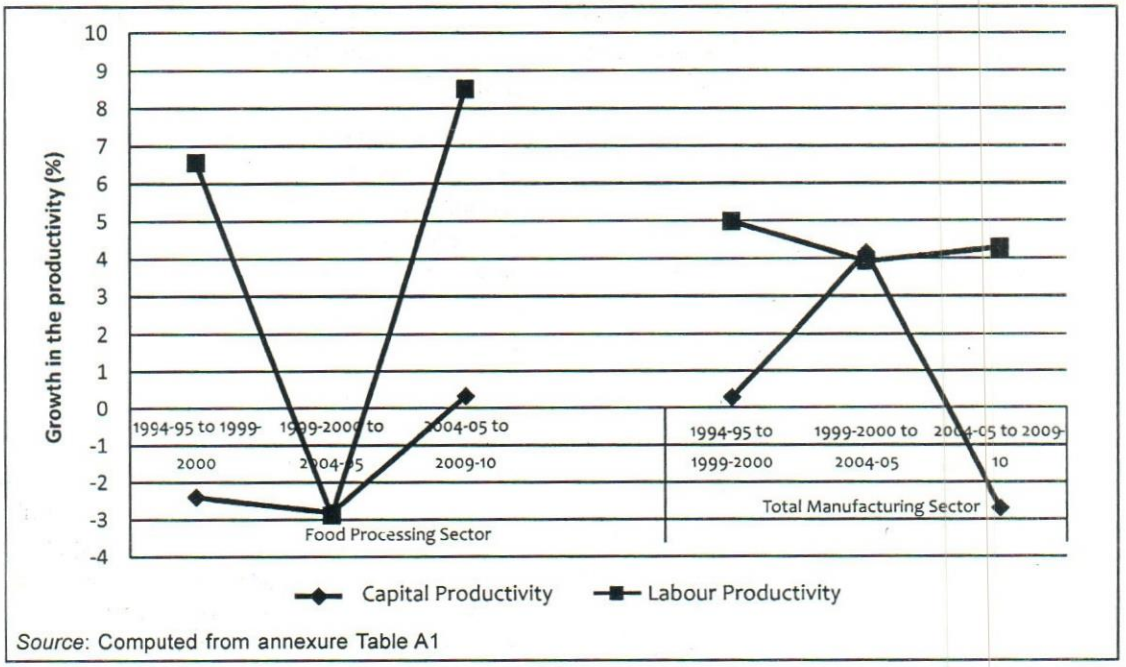
The output of an industry or sector is influenced by a number of input factors like employment, capita, technology, etc. The productivity is defined as ratio of output (or GVA) per unit of input (capital or labour). The most common measures of productivity are labour productivity (GVA per worker or employee) and capital productivity (GVA per rupee of capital invested). Since input and output units are different, productivity is expressed in units.

The following chart indicates the labor and capital productivity of the organised segment of the food and beverages sector. Both the food and beverages and overall manufacturing were compared in the figure. The labour productivity of the food and beverages sector shows a 'V' trend that is high to low to high. On the other, in the same labour productivity in the overall manufacturing shows an almost a horizontal shape, there was no much changes in labour productivity. However, the capital productivity shows an opposite direction for both the sectors. The capital productivity in the food and beverages sector shows an upward movement whereas in overall manufacturing it shows a downward trend.

Labour Productivity

Labour productivity has been estimated as a ratio of GVA to the number of workers. The labour productivity in the food processing sector has increased from Rs. 94,340 in 1994-95 to Rs. 206,638 in 2009-10 i.e., almost doubled in the period under study. The labour productivity of the total manufacturing was quite higher as compared to food processing sector and it increased from Rs. 111,973 in 1994-95 to Rs. 308,903 in 2009-10. The growth pattern in food processing industries and total manufacturing is almost similar (Table 5).

The labour productivity growth in the food processing sector has been found to be declining over the years (Table 5). It is negative during the last sub-period mainly due to the



Source: Computed from annexure Table A1

Chart 5. Growth of Labour and Capital Productivity

declining growth in the labour productivity. This may be due the proportionately higher growth in the number of workers as compared to the growth in GVA. This analysis of labour productivity growth reveals that the labour productivity in the food processing sector has remained less than the total manufacturing sector. It was negative during 1999-2000 to 2004-05. This brings out the need for better resources either in terms of raw material or workforce suitable for the sector. The declining trend in the growth rate of labour productivity in the food processing sector in recent years is a matter of concern for the overall competitiveness of the sector.

Capital Productivity

Capital productivity has been estimated as a ratio of GVA to the invested capital i.e., GVA per rupee of Invested Capital. Capital productivity has declined marginally from Rs. 0.34 in 1994-95 to Rs.0.33 In 2009-10. Table 5 provides growth for labour productivity and capital productivity during 1994-95 to 2009-10. In the case of labour productivity, it may be noted that though there are period to period fluctuations, the average annual productivity growth during the entire period was 3.94 per cent. Though, the rate of growth in the first five years period i.e., during 1994-95 to 2004-05, was just 0.54 per cent per annum, it grew by 8.94 per cent per annum in the third sub-period, i.e., during 2004-05 to 2009-10. On the other hand, average annual growth in capital productivity during 1994-95 to 2009-10 was negative (-1.64 per cent). This growth was negative throughout the period except in the last sub-period (i.e., during 2004-05 to 2009-10) when it grew by just 0.32 per cent per annum.

Conclusions

The food processing industry in the country is in nascent stage and has potential for higher growth in future. There is a rapidly increasing demand for processed food caused by rising urbanization and income levels. Food processing has been declared a priority sector by the government. However, the sector as a whole turned out to be a job loosing sector.

The growth in the food processing sector is due to the contribution of industries in organized sector. There was an impressive growth of the food processing sector during 1994-1995 to 2009-10. The growth in the share of employment in organized sector from 24 per cent in 1994-1995 to 29 per cent in 2009-10 is a welcome feature of the employment trends. While organized sector employed just 29 per cent of the total employment, it contributed 66 per cent of the total GVA by the sector

The efficiency of the food processing sector was found to be slightly less than that of total manufacturing and has declined marginally over the period under study. The labour productivity of food processing sector has exhibited a fluctuating trend and on the average increased by

3.9 per cent per annum. This was in similarity to the trend observed in the case of total manufacturing sector, where labour productivity increased annually by 4.4 per cent. There is an upward move of fixed capital and factories in food and beverages Industry and in total manufacturing. The employment pattern in both food and beverages industry and overall manufacturing has remained same over the period of time that is per factory employment is almost constant.

The employment per factory has remained constant but fixed capital per factory had increased significantly. Similarly there was a increase in output, and GVA for both food and beverages industry and all manufacturing component. This may be attributed to the automation, modernisation and technical upgradation of the industry. Capital productivity has remained constant in food and beverages industry whereas it was shows an increase in all manufacturing industries.

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Technology is just a tool. In terms of getting the kids working together and motivating them, the teacher is the most important.

—Bill Gates

Feature

Productivity from Technological Upgradation: A Case Study

MOHIT KUMAR KOLAY

This paper is based on an iron and steel plant that has been modernizing its plant facilities and services over the years. Technological upgradation has been measured here by the inflation adjusted net block in plant and infrastructures. The level of productivity has been assessed using performance in four broad areas, namely, quantity of output, quality of output, cost effectiveness, and productivity of scarce natural and national resources in relation to the level of technological upgradation. This study has been conducted over five decades from 1960-61 to 2013-14. In spite of a steady increase in sales and profits, productivity in all areas has been exponentially going down, contrary to exponential enrichment in its technology base over the entire study period.

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Introduction

When the global economy has been struggling at less than a 3 per cent growth rate, and total factor productivity of capital and labour inputs together has dropped below zero in 2013 (Conference Board, 2014), it is encouraging to know that India and China have been performing well. High performing Asian economies have been in the limelight when they were added by the World Bank in its book in 1993 for their investment growth and technological progress.

The Indian economy, in particular, has gone through tremendous changes on all fronts over the six decades since independence. The Structural Adjustment Program of the government in the early nineties has done away with the red tape and state control bringing competition and ushering in global players, thus moving away from regulation-nationalization-protection to liberalization-privatization-globalization. With massive investments in infrastructure and education sectors in the country's eleventh five-year plan (2007-2012), the Indian economy has been on a path of success through technological upgradation and manpower development. The GDP growth rate of 7.7 per cent as compared to world average of 2.2 per cent in 2012 was no doubt a great achievement for the Indian economy. During the last two years, the GDP growth rate of India has no doubt been subdued below 5 per cent, but this is still much higher than the current world average of less than 3 per cent. The availability of skilled manpower from world-class elite technology and management institutes at a comparatively cheaper rate provide the matching foundation for gaining the benefits from technology upgradation in both the manufacturing and the services sector. The rising income level of the country's billion-plus population provides a unique market opportunity (third largest in the world as per Global Competitiveness Report, 2007-08).

If we look at the iron and steel sector, the gateway to India's modernization and technological upgradation, we have a somewhat conflicting picture. Within the country, the manpower productivity varies from 100 tons per man-year (at the best managed private sector steel plant) to 75 tons per man-year (for a giant public sector steel plant). However, the best figure of 100 tons per man-year productivity appears very meagre as compared to 980 of Japan and 1345 of Korea. The per head annual consumption of steel in India has been 55 kgs on an average as against a global average of 206 kg and more than 500 kg for USA and Japan (Hincks and Pavlova, 2012).

Pricing and distribution of iron and steel in India has been deregulated now. However, benefits from technological upgradation might be really constrained in India where 45 per cent of the input cost for steel making, i.e., fuel, coal, and electricity are still under the control of administered prices, and the price of electricity has been 10 cents in India as against 3 cents in USA; cost of capital 14 per cent as against 2.4 per cent in Japan, and 6.4 per cent in USA. A study of 60 steel units in India over the period 1989 to 1996 (Sahoo, 2004) reveals that despite technological upgradation, there has been a decline in productivity growth due to growing inefficiency over the period.

In such a mixed scenario of technological progress and upgradation in India, it would be really interesting to study how a century old Indian steel company has been continually improving and modernizing its plant facilities over the last five decades. It has enriched its technology base more than 300 times, while annual profits have been escalated by more than 1250 times to become the world's lowest cost steel producer since 2001 along with Korea. But can we confirm that its technological renovations and modernization have enabled the company to move forward on the appreciating track of productivity gains or otherwise.

Measure of productivity gains from technological upgradation

Since the seminal work of Solow (1957), when labor and capital explained only 13 per cent of US output, the unexplained part of 87 per cent has been causally identified with growth of residual productivity as reflection of technological progress. In macroeconomics, it is an umbrella term containing everything that could not be traced back to the accumulation of factors of production, included in the aggregate production function used to measure the total factor productivity of technological progress. The understanding of the technology to break the old ones to improve further is more important for sustained viability particularly in a developing economy than the modernity of the technology itself. At an organizational level, considerable efforts have been made in the past to assess the effectiveness of technology of the plant and infrastructures based on the performance measure particularly in the fields of healthcare, chemicals, and information processing (Attenpohl, 1987; McGivney and Schneider, 1988; Reynolds, 1989; Wilensky, 1990; Chambers, 1991; Kilpatrick, Dhir, and Sanders, 1991). The scale of operations of the plant is indeed a fundamental measure of performance as agreed to by one and all, but the design and operational parameters of the technology as considered in the performance measure may be really causal in nature, and may not reflect the end result performance (Kolay, 1994; Neely, Gregory and Platts, 1995). What is important is to meet the requirements of customers in time with the desired level of quality of supplies at an affordable price. Thus, the output parameters as the measure of technological up-gradation and progress can be considered as i) output level, ii) quality level, and iii) cost effectiveness (Kolay, 1998). But for sustained performance, conservation of input of natural and scarce resources used is also important. Therefore, this paper recognizes four basic performance areas to assess the productivity of technological upgradation as reflected in Figure-1.

Using the traditional measure of productivity as output per unit of input, the productivity of technological upgradation has been measured here by total performance (Kolay, 1993) divided by the technology base deployed by the organization.

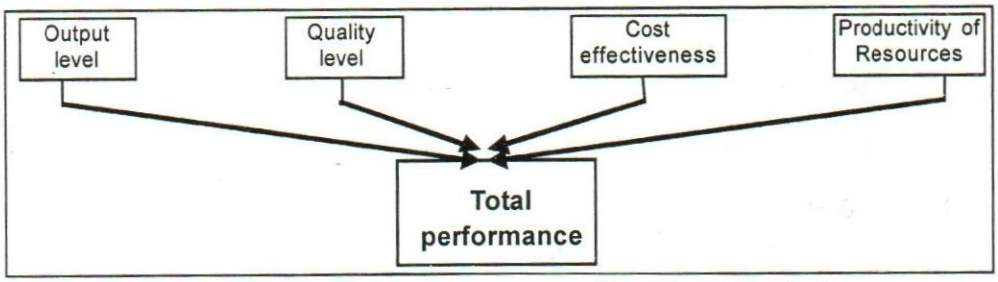

Figure 1: Total performance and its constituent building blocks

The case study

A case study of technological productivity of an integrated iron and steel plant in the private sector of India has been taken up here using its published database. This integrated steel plant which is more than a century old, has gradually increased its capacity and modernized its plant facilities in different phases. It had produced 1.3 million tons of saleable steel in 1960-61, increased to 8.9 million tons by the end of 2013-14 as a stand-alone unit. Of course, it has become a big business conglomerate through merger and acquisitions. However, the case study here will pertain only to the original parent company as the stand-alone unit. While the production capacity has been increased by only seven times over the study period of last 54 years, its technology base in terms of net block has been upgraded many fold, in fact, 366 times by the end of the study period of 2013-14. With such an increased technology base its revenue has been skyrocketed by 540 times, so also its profit by 1257 times during the last 54 years. But the question arises as to whether the organization has been able to improve its productivity commensurate with investments made in renovation and modernization of its technology base.

On the output front, the level of performance as a result of technological up-gradation has been measured firstly by the level of total annual output of saleable steel including semi-finished steel for sale (with 50 per cent weighting) directly from the published figures. The company manufactures various grades of flat and non-flat products, and in absence of figures pertaining to quality and section extras in the prices of various items, and the sales mix, the inflation adjusted annual gross revenue per ton of saleable steel has been considered as the surrogate measure of average quality level of its output. The cost effectiveness level has been assessed here directly by the extent of profitability achieved on its sales. On the conservation of resources used, the company consumes two most important natural resources, the iron ore and the coal from its captive mines and collieries. In absence of figures available for coal consumption, (particularly they also supplement with purchased coal and coke at times besides coal being used for captive power generation) only iron ore productivity has been considered here, neglecting the performance on coal productivity front. The capital productivity in terms of return on capital has been considered here as yet another performance area in the context of scarce resources used by the organization. Thus, the study considers the five output parameters as:

- Steel output, i.e., total saleable steel production,
- Steel quality, i.e., gross inflation adjusted revenue per unit of saleable steel,
- Cost effectiveness, i.e., profitability on sales,
- Iron ore productivity, i.e., iron ore consumed per unit of saleable steel, and
- Productivity of capital, i.e., return on total capital used

Taking these five end result organizational performance parameters, the productivity of technological renovations and modernization has been assessed by relating its performance with the extent of technology base deployed in terms of net block with due adjustment for inflation in yearly additions in plant facilities. The total study period of 54 years from 1960-61 to 2013-14 has been divided into five decades (the last period consisting of 14 years), assuming 1960-61 as the base year for comparison.

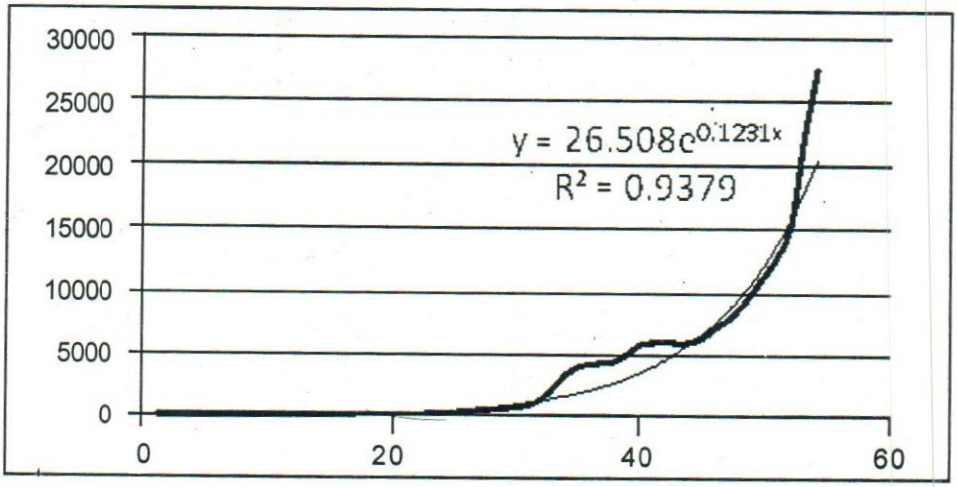

Figure 2: Technology base index

The technology base of the organization has been modernized and upgraded in different phases, thereby increasing its net block from INR1168 million in 1960-61 to INR428 billion by the end of 2013-14. Taking the effect of inflation (inflation index for manufactured goods) into account for annual additions in gross block, the adjusted net block index with 1960-61 as the base is shown in Figure 2 as the reflection of technology base exponentially increasing over time. The average level of technology base in each of the five decades (see Table 1) has been increasing consistently to reach 277 times (adjusted net block basis) of the base year mark by the end of the study period. With such an appreciating track of technology base, both quantity and quality of steel have been consistently on the appreciating track as evident from Table 1. Cost effectiveness went down in 1970's, but again picked up strongly by the turn of current millennium with an overall average of 30 per cent plus of the base year mark. Iron ore productivity has been more or less on the downhill in all decades except 1980's with an overall average of 7 per cent minus of the base year figure. Capital productivity shows consistently good results, particularly in the new millennium with a multiplier of 3.5. With equal weighting to each of the five output parameters, total performance of the old steel company has been consistently improving during each of the five decades reaching 3 times the base year mark by the end of the study period as presented in Table 1.

Table 1: Average performance level

Performance parameters	1960's	1970's	1980's	1990's	2000's	2013-14
Average input:						
Technology level	87.42	106.60	420.42	3659.74	11068.25	27656.09
Average output:						
Steel output	114.28	114.66	147.39	205.20	400.56	655.56
Steel quality	102.72	112.22	170.66	230.33	314.84	314.15
Cost effectiveness	110.27	65.72	108.15	104.79	267.88	232.92
Iron ore productivity	95.60	91.18	103.26	94.41	82.99	85.89
Capital productivity	148.91	145.80	241.20	124.58	349.70	187.13
Total performance	114.35	105.92	154.13	151.86	283.19	295.13

However, such a level of performance has been too inadequate on all fronts compared to the accelerated level of technology base. In fact, in all five areas, productivity level has been consistently going down in each of the five decades till the end of the study period of 2013-14 as reflected in Table 2.

On the steel output front, the average productivity in the 1960s and 1970s was above the base year mark, but this had gone down consistently to a nominal figure of 2.37 by the end of 2013-14 (see Figure 3) with an average for the current decade of only 4.03. On the steel quality front, the scenario of productivity level in relation to technology base

Table 2: Average productivity level per unit of technology base

Productivity parameters	1960's	1970's	1980's	1990's	2000's
Steel output/technology base	131.77	111.35	43.27	7.01	4.03
Steel quality/technology base	118.19	107.17	47.91	8.28	3.51
Cost effectiveness/technology base	127.10	63.84	31.78	4.00	2.94
Iron ore productivity/technology base	109.45	86.79	31.58	3.61	0.93
Capital productivity/technology base	173.04	138.17	76.15	4.95	4.49
Overall total productivity	131.91	101.01	46.14	5.57	3.18

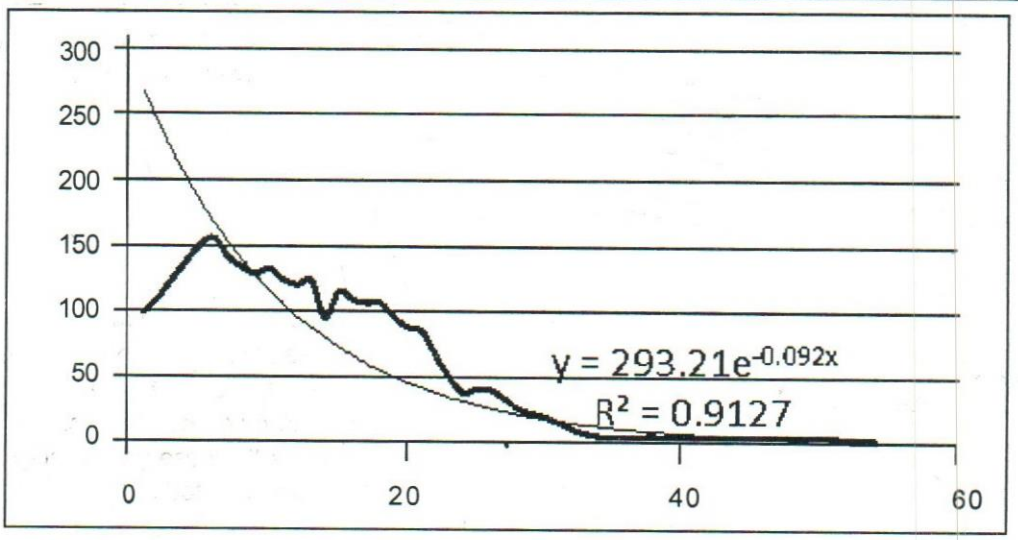

Figure 3: Steel output/tech. base

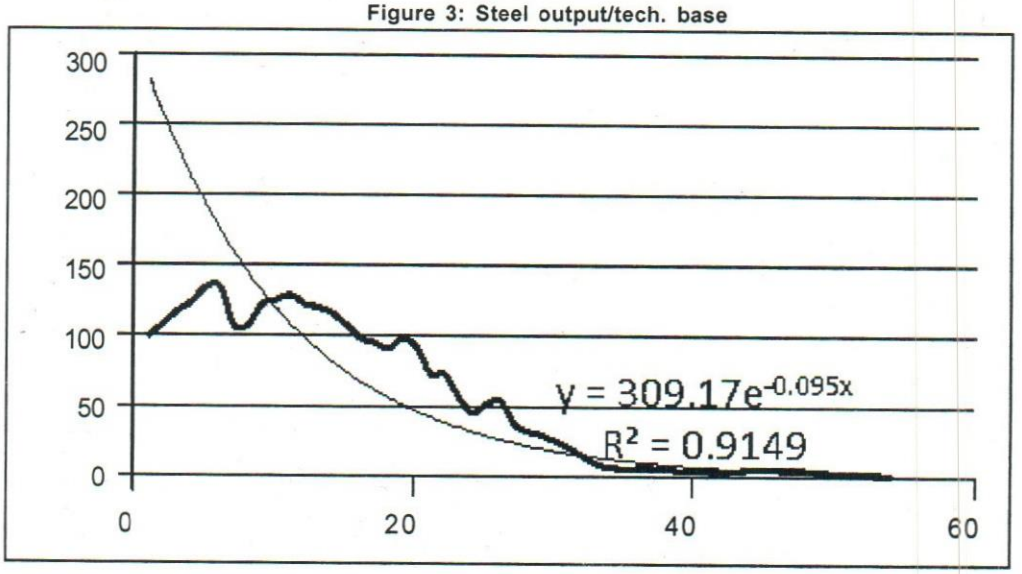

Figure 4: Steel quality/tech. base

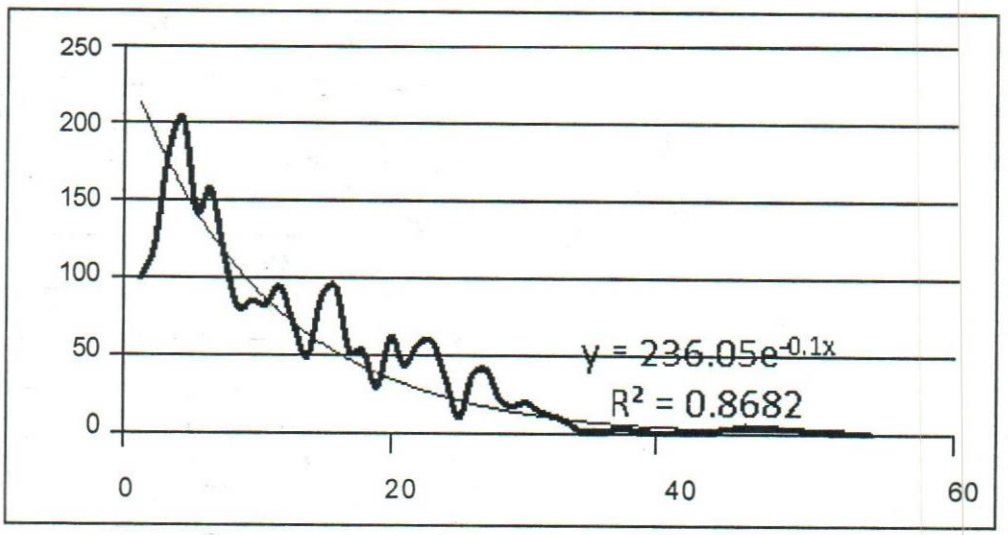

Figure 5: Cost effectiveness/tech. base

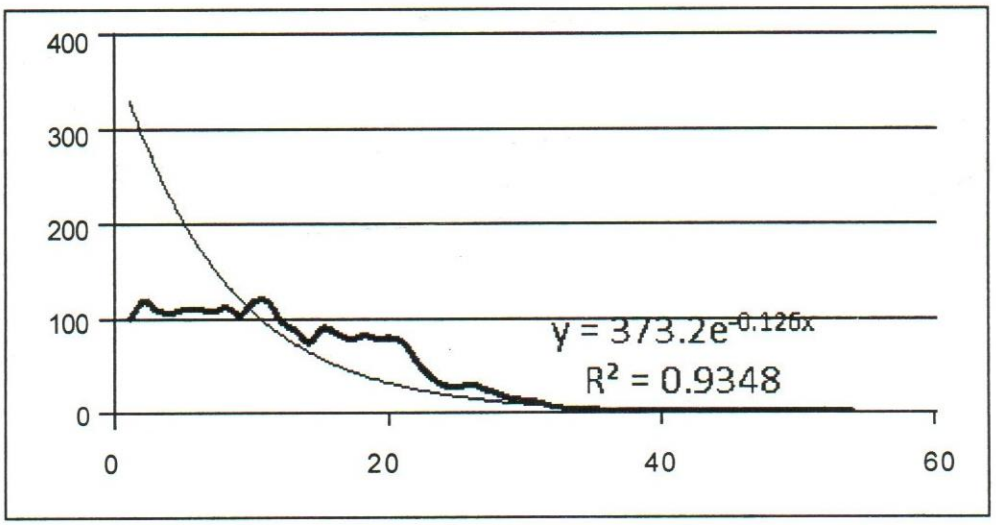

Figure 6: Iron ore productivity/tech. base

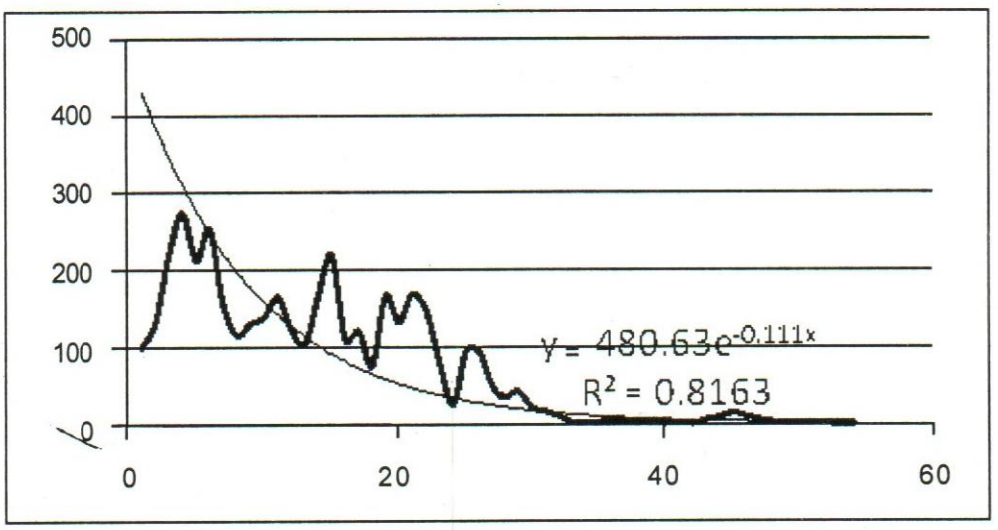

Figure 7: Capital productivity/tech. base

has been similar, above the base year in the 1960s and 1970s, but then declined consistently reaching again a nominal figure of 1.14 by the end of 2013-14 (see Figure 4) with an average for the current decade of 3.51. On the cost effectiveness front, the level of productivity as compared to technology base, only 1960's was above the base year, then started reducing reaching as low as 0.84 by the end of the 2013-14 (see Figure 5) with an average for the current decade of only 2.94. On iron productivity front, the picture is nothing different, above base year mark only in 1960's, then moving on the downhill reaching as low as 0.31 by end of 2013-14 (see Figure 6) with an average for the current decade of only 0.93. As regards capital productivity, the average level during the first decade of 1960's was 73 per cent better than base year mark, but then started on the declining path as usual like productivity level in other performance areas, reaching as low as 0.68 by the end of 2013-14 (see Figure 7) with an average for the current decade of 4.49.

Taking into account declining trend of productivity in all five areas of performance, the overall productivity level in relation to ever increasing technology base has been consequently declining consistently reaching 1.07 by the end of 2013-14 as compared to base year mark of 100 during 1960-61 (see Figure 8). In fact, the overall total productivity along with productivity level in all five constituent areas reflect an exponentially declining trend on an average all throughout (Figure-3 to Figure 8)

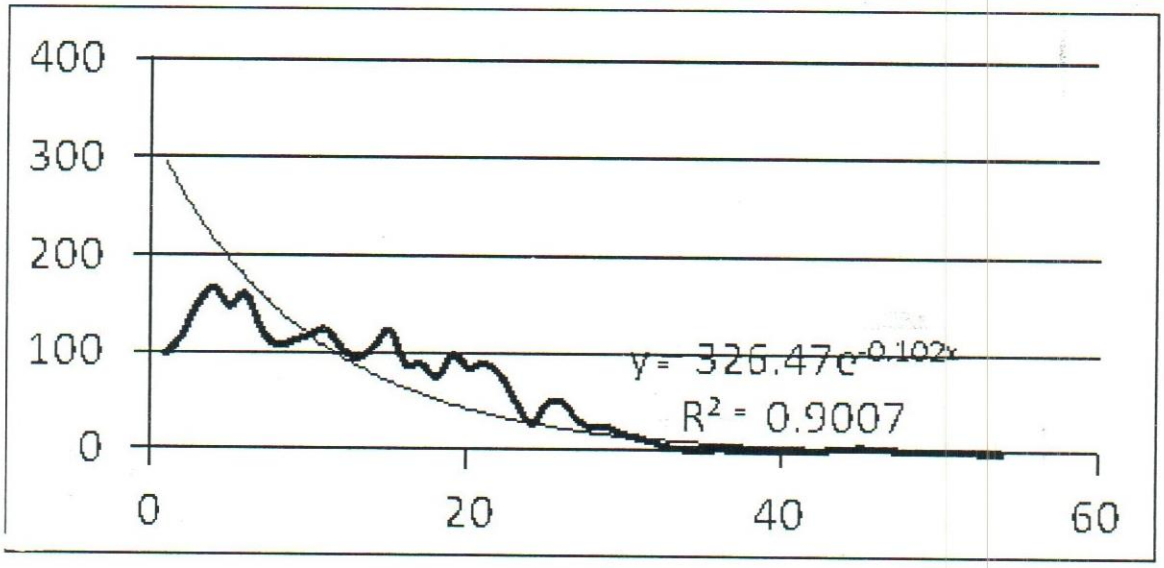

Figure 8: Overall total productivity

compared to exponential growth in technology base as in Figure 2.

Conclusion

The organization has been trying to keep pace with technological advances in iron and steel production, and gradually renovating and modernizing its plant facilities in all areas of mines, and collieries, coke ovens, sintering, blast furnces, steel making, and downstream in its primary and finishing rolling mills, including various areas of its plant services. No doubt, it has been able to increase its sales and profits over the years. In fact, it has been able to acquire a place in the global scenario as one of the lowest cost steel producers in the world. But we see here, the level of its performance in five areas of concern has not been adequate enough compared to ever-increasing level of technology base, thus showing the exponential decline in its productivity levels in each area of concern. The organization is well known for its effective industrial relations and human resources management.

Inspite of that, such an exponential decline in the productivity level in relation to upgraded technology base raises a question for further examination. Iron and steel technology is no doubt capital intensive, and the likely gains in productivity levels as a result of modernization may accrue over time. Cost of technological improvements and upgradation might be higher compared to resulting gains. It would be interesting to study the productivity achievements of similar iron and steel plants in other countries going in for modernization of its plant facilties to have more insights to account for the decline in productivity scenario of the old iron and steel plant in India.

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Manufacturing is more than just putting parts together. It's coming up with ideas, testing principles and perfecting the engineering, as well as final assembly.

—James Dyson

Feature

Self-Help Groups and Economic Empowerment of Rural Women in West Garo Hills District, Meghalaya

J. W. MOMIN AND D. C. KALITA

The present study envisages the economic impact of Self-Help Groups on empowerment of rural women in West Garo Hills district of Meghalaya. The study was conducted in West Garo Hills district of Meghalaya and comprised of a sample of 200 women SHG beneficiaries under SHG finance. The samples were stratified into three size groups viz., Group I (Less than Rs. 65000.00), Group II (Rs. 65001 - 135000) and Group III (Rs. 135001.00 and above) based on annual income by using the Cumulative Root Frequency Rule. On an average, 1274.92 per cent of the sample beneficiaries had access to credit sources for loan and 1387.05 per cent of the SHG beneficiaries had frequently visited banks, line departments, etc. The per capita income of the SHG beneficiaries across various size groups showed an increasing trend with the size groups ranged from 42.90 per cent in Group I to 105.83 per cent in Group III beneficiaries and 127.28 per cent of the employments had been generated through different employment generating activities. The SHG beneficiaries of various size groups have registered positive and significant changes in the better economic standards of life.

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Introduction

The self-help groups (SHG) finance is one of the most crucial inputs for economic activity, growth and development. In rural areas, women living below poverty line are unable to realize their potential. SHG programmes are currently being promoted as a key strategy for simultaneously addressing both poverty alleviation and women's empowerment (Puhazhendi and Satyasai, 2001, 26.). The participation of women in SHGs made significant impact on their empowerment both in social and economic aspects (Kumar, 2009, p. 13). The SHG and economic empowerment of rural women variables used to influence the types of development on income generating activities of farm and non-farm sectors in the area. This is because, the activities vary in their level and types of resource requirement like land, labour, capital and the managerial skill which is indirectly against the outcome of level of income generation. One of the benefits of joining SHG was the accessibility to credit sources.

The very nature of SHG has created faith on the normal sector to disburse loan to the poor in groups. The members of SHGs had taken loans from formal sector for either production or consumption or both purposes, which was not possible without SHG (Meher, 2003, p. 315). The creation of income generation and employment opportunities for rural poor enhanced their better standard of living where beneficiaries organized income generating activities and develops employment opportunities among rural women (Jerenabi, 2010, p. 35). In this study, an attempt is made to present the results of the study obtained through analysis of the data collected from the samples of the specified universe on Self-Help Group and economic empowerment of rural women. Hence, the SHG and economic empowerment of rural women variables of the sample

households of SHG beneficiaries such as reason for joining SHG, sources of income for thrift, credit linkages, per capita incomes, expenses and savings of the sample household, credit linkages, etc. are discussed below.

Methdology

The present study was conducted in the West Garo Hills district of Meghalaya. The present study comprised of 200 sample women SHG beneficiaries under SHG finance. Multi-stage random sampling technique was adopted for the selection of sample SHG beneficiaries. At the first stage, a list of women SHG beneficiaries under SHG finance during 2010-2011 was collected from the NERCORMP[1] Office, Dakopgre, Tura. Altogether, there were 1115 SHGsin 192 villages and 8 community and rural development blocks under NERCORMP till 2011. Then 4 community and rural development blocks viz., Rongram, Gambegre, Dadenggre and Selsela were selected randomly in the second stage. In the third stage, 5 villages were selected randomly from each block and finally 10 women SHG beneficiaries were selected randomly from each selected villages. Thus a total of 200 sample women beneficiaries were selected for the present study. Then, the selected beneficiaries were stratified into three size groups viz., Group I (Less than Rs. 65000.00), Group II (Rs. 65001 - 135000) and Group III (Rs. 135001.00 and above) based on annual income under SHG finance by using the Cumulative Root Frequency Rule. Simple tabular analysis technique was used to estimate the empowerment status of the rural women. The significant positive differences as tested with Fisher's 't' test indicates the impact of SHG finance and the multiple linear regression equation of the following forms with SHG finance as one of the independent variables.

(i) $Y_1 = a + bx + e$

(ii) $Y_2 = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + e$

Where,

Y_1 = Income of beneficiaries after SHG finance (Rs.)

Y_2 = Magnitude of SHG finance received by the women beneficiaries (Rs.)

X = Amount of SHG finance

X_1 = Expenditure on various items (Rs.)

e = Error term

a, b, b_0, b_1, b_2, b_3 and b_4 were the unknown parameters estimated with the help of Ordinary Least Square Method. Positive and statistically significant regression coefficient such as b and b_1-b_4 were indicated the impact of SHG finance on economic empowerment of rural women beneficiaries for the simple and multiple regression models respectively. Moreover, the impact of SHG finance on economic empowerment of SHG women beneficiaries were examined by estimating the difference of economic empowerment variables before and after the SHG finance received by the beneficiaries. The significance of difference of economic empowerment variables before and after the SHG finance was tested by applying the fisher 't' test.

Table 1: Credit Linkages across Various Size Groups of SHG Beneficiaries (In numbers)

Indicators	Size Groups									Average Increment Percentage
	Group I			Group II			Group III			
	Before	After	Increment	Before	After	Increment	Before	After	Increment	
Access to Credit Sources for Loan	3	70	67* (2233.33)	5	61	56* (1120.0)	7	40	33* (471.43)	1274.92*
Visit to Bank, FIs, Govt. Offices, etc.	12	375	363* (3025.0)	36	404	368* (1022.22)	158	338	180* (113.92)	1387.05*

Figures in parentheses indicate increment percentages to before SHG

* - Significant at 5 per cent probability level.

Results and Discussions

Credit Linkages

One of the benefits of joining SHG is the accessibility to credit sources. The very nature of SHG had created faith on the formal sector to disburse loans to the poor in groups. The members of SHGs had taken loans from formal sector for either production or consumption or both purposes, which were not possible without SHG. The access to credit sources of SHG beneficiaries across various size groups

[1]NERCORMP stands for North-Eastern Region Community Resource Management Project.

was presented in Table 1. From the table, it was cleared that on an average 1274.92 per cent of sample beneficiaries had access to credit sources for loan after joining the SHG. This was found to be exhibited a decreasing trend with the increase in size groups. This was mainly due to the fact that the higher income size groups had higher capacity to manage from their own sources to organize income generating activities. The SHG beneficiaries after joining SHGs frequently visited banks, line departments, etc. which accounted for 1387.05 per cent in the average situation. The increment percentage was found to be the highest (3025.00 per cent) in Group I and lowest (1022.22 per cent) in Group III beneficiaries. The beneficiaries of higher size groups before joining SHGs tried to access to the credit sources but unfortunately they could not receive the loans except few numbers of beneficiaries. Similar results were also reported by Das (2012). However, the beneficiaries of size groups having lower incomes before joining SHGs were not aware of the availabilities of credit facilities and schemes.

Impact of SHG on Economic Empowerment

The impact of rural women SHGs on economic empowerment is presented in Table 2. From this table, it was indicated that an average increment of per capita income was estimated to be of 71.33 per cent in various size groups of sample beneficiaries. The per capita income of the SHG beneficiaries across various size groups showed an increasing trend with the size groups ranged from 42.90 per cent in Group I to 105.83 per cent in Group III beneficiaries. Thus, the results showed that the beneficiaries with higher size groups had higher increment of per capita income and vice versa. It might be due to the fact that the beneficiaries with lower incomes size had obtained limited resources such as land, fund availabilities, etc. to organize higher income generating activities.

An average increment of 127.28 per cent of the employments after SHG finance had been generated through different employment generating activities. The increased employment generations of sample beneficiaries was found to be the highest (181.70 per cent) in Group II and lowest (93.23 per cent) in Group I size group. Thus, the result of the study revealed that the implementation of SHG programmes had significant and positive impact on employment generation of SHG beneficiaries in all the size groups of beneficiaries. The higher increment of employment after joining SHG in Group II beneficiaries might be due to their financial strength and availability of resources such as land, funds, etc. to organize employment generating activities. Similar results were also reported by Christuraj and Saraswathy (2009).

The promotion of savings in SHG members was one of the characteristics of SHG functionaries without which the implementation of SHG programmes would have been meaningless. It was clear from the table that the SHG beneficiaries had promoted mandatory saving policies which the beneficiaries had undertaken out of their earnings. The table showed that the members' savings was increased by 577.69 per cent in the average situation of sample beneficiaries. Between the different size groups of beneficiaries, the increased in savings of sample beneficiaries showed a decreasing trend with the increase

Table 2: Economic Empowerment of SHG Beneficiaries across Various Size Groups

Sl No.	Particulars	Size Groups									Average Increment Percentage
		Group I			Group II			Group III			
		Before	After	Increment	Before	After	Increment	Before	After	Increment	
1.	Income (Rs.)	33015.17	44880.67 (35.94)	11865.51*	58124.24	96167.42 (65.45)	38043.18*	93255.56	191620.67 (105.48)	98365.11*	68.96*
2.	Employment (Mandays)	17.60	33.29	15.49* (89.21)	22.68	64.70	42.02* (185.24)	52.76	123.82	71.06* (134.71)	136.39*
3.	Savings (Rs.)	187.64	2036.85	1849.21* (985.51)	956.06	5071.82	4115.76* (430.49)	2711.11	11307.56	8596.45* (317.08)	577.69*
4.	Assets (Rs.)	19503.37	262592.51	67561.80* (34.64)	85984.85	338787.88	252803.03* (42.65)	278000.00	421555.56	143555.56* (51.64)	42.98*
5.	Consumptions (Rs.)	25410.11	29730.34	4320.22* (17.0)	26551.52	37354.55	10803.03* (40.69)	31511.11	42755.56	11244.44* (35.68)	31.12*

Figures in parentheses indicate increment percentages to before SHG
* - Significant at 5 per cent probability level

in size groups. The beneficiaries with lower income size had higher increment percentages than beneficiaries with higher income size which showed that the beneficiaries of lower income size groups before joining SHGs had ignored saving patterns. Similar results were reported by Banerjee (2009). The substantial increase in the savings over post SHG programmes had indicated that the marginal propensity to save which had improved after joining SHGs. This showed that there was a remarkable change in savings pattern of SHG beneficiaries after joining the groups.

The SHG programme emerged as the major source of credit for its members. Loans are provided to meet the income generating activities as well as emergency needs of the members such as children education, housing, etc. Therefore, accessibility to credit by beneficiaries is one of the objectives of implementation SHG programmes in the study areas. This table shows that about 1187.73 per cent in Group I, 1074.31 per cent in Group II and 614.08 per cent in Group III beneficiaries were increased as borrowing amounts after joining SHGs. Before joining SHG, the beneficiaries had received loan amount of Rs. 224.58 in Group I, Rs. 628.85 in Group II and Rs. 1206.67 in Group III respectively, which after joining SHGs, have been increased to Rs. 2891.95 in Group I, Rs. 7384.62 in Group II and Rs. 8616.67 in Group III beneficiaries respectively. This implies that the SHG finance evolved lending practices among various size groups of sample beneficiaries. Similar findings of the study were reported by Reji (2009). The higher percentage of increment in borrowing before joining SHGs was observed in lower size groups which indicated that the beneficiaries were not guaranteed of repayment of loans by other FIs.

This table indicated that the possession of assets of SHG beneficiaries after joining groups was increased by 42.98 per cent in average size groups of sample beneficiaries which showed an increasing trend with the increase in size groups. The increase in assets position was found to be varied from 34.64 per cent in Group I to 51.64 per cent in Group III beneficiaries. Higher asset position in higher size groups was mainly due to their higher income and savings related activities.

The consumption pattern of the sample beneficiaries varied from one household to another depending on the size of incomes and family size. This table shows that the difference in level of consumption before and after joining SHGs was 31.12 per cent in the average situation. Among the size groups, this was found to be the highest (40.69 per cent) in Group II and lowest (17.0 per cent) in Group I beneficiaries.

Regression Analysis

The multiple regression technique was employed to examine the impact of SHG finance on incomes and employments of SHG beneficiaries. The analysis represents the loan as independent variables and income and employment generation as dependant variables. The result of multiple regression analysis is presented in Tables 3 and 4. The analysis contained in Table 3 showed positive and highly significant impact of SHG finance on incomes

Table 3: Result of the linear regression analysis of income generation of SHG women beneficiaries after SHG Finance across various size groups

Variables	Group I		Group II		Group III		As a whole	
	Regression Coefficient	T – Stat	Regression Coefficient	T – Stat	Regression Coefficient	T - Stat	Regression Coefficient	T - Stat
X1	0.9868 (0.1290)	4.6789*	0.6776 (0.2140)	3.6578*	0.2129 (0.1123)	6.8765*	0.2354 (0.2350)	6.7812*
R2	0.7658		0.6123		0.5823		0.6189	

*- Significant at 5% probability level

of SHG beneficiaries. The regression co-efficient of the loan from SHG and other FIs was positively and statistically significant at 5 per cent probability level in various size groups of sample beneficiaries. The result of the analysis revealed a significant positive relationship of sample beneficiaries owing the loan dummy variables with the incomes in all the size groups of beneficiaries. The variable of SHG finance explained about 76, 61, 58 and 62 per cent variation in the incomes of SHG beneficiaries of size groups I, II and III respectively and the overall size groups as a whole.

Similarly, Table 4 indicates that the implementation of SHG programme has significantly and positively influence the employment generation of SHG beneficiaries across the various size groups. The regression co-efficient

Table 4. Result of the linear regression analysis of employment generation of SHG women beneficiaries after SHG Finance across various size groups

Variables	Group I		Group II		Group III		As a whole	
	Regression Coefficient	T – Stat	Regression Coefficient	T – Stat	Regression Coefficient	T - Stat	Regression Coefficient	T - Stat
X_1	0.5515 (0.1109)	7.6510*	0.7522 (0.2310)	4.3214*	0.2964 (0.0230)		3.1290* (0.2148)	0.3976
R_2	0.7123		0.6908		0.7754		0.5634	

*- Significant at 5% probability level

of the loan from SHG and other FIs was positively and statistically significant at 5 per cent probability level on employment generation in all the size groups of sample beneficiaries. The results of the analysis showed the significant positive relationship of the sample SHG beneficiaries owing the loan dummy variables with the employment generation across various size groups of SHG beneficiaries. Thus, the findings of the study was indicated the positive impact of SHG finance on the employment generation of sample beneficiaries. The variable of SHG finance explained about 71, 69, 77 and 56 per cent variation in the employment generation of SHG beneficiaries of size groups I, II and III respectively and the overall size groups as a whole.

Conclusion

Thus, it can be concluded from the analysis that the SHG finance has helped to empower the rural women of the study area in their economic sphere of life. The results also showed that the SHG beneficiaries of various size groups have registered positive and significant changes with regard to better economic standards of life. The beneficiaries of lower size groups showed remarkable changes of better economic life as there was availability of financial sources to generate incomes in a sustainable manner.

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Loyal and efficient work is a great cause, even though it may not be immediately recognized, ultimately bears fruit.

—Jawaharlal Nehru

Feature

Six Sigma Approach for Productivity Enhancement

SATYA RAJU AND T SOWDAMINIT

Six Sigma is an approach for quality improvement of a product or process. The present environment requires a Six Sigma approach for success and sustainability. Six Sigma means on an average maintaining less than 3.4 defectives per million opportunities (DPMO). It is a powerful business strategy and well recognized by several organizations in the recent years. It involves professionalizing of quality management functions. Indian companies such as Motorola, General Electrics, ABB, Samsung, SDI, WIPRO and other companies have been following this approach successfully. This paper examines these issues and outlines the status of this quality improvement proesss for the future.

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Introduction

Product or process quality is definitely required for any organization in the competitive environment for sustainability. Productivity and profitability can be enhanced through the Six Sigma approach. Therefore, in the present globalized scenario, the corporate world should focus on Six Sigma for sustainability and success.

Organizations look for ways to improve the production and management processes in order to remain competitive in the market. This calls for ways to reduce production cost, enhance productivity and improve product quality. Therefore, organizations must utilize all the available resources efficiently and effectively in order to cater to their customers with high quality products at a low price. For these reasons, researchers all over the world have proposed several improvement strategies and tools to satisfy organizational needs. Such initiatives include Total Quality Management, Quality Awards, Total Preventive Maintenance (TPM), Lean and Six Sigma. Quality management is the main focus of several organizations in the globalized era. National and institutional systems for evaluation, assessment, accreditation and audit are now routine aspects in the majority of European countries. However, this does not mean that quality work and quality improvement are integrated parts of the sector. Different organizations use different methodologies, approaches and tools for implementing quality management and programs for continuous quality improvement.

Concept of Six Sigma

Six Sigma is a scientific, systematic and statistical approach to business process improvement and is considered to be an important business strategy. The term Six Sigma refers to the capability of the process to deliver units within the set limits. The Greek letter σ or 'sigma', corresponding to our 's', is a notation of variation in the

sense of standard deviation. For a stable process, the distance from the process mean to the nearest tolerance limit should, according to the Six Sigma approach, be at least six times the standard deviation σ of the process output. However, the process mean is also allowed to vary somewhat over time. If the process mean varies at most 1.5 σ from the target value, then on average at most 3.4 Defectives per Million Opportunities (DPMO) will occur if the output is normally distributed. See table below 6σ-process corresponds in a sense to a value of 2.0 of the capability index Cp or 1.5 for CPK when allowing for a 1.5 σ drift in process mean.

Defectives Per Million Opportunities

Process σ	$(T_U-T_L)\sigma$	*Value of* C_p	*DPMO when perfectly centred*	*DPMO with a 1.5 σ- shift, that is, when* $C_{pk} = 1.5$
2	4	0.67	46,000	308,537
3	6	1.00	2,700	66,807
4	8	1.33	60	6,210
5	10	1.67	0.6	233
6	12	2.00	0.002	3.4

Source: Bergman and Klefsjö (2003)

The correspondence between 'sigma', capability index Cp = (TU – TL)/σ, the number of defective units with process average on the target value, and the number of defective units when allowing a variation of the process average up to +/– 1.5 σ from the target value. In layman terms the Six Sigma is a metric representing a process that is performing virtually free of all defects. Some scholars and practitioners have attempted to describe Six Sigma in one or two definitions. However, many have concluded that there are at least three definitions: Six Sigma can be viewed as a metric, a mindset, and a management system.

As a Metric: The term "Sigma" is often used as a scale for levels of 'goodness' or quality. Using this scale, 'Six Sigma' equates to 3.4 defects per one million opportunities (DPMO). Therefore, Six Sigma started as a defect reduction effort in manufacturing and was then applied to other business processes for the same purpose". As a Mindset: "Six Sigma is a business improvement approach that seeks to find and eliminate causes of mistakes or defects in business processes by focusing on process outputs that are of critical importance to customers" (Snee, 2004). "Six Sigma is a highly disciplined process that helps us focus on developing and delivering near-perfect products and services. The central idea behind Six Sigma is that you can measure how many defects you have in a process, you can systematically figure out how to eliminate them and get as close to 'zero defects' as possible. Six Sigma has changed the DNA of GE – it is the way we work - in everything we do in every product we design" (General Electric at www.ge.com). It is considered an organizational mindset that emphasizes customer focus and creative process improvement. The philosophy of Six Sigma recognizes that there is a direct correlation between the number of product defects, wasted operating costs, and the level of customer satisfaction. With this mindset, individuals are prepared to work in teams in order to achieve Six Sigma and its ultimate goal of reducing process variation to no more than 3.4 defects per million opportunities. As a Management System: The Six Sigma Management System drives clarity around the business strategy and the metrics that most reflect success with that strategy. It provides the framework to prioritize resources for projects that will improve the metrics, and it leverages leaders who will manage the efforts for rapid, sustainable, and improved business results. "Six Sigma is a useful management philosophy and problem-solving methodology but it is not a comprehensive management system" (Mc. Adam and Evans, 2004).

Need for Six Sigma

Six Sigma as a powerful business strategy which has been well recognized as an imperative for achieving and sustaining operational and service excellence. While the original focus of Six Sigma was on manufacturing, today it has been widely accepted in both service and

transactional processes. It is also a measure of quality that strives for near elimination of defects using the application of statistical methods. In Six Sigma, a defect is defined as any process output that does not meet customer specifications, or that could lead to creating an output that does not meet customer specifications. One key innovation of Six Sigma involves the "professionalizing" of quality management functions. For global competitiveness, Indian industries have been striving to achieve overall operational excellence in their businesses.

Literature Review

The goal of Six Sigma is to increase profits by eliminating variable defects and waste that undermine customer loyalty. It is the one methodology which can serve as the lever for business improvement growth performance and profits. Six Sigma is a proven and highly effective business initiative for improving customer satisfaction and increasing efficiency of processes (Rath & Strongs, 2003) said that six sigma solutions help business leaders understand the methodology, major issues of six sigma and helps in the successful implementation. It highlights critical factors that make or break implementation offers, best practices for getting it right the first time and offers real life examples and case studies that light the path to success. It offers the perspective needed to make the wise choice when considering any aspect of the methodology and issue of importance to today's business leaders. It is a link between process leadership culture and customer which leads through every cycle of deployment such as Motorola, Johnson & Johnson, Honeywell and GE. It is unparalleled in customer satisfaction and helps to achieve greater profitability.

Six Sigma is probably one of the best methodologies to pervade the world of improvement (Debhasis Sarkar, 2004). What differentiates six sigma from other quality methodologies is its measurement orientation rigorous training scheme process centricity and stake holder involvement. Six Sigma is a highly disciplined process, which helps to create and deliver near perfect products and services to customers and not just another quality programme.

The goal of Six Sigma is to increase profits by eliminating variable defects and waste that undermine customer loyalty. It is the one methodology which can serve as the lever for business improvement growth performance and profits. If we speak about Six Sigma in context of Indian industry the first thing that comes to our mind is the Mumbai Dabbawalas who for the past 120 years with 4,500 semi-literate members, have been providing a quality door-to-door service to a large and loyal customer base (Pradip Thakker, 2006). The process followed by Dabbawalas in order to deliver the tiffin boxes to the respective places within the stipulated time includes an elegant logistics system, using 25 kms of public transport, 10 kms of foot work and involving multiple transfer points. Mistakes rarely happen. For one the system limits the routing and sorting to a few central points, secondly a simple colour code determines not only packet routing but packet prioritising as lunches are transferred from train to bicycle to foot.

There is a desirability of incorporating Six Sigma thinking into an undergraduate business curriculum, and several alternatives for doing so have been suggested (William J. Stevenson & A. Erhan Mergen, 2006). Although many companies have adopted Six Sigma programs to improve business results, few business programs have kept pace by incorporating Six Sigma thinking into their curriculum. Business employs Six Sigma concepts in improving operations and achieving higher standards of quality. Projects are selected that are likely to achieve reductions in cost time and increased profits. The linking of project selection based on business results is central to the desirability of teaching Six Sigma thinking to business students. Doing so will mean that graduates will be better prepared for careers in business, and have a competitive advantage over graduates who don't have this knowledge. Indra Devi Rajamanoharan, Paul Collier, Brain Wright detailed in their article that drawing on International Federation of Accountants IFAC conceptual frame work for management accounting this study argues that many of the principal roles in the Six Sigma DMAIC process fit closely with IFAC'S four key roles for management accounting. The results showed that the SS features applicable at all phases of the DMAIC process match closely with IFAC'S key roles for management accounting. At the broadest level, the case studies illustrated that the role of management accounting had undergone considerable change. In parallel with the changes that were taking place in the wider business activities with adoption of the DMAIC management process, changes occurred mainly in the course of project prioritization define phase and in project deployment measure phase onwards at both SS members of management accounting in terms of the 14 concepts that form part of the conceptual framework for management accounting. Therefore the results of this study provide a common understanding of the potentially

usually role that IFAC'S best practice of management accounting could play in the DMAIC phases.

Six Sigma is one of the Strategic tools used by leading organizations to achieve accuracy and speed and at the same time reduce cost and increase customer satisfaction and profits, (Jayesh Pathak and Tushar N Desai, 2011) presents methodologies of Six Sigma, differentiate Six Sigma with Total Quality Management (TQM) elucidate the strengths and barriers, strengths and barriers of Indian Industries in implementing Six Sigma. They also explained key factors for implementing a successful Six Sigma program, benefits of implementing of Six Sigma program, some common myths of Six Sigma as well as obstacles and challenges of Six Sigma methods. Six Sigma as a transformational quality methodology and works towards process improvements and continuous enhancement of the process (Dhruv Desai, 2009). He has taken an example of breakthrough improvement, by considering a recruitment process which recruits Feet on Street (FOS) sales executives and has a service level agreement of 15 days from resource requisition to joining. In the event of recruitment turnaround time and also various example projects like automatic payroll benchmarking with competitors, productivity enhancement. This is a low-hanging fruit for HR.

Design for Six Sigma

It is an approach to designing or re-designing a new product and/or service for a commercial market, with a measurably high process-sigma for performance from day one. The intension of DFSS is to bring such new products and/or services to market with a process performance of around 4.5 sigma or better, for every customer requirement. This implies an ability to understand the customer needs and to design and implement the new offering with a reliability of delivery before launch.

Seven Steps for Six Sigma Introduction

When a company intends to introduce Six Sigma for its new management strategy, the following is the multi-step procedure:

- Top-level management commitment for Six Sigma is first and foremost. The CEO of the corporation or business unit should genuinely accept Six Sigma as the management strategy. Then organize a Six Sigma team and set up the long-term Six Sigma vision for the company.
- Start Six Sigma education for champions first. Then start the education for WBs, GBs, BBs and MBBs in sequence. Every employee of the company should take the WB education first and then some of the WBs receive the GB education, and finally some of the GBs receive the BB education. However, usually MBB education is practiced in professional organizations.
- Choose the area in which Six Sigma will be first introduced.
- Deploy CTQs for all processes concerned. The most important is the company's deployment of big CTQs from the standpoint of customer satisfaction. Appoint BBs as full-time project leaders and ask them to solve some important CTQ problems.
- Strengthen the infrastructure for Six Sigma, including measurement systems, Statistical Process Control (SPC), Knowledge Management (KM), and Database Management System (DBMS) and so on.
- Designate a Six Sigma day each month, and have the progress of Six Sigma reviewed by top-level management.
- Evaluate the company's Six Sigma performance from the customers' viewpoint, benchmark the best company in the world, and revise the Six Sigma roadmap if necessary.
- The right selection and prioritization of projects is one of the critical success factors of a Six Sigma programme. The prioritization of projects in many organizations is still based on pure subjective judgment. Very few powerful tools are available for prioritizing projects and this should be major thrust for research in the future.
- The calculation of defect rates or error rates is based on the assumption of normality. The calculation of defect rates for non-normal situations is not yet properly addressed in the current literature of Six Sigma.
- Very little research has been done on the optimization of multiple CTQs in Six Sigma projects Non-standardization procedures in the certification process of black belts and green belts are another limitation. This means not all black belts or green belts are equally capable.
- The start-up cost for institutionalizing Six Sigma into a corporate culture can be a significant

investment. This particular feature would discourage many small and medium size enterprises from the introduction development and implementation of Six Sigma strategy.

Corporate Experiences

Motorola – The Cradle of Six Sigma is Motorola. The first organization to embrace the new quality movement in the form of Six Sigma was Motorola. Motorola was established by Paul V. Galvin in 1929. Starting with car radios, the company thrived after the Second World War and moved its product range via television to high technology electronics, including mobile communications systems, semiconductors, electronic engine controls and computer systems. It has become an international leading company with more than $30 billion in sales and around 130,000 employees.

General Electric (GE) has the unique distinction of being at the top of the Fortune 500 companies in terms of market capitalization. Market capitalization means that if someone multiplies GE's outstanding shares of stock by its current market price per share, GE is the highest-valued company listed on all U.S. stock exchanges. The monetary value exceeds the gross domestic product of many nations around the world. Even though Motorola is the one of the founders of Six Sigma, GE is the company which has proven that Six Sigma is an exciting management strategy. GE is indeed the missionary of Six Sigma. GE began its Six Sigma program in 1995, and has achieved remarkable results. An annual report of GE states that Six Sigma delivered more than $300 million to its operating income. In 1998, this number increased to $750 million. At the GE 1996 Annual Meeting, CEO Jack Welch described Six Sigma as follows: "Six Sigma will be an exciting journey and the most difficult and invigorating stretch goal we have ever undertaken. ... GE today is a quality company. It has always been a quality company. ... This Six Sigma will change the paradigm from fixing products so that they are perfect to fixing processes so that they produce nothing but perfection, or close to it", this speech is regarded as a milestone in Six Sigma history.

> "It is not a secret society, a slogan or a cliché. Six Sigma is a highly disciplined process that helps focus on developing and delivering near-perfect products and services. Six Sigma has changed our DNA – it is now the way we work."
>
> ***—General Electric***

ABB is a global leader in power and automation technologies that enable utility and industry customers to improve their performance while lowering environmental impact. ABB operates in more than 100 countries and has offices in 87 of those countries to give its global and local customers the support they need to develop and conduct their business successfully. Asea Brown Boveri (ABB), the Swiss-Swedish technology group, was probably the first European multinational to introduce Six Sigma. It serves customers in five segments:

- Power Transmission and Distribution
- Automation
- Oil, Gas and Petrochemicals
- Building Technologies
- Financial Services

Six Sigma was launched in the segment of Power Transmission and Distribution in 1993 on a voluntary basis for the plants. This segment counts for around 7,000 employees in 33 manufacturing plants in 22 countries. The Six Sigma program has remained consistent over the years, the drive has matured and commitment has been generated by successful results. Six Sigma has been implemented by all transformer plants and has spread into other ABB businesses, suppliers and customers because of its own merits. The overall objective of ABB at the beginning of Six Sigma was customer focus in addition to cost reduction, cycle time reduction and self-assessment programs. Since 1993, several initiatives have been attempted with the objective of finding a pragmatic approach.

Samsung SDI: It is the Leader of Six Sigma in South Korea. The First National Quality Prize of Six Sigma was given to two companies. One is Samsung SDI and the other is LG Electronics, which are virtually the leaders of Six Sigma in South Korea. Samsung SDI was founded in 1970 as a producer of the black/white Braun tube. It began to produce the color Braun tube from 1980, and now it is the number one company for Braun tubes in the world. The market share of Braun tubes is 22 percent. The major products are CDT (color display tube), CPT (color picture tube), LCD (liquid crystal display), VFD (vacuum fluorescent display), C/F (color filter), Li-ion battery and PDP (plasma display panel). The total sales volume is about $4.4 billion and the total number of employees is about 18,000 including 8,000 domestic employees. It has six overseas subsidiaries in Mexico, China, Germany, Malaysia and Brazil. The CEO of Samsung SDI, Son Wook, declared

the slogan "True leader in digital world" as the Six Sigma vision at the end of 1996. The definition of Six Sigma in the company is "Six Sigma is the management philosophy, strategy and tool which achieves innovative process quality and development of world number one products, and which cultivates global professional manpower, and a way of thinking and working from the viewpoint of customer satisfaction."

Wipro Limited was established in 1945 and commenced its operations in 1946 as a vegetable oil company. In the early 1980s, Wipro diversified into the Information Technology sector with Liberalization hitting India in the 1980s. This has been a fascinating transformation from a vegetable oil company into a global IT services giant. Today, Wipro Technologies has become a global service provider delivering technology driven business solutions that meet the strategic objectives of clients. Wipro has 40 plus 'Centers of Excellence' that create solutions related to specific needs of Industries. Wipro can boast of delivering unmatched business value to customers through a combination of process excellence quality frameworks and service delivery innovation. Wipro is the first Indian company to adopt Six Sigma. Today, Wipro has one of the most mature Six Sigma programs in the industry ensuring that 91% of the projects are completed on schedule, much above the industry average of 55%. As the pioneers of Six Sigma in India, Wipro has already put around ten years into process improvement through Six Sigma. Along the way, it has scaled Six Sigma ladder, while helping to roll out over 1000 projects. The Six Sigma program spreads right across verticals and impacts multiple areas such as project management, market development and resource utilization. Six Sigma at Wipro simply means a measure of quality that strives for near perfection. It is an umbrella initiative covering all business units and divisions so that it could transform itself in a world class organization. At Wipro, it means:

- Have products and services meet global benchmarks
- Ensure robust processes within the organization
- Consistently meet and exceed customer expectations
- Make Quality a culture within.

The Future of Six Sigma

Six Sigma will be around as long as the projects yield measurable or quantifiable bottom-line results terms in monetary or financial. When Six Sigma projects stop yielding bottom-line results, it might disappear. While Six Sigma will evolve in the forthcoming years, there are some core elements or principles within Six Sigma that will be maintained, irrespective of the "next big thing". One of the real dangers of Six Sigma is to do with the capability of black belts (the so-called technical experts) who tackle challenging projects in organizations. We cannot simply assume that all black belts are equally good and their capabilities vary enormously across industries (manufacturing or service), depending a great deal on the certifying body. Another danger is the attitude of many senior managers in organizations that Six Sigma is "an instant pudding" solving all their ever-lasting problems. The Six Sigma tool kit will continue to add new tools, especially from other disciplines such as healthcare, finance, sales and marketing. Having a core set of tools and techniques is an advantage of Six Sigma that brings speed to fix problems and its ease of accessibility to black belts and green belts. Six Sigma does provide an effective means for deploying and implementing statistical thinking which is based on the following three rudimentary principles:

- All work occurs in a system of interconnected processes.
- Variation exists in all processes.
- Understanding and analyzing the variation are keys to success.

Statistical thinking can also be defined as thought processes, which recognize that variation is all around us and present in everything we do. All work is a series of interconnected processes, and identifying, characterizing, quantifying, controlling and reducing variation provide opportunities for improvement. The above principles of statistical thinking within Six Sigma are robust and therefore it is fair to say that Six Sigma will continue to grow in the forthcoming years. In other words, statistical thinking may be used to create a culture that should be deeply embedded in every employee within any organisation embarking on Six Sigma programmes, Hoerl (2004), expects further globalization of Six Sigma, standardization of the DFSS process, and greater integration of the Six Sigma ideas and methods into the normal operations of companies.

However the total package may change in the evolutionary process. It is important to remember that Six Sigma has a better record than total quality management (TQM) and business process re-engineering (BPR), since its inception in the mid-late 1980s. The ever-changing need

to improve will no doubt create needs to improve the existing Six Sigma methodology and hence develop better products and provide better services in the future. As a final note, the author believes that companies implementing or contemplating embarking on Six Sigma programmes should not view it as an advertising banner for promotional purposes.

Six Sigma as a powerful business strategy has been well recognized as an imperative for achieving and sustaining operational and service excellence. While the original focus of Six Sigma was on manufacturing, today it has been widely accepted in both service and transactional processes. Although the total package may change as part of the evolutionary process, the core principles of Six Sigma will continue to grow in the future. Six Sigma has made a huge impact on industry and yet the academic community lags behind in its understanding of this powerful strategy. Six Sigma is a company-wide management strategy for the improvement of process performance with the objective of improving quality and productivity to satisfy customer demands and reduce costs. It is regarded as a new paradigm of management innovation for company survival in the twenty first century.

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Almost all quality improvement comes via simplification of design, manufacturing... layout, processes, and procedures.

—Tom Peters

Feature

Economic Analysis of Karnataka's Changing Cropping Pattern: Evidence of Major Crops

BALAJI

Growth, productivity and the cropping pattern in agricultural performance have been analyzed in major districts and regions in the state of Karnataka. To objectively confer the empirical resonance growth has been estimated. The result shows that growth of area and productivity from Karnataka has been impressive during the pre and post-green revolutions and liberalization period. But, a decline in green revolution and subsequently of liberalization has not provided any improvement in the agricultural sector. Most of the crops experienced a negative growth rate in the post-reform period except rice. The cropping pattern is highly skewed towards rice, and crop diversification is very low making it subsistence agriculture in the sense that if there is a natural calamity the entire crop is lost.

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Introduction

The performance of Karnataka's agriculture in post-independence has thrown up a number challenge for policy makers. The huge investment in irrigation, increased use of fertilizer and high yielding varieties have ushered in neither stability nor considerable growth in agriculture output.

The late sixties recorded significant additions to productivity growth through the impact of the Green Revolution. However, the post-reform period did not sustain the tempo of productivity growth achieved earlier. The stagnation in productivity of cereal crops in the post-reform period apparently lead to a change in the cropping pattern in favour of non-cereal crops mainly in response to relatively profitable crops. The state of Karnataka is blessed with varied agro-climatic conditions which permits the farmers of the state to cultivate not only one variety of crop in a season but a number of crops like cereals, pulses, oilseeds, commercial crops and horticultural crops across different seasons. Cropping pattern in state varies from region to region and vast changes are continuing- as new crops are being introduced and the primary crops on are the decline.

Karnataka is one of the top ten states producing food grains in India. It is blessed with ten agro-climatic zones suitable for growing a variety of food grains ground year. The state has a grass suitable cultivated area of 12.35 million ha. Rice, sorghum maize and wheat are the major cereals grown in the state. The total area under cereal crops has increased from 5.4 million ha in 1990-91 to 5.6 million ha in 2001. The production of cereal crops has gone up from 7.1 million ha in 1990-91 to 9.9 based on triennium 1998-99 to 2000-01. R S Deshpande and

others study that the technological changes of the sixties were addressed to the 71 per cent of the total-holding growing cereal. Introduction of the Green Revolution in late 1960s and early 1970s to meet the food shortage in the country had adversely affected the cropping pattern in the country (Velavan and Balaji, 2012). Agricultural growth during the pre and post- liberalizations period undertake an in-depth analysis of the reasons for slowdown in agricultural in the post-reforms period. Indian has made agricultural an emerging sector since independence of growth in area, output and productivity of many crops. It has gone through a green revolution, a white revaluation, a blue revolution and yellow revolution. However, an understanding of the shift that have taken place in the area under crops and their consequent impact on the major corps over time across districts in imperative in evolving suitable policy or corrective measures. Thus, there is need to study the growth at much disaggregate levels so that policy implications will be more relevant. A few Karnataka studies (Nadkarani, and Deshpande, 1982; Rajapurohit, 1983; Mahandradev, 1987; Vani and Vyasulu, 1996; Huchhappvar and Kunnal, 2002) concluded that there has been divergent growth in agricultural sector in the post-green revolution period. However, the analysis has not been extended to the post-reform period when it comes to the agricultural sector of Karnataka. This paper intends to bridge that gap by analyzing the growth and cropping patterns in Karnataka in pre and post green revolutions and in the liberalisation period.

After a brief introduction, this study deals with methodologies and data sources in the second section. The third section is devoted to discussion on reforms in agriculture; while the fourth section reveals the results and discussions. The study finally concludes with some policy implications.

Data and Methodology

The present study is based on secondary data viz. time series data on area, and productivity and so on for major crops viz. Rice, Ragi, Jowar,Bajra, Maize, Wheat, Millets and Total Cereals as aggregate levels. The time period of the study consists of fifty seven years from 1955-56 to 2011-12. Most of the data are collected from various issues of Directorate of Economics and Statistics, and Agricultural Data book.

Measuring Growth Rate

The growth rate agricultural area and yield is calculated by using the method of kinked growth model. This kink model of compound growth rate is an improved and alternative growth model where there are break points in time series data and different sub-periods. The model is explained below with its generalization and then a particular model is derived from it based on the number of kinks present in our data series theoretically.

The generalized method of kink model where there are *m* sub-periods with *m-1* kinks having kink points denoted as $k_1, k_2 \ldots k_{m-1}$, and the sub-period dummies as $D_1, D_2 \ldots D_m$, after applying *m*-1 linear restriction such as:[1,2]

$$a_i + b_i k_i = a_{i+1} + b_{i+1} k_i, \text{ for all } i = 1, \ldots . m-1 \qquad (1)^3$$

Can be obtained as:

$$LnY_t = a_1 + b_1\left(D_1 t + \sum_{j=2}^{m} D_j k_1\right) + b_2\left(D_2 t - \sum_{j=2}^{m} D_j k_1 + \sum_{j=3}^{m} D_j k_2\right) + \ldots$$

$$+ b_i\left(D_i t - \sum_{j=1}^{m} D_j k_{i-1} + \sum_{j=i+1}^{m} D_j k_i\right) + \ldots + b_m(D_m t - D_m k_{m-1}) + u_t \qquad (2)$$

From this generalized model (Eq. 2) we derive our kink model having two kinks and three sub-periods. The growth model can be derived by imposing two linear restrictions such that the sub-period trend lines meet at k_1 and k_2:

$$a_1 + b_1 k_1 = a_2 + b_2 k_1 \qquad (3)$$

$$a_2 + b_2 k_2 = a_3 + b_3 k_2 \qquad (4)$$

Substituting for a_2 and a_3, we get the kinked exponential model as:

$$lnY_t = a_1 + b_1(D_1 t + D_2 k_1 + D_3 k_1) + b_2(D_2 t - D_2 k_1 - D_3 k_2) +$$

$$b_3(D_3 t - D_3 k_2) + u_t \qquad (5)$$

[1]Vivekanad, M and Satyapriay (1994) Karnataka changing cropping pattern, Agricultural situation in India Vol. XLIX No. 06

[2]Basawaraj et al. (2007) Economic analysis of post-Harvest losses in food grains in India: A case study of Karnataka Agricultural Economics Research Review vol. 20 Jan-Mar pp 117-126.

[3]Balla and Singh (2012) Economic liberalization and Indian agricultural: A District-Level study, Sage Publication India.

Where Y is the concerned variable (Area and productivity) for which the growth rate is being calculated. D_1 is a dummy variable that takes on a value of 1 in the first sub-period and a value of 0 in the second and third sub-period; D_2 is a dummy variable that takes on a value of 1 in the second sub-period and a value of 0 in other sub-periods; D_3 is a dummy that takes on a value of 1 in third sub period and zero in other two periods. The coefficient of b_1 is the growth rate during the first sub-period; and b_2 is the growth rate during the second sub-period and b_3 is growth rate during third sub-period. So the elimination of discontinuity between sub-periods and provides a superior basis for comparison of sub-period growth rate.

Table 1: Percentage Distributions of Area under Major crops

(Triennium average centered)

Crops	1960-61	1970-71	1980-81	1990-91	2000-01	2005-06	2011-12
Rice	10.28	11.7	11.14	11.73	12.08	12.09	12.11
Ragi	9.96	10.65	10.57	10.56	8.33	7.64	6.22
Jowar	29.69	22.24	19.91	21.55	14.51	1.24	11.14
Bajra	5.00	5.62	5.64	4.25	2.17	3.51	2.48
Maize	0.11	0.63	1.57	2.5	5.45	7.62	10.09
Wheat	3.27	3.43	3.22	1.98	2.17	2.06	2.3
M.Millets	4.44	5.43	3.68	1.59	0.58	0.42	0.22
Total Cereals	62.73	59.71	55.73	54.16	46.87	34.04	44.58
Pulses	13.06	14.44	15.31	15.31	16.66	16.13	20.18
total food grains	75.79	74.15	71.04	71.04	63.33	50.17	64.76
total oilseeds	12.47	13.98	12.54	20.51	15.42	23.26	16.29
Cotton	9.84	11.42	13.12	5.96	4.49	3.36	3.72
Sugarcane	0.72	1.04	2.54	2.72	3.39	1.74	2.74
Tobacco	0.39	0.38	0.52	0.46	0.58	0.82	0.96
Gross cropped area	**100.00**	**100.00**	**100.00**	**100.00**	**87.21**	**79.35**	**88.47**

Source: Compiled from various issues Director Economics and Statistics, Government of Karnataka, Bangalore

Results and Discussion

Changes in cropping pattern

Crop diversification acts as a mechanism for incorporating risk aversion into a farmer's decision making process in which crop specialization/concentration may lead to highly unstable income due to variance in yield, production, or price for the particular crop (World Bank, 1988). It declines the risk involved in the cultivation of one crop thereby ensures the sustainability of agricultural growth and marks a strong bearing on the welfare of the farmer (Johnson and Brester, 2001). It is acknowledged that the farmers allocate area across different crops based on their relative profitability (Gulati and Sharma, 1997).

Trade liberalization was expected to speed up the process of crop diversification from low value crops to high value cash crops. However, in case of India it was found that pace of cropping pattern changes slowed down in the post-reform period compared to the pre-reform period (Bhalla and Singh, 2009). Looking at cropping pattern changes in case of Karnataka, it is apparent that there was efficient allocation of areas to other crops though, rice accounted for a bulk share of 50 percent. However, after reform, that trend reversed as there has been completely concentration cropping pattern where rice accounts for more than 75 percent of gross cropped area. It has serious implications for agricultural growth and sustainability and food security. Because rice is a kind of crop that requires standing water on the field and it is suitable for areas getting more than 700 mm of rainfall during the growing period.

Table 2: Discontinuous Kinked Exponential Growth Area Under Major Crops – Karnataka

Crop	Total period 1955 to 1964	Total period 1965 to 1990	Total period 1991 to 2011-12
Rice	0.89***	0.12**	0.44***
Ragi	0.59***	0.04	-0.77
Jowar	-0.66	-0.21	-1.67
Bajra	0.86	-0.50	-0.95
Maize	6.17***	4.17***	1.99***
Wheat	0.79	-0.45	-0.84
Millets	1.36**	-1.88	-4.37
Cereals	0.22*	-0.20	-0.12
Pulses	-0.01	0.38***	0.69***
Oilseeds	-1.07	1.34***	-0.19
Cotton	0.34	-0.89	-1.27
Sugarcane	1.94	2.08***	-0.60

Note: The figures for third period are simple average of first two periods.
The symbols *** ** and * indicate 1%, 5% and 10% level of significance. The percentage changes = *b**100.
Source: Compiled from various issues Director Economics and Statistics, GOK, Banglore.

Growth Rate of Area, and productivity of Major Crops and Crop Groups

From Table 2 we look at the green revaluations and impact of liberalizations trade of agriculture in Karnataka at much disaggregate levels. The analysis is initiated taking major crops of Karnataka.

The above Table 2 analysis growth rate of area and productivity of all major crops for three periods i.e., pre and post green-revolutions and the post-liberalization era. The results for the area shows that except tobacco, sugarcane and almost all the crops experienced a deceleration in the green revolution era. In case of crop groups, oil seeds experienced a rise along with pulses in the post-green revolution period. However, in the post-liberalization period the growth rate of most of the crops decelerated except tobacco and pulses as a crop group. The reason behind such a dismal picture is that pre-green revolution and the liberalization period, the farmers were cultivating different crops together and that used to act as coping strategy to weather anomalies i.e., drought and flood, thereby minimizing the crop loss. So there was high crop diversification. But, post-liberalization in 1991 and subsequent year the government encouraged high value crops instead of those traditional crops which are considered as drought tolerant or flood resistant. In 1997, the eighth five-year plan initiated on special food rains productions programme namely 'integrated programme for rice development' restrictions on export of common rice were lifted in 1992. And more rice production was encouraged (Chand, 2008). Again the competing demand after neoliberal policies of 1991 and subsequent years for industrialization, urbanization and rural habitations and so on led to synchronizations of cultivable area (Bhalla and Singh, 2012). The area under maize shows higher growth rate, only because of diversions area from crops cultivations.

Table 3: Discontinuous Kinked exponential growth of Productivity Under major crops – Karnataka

Crop	Total period 1955 to 1964	Total period 1965 to 1990	Total period 1991 to 2011-12
Rice	-0.07	1.44***	-5.93
Ragi	-2.62	2.05***	-5.66
Jowar	1.87	1.20***	-4.87
Bajra	0.55	1.87***	-5.44
Maize	3.58**	2.15***	-6.66
Wheat	2.00	2.00***	-5.14
Millets	-0.27	1.41***	-5.76
Cereals	0.48	1.83***	-5.08
Pulses	0.87	0.93***	-5.46
Oilseeds	-1.38	1.22***	-6.35
Cotton	-0.34	2.31***	-1.14
Sugarcane	1.59	-0.07	1.02***

Note: The figures for third period are simple average of first two periods.
The symbols ***, ** and * indicate 1%, 5% and 10% level of significance. The percentage changes = *b**100.
Source: Compiled from various issues Director Economics and Statistics, GOK, Bangalore.

Table 3, an Analysis of growth of productivity, tells the same dismal story in the post-reform period. Except maize and ragi all other crops experienced a deceleration in the post-green revolution and liberalization period. Since the productivity is kg per hectare production it reflects the combined effect of both area and production. This is evident from the pattern of change area and productivity of rice, ragi, jowar, bajara maize, wheat, oilseeds, cotton and sugarcane. The changes in cropping pattern are induced by their relative price/ profitability rather than by productivity.

Inter-district response

Much of the divergence between area and productivity growth is observed post-reform. However, these divergences are not uniform across districts and are confined to the districts where these crops are dominant.

Rice

Rice is a major cereal crop of the state, occupying about 14.5 of the cropped area. The reform period has witnessed stagnation in growth of area under rice as well as its productivity in the state. However, with new irrigation opportunities there is a shift towards rice cultivation irrespective of the productivity level as witnessed in the districts of Ballari, Bidar, Kalburgi, Koalar, Mysure and Raichur. In the ancient rice growing malnad and coastal district, the stagnation in productivity level has led to a shift in rice are to like sugarcane cocoanut and other garden crops.

Ragi

Unlike jowar, ragi is mainly cultivated in the southern districts of Karnataka. While area under in the ragi in the state stagnated during the reform period, the three major ragi growing districts Mysure, Mandya, Bangalore recorded an increase in area however, there was no growth in productivity either at the state level or these three major ragi cultivating district which recorded an increase in the area.

Jowar

Next to rice a major cereal crop is mainly cultivated in the northern Karnataka with seven districts accounting for 90 per cent of area under jowar. At the state level, area and productivity of jowar during reform period have stagnated. Belagavi and Dharwad districts, however, recorded a significant growth in area though there was no productivity gain during this period. The increase in area can be explained by the growth in gross cropped area in these districts.

Bajra

Vijyapura, Raichur, Kalaburgi and Belegavi are four major bajara producing districts in Karnataka state. These four districts account for the 82.44 per cent of the area 83.22 per cent of production of bajra in the state. Vijayapura the single largest producer of bajara in state (with 31.22 per cent of bajara area) accounts for a little over 10 per cent of the cropped in district.

Maize

Karnataka is the largest maize producing state in India, contributing 10 per cent to the India's total maize production in 1995 (Singh and Marries, 1997). It rose to 15.3 per cent (Josh et al., 2005). In terms of yield, Karnataka maintains the first position in India with 3.10 tonnes per hectare in 1999 (Josh et al., 2005), but according to Sridhar (2008), it was 2.79 tonnes per hectare in 2006-07. Maize, a relatively new crop in Karnataka's cropping system is cultivated mainly in Belagavi Vijyapura, Davangere, Chitrdura and Ballari with 72 per cent of the state area and production.

Wheat

Wheat, which forms about 1.82 per cent total food grains productions in the state, is grown mainly the districts, is grown mainly Belegavi, and Dharwar (75.14 per cent of state area under wheat and 90 per cent of its production).

Pulses

Area under pulses sate has stagnated around 23 per cent of the gross cropped area. Productivity levels of pluses have remained around the same level. However area under pulses has shown increase in the traditionally major pluses producing districts like Kalaburgi, Bidar and Dharwar. Generally there appeared a shift from pulses area to other crops like oilseed in the southern districts of Karnataka.

Oilseeds

Area under oilseed in the state increased by 80 per cent during post reforms period, from 12.51 lakh hectares to 25.51 per cent hectares and production increased 6.50 per cent to 13.39 per cent or 80 per cent. Cultivation of oilseeds is wide spread over the entire state. Area under oilseeds registered a significant growth in most of the districts though its productivity either stagnated or declined.

Cotton

Despite a growth rate of 7.5 per cent in the productivity at the state level, area under cotton registered a negative growth of 5.4 per cent. A similar pattern is observed in the major cotton produced districts namely Dharwar, Belegavi and Raichur. With the introduction of irrigational facilities much of the area under rainfed was diverted to other crops. The increases in the proportion of irrigate cotton added to productivity growth and the level of cotton production maintained.

Sugarcane

Area under sugarcane increased from 1.54 per cent lakh hectares only or by 95 per cent and production from 121.27 to 207.50 lakh tones or by 72.7 per cent during the post reforms with stagnating productivity. In eight of the fourteen sugarcane growing districts, there was significant growth in area. The two factors responsible for this growth in area the introduction of irrigation and shift from rice or wheat to sugarcane cultivation as sugarcane is high value crop relative to rice or wheat. This occurred in the major sugarcane growing of the state, namely Belegavi, Vijyapura Manday and Bidar.

Above crop- wise discussed post reform witnessed stagnation in productivity in most of crops and a change in the copping pattern with regional variations. The change in the cropping pattern has been in favour of high value crops from bajara, jowar and ragi to maize oilseeds and pulses and from rice to sugarcane and garden crops. The introduction of irrigation opened up opportunities for rice and sugarcane cultivation. Thus the change in the cropping pattern in the state is induced not by any productivity growth but by the relative profitability of the alternative corps.

Conclusion

A distinct decline in the growth of cereal productions in the state can be discerned during the last five and a half decades. First, incidences of green revolution and subsequently of liberalization have not provided any improvement in agricultural sector. Most of the crops experienced a negative growth rates in the post-reform period except rice. In the green revolution, new seeds and package of practices coupled with irrigation resulted in growth in cereal output mainly through productivity and witnessed the stagnation of irrigation cereal output as productivity levels remained same. However, the only consoling feature was that the expansion of irrigation resulted in the lowering of instability in output. The cropping pattern is highly skewed towards rice and crop diversification is very low making it subsistence agriculture in the sense that if there is a natural calamity the entire crop is lost.

The policy implications are that (i) there is a need to achieve further growth in cereal output to attain in self-sufficiency and (ii) more needs to be done to consolidate the relative advantage this state has had in non-cereal production. The effort could be in both the directions or towards any one. The former is possible only if there could be a break in the technology of cereal crop production and if the attainment of self-sufficiency is set as a major goal. Crop diversification should be encouraged. The direct incentives like proving the seeds and other inputs at cheaper rate should be undertaken. The poor extension services hinder the adoption new varieties and techniques. Because of the asymmetric information and lack of infrastructure puts them in great trouble when there is natural calamity like drought or submergence of crops due to flood. Yield stabilizing measures should be prioritized, especially since the study concluded a negative relationship between area, growth rate yield and cropping pattern.

NOTES

1. As Boyce (1987) pointed out that when the exponential growth rate is estimated independently in different sub-periods, the resulting trend lines are likely to be discontinues leading to anomalies that the sub-period growth rates are more or less than the growth rate of the whole period. But the kinked growth rate model takes care of that deficiency. Thus, this is an improvement over the discontinuous simple compound growth rate model. Because of the fact that the sub-period growth rates cannot be either greater or lesser than the growth rate of whole period.
2. As Boyce (1987) pointed out that when the exponential growth rate is estimated independently in different sub-periods, the resulting trend lines are likely to be discontinues leading to anomalies that the sub-period growth rates are more or less than the growth rate of the whole period. But the kinked growth rate model takes care of that deficiency.
3. There has been a controversy regarding the trade liberalization and crop diversification linkages and also the consequences. The details about the debate can be found in Fraser (2006).

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The first rule of any technology used in a business is that automation applied to an efficient operation will magnify the efficiency. The second is that automation applied to an inefficient operation will magnify the inefficiency.

—Bill Gates

Database

Manufacturing Growth : India vis-a-vis Select Countries

RAJESH SUND

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Introduction

As economic reforms gain momentum, India's growth is likely to accelerate towards its high long-run potential. According to the latest India Development Update of the World Bank, simply halving the delays due to road blocks, tolls and other stoppages could cut freight times by some 20-30 per cent and logistics costs by an even higher 30-40 per cent. This alone can go a long way in boosting the competitiveness of India's key manufacturing sectors by 3 to 4 per cent of net sales, thereby helping India return to a high growth path and enabling large-scale job creation. However, to realize its full potential, India needs to continue making progress on its domestic reforms agenda and encourage investments. The government's efforts at improving the performance of the manufacturing sector will lead to more jobs for young Indian women and men.

At the World Bank, the Development Data Group coordinates statistical data and maintains a number of macro, financial and sector databases. These databases are used by teams to prepare Country Assistance Strategies, poverty assessments, research studies and other forms of economic and sector work. Working closely with the regions and sectors, the group is guided by professional standards in the collection, compilation and dissemination of data to ensure that all data users can have confidence in the quality and integrity of the data produced. Much of the data comes from the statistical systems of member countries, and the quality of global data depends on how well these national systems perform.

Information has been collated for various parameters related to manufacturing of select countries from the World Bank data. Manufacturing refers to industries belonging to International Standard Industrial Classification (ISIC) divisions 15-37. Manufactures comprise commodities in Standard International Trade Classification (SITC) sections 5 (chemicals), 6 (basic manufactures), 7 (machinery and transport equipment), and 8 (miscellaneous manufactured goods), excluding division 68 (non-ferrous metals). Other manufacturing, a residual, covers wood and related products (ISIC division 20), paper and related products (ISIC divisions 21 and 22), petroleum and related products (ISIC division 23), basic metals and mineral products (ISIC division27), fabricated metal products and professional goods (ISIC division 28), and other industries (ISIC divisions 25, 26, 31, 33, 36, and 37) includes unallocated data. When data for textiles, machinery, or chemicals are shown as not available, they are included in other manufacturing.

Data pertaining to Ease of Doing Business for India's vis-à-vis some of the important countries are given in table 1. Economies have been ranked in terms of their ease of doing business. A high ease of doing business ranking means the regulatory environment is more conducive to the starting and operation of a local firm. India has dropped down two places to stand at 142nd out of 189 countries ranked by the World Bank; however China has improved by 3 points in the year 2014 over 2013.

According to the World Bank data, the manufacturers share in the Structure of Merchandise Exports for India had declined 16 per cent from the year 2000 to 2013. Fuel share has increased from 3 to 20 per cent during the same period. manufacturers exports are relatively the same but India did experience a slight decline from 47 to 42 per cent in the manufacturers imports. Value added in Manufacturing is the sum of gross output less the value of intermediate inputs used in production for industries classified in ISIC major division D. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. Annual growth rate for manufacturing value added is based on constant local currency and aggregates are based on constant 2005 U.S. dollars. Manufacturing value added (% of GDP) for all select countries as well as India remains almost same over the period 2000 to 2013. Whereas, in case of manufacturing, value added (Annual % growth) India experienced a decline from 7.4 to 5.3 over the same time period.

Table 1: Ease of Doing Business Index
(1=most business-friendly regulations)

Sr. No	Countries	2013	2014
1	Brazil	123	120
2	China	93	90
3	France	33	31
4	Germany	13	14
5	**India**	**140**	**142**
6	Japan	27	29
7	Malaysia	20	18
8	Philippines	86	95
9	Singapore	1	1
10	South Africa	37	43
11	Sri Lanka	105	99
12	Switzerland	22	20
13	Thailand	28	26
14	United Kingdom	9	8
15	United States	7	7

Table 2: Structure of Merchandise Exports

Sr. No.	Countries	Merchandise Exporets		Food		Agricultura lraw materials		Fuels		Ores and metals		Manufactures	
		$ billions		% of total		% of total		% of total		% of total		% of total	
		2000	2013	2000	2013	2000	2013	2000	2013	2000	2013	2000	2013
1	Brazil	55.09	242.18	23	34	5	4	2	7	10	16	58	36
2	China	249.20	2,209.01	5	3	1	0	3	2	2	1	88	94
3	France	327.61	579.69	11	13	1	1	3	4	2	2	81	77
4	Germany	551.81	1,452.71	4	6	1	1	1	3	2	3	84	83
5	**India**	**42.38**	**313.24**	**13**	**11**	**1**	**2**	**3**	**20**	**3**	**3**	**78**	**62**
6	Japan	479.25	715.10	0	1	0	1	0	2	1	3	94	88
7	Malaysia	98.23	228.28	6	11	3	2	10	22	1	3	80	61
8	Singapore	13.78	41.02	2	2	0	0	7	17	1	1	86	71
9	Philippines	39.78	56.70	5	11	1	1	1	4	2	6	92	78
10	South Africa	29.98	95.94	8	10	3	2	10	11	11	30	54	46
11	Sri Lanka	5.43	9.95	20	27	2	3	0	0	0	1	76	70
12	Switzerland	80.50	229.16	3	4	1	0	0	2	6	3	87	89
13	Thailand	69.06	228.53	14	13	3	5	3	6	1	1	75	75
14	United Kingdom	285.43	541.59	5	8	0	1	8	19	2	3	76	63
15	United States	781.92	1,579.59	7	10	2	2	2	11	2	3	83	62

Table 3: Manufacturers Exports
(% of merchandise exports)

Sr. No	Countries	2011	2012	2013
1	Brazil	34	35	36
2	China	93	94	94
3	France	76	77	77
4	Germany	83	82	83
5	**India**	62	65	62
6	Japan	89	90	88
7	Malaysia	62	62	61
8	Philippines	59	83	78
9	Singapore	69	70	71
10	South Africa	46	48	46
11	Sri Lanka	69	69	70
12	Switzerland	87	87	89
13	Thailand	72	74	75
14	United Kingdom	63	66	63
15	United States	63	63	62

Table 4: Manufacturers Imports
(% of merchandise imports)

Sr. No	Countries	2011	2012	2013
1	Brazil	72	73	72
2	China	57	55	55
3	France	71	70	71
4	Germany	68	66	66
5	**India**	47	43	42
6	Japan	47	48	48
7	Malaysia	70	69	67
8	Philippines	50	64	65
9	Singapore	60	60	61
10	South Africa	63	62	63
11	Sri Lanka	63	63	61
12	Switzerland	80	80	81
13	Thailand	67	69	67
14	United Kingdom	64	61	73
15	United States	68	70	72

Table 5: Manufacturing, value added (% of GDP)

Sr.No	Countries	2011	2012	2013
1	Brazil	15	13	13
2	China	32	32	32
3	France	13	13	14
4	Germany	11	11	11
5	**India**	**18**	**18**	**17**
6	Japan	19	18	
7	Malaysia	24	24	24
8	Philippines	21	21	20
9	Singapore	10	10	10
10	South Africa	20	20	19
11	Sri Lanka	13	13	13
12	Switzerland	20	19	19
13	Thailand	34	34	33
14	United Kingdom	10	10	10
15	United States	13	13	

Table 6: Manufacturing, value added (Annual % growth)

Sr.No	Countries	2011	2012	2013
1	Brazil	0.1	-2.4	2.7
2	China			
3	France	6.1	4.4	2.8
4	Germany	3.9	0.5	-0.8
5	**India**	**7.4**	**6.2**	**5.3**
6	Japan	-2.5	-0.5	
7	Malaysia	4.7	4.8	3.5
8	Philippines	4.7	5.4	10.3
9	Singapore	7.8	0.3	1.7
10	South Africa	2.9	1.9	0.7
11	Sri Lanka	8.2	-0.9	-0.6
12	Switzerland	-4.3	6.9	0.1
13	Thailand	1.8	-1.3	0
14	United Kingdom	0.7	1.9	
15	United States	0.1	-2.4	2.7

Source : www.worldbank.org

Book Review

John, Jacob (2013) : ***Education Loan and Inclusive Growth – India in a Comparative Perspective,*** Cambridge Scholars Publishing, 12 Back Chapman Street, Newcastle upon Tyne, NE6 2XX,UK, SBN: (10) 1-4438-4719-4, ISBN (13): 978-1-4438-4719-3, Pages 109, Price £39.99.

Higher education in India has been passing through the phase of structural transformation. However, the sector faces major crisis of funding in the 21st century. Internationally, there have been significant changes in financing higher education. Financial assistance to students in the form of student loans for pursuing higher education gains utmost importance in both developed and developing countries. This book is a comprehensive analysis of different models of education loan systems across the world and their inclusiveness among different sections of the society prevailing in different countries. It also discusses various operational features of student loans in India and other countries. This analysis indubitably illumines the future of higher education in India, and furnishes various guidelines on the educational needs of socially and economically marginalized sections of the society.

The study makes use of both primary and secondary sources. Empirical method and case study approaches are used. Another innovative tactics used by the author is to conduct elaborate consultations with the bank officials and with the recipients. This study is carried out on the basis of multi stage and purposive sampling methods. Northern, western, eastern and southern regions were considered. The survey covered with rural and urban areas. For the purpose of the study he enlisted the students in to three categories: Students who had availed loans are the first category. Students who could not join higher courses are second category. The third category includes those who had applied for educational loan but could not avail it because of their failure in meeting the requirements of the bank.

The five chapters of the book deal with the structural issues in financing higher education, equity issues in higher education, the relevance of education loan in India in comparison with the selected countries in the world, the socio economic issues in the operation of education loans in India and other countries and the relevance of Indian experience to developing countries . The higher education system in India is the third largest after the Unite States and China. India has 348 universities, 17625 colleges, over 500.000 teachers and above 10. 5 million students. Public funds are not sufficient to finance this burgeoning sector. Hence developing countries are compelled to find alternative sources of financing and the education loan can play the role of a major alternative source.

In the context of new educational policy reforms the government of India had made some interventions for expanding the scope of the higher educational loan system. Here the author gives us valuable information regarding the operational issues of educational loans in India and other countries and its inclusiveness with respect to various socio economic groups of society. He quoted different studies for highlighting the importance and the efficiency of education loans in the context of developed and developing countries. The study focuses on three major sources of financing higher education namely parent/ student fund, tax payer/government fund and contributions of philanthropists. In recent times, the twin pressures of financial austerity and rising demand for higher education have resulted in the emergence of student loan as an alternate source of financing higher education alongside with the finances of the government, educational institutions and parents.

By reviewing different books and research studies the author argued that, notwithstanding various limitations of the educational loan system, there is a need for popularizing loan as a source of funding higher education in view of ever increasing cost of education, and the declining public funds for higher education in a country like India. Financial access for students from low income families to various quality institutions should be provided. "A large section of students may get an opportunity for education in private and government colleges if a liberal loan facility is available to the person being included in the under privileged students' category"(UGC 2011). According to him, it is important to enhance the use of educational loan as a non-government source of finance within an appropriate framework of inclusiveness.

In chapter two, Dr. Jacob Joan narrates the different models of educational loan systems prevailing in various countries. Resource crunch for higher education development is not a unique problem to India. The developed countries have also been experiencing a similar phenomenon. In United States where more than 80 million

people have availed education loans, there has been five different student loan programmes. The higher education programme in New Zealand has an income contingent repayment plan which receives repayment in the form of x per cent of earnings collected alongside income tax. In the case of UK and Australia, both have income contingent loans; but these loans do not cover all tuition fees and living costs and so many students face upfront charges. In Australia the Higher Education Loan Programme (HELP) is integrated with the tax system. It is an interest-free loan which has an income contingent repayment plan with indexation of loan balance and bonus for faster repayment. In Ghana and Kenya an interesting feature of higher education loan programme is that it is opened to all categories of students without considering need and ability. In Venezuela there is no default in higher education loan programme. In Honduras private agencies are used to locate students and recover loan in order to improve loan repayment rate. It is reported that the rate of loan default is quite low in Sweden, Hong Kong and Quebec (a state in Canada). In most of the countries, repayment of education loan is reported as a major problem which affects the financial viability of educational loans.

In chapter three, the author deals with the operational issues of educational loan in India by reporting the viewpoints of borrowers, lenders and policy makers. In India banks including public, private and cooperative sector banks provide education loans. Majority of higher education loans in India are secured. Nevertheless, during the period 2004 to 2012, banks were advised by the government to provide loans up to the amount of Rs 400000 as unsecured loan. Since 2012, banks have been advised to provide educational loan up to 750000 without any collateral security and third party guarantee. The data on disbursement of loans by commercial banks in India reveals that Kerala is among the front-running states in respect of disbursement of education loan. The author concludes that education loan has an insignificant share as a source of financing of higher education in most Indian states. Now-a-days with the increase in the number of professional colleges, there has been an increasing trend towards higher education loan . Both the state and the central governments take some interest in popularizing education loan schemes. The government of India provides tax exemptions for education loan.

Commercial banks in India face many operational issues in managing education loan. From the field observations, the author reports several cases of default in education loan due to the inability of the beneficiaries to secure good jobs for repayment of the loan. Recovery notices from banks have started haunting the students while struggling with unemployment or poorly paid jobs. Some of them find the course very difficult and boring, and unable to pass the examination. Some students have ended up in poor quality institutions and some paid huge amounts by way of donations for courses in self-financing colleges. The field survey also reveals that the student loan applications were accompanied by false declarations and approval certificates- mostly in the case of nursing institutions in Karnataka and Andhra Pradesh. Another issue is the high interest component of education loan for long term courses. Only very few students get high salaries in the initial years and subsequently debt burden of families become very high. From the field experience the author recommended that a liberalized education loan policy is essential to accommodate the low income sections of the society. The banks are taking a highly commercial approach, sticking to norms and rules despite government of India's instruction to relax and popularize education loans. The commercial banks in India try to keep the non-performing loans at a minimum level by reducing loan exposure to lower income and below poverty level families (BPL).

The statewide data shows that almost 78 5 per cent of education loans are taken for financing professional courses. The banks select the loan beneficiaries on the basis of current income and wealth of student's family or expected earnings to the student from higher education. The author finds that 56 per cent of education loan beneficiaries were males while in case of Kerala large number of female students had taken loan for nursing courses. About 42 per cent of students reported that they are regular in repayment. About 9 per cent of respondents were defaulters, while about 25 per cent were reluctant to reveal the information. Parents of about 30 per cent beneficiaries belonged to the occupational category of agriculture, 10 per cent attached to industry and 38 per cent to the service sector. Regarding the impact of education loan on various sections of students and families, the author finds that the interests of students from poor and low income families in using education loan as a tool for financing higher education is not served due to the rigid approach, arbitrary decisions and wrong interpretations by several branches of commercial banks. The commercial banks are under severe compulsion to meet the interest of their shareholders in generating profit and keeping non-performing assets to a minimum. They

have greater concern for the misuse of education loan by some sections of society and growing trend of default in growing repayment.

In chapter five, the author evaluates four different models of education loan scheme, drawn from different country experiences. These include education loan with government guarantee to commercial bank, education loan with government direct lending, education loan outsourced with core public management and the education loan integrated with the taxation system. The Indian education system has similarities with model 1, which provides guarantee of repayment of student loan to the commercial bank by the government. In the disbursement of educational loans so many complications have been experienced, like lack of uniformity, conflicts regarding secured and unsecured loans, financial inclusion, income constraints, interest and repayment problems, operational problems, neglect of poor families, etc. The author argues that education loan schemes should be redesigned based on the principle of financial inclusion. The students from BPL families, SC/ST and low income groups should get special treatment. His vision for establishing a national body for coordinating the education loan is worthwhile. He perceives that extending the access to higher education loan for students from low income families and simplifying supply constraints by removing regulatory barriers is the need of the hour. The book gives valuable insights for the educational planners and policy makers. Dr. Jacob John laments that at present the government of India does not play a proactive role in popularizing education loan. Even though subsequent judicial interventions are actively occurred, only some state governments replicate the urgency of reforms and policy interventions to make education loan a viable tool for financing higher education.

The book, on the whole, is an excellent study on financing of higher education and loan practices. The cross-national studies as well as regional and countrywide analysis provide valuable insights in to higher education loan practices in different dimensions. Cross country comparisons help the countries to learn from each other about the applicability of the higher education loan system, and in this context, the book serves the purpose very well.

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