IMPACT OF ECONOMIC OPENNESS ON INDUSTRIAL EFFICIENCY: A STUDY ON TRANSITION IN INDIAN MANUFACTURING SECTOR

A thesis Submitted to the University of Hyderabad in partial Fulfillment of the requirements for award of

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In

ECONOMICS

BY

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CERTIFICATE

This is to certify that the thesis entitled "***Impact of Economic Openness on Industrial Efficiency: A Study on Transition in Indian Manufacturing Sector"*** submitted by ***Rajendra Prathipati***, Regd. No. 03SEPH12 in partial fulfillment of the requirements for the award of ***Doctor of Philosophy*** in Economics is a bonafide work carried by him under my supervision and guidance which is a Plagiarism free thesis. This thesis has not been submitted previously in part or in full this University or any other University or Institution for the award of any degree or diploma.

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DECLARATION

I, ***Rajendra Prathipati*** hereby declare that this thesis entitled ***"Impact of Economic Openness on Industrial Efficiency: A Study on Transition in Indian Manufacturing Sector"*** submitted by me under the supervision of Dr. B. Nagarjuna is a bonafide research work which is also free from Plagiarism. I also declare that it has not been submitted previously in part or in full to this University or any other University or Institution for the award of any degree or diploma. I here agree that my thesis can be deposited in Shodhganga/INFLIBNET.

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(REG. NO.03SEPH12)

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(Psalm 9:1)

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Dedicated To my God

Prince of Peace

and

My beloved Parents

Ramesh, Veeramma

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ABBREVIATIONS

ASI:	Annual Survey of Industry
BIFR:	Board for Industrial and Financial Reconstruction
BOP:	Balance of Payments
CAGR:	Compound Annual Growth Rate
CMIE:	Center for Monitoring Indian Economy
CSO:	Central Statistical Organization
DEA:	Data Envelopment Analysis
DGCI&S:	Director General of Commercial Intelligence and Statistics
DMICDC:	Delhi Mumbai Industrial Corridor Development Corporation
EPWRF:	Economic and Political Weekly Research Foundation
FCCBs:	Foreign Currency Convertible Bonds
FDI:	Foreign Direct Investment
FERA:	Foreign Exchange Regulation Act
FII :	Foreign Institutional Investment
GDP:	Gross Domestic Product
GDRs:	Global Depository Receipts
GSP:	Generalized System of Preference
IEM:	Industrial Entrepreneur Memorandum
IMF:	International Monetary Fund
ISTP:	Indian Science and Technology Policy
LDC:	Least Developed Country
MIPB	Manufacturing Industry Promotion Board
MNCs:	Multinational Companies
MPIs	Malmquist productivity Indices
MRTP:	Monopolies and Restrictive Trade Practices
NEP:	New Economic Policy
NIC:	National Industrial Classification
NIMZ:	National Investment and Manufacturing Zones
NIP :	New Industrial Policy
NMP:	National Manufacturing Policy
NRI:	Non Residential Indian
NSSO:	National Sample Survey Organization
OCBs:	Overseas Corporate Bodies
OECD:	Economic Co-operation and Development
PIAM:	Perpetual Inventory Accumulation Method
PSUs	Public Sector Units
QRs:	Quantities Restrictions
SEBI:	Securities and Exchange Board of India
SEZs:	Special Economic Zones
SIA:	Secretariat for Industrial Approval
WB:	World Bank
WDR:	World Development Report
WPI:	Wholesale Price Index
WTO:	World Trade Organization

CHAPTER-I

INDIAN INDUSTRIAL SCENARIO IN TRANSITION –AN OVERVIEW

CHAPTER - I

Indian Industrial Scenario in Transition - An Overview

Introduction

Over the past three decades, *Economic Openness* has become an important part of many countries. It has witnessed revolutionary changes in the manufacturing sector in India and across the world. Most of the economists were in opinion that the economy was in the worst, this condition experienced since independence. This problem doesn't develop suddenly, but it was accumulated over several years. It is evident that, in the 1980's it was notified large and persistent macro economic imbalances. The Balance of payments situation was highly precarious, inflationary pressures are large and fiscal imbalances persist. In this situation, the Government had decided to introduce Economic Openness[1].

The liberalized economic policies were initiated at the event of a fiscal and balance of payment crisis. The gross fiscal deficit of the central Government increased from 6.1 per cent of the Gross Domestic Product (GDP) in 1980-81 to 8.4 per cent in 1990-91. This fiscal deficit had to be met by borrowing mostly from the central bank and the people of India. As a result, the internal debts as a proportion of GDP increased from 35.6 per cent in 1980-81 to 53.5 per cent in 1990-91, and interest payments doubled from 2 per cent of GDP to 4 per cent during the same period. The balance of payment crisis was evident from the past that the current account deficit as a proportion of GDP almost doubled from 1.3 per cent during the first half of the 1980's to 2.2 per cent of GDP during the second half of the 1980's and crossed 3 per cent in 1991. The gravity of the situation was described by the then Finance Minister himself in the following statement. "Foreign Reserves had dwindled to Rs.2, 600 cores, barely sufficient for 2 weeks of imports. International Commercial Banks were refusing to extend new credits. Large out flows were taking place from NRI deposits. Industrial growth had turned negative because of a severe import squeeze and inflation was accelerating. It looked as if we might, for the

[1] Economic Openness is consists of Liberalization, Privatization and Globalization know as LPG.

first time in our history, the countries economic and financial system would have faced an unprecedented disruption, leading to widespread unemployment, loss of output and emergence of a higher inflationary spiral."[2] Till now, we have been discussed the problems with in the country. But there were some external pressures and other influence to raise the Economic Openness in India.

1.1. External and internal Pressures on Domestic Economic Policy

Since only internal austerity measures were not sufficient to bail itself out of the economic morass in which the country had sunk, the Government left with no option but to approach the International Monetary Fund (IMF) and the World Bank (WB) to bail it out from the crisis. The twin institutions agreed to provide standby credit and long-term support to overcome the crisis, but this was contingent on the conditionality of India accepting the Structural Adjustment Programmed (SAP), under which it was obliged to make commitment for change in economic policies. The International Institutions recommended to India a programmed similar to the one they had developed for the Latin American and African Countries in the eighties. The World Bank and IMF worked out both the diagnosis and the remedies, both the documents recommended that sustained high rate of economic growth alone can create productive employment and reduce poverty.

India moves towards more Economic Openness, Globalization, Liberalization, etc, was in tandem with the reform worldwide. Since nineteen eighties, a number of developing countries have turned to the market economy or a method of a more rational allocation of resources for acceleration the pace of economic development, and with the fall of the former USSR towards. The end of the decade, this trend was dramatically quickened. Certain other developments at the international level also influenced Indian economy and led to initiate the reforms in 1991. The Gulf war was created a severe balance of payment crisis in mid 1991. In addition, emergences of fiscal deficits in US economy are also the factors that influenced India's economic policy.

In response to the crisis situation of 1990-91 the Government has decided to introduce economic policy reforms, which consisted of two distinct trends:

2. Statement of the Finance Minister in Parliament on 16 December, 1991.

i. Macro Economic Stabilization

ii. Structural Adjustment Policies

The Stabilization usually refers to the policies initiated by the International Monetary Fund (IMF) and has been defined as the correction of Imbalances which are held to be unsustainable. And the policies of Structural Adjustment, on the other hand, are associated with World Bank leading for the medium term to enable reorienting the economy for greater efficiency. The World Bank defined as 'reforms of policies and institutions-micro economic (such as taxes), macroeconomic such as fixed imbalance and institutional public inefficiency.' In practice, the term has been defined variously. Analysts Corbo and Fischer have defined 'It as a process of market-oriented reforms in policies and institutions, with the goals of restoring a sustainable balance of payments, for sustainable growth in per capita income' (1995, p.2847)[3]. Other definitions carry the structural adjustment more narrowly to denote policies aimed at improving an economic efficiency and long-term growth.

Structural reforms broadly covered the areas of industrial licensing, foreign trade, foreign investment, exchange rate management and the financial sector. For the present study would like to focus particularly on "Impact of Economic Openness on Industrial Efficiency (productivity growth)". Below disused about Economic Openness and Economic prosperity and later examines the existing industrial structure changes.

1.2. Economic Openness and Economic Prosperity

While theory and cross-country studies consensually suggest that economic openness increases overall welfare (details given in figure 1.1). The below points are benefits from Economic Openness.

- **Dissemination of knowledge and innovation embodied in goods, services and investments -** Using a panel of over 23,000 European establishments 2007, Bloom et al. (2009) find that Chinese import competition led to both within firm technology upgrading, and between firm reallocation of employment towards more technologically intensive plants. These effects are growing over time as Chinese trade volumes raise, accounting for up to 38% of technology upgrading in the most

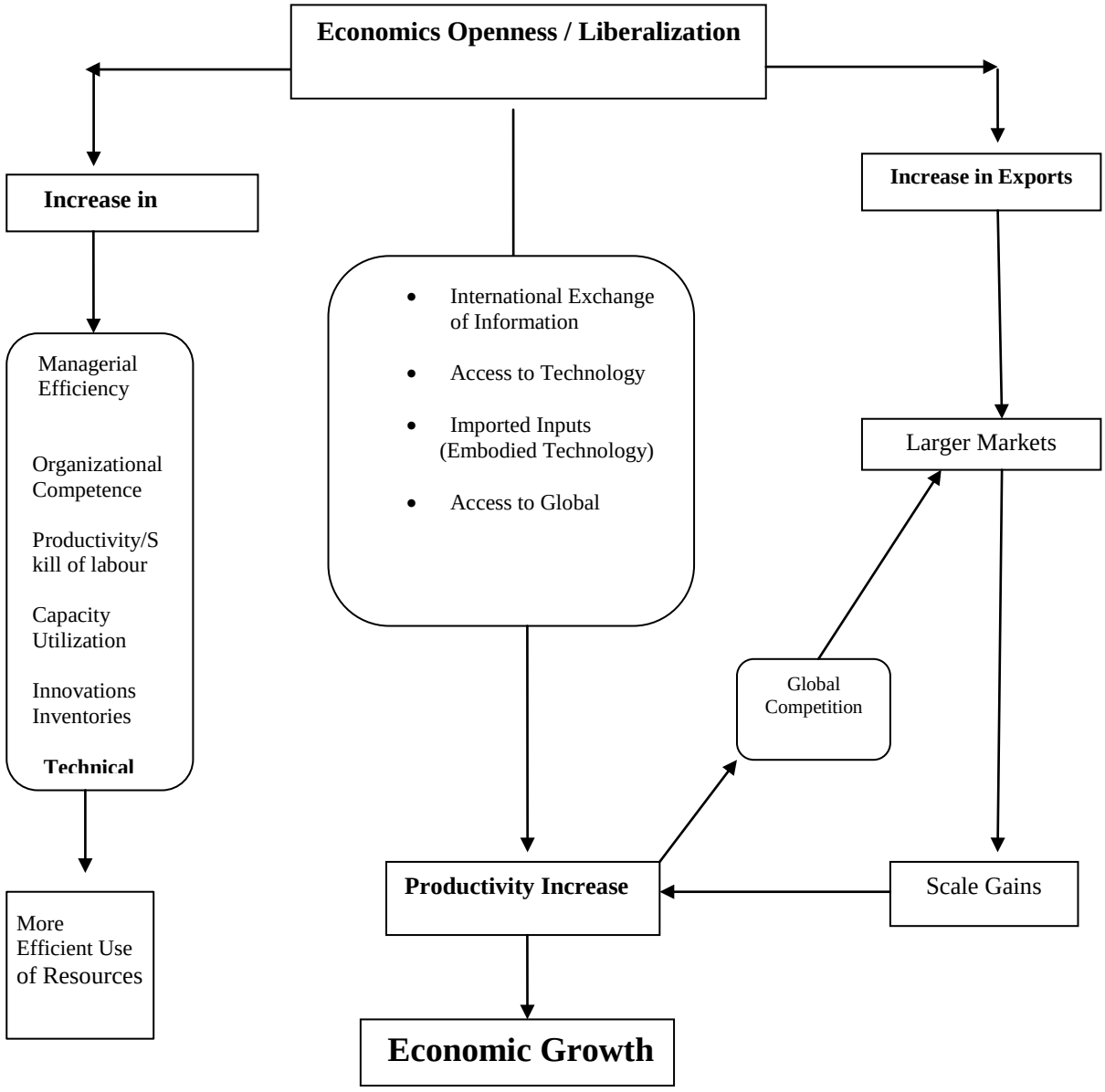
[3] Corbo, Vittorio & Fischer, Stanley, (1995), *"Structural adjustment, stabilization and policy reform: Domestic and international finance,"* Handbook of Development Economics, in Hollis Chenery & T.N. Srinivasan (ed.), Handbook of Development Economics, edition 1, volume 3, chapter 44, pages 2845-2924.

recent years. These results suggest that imports from low wage countries appear to have potentially large beneficial impacts on technical change.

- **Foreign investments contribute to economic prosperity too** - *Inward investments* may crowd out a small element of domestic investment but the net result is to increase the capital stock of an economy, which is beneficial to growth and employment. Flows of investment also enable the reallocation of resources to more efficient and productive activities. Inward FDI can be a useful vehicle for the transfer of innovative technologies and processes. Through linkages with domestic firms it can have spill over effects that work to boost the productivity of both the industry and the wider economy. Regarding developing countries, the conventional wisdom is that the benefits of inward investment are dependent on countries reaching a threshold capacity in human capital and financial development. New evidence suggests however that at the level of the firm, the impact of foreign direct investment on growth is systematically larger in low income countries than elsewhere[4]. *Investments abroad* can also bring important benefits to the home economy. If activities where the comparative advantage lies elsewhere are outsourced to more efficient locations, this can free up resources in the home to undertake more productive activities. Investment overseas may also have an export generating effect because the foreign investor uses parts of their established supplier chains in providing goods/services in the country they have invested in. Investment in fast-growing economies and industries abroad often bring high returns, improving the balance of payments. These returns can then be reinvested in higher skilled activities in the home economy, as firms often maintain head office and R&D activities in the home country, while export in lower skilled activities. Outward investment also provides a good route for technology transfer to the home economy.

[4] Randolph, B. and Campos, N. (2010), *"The Growth Effect of Foreign Direct Investment in Low-Income Countries: A Meta-Regression Analysis of the Firm-Level Evidence,"* London, DFID Systematic Review Programme Report No. 1.

Figure 1.1: Economic Openness (Liberalization) and Productivity- Possible Links[♦]



Sources: Srivastava, V (1996), Liberalisation, *Productivity and Competition: A Panel Study of Indian Manufacturing*, Oxford University Press, New Delhi.

♦ Note: Different researchers have tried to establish a possible link between Economic Openness (liberalization) and productivity .the process of liberalization would lead to more competition in an economy. This increase in competition would pressurize the firms to be technically efficient by increasing organizational competence, skills of the labour, capacity utilization and making the firms more innovative. This would probably result into more efficient use of resources. On the other hand, due to liberalization process i.e. second link establishes that would allow the firms to have international exchange of information, easy access to technology, imported inputs and access to global capital thereby, resulting into higher productivity gains and higher economic growth.

- **Enhanced competition leading to improved productivity of domestic firms** - These dynamic effects will occur through allocative efficiency (reallocation of resources across firms and most importantly inside firms), productive efficiency (reduction of managerial slack and increases in workers' efforts), and dynamic efficiency (increase in innovation)[5].

1.3. Structural Changes in Indian Industrial Sector

Since Independence, so many structural changes have been taken place in industrial sector. The Government implemented number of policies for the industrial development before 1990's. Industrial policy has always been considered as "sine-qua-non" for speedy development of country irrespective of developing one. However, it has got a special role to play in the process of development of country like India.

The measures to liberalize India's industrial policy framework begun in the late 1970s which consisted of deregulation and delicensing in certain industries, assigning a larger role to the private sector, and a gradual shift from direct physical controls to indirect controls (Raj, 1986[6]; Chandrasekhar, 1988[7]). The important industrial policy reforms introduced in 1991 includes the abolition of the institutional entry barrier, namely the system of industrial licensing, in all industries except in a small list of strategic and potentially hazardous industries and in a few industries reserved for the small scale sector and removal of investment controls on large industrial houses enforced under Monopoly and Restrictive Trade Practices (MRTP) act. Other measures under the reform package include opening up of areas reserved for the public sector to the private sector and the decision to reduce the government share in public sector enterprises. Accordingly, the number of industries reserved for the public sector was reduced to 6 in 1994 from 17 in 1991. Alongside, many of the public sector enterprises were partially privatized while retaining the government share in excess of 51 per cent. The Licensing requirements for industrial investment were dispensed with in all but 18 industries. (Detail industrial policy review has discussed in chapter III)

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[5] Aussilloux, V., Boumellassa, H., Emlinger, C. Fontagne, L. (2010), *"The economic consequences for the UK and the EU of completing the Single Market"*, BIS Economic Paper to be published in February 2011.

[6] Raj, K.N. (1986), *New Economic Policy*, *Oxford University Press*, Delhi.

[7] Chandrasekhar, C.P. (1988), *"Aspects of Growth and Structural Change in Indian Industry*", *EPW*, Special Number, Vol.23, Nos.45-47, November, pp.2359-2370.

Policy changes in the external sector such as reduction in tariff and removal of non-tariff restrictions on imports, liberalization of the foreign investment and technology import policies and exchange rate policy reforms also have a direct influence on the industrial sector. The Licensing and other physical controls of imports were eliminated for non-consumer goods and tariff rates were drastically lowered. Import licensing was done away with for most goods except consumer goods; import-weighted tariff declined to 27 per cent from (pre-1991) the level of 87 per cent; and exchange rates were devalued by 20 per cent (Ahluwalia and Little 1998, pp.4-5)[8]. The Scope of foreign direct investment was widened. Further, the 1990s also witnessed several reform measures in the financial sector of the economy that also have a bearing on the performance of the industrial sector. In general, these policy reforms can affect the industrial productivity through a variety of channels. These include (1) increased competitive pressure, (2) greater and cheaper access to better foreign technology and imported intermediate commodities, (3) removal of various constraints on input use, technology choices and investment decisions of industrial firms, (4) greater technological dynamism and (5) more realistic exchange rate and favorable economic conditions.

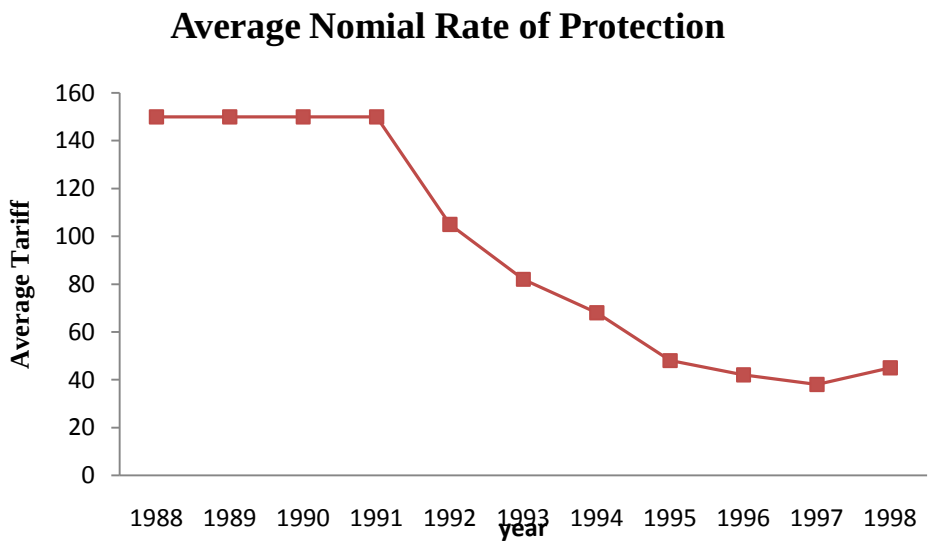
These reforms were aimed at making Indian industry more efficient and productive, technologically up-to-date and competitive; with the expectation that efficiency and productivity improvement, technological up-gradation and enhancement of competitiveness would enable Indian industry to achieve rapid growth. In brief, the above industrial reforms main objectives are to raise efficiency in productivity and to achieve significant growth in the economy the success of the reforms should be judged in terms of this yardstick.

The present study trying to find out the answers for a few broad set of questions. Prior 1991, the Indian industries protected with tariffs and Quantities Restrictions (QRs). But, after 1991 tariffs have been reduced & quantitative restrictions have been gradually removing. We can identify from the figure1.2.[9]

[8] Ahluwalia, Isher Judge and Little, I. M. D. (1998), *" Introduction"* in Ahluwalia, Isher Judge and Little, I. M. D. (eds.) (1998), *India's Economic Reforms and Development*: *Essays for Manmohan Singh*, Oxford University Press, Delhi.

9. Hasan, R., D. Mitra, and K.V. Ramaswamy (2007), *"Trade Reforms, Labour Regulations, and Labour-Demand Elasticities: Empirical Evidence from India," Review of Economics and Statistics*, 89(3, August), pp. 466–81.

Figure-1.2



Source: Hasan, Mitra and Ramaswamy (2007)

According to Rajesh Mehta's observation on "The impact of Indian recent trade policy reforms on external trade"[10], explains that the liberalization process has led to significant decline in protection of Indian industry. In this situation many questions may arise such as: Is there is any impact on Indian industries due to Economic Openness? Is there is any growth and efficiency due to these reforms? There is need for addressing these issues theoretically.

1.4. Analytical Framework

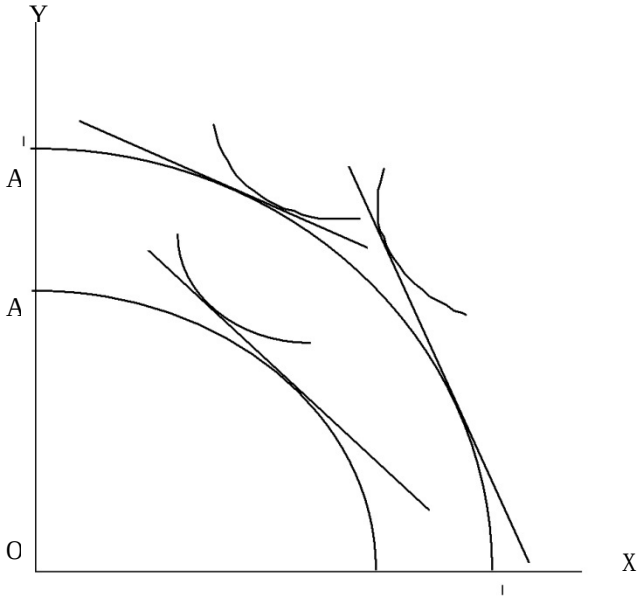
It is well known fact that the protection distorts resource allocation by attracting resources away from productive sectors towards the rent-seeking and directly unproductive activities. This results in the lower level of output and welfare than what could have been achieved in the absence of protection as shown in Figure1.3.[11] A'B' in the above figure is the production possibility curve of a country which shows the maximum limit of commodities X (exportable product) and Y (import substitution product) that can be produced in the absence of protection. Supposing that this nation enjoys a comparative advantage in commodity X.

[10] Rajesh Mehta (1997), *"Trade Policy Reforms, 1991-92 to 1995-96-Their Impact on External Trade"*,ERPW XXXII No. 15, April 12, 1997.

[11] Kishor Sharma (2000), *"Liberalization and structural change: evidence from Nepalese manufacturing Economic Growth Centre"*, Yale University, Discussion Paper No. 812.

Figure 1.3

Effects of Protection on Production and Resource Allocation



In the absence of protection the relative commodity price would be determined at P which determines the optimum level of production. At this point resources are efficiently utilized and the welfare is maximized.[12] Now, assume that tariffs and QRs are imposed on the imports of commodity Y and the tariff inclusive price is P*. Since commodity Y is protected from external competition, it attracts resources away from commodity X (exportable sector), leading to a fall in exportable output which is typically a labor intensive sector in developing countries. The decline in exportable output (commodity X) on the one hand, and the higher prices for the locally produced import substitution goods (commodity Y) on the other hand, result in the lower level of welfare as the nation now consumes at a lower indifference curve (i.e., IC_{II}). Frequently the more significant cost of protection is seen because of the loss of potential output either due to rent seeking behavior to receive preferential treatment or to the negative incentive effects which induce x-inefficiency. "These effects can push the production possibility curve inward from A'B' to AB, leading to a further decline in welfare as the nation now consumes at the lowest indifference curve (i.e., IC_{I}). The Protection also reduces efficiency by shielding domestic market from external competition and restricting access to imported inputs and technologies"[13]. However, Rodrik (1993) argues that there are no

12. This is because by exchanging X for Y the nation ends up consuming at the highest indifference curve (i.e., ICIII)

13. Srinivasan, T.N. and J. Bhagwati (1999), *"Outward-orientation and Development: Are Revisionists Right?"*, Economic Growth Centre, Yale University, Discussion Paper No. 806.

reasons to believe that protection discourages productivity improvement[14]. In fact, it is import liberalization, according to him that retards productivity growth by shrinking the domestic firm's sales and reducing incentives to invest in technological effort. Thus, whether liberalization really improves efficiency in Least Developed Countries (LDCs) or developing countries is ambiguous and must be examined empirically. In this connection objectives chosen for the study are given below:

1.5. Objectives of the Study

The study broadly aims at examining the Impact of Economic Openness on Industrial efficiency on Indian Industries Growth. More specifically the objectives are:

1. To review the Indian Industrial Policies in the context of pre and post transition period.
2. To analyze the trends in output growth (Value Added) and inputs growth (Labour and Capital) of selected Indian Manufacturing Industries (based on Technology Classification) in pre and post transition period at aggregate and disaggregate level.
3. To analyze the trends in the productivity growth of selected Indian Manufacturing Industries (based on Technology Classification) in pre and post transition period at aggregate and disaggregate level.
4. To examine what are the Source of the Total Factor Productivity of the selected Indian Manufacturing Industries of selected Indian Manufacturing Industries in the pre and post transition era.

1.6. Hypothesis

Ho: Economic Openness affected (In transition period) on industrial productivity growth adversely

H_1: Economic Openness have made industrial productivity growth progressively efficacy.

[14] Dani Rodrik, (1993), *"Trade and Industrial Policy reforms in Developing Countries: AReview of Recent theory and evidence"* National Bureau of Economoic research, Working paper No 4417,Camridge,Newyork.

1.7. Methodology

1.7.1. Area of the Study

Industrial activities in the country are broadly divided into two as Factory and Non Factory Sector. The factory sector covers units registered under Factories Act of 1948. Household and non-household industrial units not so registered constitute non-factory sector. The former is designated as registered or organized sector, the latter as unregistered and unorganized sector. All factories that employ more than ten workers with the aid of power and more than twenty workers without the aid of power are classified under registered manufacturing (or, broadly, the factory sector). All other manufacturing activities are classified are classified under unregistered manufacturing.

India largest and official industrial database, Annual Survey of Industries (ASI) covers the information about the registered manufacturing activities and does not cover the unorganized or unregistered manufacturing sector. The entire manufacturing activities in India are classified into 171 three-digit industries, which are again brought into 17 *two digit* industries. Using ASI data, this study analyses the performance and efficiency of registered manufacturing industry based on technology classification in India.

1.7.2. Selection of the Industries

In the era of globalizing world economy, competitiveness of nations depend crucially on the speed of acquiring, absorbing and effectively utilizing new technology vis-à-vis their global competitors. Technology in the form of creative application of changes in technical knowledge results in productivity improvements. In the process, it provides the nation competitive advantage by infusing technical improvements in production process. Indian Science and Technology Policy (ISTP)-2001 clearly recognized the role of technology; aims to encourage in highest level of innovation and research and development in industry. In this connection the entire Indian manufacturing industries divided based on technological classification (which is developed by the Organization for Economic Co-operation and Development (OECD)[15] into four categories.

15. OECD Science, *Technology and Industry Scoreboard*, 2003.

i. High Technology Industries
ii. Medium High Technology Industries
iii. Medium Low Technology Industries and
iv. Low Technology Industries.

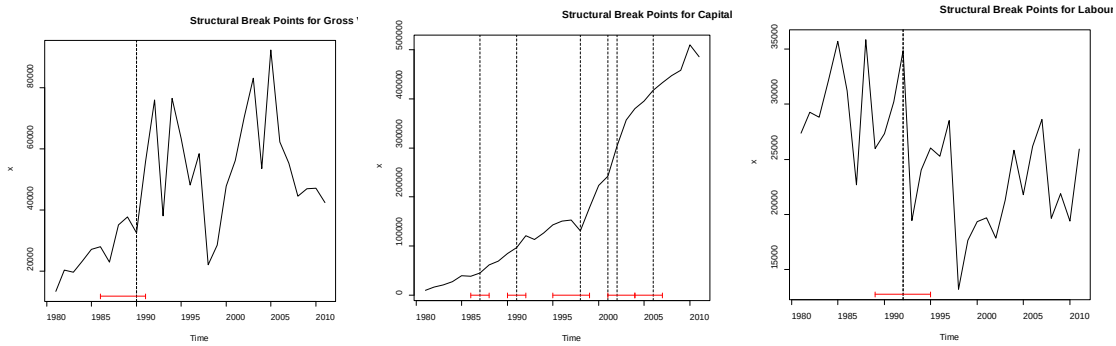
Detailed classification has given in the table 1.1. For this study, it has been consider and prepared the data based on the concordance between ISIC REV.2 CODE, NIC 87 CODE, NIC 98 CODE, NIC 2004, and 2008.

1.7.3. Period of the Study

In this study an attempt has been made to analyze the impact of economic openness on industrial efficiency. Since 1991, Indian economy has been constantly undergoing drastic economic reforms. Due to these reforms, so many changes have been taken place. Hence to capture these changes, have chosen the year 1991 is break point. The entire study divided into two vital periods and they are *pre* (1981-90) and *post transition period* (1991-2012) which is tested through structural break points.[16](refer figure 1.4).

Figure 1.4

Structural break points of Indian Manufacturing Sector



[16] The foundation for estimating breaks in time series regression models was given by Bai (1994) and was extended to multiple breaks by Bai (1997ab) and Bai & Perron (1998). Breakpoints implements the algorithm described in Bai & Perron (2003) for simultaneous estimation of multiple breakpoints. The distribution function used for the confidence intervals for the breakpoints is given in Bai (1997b). The ideas behind this implementation are described in Zeileis et al. (2003).

TABLE: 1.1 CONCORDANCE TABLE BETWEEN ISIC REV.2 CODE, NIC 87 CODE, NIC 98 CODE, NIC 2004, and 2008

Sr. No	Industries	ISIC Rev.2 code Division / Major Group/Group	NIC 87 CODE	NIC 98 CODE	NIC 2004 CODE	NIC 2008 CODE
	High – Technology Industries					
1	**Aircraft	3845	377	3530	3530	3030
2	Office and computing equipment	3825	(358+367)+394	3000+NA*	30	2620
3	Drugs and Medicines	3522	304	2423	2423	21
4	Radio ,TV and communication equipment	3832	(365+396)+366+368	(3220)+3230+3210	32	2630+2640+2610
	Medium-High-Technology Industries					
5	Professional goods	385	380+381+382	3311+3320+3330	33	2651+2652+2660+2670
6	Motor vehicles	3843	373+374+398	3410+3420+3430	34	29
7	Electrical machines excl.comm. equipment	383-3832	(360+395)+364+(361+362+369)	(3110+3120)+NA+(3130+3140+3190)	31	2710+2720+2790
8	Chemical excl. drugs (Industrial chemicals)	351+352-3522	(30+317)-305	(24)-2424	24 - (2424+2423)	20
9	Other Transport	3842+3844+3849	(371+372+397)+(375+376)+(378+379)	(3520)+(3591+3592)+(3599)	3520+3591+3592+3599	3020+3091+3092+3099
10	Non-electrical machinery	382-3825	(35)-358(390+391+392+393)	(2813+29)-3000 (NA)	29	28
	Medium-Low-Technology Industries					
11	Rubber and plastic products	355+356	310+(311+312)+313	2511+1920+2519+2520	25	22
12	Shipbuilding and repairing	3841	370	3511+3512	3511+3512	3011+3012
13	Other manufacturing	39	(383+384)+385+386+(387+388+389)	(3691)+3693+3692+3694+NA+3699	36	32
14	Non-ferrous metals	372	333+334+335+336+337+338+339	2720	2720	2420
15	Non- metallic products	36	32	26	26	15
16	Metallic products	381	34	2811+2812+289	28	25
17	Petroleum refineries and coal products	353+354	(314+315)+(316+318+319)	2320+2310	23	19
18	Ferrous metals (Iron& steel)	371	330+331+332	2710	27-2720	24-(2420+2432)
	Low-Technology Industries					
19	Paper, paper products and printing	34	28	21+22	21+22	17+18
20	Textiles, apparel and leather	32	(23+24+25)+(26)+(29)	(171)+(172+173+181)+182+19	17+19+18	13+14+15
21	Food, beverages and tobacco	31	(20+21)+22	(15)+16	15+16	10+11+12
22	Wood products and furniture	33	27	20+361	20+3610	16+3100

Source: *Classification **Based on** Organization for Economic Co-operation and Development (OECD) Science, Technology and Industry Scoreboard, 2003.*
*Note: *NA indicates not available of data **Air Craft exclude from the study due to lack of data*
ISIC: International Standard Industrial Classification, NIC: National Industrial classification.

1.7.4. Data Sources

The current study is emphasizes empirical analysis of the data relating to the particular period from 1981-2012. And, for this purpose we have used the data collected from the Annual Survey of Industries, (ASI) compiled by Central Statistical Organization (CSO), Ministry of Statistics and Programmed Implementation. In India, ASI is the principal source of industrial statistics and has been compiled since 1959 under the authority of the Collection of Statistics Act, 1953. It provides statistical information to assess and evaluate, objectively and realistically, the changes in the growth, composition and structure of organized manufacturing sector. ASI covers all factories registered under Sections 2m (i) and 2m(ii) of the Factories Act, 1948, i.e., the factories employing or have employed 10 or more workers on any day of the preceding 12 months and in any part in which a 'manufacturing process' is being carried on with the aid of power; and those employing or have employed 20 or more workers on any day of the preceding 12 months and in any part of which a 'manufacturing process' is being carried on without the aid of power and does not include a mine, subject to the operation of the Mines Act, 1952.

The 'manufacturing process' referred above has been defined (vide Section 2(k) in the Factories Act, 1948 as:

- Any process for making, altering, ornamenting, finishing, packing, oiling, washing, cleaning, breaking up, demolishing or otherwise treating or adapting any article or substance with a view to its use , sale, transport, delivery or disposal; or,
- Pumping oil water or sewage; or,
- Composing types for printing by letter press, lithography, photogravure or other similar process or book binding; or,
- Constructing, reconstructing, repairing, refitting, finishing or breaking up ships or vessels.

Along with the above ASI data source we have used the Handbook of Industrial Policy and Statistics (Ministry of Commerce and Industry, Govt. of India), Hand Book of Statistics on Indian Economy (RBI), and Center for Monitoring Indian Economy (CMIE) issues. Descriptive analysis is based upon books, working papers and eminent expert's contributions to the trade and industries. And also reference to standard journals related to the trade and industries was made which are furnished in the bibliography.

1.7.5. Variables

In this study variables are used output, labour, capital. The definition of the variables and the deflators used are as given below:

(a) Output (GVA): In this study Gross Value Added used to represent output. GVA in this context implies increment to the value of output that is contributed by the unit, and is obtained by deducting the value of total inputs from the value of output. Use of Gross Value Added at constant prices to represent output is a common practice in the Indian empirical literature (Goldar, 1986; Ahluwalia, 1991; Balakrishnan and Pushpangadan, 1994; Balakrishnan and Pushpangadan, 1998).

The issue of using a suitable deflator for estimating the value added for series of price changes has been debated extensively (Balakrishnan and Pushpangadan, 1994; Ahluwalia, 1994; Dholakia and Dholakia, 1994; Goldar, 2002). Normally, the single deflator method has been used. In this method, the nominal value added is deflated by an index of the price of gross output (Goldar, 1986; Ahluwalia, 1991). However In this study, the Wholesale Price Index (WPI) for manufactured products has been used to deflate the nominal values of gross value added. The WPI, 1981-82 and 1993-94 has been arithmetically brought to a common base year (1993-94) through splicing method. For the present study, 1993-94 was chosen as base year.

(b) Labour (LA): The Total number of persons engaged was taken as the measure of labo7ur input. As both workers, working proprietors and supervisory/managerial staff can affect productivity, so number of persons engaged is preferred to number of workers.

(c) Capital (FC): Gross fixed capital stock at constant (1993-94) prices is taken as a measure of capital input. ASI provides data on fixed capital stock at historical cost. It consists of land, buildings, plant and machinery, capital work in progress, furniture, fixtures and office equipments and others. For constructing the capital stock for the sector, CSO's data on fixed capital stock for 1981-82 has been considered as the benchmark year of capital stock. The Capital stock series is then constructed by using perpetual inventory accumulation method**.** Most of the studies in the Indian manufacturing sector have used the Perpetual Inventory Accumulation Method (PIAM) to construct capital stock series (Ahluwalia, 1991; Balakrishnan and Pushpangadhan, 1994;

Trivedi, 2004). This study also used the PIAM for generating the series on capital stock.

Capital stock for the industrial sector in the subsequent years has been arrived at by adding the real investment figures to the stock of capital of the previous year. The relationship between gross fixed capital stock in year t, denoted by K_t, the benchmark capital stock, K_0, the benchmark year for the present study is the year 1881-82 as the study covers the period 1981-82 to 2011-2012. Following Benerji (1975) and Balakrishnan & Pushpangadan (1994) double of the fixed capital is taken as measure of capital stock for the benchmark period ($K_0 = 2 (B_t)$, where t= 1981-82).

The investment series, (I_t), may be written as:

$$K_t = K_0 + \sum_{t=1}^{T} I_t$$

The investment figures were obtained using the formula:

$$I_t = (B_t - B_{t-1} + D_t)/ R_t$$

Where B = Book value of fixed capital in the year‘t’

B_{t-1} = Book value of fixed capital in the year (t-1)

D_t = Depreciation in the year‘t’

R_t = Price index for machinery and machine tools (base year 1993-94)

1.7.6. Data Analysis Techniques

1.7.6.1. DEA Analysis

To test hypotheses, Malmquist Productivity Index methods used to calculate Total Factor Productivity (TFP) of the Indian Manufacturing Sector based on technological classification. DEA based Malmquist productivity approach has been used extensively to measure performance in various sectors. Detail methodology has explained in the fifth chapter.

1.8. Organization of the Study

The present study can be divided into six chapters. First chapter deals with a brief introduction of Economic Openness, discussed on industrial structure before 90s, objectives of the study, methodology and sources of data. In the second chapter, review of literature related to impact of Economic Openness on industries efficiency and productivity which has been already debated by various eminent economists. In Chapter three reviewed evaluation of industrial reforms. Fourth chapter gives a vivid analysis the growth performance of Indian Manufacturing Sector (based on technological classification) during the pre and post transition periods for different industries as group-wise as well as individual industry. The growth rates of value added, capital stock and labour are estimated and evaluated of different periods. Chapter five discusses on the efficiency (productivity growth) of Indian manufacturing industry; using Malmquist Data Envelopment Analysis for selected industry groups for different periods. Finally, chapter six devotes to present the summary of study and findings and also draw major conclusions of the study. Based on the theoretical and empirical analysis, various policy suggestions are recommended for the better performance of Indian Manufacturing Sector as a whole in general and selected industries in particular.

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CHAPTER-II

REVIEW OF LITERATURE

CHAPTER - II

REVIEW OF LITERATURE

Introduction

The Indian Manufacturing Sector has undergone significant changes through various reform programmes. The components of these reforms, such as, removal of entry barriers, import tariff reduction, removal of quantitative restrictions on imports of the intermediate and capital goods, not only introduced competition-both internal and external, but also contributed towards more efficient allocation of resources by reducing distortion introduced by the earlier policies. These impacts are reflected on a higher growth in real manufacturing output and a faster employment growth in the higher productivity factory segment.

Since the introduction of economic reforms, a number of studies have been examined the impact of components of economic reforms on industrial performances. Most of these studies find that trade reform in developing countries was indeed accompanied by productivity growth, technology advancement and a reshuffling of resources towards the more efficient firms, although in some cases the evidence may fail to convince because of the hurdles involved in the methodology used in these studies. This is true in the case of India, where in some case studies using slightly different methodologies find opposite results. However, aside from methodological issues, India seems to be an exception with respect to other trade liberalization of developing countries, since most studies find that the 1991 trade reform was in fact accompanied by a reduced productivity growth.

India's post-independence development strategy was one of national self-sufficiency, and stressed the importance of government regulation of the economy. It was only the second half of the 1980s, when the focus of India's development strategy gradually shifted towards export-led growth, supported by measures to promote exports and liberalise imports for exporters that the process of liberalization began. Since the theory appears to suggest that virtually anything may happen to productivity growth after

opening up to trade, the question has largely become an empirical one. However, until recently, these hypotheses linking trade with competition and productivity growth received relatively little empirical attention.

Against this background, the present study gives detailed review literature that establishes economic openness and industrial performance (efficiency). This chapter divided into two sections. First section disused on some review of literature related to technical efficiency and productivity of Indian manufacturing industry and in the section two focused on empirical studies related to the inter- relationship between economic openness and industrial performance.

2.1. Studies Related to Total Factor Productivity on Indian Manufacturing Sector and International Studies

Ahluwalia (1991) analyzed trends in Total Factor Productivity and Partial Factor Productivities in the organized manufacturing sector in India over the period 1959-60 to 1985-86. The Total Factor Productivity growth was measured for the 63 industrial groups based on the Trans-log production function framework. To prepare annual estimates of total factor productivity growth, annual data on Value Added, capital stock, employment, wages are taken for organized manufacturing sector Annual Survey of Industries (ASI). The estimate of Total Factor Productivity growth is -0.4 per cent per annum, suggesting virtually zero growth in TFP over the study period. It is also found that during this period, there is strong rising trend in capital-intensity, a weaker rising trend in labour productivity, and a secular decline in capital productivity.

Ravi kiran (1999) investigated on "Productivity in Indian manufacturing industries". In this study, productivity indices as well as the growth rates of inputs (labour and capital) and output (Value Added) have been analyzed for the period 1973-74 to 1995-96. Results showed that performance of Indian Manufacturing Sector in terms of partial productivities and total factor productivity has improved in the post-1981 period. The sectors depicting a higher rate of growth in total factor productivity i.e. Water Works and Supply, Gas and Steam, Chemical and Chemical Products, Cold Storage, Transport Equipment and Parts and Non metallic Mineral Products are the sectors depicting improvement in labour and capital productivity in the post- 1981 phase. Most of these

sectors have a positive rate of growth of Capital Productivity in the second period of analysis.

Kishor Sharma (2000) investigated consequences of liberalization on structural changes of manufacturing industry in Nepal. The main objective of the study is to examine what happens to output structure and trade orientation following liberalization? Will there be any impact on manufacturing productivity? Will spatial distribution of manufacturing activity change? The results indicate some structural changes in manufacturing output and trade orientation following the liberalization program but no significant improvements were recorded in productivity growth and spatial distribution of manufacturing. The Export intensity rose significantly, despite poor productivity performance of export oriented industries in the post-liberalization period. The impact of liberalization on the overall productivity growth has been nominal. Productivity had been declining prior to liberalization and this continued to be the case even after the liberalization. But a marginal improvement was detected in the latter period in that the rate of decline in productivity was controlled after the liberalization. There were no signs of improvements in spatial distribution of industries and the tendency to locate in relatively developed region(s) continued even after the policy liberalization

R.N. Agarwal (2001) has attempted on Technical Efficiency and Productivity Growth in the Central Public Sector Enterprises in India during 1990s. The objective of the study is to analyze the Technological Change, Technical Efficiency and Total Productivity growth of 58 large Central Public Sector Enterprises (CPSE) for the period 1990-91 to 1998-99, industry group-wise and firm-wise. Partial productivities and the Solow index of total factor productivity growth have been used for estimating productivity growth at the industry group level while panel data estimation method using the Random Effects Model and a modified form of the Composite Error Term Frontier Production Function Model as developed by Cornwell, Schmidt and Sickles, has been used for estimating the technological change and growth of technical efficiency at the firm level. The results show that the public sector enterprises have not experienced a significant technological change during the 1990s. Further, the results indicate, decreasing returns to scale in production. Results also suggest that a majority of the firms have low levels of technical efficiency and that the efficiency has not improved

significantly over time. However, the growth of technical efficiency is observed in some firms in the engineering sector.

Anita Kumari (2001) examined on the Productivity growth In Indian engineering industries during pre reform and post- reform period an analysis at company level .The study is based on company level balanced panel data relating to Indian engineering industries, electrical and non-electrical groups, for the pre-reform period of 1985-86 to 1990-91 and post-reform period of 1991-92 to 1994-95. The study reveals that productivity growth of engineering industry had declined in the post- reform period as compared to the pre-reform period. The analysis reveals that output growth had a significant positive impact on productivity growth in both the periods. Foreign equity participation had a significant negative relationship with productivity growth in both the periods. And Intermediate inputs imports had a strong positive effect on productivity growth in the post reform period.

Mahadevan (2002) estimated TFP growth 'using the South Korean Manufacturing Industry data of 1980-1994 of four industries, namely food, textile, chemical and fabricated metal using the stochastic frontier approach. It was found that the output growth in these four industries was increasingly productivity-driven. The export oriented industry experienced higher contribution of TFP growth. Further, the study showed that in the light industry like food and textile, technical efficiency change was negative but in the heavy industry, i.e. chemical and fabricated metal, it was positive.

Sanja S., Pattnayak, Thangavelu, S.M. (2003) investigated the impact of economic reforms on the Indian manufacturing industries using a panel data of manufacturing industries. A Trans-log cost function is used to analyze the production structure in terms of biased technical change and economies of scale. A panel consisting of 121 Indian manufacturing industries from 1982 to 1998 was used in estimation. The results show that there are economies of scale (only moderate) in the Indian manufacturing industries and it has been exploited after the key economic reforms in 1991. Most of the industries in the study revealed bias technology change and majority of the industries have experienced capital-using technical change. They observed TFP improvements for most of the industries after the 1991 reform initiatives.

Euler Pereira G., R. Macedo (2003) estimated the total factor productivity for 27 Brazilian industries during the period 1996-2000. The results show a negative annual average TFP growth for almost three quarters of the sectors analyzed. The first period presents an average TFP growth rate of 2.9 per cent, whereas the second one shows a TFP average negative growth rate of 8.1 per cent. Considering both the mining and the manufacturing divisions, technical change is the key component driving the TFP performance in 1996-1998.

Goldar (2004) investigated TEP growth for Indian manufacturing industry using the Translog index for three periods, 1979-80 to 1990-91, 1991-92to 1997-98 & 1991-92 to 1999-00. The estimate is based on the value-added function framework. The results shows that a fall in the growth rate of TFP in India manufacturing in the period 1991-92 to 1997-98, when compared with the period 1979-80 to 1990-91 and much lower at 1 per cent for the period 1991-92 to 1997-98. It may be noted further that, the estimated average annual TFP growth rate for the period 1991-92 to 1999-00 exceeds that for the period 1991-92 to 1997-98, but is lower than that for the period 1979-80 t o1990-91.

Kumar, Surender (2004) have attempted on Total Factor Productivity Growth of the unorganized manufacturing sector in India of 15 major Indian states for the period 1978–1979 to 2000– 2001. Data envelopment analysis is used to compute Malmquist total factor productivity index and its components. Results show that total factor productivity registered a positive growth during the period in the country as a whole. Most states in the country witnessed higher total factor productivity growth in the post 1990s reforms period than in the pre reforms period. The Decomposition of the Malmquist productivity index shows that improvement in technical efficiency rather than technical progress had contributed to the observed acceleration in the growth rate.

Nik Hashim and Basri (2004) examined on TFP growth of Malaysian manufacturing sector using stochastic frontier approach with translog production function. They found that between 1990 and 2000 TFP growth was very low for some industries at below unity or even negative for transport and food industries. The positive growth is achieved in chemical, textiles, rubber, petroleum and wood. This study found that technical efficiency was a major contribution of TFP growth except in chemical, paper and petroleum. The highest technological progress was attained in petroleum. A

highest technical efficiency is in electrical and electronic industry, while the lowest in food industry.

Anita Kumari (2005) analyzed the impact of economic liberalizations on pattern of sources of growth of output of Indian manufacturing industry from a demand side perspective. The analysis based on Chenery's factor decomposition approach based on input-output framework. It decomposes output growth into its four sources domestic demand expansion, export expansion, import substitution and intermediate demand expansion due to change in input-output coefficient. The analysis has done separately for the pre-liberalisation period, 1983-84 to 1989-90, and the post-liberalisation period, 1989-90 to 1997-98, to examine the changing pattern in the sources of growth of output as a result of policy liberalisation and structural reforms during the 1990's. The study found that output growth in manufacturing industry has been mainly driven by domestic demand expansion followed by contribution of export expansion during both pre-liberalisations as well as post-liberalisation period, but after liberalisation the contribution of both domestic demand expansion and export expansion has increased.

Metin Karadag, A. Ozlem Onders and Ertugrul Deliktas (2005) examined on Total Factor Productivity (TFP) changes in Turkish manufacturing industry. The main objective of the study is to estimate Total Factor Productivity (TFP) change of the private and public sectors in the manufacturing industry in the selected provinces of Turkey by using panel data for the period 1990-1998, using Data Envelopment Analysis (DEA) to compute Malmquist productivity indices, which are decomposed into two component measures namely efficiency change and technical change for the purpose of the study. The finding of the study is that there is not much significant improvement in TFP for the time under consideration due to the instability in economy in 1990s. Although the improvement is small, the results of the study show that efficiency change plays a major role in contributing TFP growth for the time period. Also the results show that there is no significant difference between public and private sectors as far as TFP change is concerned. At provincial level, among the total 18 provinces in Turkey only 6 provinces showed deterioration in terms of TFP change cumulatively as far public sector is concerned. Amongst the provinces that experienced improvement only 3 provinces are above 5 per cent. On the other hand all provinces experienced improvement in TFP cumulatively as far as private sector is concerned, but the highest is only 6.7 per cent.

Furthermore, the results reveal that increase in TFP is mainly explained by the efficiency change for many provinces for both public and private sectors.

Nancy Y. C. Kong and Jose Tongzon (2006) examined trends in Total Factor Productivity Growth (TFPG) in the ten major sectors of Singapore. For the period of 1985 to 2000, estimation of TFPG was done using the Malmquist Productivity Index-DEA method. The results show that during the 16 years, efficiency change was dominant in the retail sector, whereas technical change was dominant in the manufacturing sector. Efficiency changes have played a great part in TFP growth in the retail sector, this is due to the improvement in quality service of human capital that translated to efficiency of human organization in production capabilities. The catering sector was worst performer using all three measures of efficiency, technical and TFP change.

Rajesh raj S N & Mihir K. Mahapatra (2006) have examined on the performance of organized industrial sector in India and selected states, during the period of 1981-2003 especially in the reforms period. In order to capture the productivity growth in the organized industrial sector, both Partial Factor Productivity Method and Total Factor Productivity Method (Growth Accounting Method) have been employed. The analysis reveals that performance of the industrial sector has witnessed noticeable change during the reforms period. There has been substantial fall in the share of employment, Gross Value Added and Capital stock of the organized segment in the industrial sector as a whole during the reforms period, implying an improvement in the share of unorganized sector in the said variables during the 1990s and onwards. Further, the growth of gross value added in India and selected states has declined during the reforms period as compared to the pre reforms period and implying industrial sector failed to sustain the growth momentum in output during the period after 1991. In this aspect, performance of Karnataka state is somewhat better as compared to other states while Orissa suffered the serious setback during this period. Analysis of factor productivity growth reflects erosion in the organized manufacturing units with wide fluctuation in the reforms period especially during the second generation reforms period.

I.K.M. Mokhtarul Wadud (2007) investigated the productivity growth in Malaysian manufacturing over the period 1983-1999. Malmquist productivity Indices (MPIs) have been computed using non parametric Data Envelopment Analysis (DEA). Results indicated that a high majority of the industries operated with low levels of

technical efficiency with little or no improvement over time. Growth estimates revealed that two third of the industries (76 out of total 114 categories) experienced average annual productivity improvement ranging from 0.1% to 7.8%. Average annual technical progress was recorded by 95 industry categories while technical efficiency improvement was achieved by 53 industries. Overall yearly average indicated relatively low productivity growth from the mid 1990's onwards caused by either efficiency decline or technical regress. Summary results for industries showed that some of the high rates of productivity growth have been recorded in glass and glass products (7.3 per cent), Petroleum and coal (7.2 per cent), industrial chemicals (4.9 per cent) contributed from both efficiency improvement and technical progress ranging from 0.8 per cent to 5.4 per cent and from 1.7 per cent to 4.1 per cent, respectively.

Kiran and Kaur (2007) both of the authors examined the impact of reforms on productivity level of Punjab manufacturing industries during 1980-81 to 2002-03,based on 16 industrial groups of the manufacturing industries. The results depicted that there has been a fall in the capital productivity and labour productivity in the state after the reforms. The growth of value added and labour has witnessed a deceleration, while the growth in capital is observed to be positive. Further, the analysis shows that out of 16 industrial groups 11 witnessed a higher total factor productivity in the pre reforms era; while 5 observed a higher TFP in the post reforms period.

Saba Vahid (2008) attempted on productivity changes of the manufacturing sector in the United States .The main objective of the study to examine the productivity changes of the wood product manufacturing industries in the U.S from 1997 to 2002. The Malmquist Productivity Index (MPI) was selected to measure the productivity changes and Data Envelopment Analysis (DEA), a non-parametric approach, was used to measure the distance functions required for calculating the MPI. The results showed 5per cent increase in productivity of the whole sector on average over the study period, while the productivity of the wood product manufacturing decreased by 1 per cent over the same period. The efficiency decline of the industry was the main contributor to the decline of its productivity.

Atulan Guha (2008) examined the pattern of structural changes in the organized manufacturing sector at the aggregated as well as at the disaggregated 3 digit level. The results show that at the aggregate level the organized manufacturing sector has grown at a

faster rate in the pre-liberalised regime of the 80s than in the liberalised regime. Both output and net value addition have shown higher growth in the 80s. The organized manufacturing sector has grown at a lower rate, the capital formation has grown at a faster pace in the liberalised regime. The net fixed capital stock has grown at a faster rate in the liberalised regime. And with negative employment growth, the capital-intensity has also increased at a faster rate in this regime. In spite of the increase in capital-intensity, the capital productivity has declined under the liberalised period. Instead of technological up gradation, it seems that capital has merely substituted labour in this period. In the 80s, with the increase in the capital-intensity, the organized manufacturing sector also experienced an increase in capital productivity. It indicates that there was technological up gradation in the 80s. The labour productivity increased in both the periods, but the growth was higher in 80s. In the 80s, the increase in labour productivity was primarily because of increase in capital intensity coupled with the increase in capital-productivity.

Abhay Gupta (2008) analyzed growth experience of registered manufacturing sector in India between 1970 and 2003, using production function, index number and envelopment analysis methods. TFP growth rate average is 1.1per cent for both gross output based and net value added based measures. In gross output production, share of materials is 0.6 per cent, much larger than the capital and labor shares. The Share of capital is constantly increasing. For the period just after the reforms (1991-1997), input growth jumps but TFP growth is negative. But after 1998, the trend reverses and output grows slowly despite negative input growth due to large TFP growth. Aggregated TFP growth rates (Domar-weighted and Fisher index) also follow the same pattern; showing upward trends after mid- 1990s. There are no significant differences in TFP growth rates among different-sized firms. After the reforms, TFP growth increases substantially in the public corporations. Productivity transition seems to be random across different (3-digit NIC code) industries. Industries with focus towards services experienced higher productivity growth than others. These results show that the lack of productivity growth was the reason for unimpressive performance of Indian manufacturing earlier.

Jabir Ali, Surendra and E. Ekanem (2009) have attempted on efficiency and productivity changes in Indian food processing industry. The study examined the performance of various segments of food processing industry in India in terms of TFP and

efficiency change over a period of 1980-81 to 2001-02, with using DEA approach. The results show that the food processing industry in the country is growing at a rate of about 10 percent per annum. The average technical efficiency score is estimated 0.902 under VRS model with average scale efficiency score of 0.870. This implies that the average technical inefficiency could be reduced by 10 percent by improving scale efficiency and eliminating pure technical inefficiencies. It is also very important to note that technical efficiency scores for food processing industry have declined during 1990s as compared to 1980s. The analysis of returns to scale in food processing sector suggests that most of the sub-sectors have moved from increasing returns to scale towards constant and decreasing returns to scale during last two decades except meat & meat products, fish & fish products, fruits & vegetables and starch & starch products. This result clearly indicates that additional investment in the food processing segments with increasing return to scale will give encouraging and profitable output and whereas food segments with decreasing or constant returns to scale need reorientation and modernization in production process. The food industry experienced positive change in TFP with varied magnitude across subsectors. The positive gain in TFP is basically due to change in technological progress i.e. shifted in production frontier due to increased doses of capital input.

Deb Kusum Das & Gunajit Kalita (2009) have made an attempt to compute the aggregate productivity growth using the Domar aggregation technique. Building up from the Total Factor Productivity (TFP) growth estimates for 3-digit industries, they have used Domar weights to computed total factor productivity (TFP) growth for selected industries, for the period 1980-2000. Result shows that aggregate productivity for the selected 2-digit sectors show sharp year to year fluctuations. The average TFP growth displays wide differences for most of the 2-digit industries. The highest TFP growth is recorded by the leather products industry for the periods 1980-85 and 1991-95, whereas during the period 1986-90, basic chemical records the highest growth rate in TFP. The Rubber and plastics industry achieved the highest growth in TFP during the period 1996-2000. Overall, they found that the productivity performance in the 1990s was poor as compared to the 1980s as is evident for the number of industries registering positive growth in TFP.

Sabuj Kumar Mandal, S. Madheswaran (2012) examined the Total Factor Productivity (TFP) growth in Indian cement industry during the period 1989-90 to 2006-07 using company level data and applying Stochastic Frontier Approach. TFP growth is decomposed into technical progress (TP), technical efficiency change (TEC) and changes in scale component (SC). Empirical results show that TFP growth is mainly driven by SC and TP and not by TEC since TE is time invariant in nature.

Shallu Sehgal and Suparn Sharma (2011) both of the authors examined on the inter-temporal and inter-industry comparison of Total Factor Productivity (TFP) of Haryana state. Malmquist productivity index (MPI) model used which is an application of DEA to panel data to calculate the indices of TFP change, technology change, efficiency change. The study is based on pooled data for the period of 1981-82 to 2007-08 for different categories of organized sector's manufacturing industries. The study reveals that technical efficiency change is the key driver of TFPG in the manufacturing sector of Haryana during pre reforms period, however, the picture has turned around during the post reforms period. A positive impact of liberalization policy on technological advancement of the manufacturing sector of the state has been experienced. But, during the post reforms period the state has realized inefficiency in the utilization of resources in hand and it is really an alarming sign indicating that the incapability of manufacturing sector of the state in question to cope up with the technological advancement.

Arnab K. Deb (2011) examined on the pre- and post-reform performances of Indian manufacturing in terms of total factor productivity growth, for the period 1970-71 to 2007-08, in order to capture the productivity growth the non-parametric method of Data Envelopment Analysis used. Results show that at the all-India level, Total Factor Productivity growth rate in manufacturing is higher during the post-reform period. Although the majority of states experienced accelerated productivity growth, some states experienced declines in productivity after the reforms. However, the regional variation in the rates of productivity change diminished during the post-reform years.

Fulwinder Pal Singh (2012) analyzed the TFP growth trends in Indian manufacturing sector at both aggregated and disaggregated inter-state levels. the Malmquist productivity index Used for panel dataset of 16 major industrial state over a period of 29 years spanning over 1979-80 to 2007-08, the study observed manufacturing sector of India is growing with 9.1 percent per annum growth of Total Factor Productivity

(TFP) during the entire study period. Out of Sixteen Industrial states there are five states namely Uttar Pradesh, Madhya Pradesh, Gujarat, Orissa and Rajasthan where double digit TFP growth has been noticed. The manufacturing sector of Uttar Pradesh is growing with highest TFP growth at the rate of 12.8 percent per annum followed by Madhya Pradesh with TFP growth of 11.8 percent per annum. The analysis of the sources of the TFP growth in Indian manufacturing sector reveals that both technical progress and technical change are equally contributing TFP growth in sector under evaluation. It has also been observed that at all India level efficiency change is greater than technical progress.

S Ray (2012) examined the impact of liberalization on productivity growth of India's paper industry and pulp industry. Specifically, this study quantifies the level of technical efficiency and technical change in this particular manufacturing sector. Malmquist Productivity Index method used to different sub-sectors of India's Paper and pulp industry at aggregate level to examine trend in productivity growth covering a period of 28 years (from 1979-80 to 2006-07). The result of this study reveals that decline in growth rate of TFP during post-reforms (1991-92 to 2006-07) period showing adverse impact of liberalization at aggregate level. And also results indicate that during the study period, industry also experienced regress in technological progress along with stagnation in technical efficiency. Non-responding technical efficiency change and the deteriorating technical change were the main ingredients responsible for declining productivity change in Indian paper industry and pulp industry.

2.2. Empirical Studies Related to the Inter-Relationship between Economic Openness and (Technical Efficiency) Industrial Performance

Kalirajan and Zhao (1997) examined the impact of economic reforms on technical efficiency performance of China's state enterprises. The study uses aggregated data at the provincial level for the manufacturing enterprises in the China, covering the period of 1986 to 1989 with using Cobb-Douglas model. It was found that all the coefficients are statistically significant level at 5 per cent. The results reveal that the mean technical increased from 78.6 per cent in 1886 to 84.8 per cent in 1989. The Technical efficiency of China's state enterprises during 1986-89, estimated from stochastic frontier production model is time-variant, suggesting that there is a change in the level of technical efficiency across industries and across periods. Thus, it is found that, there is a positive change in the performance of industry in China during the study

period. The result shows that the technical efficiency is increased in all provinces of China during the study period. Clearly, economic reforms in 1980s have had a positive and significant impact on improving technical efficiency of the state owned manufacturing industries in all provinces of China.

Haishun Sun, Phillip Hone and Hristos Doucouliagos (1999) have investigated the technical efficiency of industries in a transitional economy (China), using data for 28 manufacturing industries across 29 provinces with the Data Envelopment Analysis (DEA) approach. The technical efficiency of each industry is measured and compared across regions and provinces. The results show that there was considerable potential for savings in resource use in many industries. These savings were most apparent in the Textile, Timber Processing and Non-Ferrous Metal industries where, on average, output could be sustained at current levels while at least halving the quantity of resources used. In general, significant savings were indicated for most industries operating in the Central and Western regions of the country. An examination of the factors associated with differences in technical efficiency scores between industries found that there is a generally positive relationship between export orientation, foreign investment and technical efficiency in Chinese manufacturing industries. The Tobit regression analysis results confirm that export orientation and foreign direct investment generally had a positive effect on technical efficiency. An inter-industrial comparison also indicates that industries whose products are highly oriented to international markets are more technically efficient than domestic-market-oriented industries. These findings lend support to the hypothesis of a positive relationship between Economic Openness and Technical Efficiency.

Ephraim Wadonda Chirwa (1998) examined the level of technical efficiency in Malawian manufacturing industries using the deterministic (nonparametric) Data Envelopment Analysis Approach, used panel data for seven manufacturing industries over the period 1984 to 1988. The results indicate high levels of technical inefficiency in most sectors. On average, for firms in Malawian manufacturing to produce existing levels of outputs, they can save inputs by 59 percent in the tea industry, 44 percent in the tobacco industry, 41 percent in the wearing apparel industry, 62 per cent in the printing and publishing industry, 21 percent in the soaps and cosmetics industry, 18 per cent in the plastic products industry and 13 percent in the fabricated metal products industry. The

results also show that 15 percent of observations exhibit constant returns to scale, while 28 percent and 56 percent exhibit decreasing and increasing returns to scale, respectively. This shows that inefficiency is partly a result of operating at sub-optimal scale of production. The average annual efficiency scores for most sectors also show a declining trend based on the 'inter temporal frontier approach', although this varies from industry to industry. Decreasing trends are observed in tea, tobacco and printing and publishing industries, while clearly visible increasing trends are observed in wearing apparel and soaps and cosmetics. Average efficiency scores are more stable in plastic products and fabricated metal products industries.

The second empirical part of the study attempted to identify sources of technical efficiency in the selected manufacturing industries using a censored regression model. The results show that the market share of the firm is positively associated with the level of technical efficiency reflecting the importance of economies of scale. Domestic monopoly power is negatively associated with the level of technical efficiency.

Aggarwal (2001) attempted on the inter-firm determinants of export performance in Indian manufacturing in the late 1990s. The objective was to test two hypotheses: first, in a liberalized regime, Multi National Enterprises (MNE) affiliates perform distinctly better than local firms in the export markets and second, MNE affiliates have greater comparative advantages in high-tech than in low- and medium-tech industries. Tobit model estimations conducted on all the sample firms. However, the evidence of the better performance of MNEs is not strong enough to suggest that India is attracting efficiency-seeking outward-oriented FDI. Even firms with higher foreign equity stakes have not performed distinctly better than others. The results also show that high-tech industries are not attracting efficiency seeking FDI as had been expected. In medium-high tech sectors their performance is somewhat better. In low-tech industries, firms with high foreign stake are found to be performing better. Two important implications of the results are: one, it appears that the economy is not fully integrated with the global economy and that the existing industrial and technological capabilities need reorientation to attract efficiency seeking FDI; two, India's competitive advantages still lie in low-tech sectors. The results also suggest that in technology based sectors own technological capabilities of firms are crucial determinants of export performance of firms.

Ephraim W. Chirwa (2001) evaluates the impact of privatization on the technical efficiency of six privatized enterprises, there state-owned enterprises, and six private enterprises competing three oligopolistic manufacturing industries in which privatization took place between 1984 and 1991, using panel data on 'Inter temporal Frontier' approach for panel data. The findings shows that the privatization in Malawi is associated with high mean technical efficiency in privatized enterprises and competing state-owned enterprises and private enterprises. This also finds that the competitive process is more important than privatization in increasing the technical efficiency of all enterprises competing in the same industries.

Unni Jeemol, , N. Lalitha and U. Rani (2001) These three of the authors studied on the trends in growth and efficiency in the utilization of resources in Indian manufacturing sector before and after the introduction of economic reforms. Further, they compare growth and efficiency across scale of production, that is, in the organized and unorganized manufacturing sector of the economy. They under took a comparative analysis with Gujarat, as it is one of the most industrially developed states with a clear emphasis in its policies towards the secondary sector. The study shows that the pattern of growth in Gujarat was similar, with the organized sector growing rapidly during the reforms period, and the unorganized sector doing so immediately before the reforms. Both the organized and unorganized sectors in Gujarat seemed doing better than the all-Indian average in terms of growth of value added. Gujarat had an exceptionally high growth of value added in the reforms period in both organized and unorganized sector. This growth was reflected mainly in the basic and intermediate goods industries in the organized sector. Growth in manufacturing sector in Gujarat was also more efficient than the average all Indian growth after the reform

M. Parameswaran (2002) examined the performance of the firms in four selected industries in terms of efficiency against the background of economic policy reforms introduced in India since 1991. Stochastic frontier production function and an associated inefficiency model are used to measure time varying firm specific technical efficiency. The results indicate that although, the change in the policy environment has a positive effect on the technical efficiency in all except in one industry, the level of efficiency is lower in the post reform period in all the industries considered. The decline in the level of technical efficiency happened in a context of higher technical progress, identified as

the upward shift of the best practice technology in all industries. This indicates that majority of the firms failed to catch up with the shifting frontier technology, resulting in an increase in their inefficiency. The hypothesis that a more liberalized trade regime enables the firms to acquire foreign technological knowledge through their export, import of technology and raw material import and thereby enhance the production efficiency was also examined. In this respect he found that firm's export activity, import of technology and raw materials are contributing to higher efficiency.

Ali Ugur (2004) explored the technical efficiency levels in the Electrical and Optical Equipment industry in Irish manufacturing sector , with a stochastic production frontier approach over the period 1991-99 using firm-level panel data. The model used is that outlined by Battese and Coelli (1995) which determines the causes of inefficiency simultaneously, rather than employing a two-step approach whereby efficiency estimates are obtained in the first step and are then regressed on a set of determinants. Results showed that technical efficiency levels have increased in two sectors, namely Electronic Valves and Other Electronic Components and Radio and Television Receivers, whereas Electric Motors and Generators and Medical and Surgical Equipment industries have experienced a decline in the average technical efficiency levels over the period 1991-99. And, found that investment intensity reduces technical inefficiency levels of firms in all of the sub sectors and no significant relationship between export intensity and the technical inefficiency levels of individual firms in all but one sector, namely Television and Radio Receivers industry. Overall, these results shows that investment intensity and labour quality play an important role in reducing technical inefficiency levels of the indigenous firms in the Electrical and Optical Equipments industry in Irish manufacturing sector.

E. Abdul Azeez (2005) attempted on the performance of Indian manufacturing sector in terms of economic Capacity Utilization (CU), over 1974-1998. The CU is estimated employing a translog variable cost function, using an iterative version of the Zellner's Seemingly Unrelated Regression Estimation (SURE) technique. The analysis reveals that the conventional installed capacity utilization measures underestimate the true economic utilization levels. Further, the Indian manufacturing sector experienced a cyclical pattern of economic capacity utilization during the period of study. It has also identified three distinct phases of economic CU movements. While phase one (1974-

1984) has marked relatively wide fluctuations the phase two (1985-1990), shown more or less a stable level of utilization. A mild variant of the fluctuations of the sort witnessed in the first phase is seen to have resurfaced in the third phase (1991-1998). The major point emerged from the study was the significant role of supply side as well as demand side factors in affecting the level of economic capacity utilization. The impact of economic reforms was not significant though the policy changes may influence supply and demand side factors determining the level of economic capacity utilization.

Jad Chaaban, Vincent Requillart & Audrey Trevisiol (2005) investigated the technical efficiency of French Cheese industry for the period 1985-2000, used a two-stage procedure to identify whether production characteristics such as technical efficiency and returns to scale affect takeovers. Using original panel data on French cheese manufacturers, first they estimate firm-specific productive efficiency and scale economies using Data Envelopment Analysis. In the second stage, they evaluated a random effects log it model of the determinants of takeover in the French cheese industry for the period 1985-2000. And they found that technical efficiency is not a significant determinant of takeovers, while the nature of scale economies is. Firms with Decreasing Returns to Scale (i.e. an over-sized production capacity) face a higher risk of takeover. This suggests that French cheese manufacturers have sought to expand their milk processing capacities by acquiring large firms. This may have been an indirect consequence of the non-transferable milk quota regime. By acquiring a competitor, a firm would be seeking an increased access to a scarce input that is absolutely needed to increase its production. Also found that firm-specific effects are significant. This indicates that one needs to incorporate individual firm-specific effects when modeling the takeover probability of cheese firms.

Oleg Badunenko, Michael .F & A. Stephan (2006) analyzed determinants of technical efficiency of German manufacturing firms using a panel of about 35,000 firms between 1992 and 2004. Initially, they obtained estimates of technical efficiency and then performed an Analysis of Covariance in a second step to investigate the determinants of the technical efficiency of firms. The results of the fixed effects approach for obtaining estimates of technical efficiency appear rather reasonable. The distribution of technical efficiency is symmetric and most of the firms are clustered close to mean value. The analysis reveals that industry effects explain the largest part, more than one third of the

model's explanatory power of technical efficiency variation. Firm size is the second most important factor that has a strong significant effect on technical efficiency. The location of a firm's headquarter is also an important factor that explains another 10 percent of variation in technical efficiency. The explanatory power of firm characteristics such as R&D intensity, outsourcing activity and the legal form is relatively small. Quite surprisingly, they found a negative effect of R&D intensity on technical efficiency, although with a very low explanatory power. This result may particularly indicate a time lag between R&D spending and the resulting efficiency improvements.

Neil Dias Karunaratne (2007) examined the micro economic reforms impact on technical efficiency of Australian manufacturing. The technical efficiency scores estimated for Australian manufacturing industries using a combined stochastic production-frontier inefficiency model that is free of simultaneity bias. The model parameters have estimated maximum likelihood techniques using a panel data set covering a cross-section of 8 industries spanning a time-series of 26 years (1969-1995). The empirical results shed light on how technical inefficiency in manufacturing has been whittled down by the microeconomic reform induced trade liberalization and technology diffusion processes. Generalized likelihood ratio tests reject the null hypotheses that trade liberalisation and technology transfer had no significant impact on the reduction of technical inefficiency. The reduction of effective rate of assistance and technical efficiency and technology proxies such as intra-industry trade and capital deepening are negatively correlated during the study period.

Musleh–ud Din, Ejaz Ghani, and Tariq Mahmood (2007) have examined the efficiency of the large-scale manufacturing sector of Pakistan using two competing techniques, i.e., the Stochastic Frontier Analysis, and the Data Envelopment Analysis for two periods 1995-96 and 2000-01, for 101 industries at the 5-digit. The results on the basis of stochastic production frontier show that there has been some improvement in the efficiency of the large-scale manufacturing sector, though the magnitude of improvement remains small. The results are mixed at the disaggregated level; whereas a majority of industrial groups have gained in terms of technical efficiency, some industries have shown deterioration in their efficiency levels, including, for example, transport equipment, glass and glass products, other non-metallic mineral products, and other manufacturing. These findings are broadly supported by the Data Envelopment Analysis,

lending a measure of robustness. Overall, the increase in technical efficiency may be attributed to economic reforms, initiated in the late 1980s, that were aimed at improving competition and creating a better business climate for domestic and foreign investors. The market-oriented reforms opened up markets for imports and foreign investment, deregulated markets, and reduced government ownership. The reforms resulted in an increased role of market forces in resource allocation and this in turn helped improve the efficiency of most of the industrial sector.

Nizamettin B & Gokhan D (2008) examined the performance measurement of Turkish and Chinese manufacturing firms. The objective of the study is to compare the relative efficiencies of manufacturing companies of China and Turkey, using weight restricted Data Envelopment Analysis (DEA). Weights of inputs and outputs are estimated by canonical correlation analysis. Mean efficiencies of the firms of the two countries are compared by t-test. the result of the study has shown that China is more efficient in converting the resources to outputs than Turkey, when current ratio, total assets/total debt, inventory turnover, cash flow, receivable turnover, property plant & equipment/total asset, number of employees were used as the resources and net income per employee, net income per share, earnings before interest and taxes margin and growth in sales as outputs for firms.

Suwanee A. and Gavind C Reid (2009) attempted on Technical efficiency of Thai manufacturing sector. The main focus is the relationship between varieties of capital investment and technical efficiency has been examined, based on the Battese and Coelli (1995) model. Estimates were obtained of the output elasticity of capital and the output elasticity of labour. Two explanatory variables, the addition to capital investment in land and the addition to capital investment in machinery and equipment, were found to have significant but different impacts on efficiency. On the one hand, the positive value of the coefficient for additional investment in land suggests that the higher were such investments, the greater were inefficiencies (i.e., the lower were efficiency levels). On the other hand, the negative value of the coefficient of additional investment in machinery and equipment suggests that such investments improve the efficiency of the manufacturers. These results support that the view that post-crisis efficiency improved partly because of the increase in productive capital mobilized by the post crisis financial market restructuring, as well as because of the reduction in domestic interest rates. This

suggests that, pre-crisis, the Thai manufacturing sector had suffered from insufficient productive capital investment, but this condition abated in the aftermath of the crisis, leading to signs of improvements in efficiency in the immediate post-crisis period.

Conclusion

The empirical findings of the performance of Indian manufacturing sector show mixed results. Many studies conclude that there is a decline in the Total Factor Productivity growth and technical efficiency in India during post-reform period. The use of appropriate measurement techniques is very important in understanding the industrial performance, thereby suggesting better policy implications for Indian Manufacturing Sector. Hence in this study is developed to discuss the various available measurement techniques in assessing the total factor productivity growth and technical efficiency.

In Indian context, there are so many studies focused on manufacturing industry, but based on technology classification on Manufacturing Sector there is less attention paid in this field. Because of that, the study carried out on Economic Openness on industrial efficiency (productivity) based on technology classification in transition period with using Data envelopment analysis.

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CHAPTER-III

EVALUATION OF INDIAN INDUSTRIAL POLICIES

CHAPTER - III

Evaluation of Indian Industrial Policies

Introduction

After Independence, the Government of India spelt out its approach to the development of the industrial sector in the Industrial Policy Resolution 1948. This was followed by the Industrial Policy Resolution, 1956. In between, the government introduced the Industries (Development and Regulation) Act, 1951, to regulate and control the development of the private sector. In 1969, MRTP Act (Monopolies and Restrictive Trade Practices Act) was adopted to prevent concentration of economic power and control monopolies. Another legislation that had considerable implication for industrial policy (as far as the participation of foreign companies in industrial sector of India is concerned) was the Foreign Exchange Regulation Act (FERA) adopted in 1973. However, all these measures which guided and determined the State intervention in the field of industrial development failed to achieve the objectives laid down for them. They also created a number of inefficiencies, distortions and rigidities in the system. Therefore, the government started liberalizing the industrial policy in 1970s and 1980s. The most drastic liberalization was carried out in 1991 when a New Industrial Policy (NIP) was announced.

3.1. Situation at time of Introduction of the New Industrial Policy

In the summer of 1991, India found itself in one of its worst balance of payments crisis since 1947. There was a crisis in the making, during the second half of 1980s, had been evident for a long time. The inflow of foreign barrowing had increased at a fast rate during the late 1980s. This was due to the excess of domestic expenditure over income - the fiscal deficit of the Centre and the State rose to 11 per cent in 1991. The political need to undertake large-scale maintenance imports was financed by short-term barrowings. During this period, total public debts as a proportion of GNP doubled and reached up to

60 per cent. The foreign currency reserves were exhausted rapidly. Matters were become worse by an accompanying double-digit inflation in 1990-91.

India's credit rating got reduced for the first time in its history; it was on the edge of defaulting on its international commitments; was denied access to external commercial credit markets. A net outflow of Non Resident Indian (NRI) deposits commenced in October 1990 and continued in 1991 also. The only way left for India was to barrow against the security of its gold reserves transported abroad. But, out of all terrible things, some good emerges and from the Balance of Payments (BOP) crisis of 1991, these emerged long overdue necessitated for the economic reforms (*Economic Openness*). Apart from an immediate programme of macroeconomic stabilization, structural reforms were also introduced in the industrial and trade policy regime with a view to improve growth, efficiency, productivity and international competitiveness of Indian Economy.

3.2. Industrial Policy Regime

The economic reforms were introduced all most all the sectors of Indian economy. In this regard, the major policies framed for the Indian Industrial Sector. The Industrial policy document of 1991 states that "the major objectives of the new industrial policy package will be, to build on the gains already made and correct the distortion or weakness that may have crept in, maintain a sustained growth in productivity and gainful employment to attain international competitiveness. The pursuit of these objectives will be tempered by the need to preserve the environment and ensure the efficient use of available resources. All sector of industry whether small, medium or large, belonging to the public or private or cooperative sector will be encouraged to grow and improve on their past performance. The Government's policy will be continuity with change."[1]

In pursuit of the above objective, the government has decided to take a series of initiatives in respect of the policies in the following areas:

a. Industrial Licensing
b. Foreign Investment
c. Foreign Technology Agreement
d. Public Sector Policy

1. Industrial policy document 1991, Government of India.

e. MRTP Act
f. Industrial Location Policy
g. Abolition of Phased Manufacturing Programme for new projects
h. Removal of Mandatory Convertibility Clause

3.3. Industrial Licensing

Industrial licensing is governed by the industries (Development and Regulation act 1951). The industrial policy revaluation of 1956 identified the following three categories of industries: i) those that would be reserved for development in the public sector, ii) those that would be permitted for development through private enterprise with or without state participation, and iii) those that in which the investment initiatives would ordinarily emanate from private entrepreneurs.

Keeping the above in view, the changing industrial scene in the country and the policy has undergone several modifications. Industrial Licensing Policy and procedures have also been liberalized from time varies.

In order to achieve the objective of the strategy of the Indian industrial sector in 1990's and beyond, it is necessary to make a number of changes in the system of industrial approvals. The major policies initiate to encourage Indian entrepreneurs by assisting them to meet emerging domestic and global challenges. The foundation of any such package of measures must be for the entrepreneurs to make investment decision on the basis of their own commercial judgment. The attainment of technological dynamism and international competitiveness requires that enterprises must be enabled to respond swiftly to the fast changing external conditions that have become characteristic of today's industrial world. The Government policy and procedures must be geared up to assist entrepreneurs in their efforts. This can be done only if the role played by the Government were to be changed from the control to provide help and guidance by essential procedures fully transparent.

Flexibility in the licensing policy calls for bold and imaginative decisions designed to remove restraints on capacity creation, while at the same time, ensuring that national interests over are not jeopardized. The industrial licensing system has been gradually moving away from the concept of capacity licensing. The system of reservation

for public sector undertaking has been evolving towards an ethos of greater flexibility and the private sector enterprise has been gradually allowed to enter into many of these areas on a case-by-case basis.

As a sequel to this, in a major move to liberalize the economy, the new industrial policy abolished all industrial licensing, irrespective of the level of investment, except for certain industries related to security and strategic concerns, social reasons, concerns of safety and overriding environmental issues, manufacture of products of unsafe nature and articles of elitist consumption. However, of these 18 industries, three industries (motor cars, white goods and raw hides and skins and leather) were de-licensed in April 1993; entertainment electronics industry in December 1996; five industries (animal fats and oils, tanned or dressed fur skins, chamois leather, asbestos and asbestos – based products, plywood and other wood and paper and newsprint) in July 1997; four industries (coal and lignite, petroleum products, bulk drugs and sugar) in 1998-99. Thus, at present only 5 items of health strategic and security considerations remain under the purview of industrial licensing. These are alcohol cigarettes, hazardous chemicals, electronics aerospace and defense equipment, and industrial explosives. In respect of de-licensed industry, no approval is required from the government. However, entrepreneurs are required to submit an Industrial Entrepreneur Memorandum (IEM) to the Secretariat for Industrial Approvals (SIA) provided the value of investment on plant and machinery of such unit is above Rs.10 crore.

As a whole, the Indian economy may benefit by becoming more competitive, efficient and modern, it takes a rightful place in the world of industrial progress.

3.4. Foreign Investment

There is a growing interest in the developing economies about the role of foreign direct investment in the process of economic development. In financing India's external needs, Foreign Direct Investment has so far played a minimal role. The current account deficit during 1980s was net largely by external commercial borrowing, external assistance and inflows under non- resident bank deposit. The external assistance, commercial borrowings and non-resident deposits contributed 21.8 per cent 24 per cent and 25.5 per cent respectively of the total financing needs. However, since the initiation

of the adjustment programmer in 1990-01, a much larger role has been envisaged for Foreign Direct Investment (FDI).

Since July 1991, the Government has consistently passed the objective of attracting larger volumes of foreign investment to enhance the resources availability in infrastructure and others critical areas of the economy. "The rules have been considerably eased and the World Bank considers India's present foreign investment regime more liberal than those prevailing in Asian countries (including China, Indonesia, Taiwan and Thailand), which have been successful in attracting foreign investment)"[2].

In the present climate of global integration, the Government has been allowing the multinationals to enter the country not just with their products, but also with direct finance, participation in running the units and with the latest technology. The two considerations that have led the Government to adopt more liberal measures for FDI are:

1. The foreign competition in the domestic market will stimulate local producers to minimize their production cost and after improved products, services and

2. The economy will benefit from the inflow of modern technology accompanying foreign investment.

The new policy encourages foreign investment of two categories.

1. Foreign Direct Investment (FDI), and
2. Foreign Institutional Investment (FII)

3.4.1. Foreign Direct Investment

The policy towards foreign Investment was liberalized in 1991 to permit automatic approval for foreign investment unto 51 per cent of equity in 34 priority sectors, which has new been extended to 48 sectors. The limit us unto 50 per cent, in the mining sectors, and up to 74 per cent in nine specified sectors[3]. The Non-resident Indian (NRIs) and overseas corporate bodies (OCBs) in which NRIs hold at least 60 per cent of the equity can invest up to 100 per cent in there sectors through the automatic route. No approval is required for FDI inflow up to 24 per cent of the equity in any Indian firm and up to 20 per cent in any new private bank (40 per cent for NRIs).

2. *"India: Recent Economic Developments and Prospects"*, A World Bank country study, Washington DC 1995, p.43.

The investment limit for telecommunications services (basic, cellular and paying) is 49 per cent; domestic air taxi operations or airlines is 40 per cent (100 per cent for NRIs) and the bulk drugs producing pharmaceutical sector is 51 per cent Items for which approach for foreign direct investment is not covered by automatic route include: items reserved for the small scale sector; items which require industrial licensee under the existing policy; all items for aerospace and defense equipment whether specifically mentioned or not; and all items relating to production and use of atomic energy. The limit was subsequently raise from 51 per cent to 74 per cent and then to 100 per cent for many industries. Presently, FDI is permitted up to 100 per cent on the automatic route in most of the sectors subject to sectoral rules or regulations applicable. FDI is prohibited only in the following sectors: retail trading (except single brand product retailing), atomic energy, lottery business and gambling and betting.

3.4.2. Foreign Institutional Investment

Policies relating to inflow of investment by Foreign Institutional Investors (FIIs) and through Global Depository Receipts (GDRs) have undergone various changes since 1991. Indian companies were permitted to raise capital through Euro-Market issues of Global Depository Receipts (GDRs) and Foreign Currency Convertible Bonds (FCCBs). Indian companies have been allowed to access international capital markets since February 1992. Reputed FIIs including pension funds, mutual funds, asset management companies, investment trusts, nominee companies and incorporated or institutional portfolio managers have been allowed to invest in the Indian capital market since September 1992. The investing FIIs need to be registered institution within their respective home countries or countries of origin and also revised with Securities and Exchange Board of India (SEBI). A single FIIs can invest up to 10 per cent while a group of FIIs can invest up to 30 per cent of share capital of listed companied. Investment by FIIs can also be put in non-listed companies. However, this is subject to the approval of limit by the Board of Directors and a special resolution passed by the general body. FIIs can hold up to 100 per cent of the equity in debt-funds, as well as in government securities. The profits from portfolio investment can be repatriated freely subject to Indian foreign exchange regulations.

3.5. Foreign Technology

There is a great need for promoting an industrial environment where the acquisition of technological capability receives priority. In the fast changing world of technology, the relationship between the supplies are users of technology must be a continues one; such a relationship became difficult to achieve when the approval process includes unnecessary governmental interference on a care to care basis involving endemic delays and fostering uncertainty. With a view to injecting, the desired level of technological dynamism in Indian industry, government will provide automatic approval for technology agreements related to high priorities within specified parameters.

Similar facilities will be available for three industries as well of such agreements do not require the expenditure of free foreign exchange. Indian companies will be free to negotiate the in terms of technology transfer with their foreign counterparts according to their own commercial judgment.

3.6. Public Sector Role

The new economic policy recognized the weaknesses and shortcomings of the public sector and its working and suggested a re-look at the same. Action was planned in five important aspects of public sector. The main ideas were to with draw as much from the public sector as possible and leave a larger field open for private sector. Accordingly, the areas reserved for public sector were to be reduced and no new public sector enterprises were to be taken up.

The new policy recognized the heavy financial burden cast by the public sector on the exchequer. Also, since the public sector had involved itself in areas not intended for it in the beginning, a new approach was suggested which proposed that a realistic review be taken of the public sector. In the words of the Finance Minister, it is in national interest that public sector enterprises become more efficient, more productive and more profit oriented.

The Government promised that it will ensure that the public sector plays its rightful role in the evolving socio-economic scenario of the country, and it runs on business line as envisaged in the Industrial Policy Resolution of 1956, and would continue to innovate and lead in strategic areas of national importance.

The public enterprise sector has not generated internal surplus on a large enough scale and, because of its inadequate exposure to competition; has contributed to a high – cost structure. To address these problems, the Government has decided to adopt a new approach, key element of which will be:

- The existing portfolio of public investments will be reviewed with a greater sense of realism to avoid areas where social considerations as not paramount or where the private sector would be more efficient;
- Enterprises in areas where continued public sector involvement is judged appropriate will be provided a much greater degree of managerial autonomy.
- Budgetary transfers to public enterprises will be progressively reduced.
- To provide further market discipline for public enterprises, competition from the private sector will be encouraged and part of the equity in elected enterprises will be disinvested and
- Chronically sick public enterprises will not be allowed to continue incusing heavy losses.[3]

There points were re-emphasized in the Governments subsequent memorandum to the IMF. "The key elements of the Governments strategy for public enterprise reform are strengthening managerial autonomy; the promotion of increased private sector competition in areas where social considerations are not paramount; reducing budgetary constraints and increasing dividend payments to ensure are adequate return on the Government equality; partial divestment of equality in selected enterprises to mobilize non-inflationary resources and to widen public participation in the public sector, in order to introduce a greater sense of accountability; and restricting or closure of patently unviable enterprises."[4]

There will be a review of the existing portfolio of public investments in respect of industries based on low technology. The small-scale and non-strategic areas, inefficient and un-productive areas, areas with low or nil social consideration or public purpose, and areas where the private sector has developed sufficient expertise and resources. The focus in the public sector will be on strategic, hi-technology and essential infrastructure

3. *"Memorandum to IMF"*, December 1991, p.13

4. *"Memorandum to IMF"*, July 1992, pp.5-6

areas. According the priority areas for growth of public enterprises in the future will the following:

- Essential infrastructure goods and services.
- Exploration and exploration of oil and mineral resources.
- Technology development and building of manufacturing capabilities in areas, which are crucial in the long-term development of the economy and whether private sector investment is inadequate.
- Manufacturing of products where strategic considerations predominate such as defense equipment.

As promised in the policy statement, the areas reserved for public sector were reduced to only six, where security and strategic concerned predominated. On May 9, 2001, the government opens duo arms and ammunition sector also to the private sector. This is now leaves only 3 industries reserved exclusively for the public sector those are atomic energy, minerals specified in the schedule to the atomic energy and rail transport.

The policy talks of more operational freedom to managements through MOUs (Memorandum of Understanding). MoUs were being signed even in the past and no new measures were required, except to speed up the process. Accordingly, the number of public sector units (PSUs), which signed MoUs, went up to 110 in 1996-97 as compared to 104 in 1995-96. No noticeable charge in either the relations between the PSUs and the Administration Ministries or in the performance of PSUs was experienced as a result of this system.

The government proposed to devote special attention to those undertakings, which were sick and decided to refer them to the Board for Industrial and Financial reconstruction (BIFR). If we obverse the Economic survey:

“Recording that sickness is a serious problem in many public sector units; this Government amended the Sick Industrial Companies Act to bring public sector undertakings also within its purview. This makes sick public sector units subject to the same discipline as private sector units including reference top the Board for Industrial and

Financial Reconstruction (BIFR) for identification of a viable restructuring package or closure as the case may be"[5].

Chronically sick units, which are unlikely to be turned around, will, for the formulation of revival/ rehabilitation schemes, be referred to the BIFR, or other similar high-level institutions created for the purpose. A social security mechanism will be created to protect the interests of workers likely to be affected by such rehabilitation packages.

To ally the feels on this count, the Finance Minister clarified that:

"This does not mean that all sick units will be closed down. All units, which are potentially viable units, will be provided opportunities and resources for restructuring. Only patently unenviable units will need to be closed down and that too after formulation of credible social safety nets to protect the interest of workers in the affected enterprises. It will be our efforts to provide opportunities for gainful employment for all those able and willing to work"[6].

Out of 246 PUSs, ninety eight were reported to be incusing losses (accumulated losses being opportunity Rs.10, 000 crore) and fifty eight were considered beyond redemption. Their total employment was of the order of 4.17 lakh workers. And their total accumulated losses were as high as Rs.25, 000 crore. The Government promised that the budgetary supports to loss making Public Sector Enterprises (PSEs) in the form of 'non-plan' loans from the Government is going to the phased out by 1994-95. This public enterprises survey (1996) mentions that the following non-plan loans were provided in the budgets 1993-94 Rs.779.33 core; 1994-95: Rs.901.47 crore; 1995-96: Rs.1, 133.70 crore. Thus, after having made the initial decision to reduce the same, the figure has actually been going up.

The public sector equality was proposed to be disinvested up to 49 per cent in a select of profit-making enterprises, not only to mobilize non-inflationary resources for the budget but also to broad-based the ownership by encouraging wider public participation.

5. *"Economic survey"*, 1991-92, part 1, government of India

6. Dr.Manmohan Singh, Finance Minister, Government of India, Recent Developments in India Economy, Part I edited by Uma Kapila, Academic, Foundation, 1992.

A part was to be offered to mutual funds, financial institutions, general public and workers. It was expected that this would also make the managements of the PSE's more commercially oriented, and induce them to fall in line with the market discipline.

The PSEs are being allowed not only to form joint ventures, but also to raise fresh equality from the market to finance their expansion plans. In this way, the performance of an enterprise measured terms of financial profitability will be one of the main factors that determines its ability to expand and to raise resources from the capital market. Boards of public sector companies would be made more professional and given greater powers, more flexibility has been granted to PSEs with respect to their pricing decision. Among all of these programmes, one that has been in operation a liaised with some seriousness in the policy with respect to disinvestment. This was suggested first by V.Krishnamurthy committee and Dinu--Khatkhate committee in 1992 and C. Rangarajan committee in 1993. However, the Government did not take their recommendations very seriously.

Most of the countries, where public sector reform has been attempted, have created special high-level bodies to deal with the problems associated with disinvestment more effectively. Perhaps in response to the recommendation in *The India Infrastructure Report* (Rakesh Mohan Committee, 1990) that a new 'High-powered and expert institution for public sector restructuring' should be set up, the G.V. Rama Krishna committee on disinvestment came to be established in August 1996.

The commission was advice the Government on the methodology, time, size and price of disinvestment of the public sector shades and was also to draw a long-term programme in this regard. The intention is to make to disinvestment exercise more transparent and responsive. The commission will progressive the PSUs referred to it by the Government in terms of the overall disinvestment programme. It will recommend the preferred mode of disinvestment domestic capital markets/ international capital markets/auction/private sale to identified investors/any other) in each of the identified PSUs.

The government has also announced its intension to offer a part of government shareholding in the public sector enterprises to mutual funds, financial institution, the general public and the workers. A beginning in this direction was made in 1991-92

themselves by disinvesting part of the equalities of selected public sector enterprises over the period 1991-92 to2005-06; the government has raised nearly Rs. 49,214 crore through this means the new industrial policy indicates the government's intention to invite a greater degree of participation by the private sector in important areas of the economy.

3.7. Monopolies and Restrictive Trade Practices Act (MRTP)

The MRTP Act was amended in 1991 and the so-called MRPT companies in on longer required did the threshold limit of assets in respect of MRPT and dominant undertaking away with the pre-entry scrutiny of investment decision in the de-licensed industries. The amended Act places more emphasis on the prevention and control of monopolistic, restrictive and unfair trade practices so that consumers are adequately protected.

There was a promise that the provisions regarding restrictions on acquisition of and transfer of shares will be appropriately incorporated in the companies Act. It was made clear that the government will endeavor to abolish the monopoly and sector or any individual enterprise in any field of manufacture except on strategic or military considerations and open all manufacturing activity to competition this was expected to enable Indian firms to become large enough to compete effectively in global markets.

3.8. Industrial location policy liberalized

An important item of the policy related to location of industrial. The policy was made much more flexible and it was provided as follows:

"In location other than cities of more than 1 million populations, there will be no requirement of obtaining industrial approvals from the central government except for industries subject to compulsory licensing. In respect of cites with population greater than 1 million, industries other than those of a non-polluting nature such as electronic, computer software and printing will be located outside 25km of the periphery, except in prior designated industrial areas. A flexible location policy would be adopted in respect of require industrial regenerations. However, zoning and land use regulation and

environmental legislation under the jurisdiction of local authorities will continue to regulate industrial location"[7].

3.9. Abolition of Phased Manufacturing Programmers for new projects

To force the pace of indigenization in manufacturing, phased manufacturing programmers have been in force in a number of engineering and electronic industries. The new industrial policy has abolished such programmers in facture as the government feels that due to substantial reforms made in the trade policy and the devaluation of the rupee, these are no longer any need for enforcing the local content requirement on a case-by case, phased manufacturing programmers will continue.

3.10. Removal of mandatory convertibility clause

A large part of industrial investment in India is financed by loans from banks and financial institution. These institutions have followed a mandatory practice of including a convertibility clause in their lending operations for new project. This has provided them an option of converting part of their loans into equity if felt necessary by their management. Although, this option has not generally been exercised, it has often been interpreted as an unwarranted threat to private firms of takeover by financial institutions. The new industrial policy has provided that henceforth financial institutions will not impose this mandatory convertibility clause.

3.11. Appraisal of New Industrial Policy

According to J.C. Sandesara "the new industrial policy seeks to raise efficiency and accelerate industrial production in five different ways"[8].

They are as follows:

1. A number of changes in industrial licensing policy, foreign investment, foreign technology agreement and MRTP Act are such as to do away with the prior clearance of the government. In such cases, the project time and project cost will be reduced. Material and human resources engaged in cultivating contacts and

[7] . Reserve Bank of India, *Report on currency and finance*1998-99, p-8

[8] . J.C Sandesara, "New Industrial Policy: Questions of Efficient Growth and Social objectives," Economic and Political Weekly. August 3-10, 1991, page no.1870

'getting things done' will be released for more productive uses. Thus efficiency will be improved.

2. The changes in respect of foreign investment and foreign technology agreement are also designed to attract capital, technology and managerial expertise from abroad. This will raise the availability of such scarce resources in the country on the one hand, and will improve the level of efficiency of production on the other hand.

3. Some changes as regards public sector may enhance the 'allocative efficiency'. Opening up of eleven areas (so far reserved for the public sector) to the private sector implies an opening for the sector which has, by and large, given a better account of itself.

4. Other measures in this area such as purposeful formulation and implementation of Memorandum of Understanding and its monitoring, professionalization, greater autonomy may be expected to improve the performance of the enterprises that will remain the public sector.

5. Greater emphasis in controlling and regulating monopolistic, restrictive and unfair trade practices and the strengthening of the powers of the MRTP commission will curd anti-competitive behavior of firms in the monopolistic, oligopolistic and ineffectively competitive markets and thus promote competition and efficiency.

3.12. Other Major Policies to Boost Manufacturing Sector

3.12.1. National Manufacturing Policy (NMP)

. Government has taken a number of initiatives to improve the industrial climate and boosting manufacturing sector in the country. "The Government of India notified the National Manufacturing Policy on 4th November, 2011 with the objective of enhancing the share of manufacturing in GDP to 25 per cent within a decade and creating 100 million jobs. It also seeks to empower rural youth by imparting necessary skill sets to make them employable. Sustainable development is integral to the policy and technological value addition in manufacturing has received special focus. The policy is based on the principle of industrial growth in partnership with States. The Central

Government will create the enabling policy frame work, provide incentives for infrastructure development on a Public Private Partnership (PPP) basis through appropriate financing instruments, and State Governments will be encouraged to adopt the instrumentalities provided in the policy. One of the instruments in the NMP is the creation of National Investment and Manufacturing Zones (NIMZ) as planned Integrated Industrial Townships. Nine NIMZs have been announced, eight of which are along the Delhi Mumbai Industrial Corridor (DMIC)"[9].

"Major feature of NMP is the rationalization and simplification of regulations based on the basic principle of self regulation of industry to the extent possible. The Central/State Governments will suspend operation of particular provisions wherever such powers exist subject to an alternative mechanism, annual audits by concerned departments and third party certification. For the effective implementation of the NMP, a number of institutional structures have been constituted. These include Manufacturing Industry Promotion Board (MIPB), under the Chairmanship of Commerce & Industry Minister; High Level Committee (HLC) under the Chairmanship of Secretary, DIPP; Board of Approval (BOA) under the concerned Joint Secretary. In addition Green Manufacturing Committee (GMC) has also been set up to promote green technology for manufacturing under NIMZ"[10].

3.12.2. Other Ministries engaged in manufacturing to implement various policies, programme, and Schemes

There are number of Ministries/ Departments which implement various policies, programme, schemes that contribute to growth of manufacturing. These include Ministry/ Departments of Micro Small & Medium Enterprises, Heavy Industries, Steel, Textiles, Food Processing Industries, Chemical & Petro Chemicals, Fertilizers, Pharmaceuticals, Petroleum & Natural Gas, Defence Production, Electronic & IT, Shipping etc. On an estimate about 30 schemes relating to manufacturing are being implemented by these Ministries/ Depts. Efforts are on to discuss with these Ministries/ Departments, feasible measures to reverse the current slow down on manufacturing and achieve the goals of the

[9] Jitender Singh, (2013), *"Analysis of Trends in the Manufacturing Growth in Last Five years", Research Studies* ,Office of the Economic Adviser, Department of Industrial Policy &Promotion, Ministry of Commerce & Industry, Government of India.

[10] Ibid.

NMP. Efforts are also on to build databanks of schemes/ programmes, training institutes / agencies, R&D and centers of excellence to provide a common knowledge platform and enable sharing of common facilities/ resources/ inputs. MSMEs play a crucial role in driving growth of manufacturing, export and creating employment. The Traditional labor intensive sectors like textiles, leather, manufactures, handicrafts and carpets have huge potential in this regard. Manufacturing sector needs a boost with special emphasis given to MSMEs. Besides NIMZ, SEZs are key tools for facilitating the growth in the Manufacturing Sector.

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CHAPTER-IV

GROWTH PERFORMANCE ANALYSIS OF INDIAN INDUSTRIES - BASED ON TECHNOLOGICAL CLASSIFICATION

CHAPTER - IV

Growth Performance Analysis of Indian Industries Based on Technological Classification

Introduction

Developing countries have been progressively adopting market friendly reforms during the 1980s and 1990s. Indian economy has also undergone similar reforms since the mid-1980s and especially during the 1990s. Due to reforms (*Economic Openness*), changes have been taken place in the almost all the important sectors of Indian economy. The performance of the Indian Industrial sector has undergone noticeable changes since Independence till date. There has been diversification of the industrial structure along with variation in growth during this period. With reference to growth in Industry, early 1950s to mid-1960s witnessed substantial growth, while there was deceleration during mid-1960s to late 1970s. Again, there was revival in 1970s followed by massive growth in the 1980s. During the early 1990s, to revitalize the Indian economy performance of the macroeconomic indicators and to sustain higher growth in the long run, a series of economic reforms were introduced in the Indian economy during the 1990s. As part of the economic reforms, certain industrial and trade policy reforms were introduced.

The main objective of reforming the industrial sector was to enhance its efficiency and growth. In this background, the impact of reforms on growth of the Industrial sector needs to be examined. The debate has revolved around the performance of Indian Manufacturing Sector in recent times, particularly in the post 1991 reform period has been controversial and has attracted the attention of the several researchers. And the question is that whether the shift in policy regime made any significant changes in its growth performance of Indian Manufacturing Sector of the post reform period (1991). Hence, the present study starts with an examination of the Indian Manufacturing Sector growth performance in the context of the shift in the policy regime.

In this chapter, an attempt is made to examine the growth performance of the industrial manufacturing sector based on technology classification those are as follows: High Technology, Medium High Technology, Low Technology and Medium Low Technology Industrial Sectors. The analysis carried out for the entire study period is from

1981-82 to 2011-12. To analyse impact of the Economic Openness on Indian Industries and the entire study period broadly divided into two pre transition period (1981-1991) and post transition period (1991-2012). To study the growth performance of these industries, variables are used in the analysis are the Gross Value Added (GVA), Fixed Capital (FC) and Labour (LA).In order to observe the performance of industries growth rates were computed according to the following formula:

$$P_{t} = P_{o}(1+r)^{n}$$

$$P_{t} / P_{o} = (1+r)^{n}$$

$$1+r = (P_{t} / P_{o})^{1/n}$$

$$r = (P_{t} / P_{o})^{1/n} - 1$$

Where P_t = current year value

P_o = initial year value

r = compound annual growth rate

n =number of years

In this connection the study divides into two sections. Section I deals with macro level growth performance analysis of Indian Manufacturing Sector. Section II provides an analysis of impact of Economic Openness on industrial growth with reference to a particular group of industries based on technology.

4.1. Growth Performance Analysis of Indian Manufacturing Sector at Macro level

4.1.1. Growth Performance of Indian Manufacturing Sector in pre Transition Era

Three important phases of the industrial growth can be identified in the pre 90s era. - The *first phase* is from 1950-51 to 1964-65, *second phase* is from 1965-66 to 1970s and *third phase* is from 1979-80 to 1989-90. The first phase of industrial growth is tagged as phase of rapid industrial growth i.e. from 1950-51 to 1964-65. The Manufacturing Sector grew at an average rate of 5.8 per cent in first half of fifties and 6.5 per cent in the second half of the decade. The growth was mainly due to the second five year plan of building a strong capital base through investment in public sector especially as the private sector was in the emerging stage. The Second phase is tagged as deceleration phase of industrial growth. The late sixties and seventies witnessed in manufacturing was due to

emergence of macro political-economic uncertainties such as wars with Pakistan and China, rising prices, oil prices shocks, licensing requirements for investment, reservation of industries in public sector. The Third phase observed a revival of industrial growth with the gradual withdraw of constraints and controls through sequential policy reforms. The table 4.1 below shows that growth rates in manufacturing between 1950-51 to1989-90. There was an improvement in manufacturing growth during 1980s.

Table 4.1: Indian Manufacturing Sector's Growth in Pre Transition Period

Sectors	1950-51 to 1955-56	1956-57 to 1965-66	1966-67 to 1979-80	1981-82 to 1989-90
Manufacturing	5.8	6.5	4.3	5.8
Registered	6.2	8.2	4.5	7.6
Unregistered	5.6	4.5	4.1	3.4
GDP	3.6	3.6	3.4	5.6

Source: Central Statistical Organization

4.1.2. Paradigm Shift of Industrial Policy and Manufacturing Sector in Post Transition Era

Industrial Policy since 1991 has been more for facilitating industrial development. Industrial licensing was abolished for most of the industries and there are only 5 industries related to security, strategic and environmental concerns where an industrial license is currently required. Along with the removal of the industrial licensing, reforms were initiated in areas of reservation of products for exclusive production in the small scale sector. The Government has also enacted the Micro, Small and Medium Enterprises Development (MSMED) Act, 2006 stepping up the investment limit to Rs.5 core for small enterprises and Rs. 10 core for medium enterprises. The table 4.2 below indicates manufacturing growth at an average rate of 7 per cent during 1992-2001 and it is increased to 7.4 per cent in 2001-12.

Table 4.2: Indian Manufacturing Growth in Post Transition Period

Sectors	**1992-93 to 2000-01**	**2001-02 to 2011-12**
Manufacturing	7	7.4
Registered	7.4	9.1
Unregistered	6.4	5.7
GDP	6.2	7.5

Source: Central Statistical Organization

4.1.3. Trends in Indian Manufacturing Sector of Employment and GDP

The Table 4.3 shows that the sectoral share of employment as compiled from various NSSO rounds from1987-88 onwards to 2009-10. During the past two decades there has been about 13 percentage point reduction in the employment share in agriculture despite no increase in manufacturing share in employment. In fact, there has been a decrease in the share of employment in manufacturing between 2004-05 and 2009-10. As seen from the Table 4.4, the decline of number of persons employed in manufacturing from 56 million in 2004-05 to 52 million in 2009-10 and it resulted that about 4 million workers have withdrawn from the manufacturing sector. The reasons for decline in the manufacturing employment may be the sluggish global demand for major export items like textiles, handicrafts, leather which are labour intensive.

Table 4.3: Sectors Share in Employment

NSSO Rounds	**Reference Years**	**Agriculture**	**Manufacturing**	**Industry**	**Services**
66th	(2009-10)	51.8	11.4	21.9	26.3
61st	(2004-05)	56.5	12.2	18.7	24.8
55th	(1999-00)	60.1	11	16.3	23.6
50th	(1993-94)	64.3	10.5	14.8	20.9
43rd	(1987-88)	64.5	11.2	16.1	19.4

Source: Computed from various rounds of NSSO

Table 4.4: Manufacturing Sector -Number of Persons Employed in Millions

NSSO Rounds	Reference Years	Rural	Urban	Total
66th	(2009-10)	24.12	28.23	52.35
61st	(2004-05)	27.76	28.3	56.06
55th	(1999-00)	22.99	21.99	44.98
50th	(1993-94)	19.55	17.9	37.45
43rd	(1987-88)	19.73	19.16	38.88
38th	1983	15.84	14.65	30.49

Source: Computed from various rounds of NSSO

4.1.4. International level comparison of Indian Manufacturing Sector's in GDP and Employment

Table 4.5 gives a clear picture about the share of Indian Manufacturing sector value added in GDP and share of industrial employment in total employment across a few countries. The Manufacturing value added of GDP is 14 per cent in India compared to 13 per cent in United States and 31 per cent in China. The share of employment in industry is total of 22 per cent in India as compared to 27 per cent in China. The Table as follows:

Table 4.5: Share of Indian Manufacturing Sector in GDP and Employment in Industry

Countries	Manufacturing Value Added (% of GDP)	Employment in Industry (%) of total employment)
Thailand	36	20
China	31	27
Korea	31	17
Malaysia	26	27
Japan	19	25
Sri Lanka	17	25
Brazil	15	22
Pakistan	15	20
India	14	22
US	13	17
Indonesia	11	19
Bangladesh	10	15

Source: World Bank Note: Figures are ranging from 2009-2011

4.1.5. Trends in Export of Indian Manufacturing Sector

Manufacturing production and exports have been driving the rapid growth of many dynamic emerging economics. Table 4.6 and figure 2.1 gives a clear picture about the trends in exports of Indian Manufacturing sector from 1981-82 to 2012-2013. There has been a sharp acceleration in India manufacturing exports performance from mid 1990s (post transition period) when compare to 1980s (pre transition period). During the last decade of reforms, India's exports have performed well. Positive policy measures combined with robust growth of world trade have led to this improved performance. Compared to pre-liberalization period, India's export to GDP ratio has increased. And also The Table 4.7 and (figures from 2.2 to 2.10) shows that the Sector wise Exports of Indian Manufactured products performance. Almost all sectors (Textile and Textile Products, Manufacture of Leather, Chemicals and Related Products, Manufacture of Metals, Machinery and Instruments, Pharmaceuticals & others, Transport Equipment, Electronic Goods and Petroleum Products) steady rise from 1990s.

Figure 4.1

Table 4.6: Exports of Manufactured Goods in India

Year	Manufactured Goods
1987-88	106.26
1988-89	146.41
1989-90	199.32
1990-91	233.19
1991-92	324.13
1992-93	406.6
1993-94	522.45
1994-95	640.67
1995-96	794.33
1996-97	873.77
1997-98	986.6
1998-99	1085.06
1999-00	1287.61
2000-01	1568.58
2001-02	1591.46
2002-03	1947.65
2003-04	2228.29
2004-05	2728.72
2005-06	3212.61
2006-07	3842.61
2007-08	4145.99
2008-09	5664.02
2009-10	5464.56
2010-11	7198.63
2011-12	8885.99
2012-13	9996.12

Source: Directorate General of Commercial Intelligence and Statistics

Table 4.7: Sector wise Exports of Manufactured Products (Rupees in Billion)

Year/ Products	Textile and Textile Products	Manufacture of Leather	Chemicals and Related Products	Manufacture of Metals	Machinery and Instruments	Pharmaceuticals & others	Transport Equipment	Electronic Goods	Petroleum Products	Other Manufactured Goods
1987-88	39.08	12.51	10.26	2.88	5.15	6.86	2.53	2.00	6.49	1.08
1988-89	43.99	15.22	15.79	4.42	7.38	11.20	3.63	2.90	5.05	1.32
1989-90	62.38	19.50	25.87	7.42	10.05	18.79	5.26	5.04	6.97	1.64
1990-91	77.92	26.00	31.01	8.19	12.49	22.16	7.19	4.17	9.38	1.40
1991-92	115.69	31.28	46.07	11.94	14.33	34.53	12.24	6.54	10.22	2.09
1992-93	145.03	37.00	51.73	16.22	15.69	33.25	15.46	6.15	13.79	4.04
1993-94	171.64	40.76	74.56	20.80	20.04	43.07	18.57	9.52	12.48	4.87
1994-95	223.49	50.57	96.30	22.17	22.82	55.35	24.22	12.94	13.09	6.74
1995-96	268.65	58.61	120.32	27.64	27.76	72.56	30.94	22.42	15.18	8.91
1996-97	306.57	57.01	138.90	32.43	37.53	88.66	34.39	27.82	17.10	9.51
1997-98	336.36	61.57	163.39	38.03	44.44	104.87	34.53	28.23	13.11	8.76
1998-99	373.01	69.87	168.67	43.75	48.59	111.68	32.05	21.15	3.76	9.63
1999-00	425.62	68.91	203.95	53.11	51.27	133.82	35.11	29.51	1.69	11.82
2000-01	515.55	88.83	268.89	72.08	72.19	167.39	45.31	48.04	85.42	16.26
2001-02	486.77	91.10	288.62	76.50	82.70	176.32	48.69	55.86	101.07	18.52
2002-03	562.21	89.45	360.80	89.42	97.20	225.45	64.55	60.63	124.69	23.02
2003-04	587.79	99.39	434.06	111.50	127.58	268.62	89.88	79.42	163.97	28.18
2004-05	609.06	108.81	559.11	152.83	167.12	320.77	127.14	82.31	314.04	36.96
2005-06	726.18	119.44	653.90	187.42	224.80	404.09	191.39	96.21	515.33	43.55
2006-07	786.13	136.50	784.42	229.92	304.20	495.88	223.98	129.14	845.20	54.89
2007-08	782.09	141.01	853.28	283.89	367.50	561.73	282.82	135.32	1141.92	52.52
2008-09	920.62	163.55	1044.42	347.17	503.42	718.80	512.98	313.01	1233.98	61.02
2009-10	941.89	159.46	1086.87	262.03	452.56	748.06	466.10	258.95	1328.99	74.27
2010-11	1103.75	178.18	1315.44	385.28	539.42	879.59	731.21	373.78	1887.79	96.45
2011-12	1343.12	229.72	1778.16	459.19	685.82	1175.48	1013.11	424.19	2679.15	122.07
2012-13	1487.73	264.99	2172.57	545.97	827.88	1471.43	1001.65	438.83	3276.79	143.08

Source: Directorate General of Commercial Intelligence and Statistics,

Note: Due to change in commodity classification by DGCI&S, data on' from 1970-71 to 1975-1976 and 1976-77 to 1986-8 may not comparable.

Figure 4.2

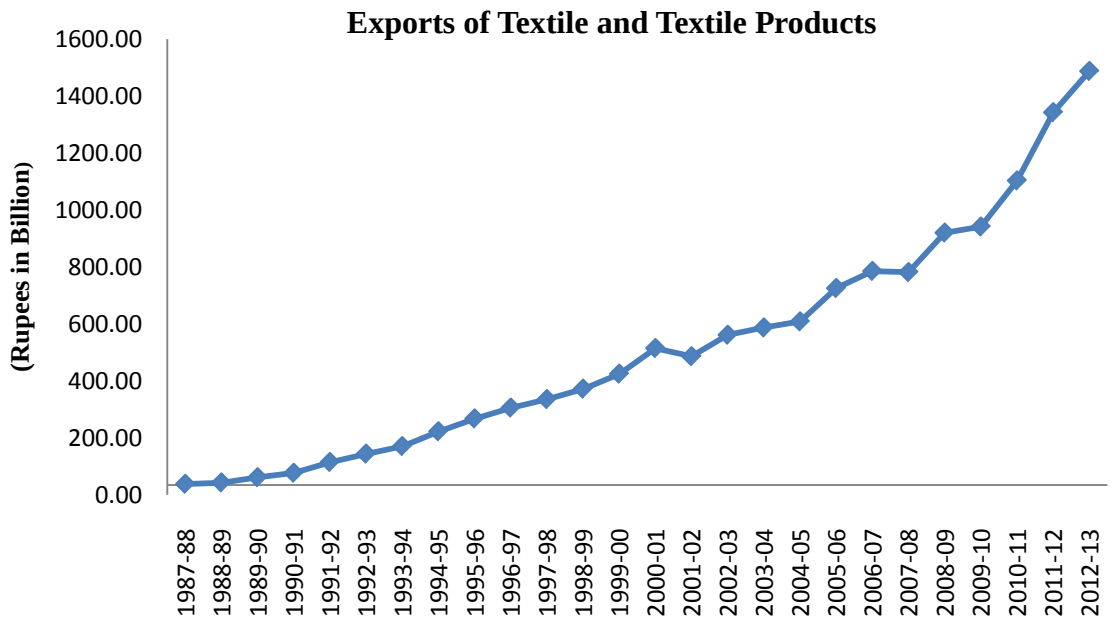


Figure 4.3

Figure 4.4

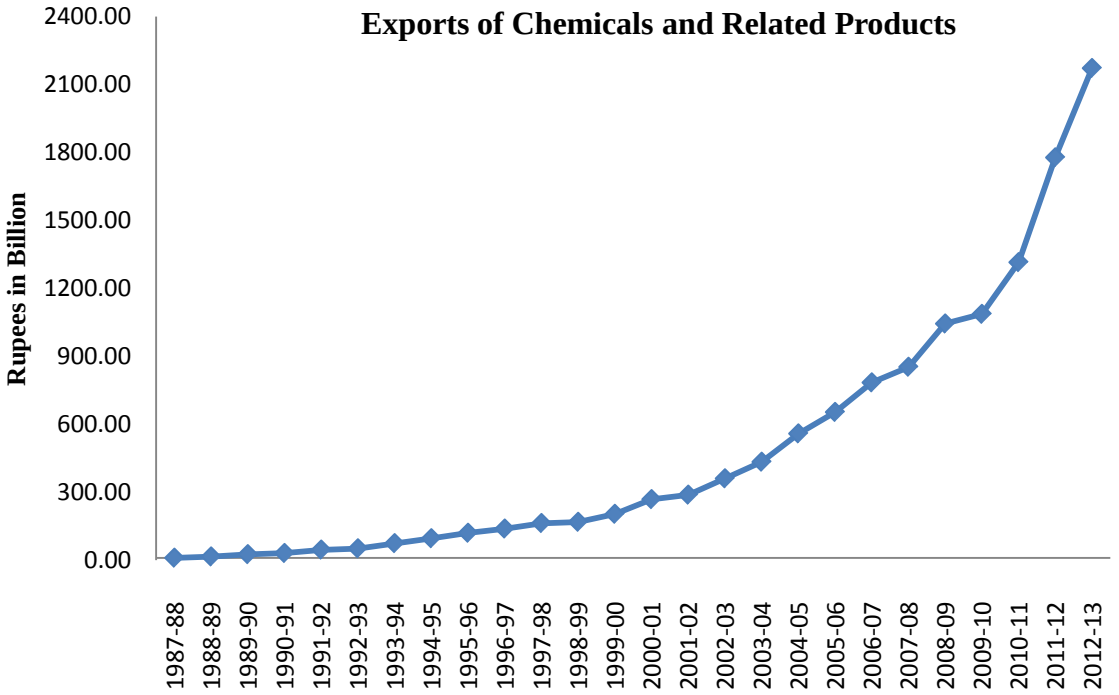


Figure 4.5

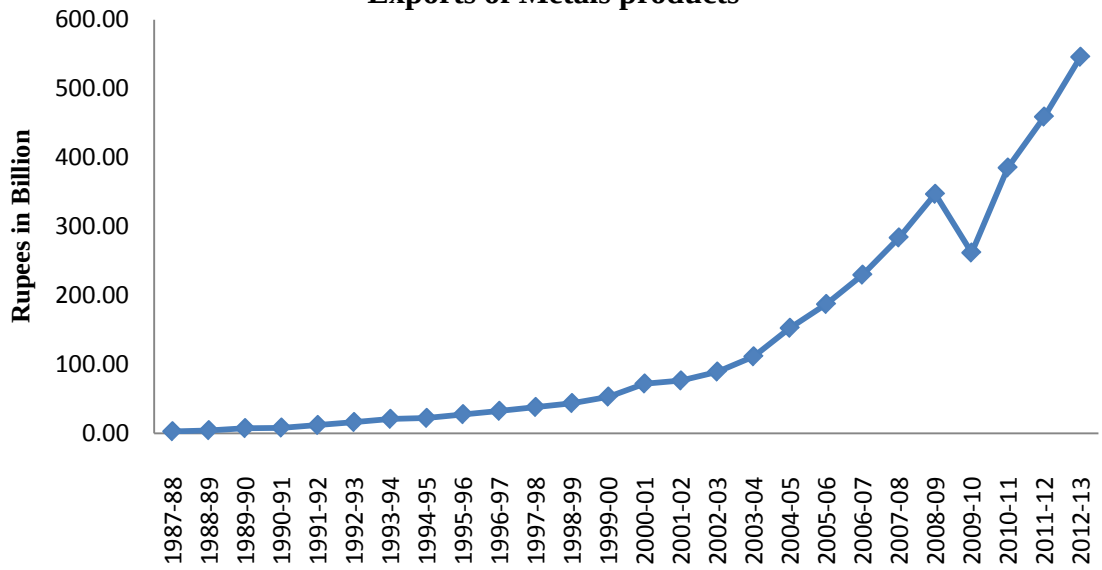


Figure 4.6

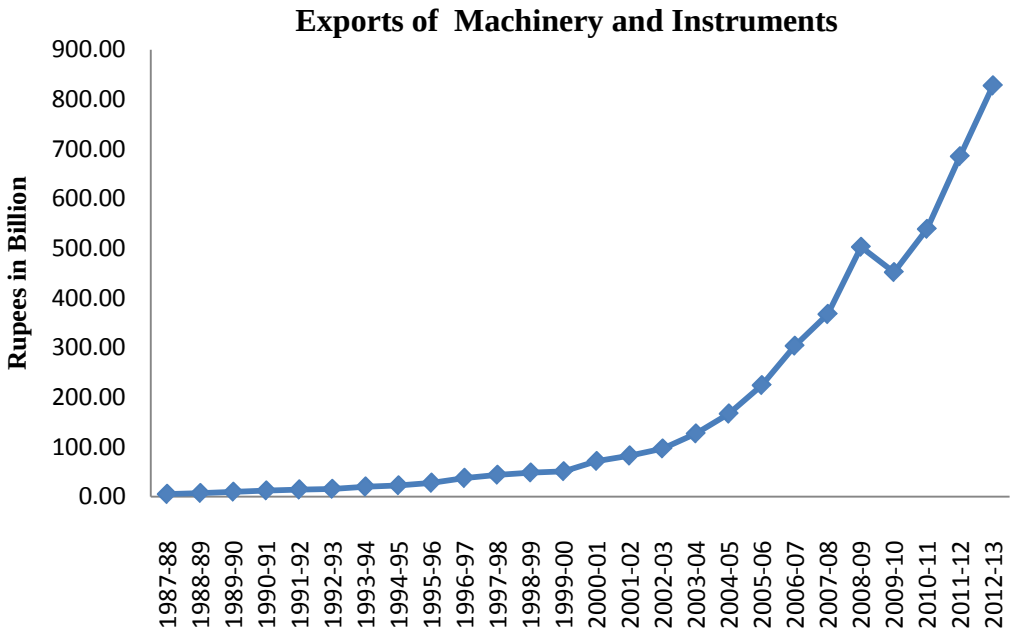


Figure 4.7

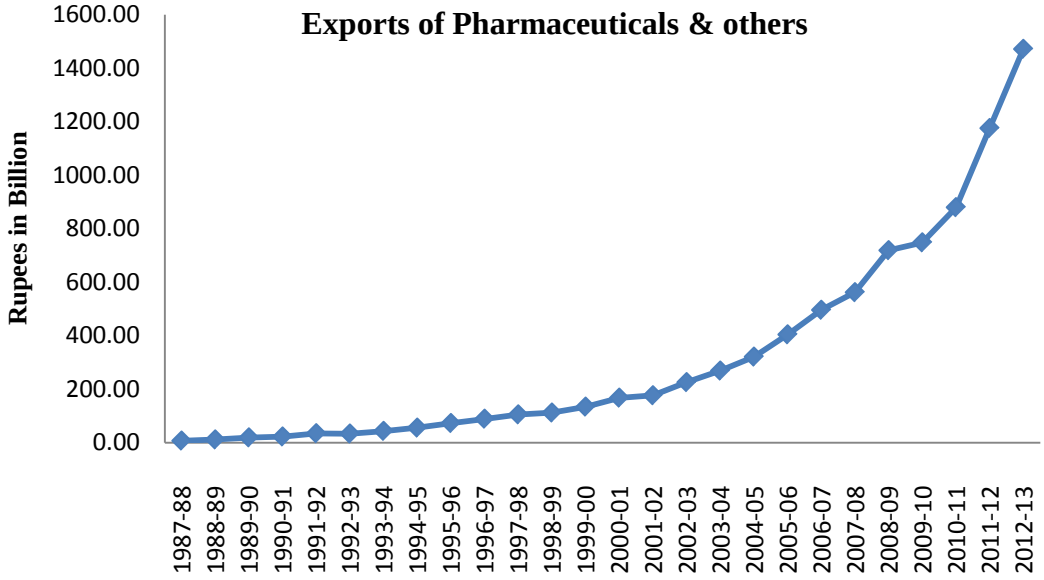


Figure 4.8

Exports of Transport Equipnment

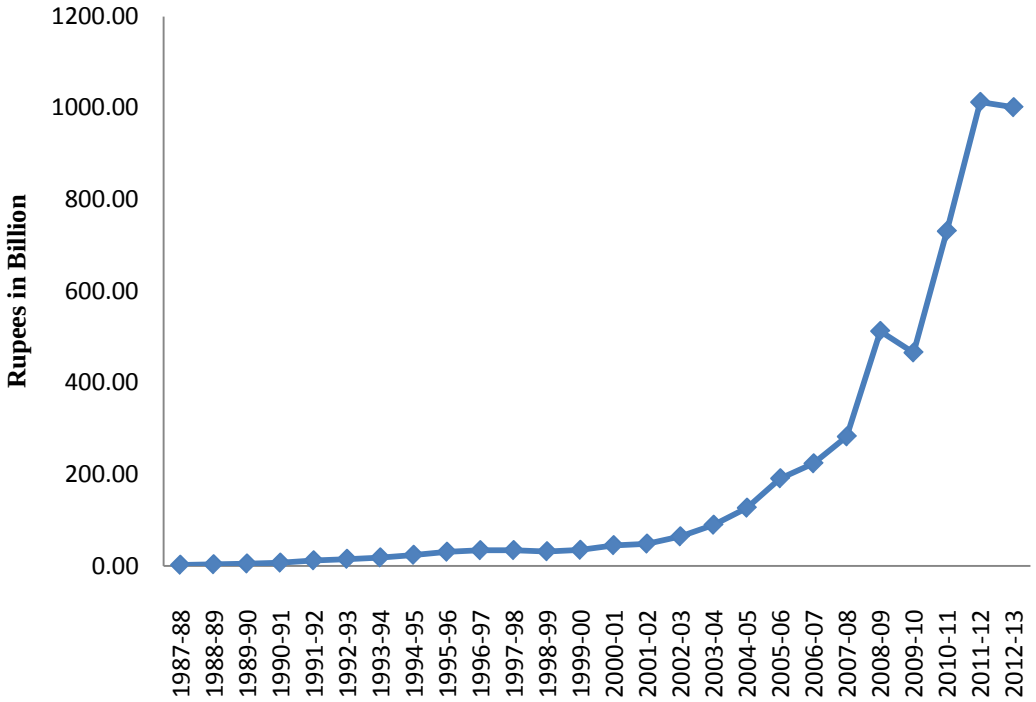
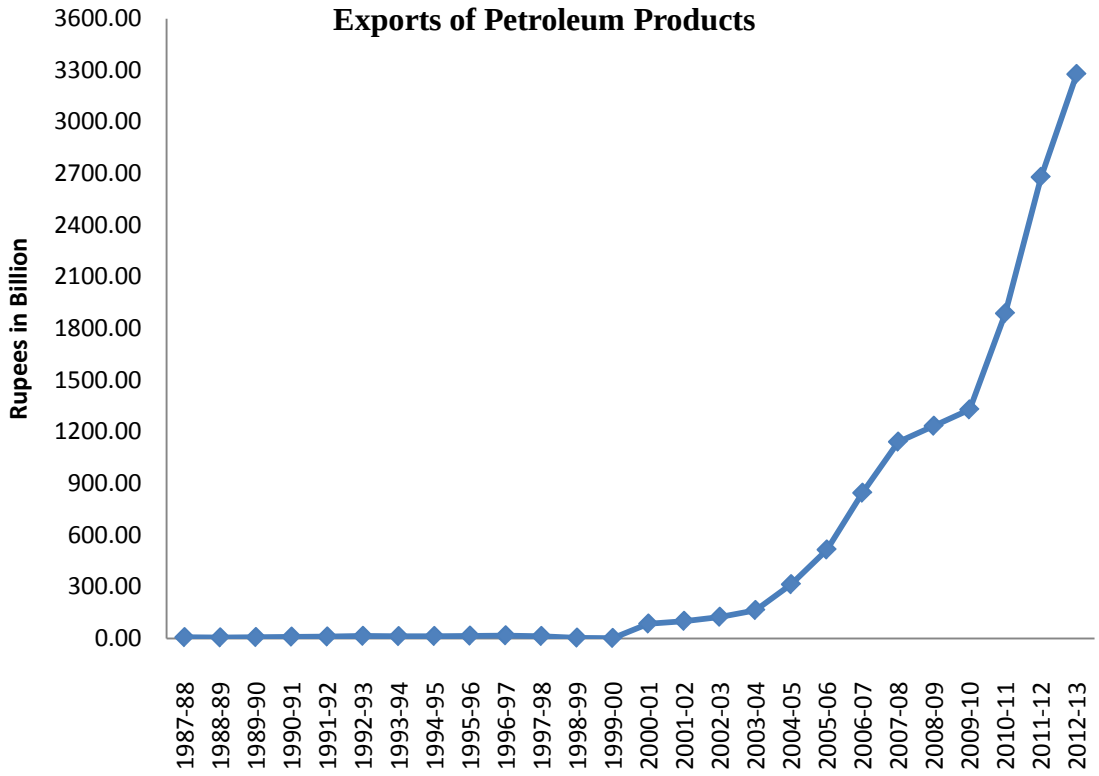


Figure 4.9

Exports of Electronic Goods

Figure 4.10



4.2. Growth Performance Analysis of Technology Based Classification

4.2.1. Growth Rates of Gross Value Added, Capital and Labour in High Technology Manufacturing Sector

The trend rates of growth of GVA provide in the Table 4.8 stood at 10.3 per cent for aggregate High Technology Manufacturing Sector of the entire study period. In terms of Gross Value Added the Radio, TV & Communication Industry is the best performer with a growth rate of 13.2 per cent and followed by Office & Computing Equipment Industry. On the contrary, the worst performing industry was Drug & Medicines with 8.6 per cent rate of growth.

A further analysis of pre and post transition period suggests that the trend in growth rate of GVA during post transition period had increased from 6.2 per cent to 13.6 per cent for the entire High Technology Manufacturing Sector. Almost all industries are positive in the post transition period. The highest growth rate of GVA recorded by Radio,

TV & Communication Industry was 21.2 per cent and the lowest growth rate of GVA recorded by Drug & Medicines Industry indicates 10.2 per cent.

It has been noticed that the growth rate of capital recorded 17.2 per cent for aggregate High Technology Industrial sector of the entire study period. The growth rate of capital was attained the highest 20.7 per cent in the Office & Computing equipment Industry during the entire study period. The Drug & Medicines Industry was the lowest 15.4 per cent in growth rate of capital of this period.

A pre and post transition period comparison analysis depicts that the trend in growth rate of capital during post transition period have increased from 13.6 per cent to 21.8 per cent for the entire High Technology Manufacturing Sector. Almost all industries are in positive growth rate of capital recorded in the post transition period. The growth rate of capital is highest in the Office & Computing equipment Industry to the extent of 32.0 per cent and the lowest growth rate of capital was recorded by the Drug & Medicines industry to the extent of 16.3 per cent in the post transition period when compare to pre transition period.

At the aggregate level, the growth rate of labour was found lower than the Gross Value Added and Capital in all the industries during the entire study period. In most of the industries, the growth rate was found to be less than 2 per cent during this period. A further analysis of pre and post transition period suggests that the trend in growth rate of labour during post transition period was negative and it was fallen from 3.9 per cent to -1.67 per cent for High Technology Manufacturing Sector at aggregate level. The highest growth rate of labour was found in the Office & Computing equipment industry to the extent of 3.0 in the post transition period. Drug & Medicines Industry has scored the lowest growth rate of labour to the extent of -3.9 during this period.

However, at disaggregate industrial level of pre and post transition period comparison depicts that the trend in growth rate of labour during post transition period have been decreased drastically in almost all industries.

Table 4.8: Compound Annual Growth Rates (CAGR) of High Technology Manufacturing Sector Pre and Post Transition Period

Industry Group	Value Added			Capital			Labour		
	Pre Transition period	Post Transition period	Entire period	Pre Transition period	Post Transition period	Entire period	Pre Transition period	Post Transition period	Entire period
Office& Computing Equipment	7.5	11.9	11.3	12.5	32.0	20.7	-0.0	3.0	-1.4
Drug &Medicines	6.0	10.2	8.6	14.4	16.3	15.4	2.0	-3.9	3.5
Radio, TV &Communication	6.2	21.2	13.2	13.5	27.6	19.2	8.4	1.3	2.7
Aggregate	6.2	13.6	10.3	13.6	21.8	17.2	3.9	-1.67	2.8

Source: Computed using the data from Annual Survey of Industries, EPW Research Foundation.

4.2.2. Growth Rates of Gross Value Added, Capital and Labour in Medium High Technology Manufacturing Sector

The Table 4.9 depicts a synoptic view of the trend in growth rate of GVA of Medium High Technology Manufacturing Sector at aggregate and disaggregates level. The pattern of growth of GVA in the Medium High Technology Manufacturing Sector stands at 7.1 per cent for the entire study period. Industry-wise calculated growth rates reveals that Professional goods Industry and also Other Transport Industry recorded the highest growth rate of 12.5 per cent during the entire study period in terms of GVA and followed by Chemicals excl. drugs industry with 7.9 per cent. The lowest growth rate of GVA recorded in the Electrical machines excl.com equipment Industry with 4.1 per cent.

A comparative analysis of pre & post transition period shows that there has been an increase in the growth rate of GVA at aggregate level from 6.8 per cent in pre Transition period to 8.7 per cent in post transition period in the Medium High Technology Manufacturing Sector. Out of 6 industrial groups, 5 industries have witnessed acceleration in the growth rate of GVA during the post transition period. The highest growth rate of GVA was found in the Other Transport Industry with 14.8 per cent in the post transition period. Non electrical industry has lowest growth rate of GVA with 5.8 per cent during the same period.

It has been noticed that the growth rate of capital was recorded as 13.1 per cent for aggregate Medium High Technology Manufacturing Sector in the entire study period. The growth rate of capital is highest with 17.1 per cent in the Professional goods industry and the lowest was recorded in the Electrical machines excl.com equipment industry with 11.6 per cent in the same period. A pre and post transition period comparison depicts that the trend in growth rate of capital during post transition period it was decreased from 17.6 per cent to 10.2 per cent for the entire Medium High Technology Sector. Almost all industries are witnessed turn down in the growth rate of capital recorded in the post transition period. The growth rate of capital highest in the Professional goods industry to the extent of 27.4 per cent and lowest growth rate of capital recorded by Non-electrical industry to the extent of 16.6 per cent in the pre Transition period when compare to post transition period .

Table 4.9: Compound Annual Growth Rates (CAGR) of Medium - High Technology Manufacturing Sector Pre & Post Transition Period

Industry Group	Value Added			Capital			Labour		
	Pre Transition period	Post Transition period	Entire period	Pre Transition period	Post Transition period	Entire period	Pre Transition period	Post Transition period	Entire period
Professional goods	11.8	12.9	12.5	27.4	10.7	17.1	2.7	2.2	2.3
Motor vehicles	8.9	6.4	7.3	17.8	14.0	15.4	6.2	-0.7	2.3
Electrical machines excl.com equipment	1.9	8.9	4.1	16.9	8.4	11.6	1.6	-3.6	-1.2
Chemicals excl. drugs	7.0	10.5	7.9	17.3	10.0	12.8	0.9	1.5	1.2
Other transport	12.9	14.8	12.5	20.3	9.5	14.1	6.5	1.5	3.1
Non-electrical	4.9	5.8	5.0	16.6	8.9	12.0	0.7	-1.4	-0.5
Aggregate	6.8	8.7	7.1	17.6	10.2	13.1	2.2	-0.4	0.7

Source: Computed using the data from Annual Survey of Industries, EPW Research Foundation.

Growth rate of labour is lower than the value added and capital in all the industries during the entire study period at the aggregate level. In most of the industries, the growth rate was found to be less than two per cent during the same period. A Pre and Post transition period comparison analysis suggests that the trend in growth rate of labour during post transition period has negative from 2.2 per cent to -0.4 per cent for Medium High Technology Manufacturing Sector at aggregate level. Out of 6 industrial groups, 3 industries have witnessed acceleration in the growth rate of labour during the pre transition period except others such as Professional goods, Chemicals excl. Drugs and Other transport Industries. And, whereas the Electrical machines excl.com equipment, Non- electrical and Motor vehicles Industries recorded negative growth rate of labour during the Post transition period.

4.2.3. Growth Rates of Gross Value Added, Capital and Labour in Low Technology Manufacturing Sector

The Table 4.10 illustrates that the growth pattern of GVA in Low Technology Manufacturing Sector. The total GVA recorded an overall growth of 7.7 per cent for the entire Low Technology Manufacturing Sector. The Industry-wise analysis reveals Food, beverages and Tobacco Industry recorded the highest growth rate of 6.0 per cent and the lowest GVA was found in Wood products and furniture with 3.4 per cent in the same period.

A comparative analysis of Pre & Post transition period reveals that an average growth rates of GVA was same at aggregate level of Low Technology Manufacturing Sector. And another point is to understand in this period was that almost all industries growth rate of GVA decreased in Post transition period compare to pre Transition period. The highest growth rate of GVA was found in the Food, beverages and Tobacco Industry to the extent of 9.8 in the pre Transition period and followed by Textiles apparel and Leather Industry with a growth rate of 7.0 per cent. Wood products and furniture Industry was found at the lowest growth rate of 1.8 per cent in the post transition period.

The pattern of growth of capital in the Low Technology Manufacturing Sector stands at 13.3 per cent for the entire study period. Industry-wise calculated growth rate reveals that Wood products and furniture Industry recorded as the highest growth rate of

Table 4.10: Compound Annual Growth Rates (CAGR) of Low Technology Manufacturing Sector Pre & Post Transition Period

Industry Group	Value Added			Capital			Labour		
	Pre Transition period	Post Transition period	Entire period	Pre Transition period	Post Transition period	Entire period	Pre Transition period	Post Transition period	Entire period
Paper, paper products and printing	4.6	3.8	3.8	15.6	9.3	11.8	-0.2	-0.2	-0.1
Textiles, apparel and leather	7.0	3.3	4.2	17.8	10.9	13.7	-1.9	1.0	0.2
Food, beverages and tobacco	9.8	3.7	6.0	18.5	10.2	13.6	-1.8	0.6	-0.4
Wood products and furniture	6.2	1.8	3.4	17.2	13.0	14.2	-0.4	0.8	-0.3
Aggregate	8.7	8.6	7.7	17.5	10.3	13.3	1.4	0.6	0.9

Source: Computed using the data from Annual Survey of Industries, EPW Research Foundation.

14.2 per cent of capital during the entire study period. Paper, paper products and printing Industry found lowest growth rate as 11.8 per cent in the same period.

A pre and post transition period comparison depicts that there has been a decrease in the rate of growth of fixed capital for the entire Low Technology Manufacturing Sector from 17.5 per cent to 10.3 per cent during the post transition period. It is surprising to observe that despite of the adoption of liberalisation policies in the country, there has been a tremendous fall in the rate of growth of investment in fixed capital for all the industries. And also at disaggregate industries level all most all industries have been decreased in the post transition period. However, the highest growth rate of capital recorded in the Food, beverages and Tobacco Industry was 18.5 per cent and followed by Textiles, apparel and Leather Industry in the pre transition period. The lowest growth rate of capital found in the Paper, paper products and printing Industry to extent of 15.6.per cent in the same period

In all the industries growth rate of labour is lower than the value added and capital during the entire study period at the aggregate level. In most of the industries, the growth rate found negative during this period. A pre and post transition period comparison analysis suggests that trend growth rate of labour during Post transition period have decreased from 1.4 per cent to 0.6 per cent for Low Technology Manufacturing Sector at aggregate level. Textiles, apparel and Leather Industry recorded the highest growth rate of 1.0 per cent in of labour during the entire study period and the lowest growth rate was recorded in the Paper, paper products and printing Industry as -0.2 per cent in the Post transition period.

4.2.4. Growth Rates of Gross Value Added, Capital and Labour in Medium Low Technology Manufacturing Sector

The trend in the growth rates of GVA provided in the Table 4.11 stood at 4.6 per cent for aggregate Medium Low Technology Manufacturing Sector of the entire study period. In terms of Gross Value Added, Other manufacturing Industry was the best performer with highest growth rate of 15.6 per cent and followed by Petroleum refineries and Coal products Industry with 12.7 per cent rate of growth in the same period. On the contrary, the worst performing industry with lowest growth rate of -0.6 per cent in the Shipbuilding and repairing. A comparative analysis of pre and post transition periods

declares that the growth rate was decreased and it was 7.3 per cent at pre transition period and fallen to 3.5 per cent in the post transition.

Out of 8 industrial groups, 3 industries have witnessed acceleration in the growth rate of GVA during the post transition period and the other five was not so. The highest growth rate of GVA was found in Petroleum refineries and Coal products the Industry to the extent of 14.1 in the post transition period and followed by Other Manufacturing Industry and Rubber and plastic products. And, the lowest growth rate of GVA was recorded with -12.1 per cent in the Shipbuilding and repairing in pre Transition period.

It has been noticed that growth rate of capital recorded as 13.3 per cent for aggregate level of Medium Low Technology Manufacturing Sector of the entire study period. The highest growth rate was recorded as 7 .1 per cent in the Other Manufacturing Industry during the entire study period and Shipbuilding and repairing industry had the lowest growth rate of capital with 3.9 per cent during the same period.

A pre and post transition period comparison depicts that the trend in growth rate of capital during post transition period have decreased from 17.6 per cent to 10.5 per cent for the entire Medium High Technology Manufacturing Sector. Almost all industries are witnessed acceleration in the growth rate of capital recorded in the pre Transition period.

The highest growth rate of capital was recorded 25.1 per cent in the Rubber and plastic products Industry and followed by Non- metallic mineral with growth rate of 22.4, and also Metal products industries with a growth rate of 20.2 in the pre transition period. The growth rate was found lowest growth rate of capital by Shipbuilding and repairing Industry to the extent of 1.1 per cent in pre transition period when compare to Post transition period.

Growth rate of labour is lower than the Gross Value Added and Capital in all the industries during the entire study period at the aggregate level. In most of the industries, the growth rate found less than two per cent during this period. A pre and post transition period comparison analysis suggests that the trend in growth rate of labour during post transition period has shows a positive result and it raised from -0.9 per cent to 0.9 per cent for Medium Low Technology Manufacturing Sector at aggregate level. Out of 8 industrial groups, 4 industries have witnessed acceleration in the growth rate of labour during the post transition period. The highest growth rate was found in the other

Table 4.11: Compound Annual Growth Rates (CAGR) of Medium Low Technology Manufacturing Sector Pre & Post Transition period

Industry Group	Value Added			Capital			Labour		
	pre Transition period	post Transition period	Entire period	pre Transition period	post Transition period	Entire period	pre Transition period	post Transition period	Entire period
Rubber and plastic products	15.0	10.4	11.6	25.1	12.2	17.0	4.3	5.3	4.8
Shipbuilding and repairing	-12.1	8.3	-0.6	1.1	6.0	3.9	-10.1	1.5	-2.8
Other manufacturing	17.7	13.4	15.6	16.3	18.4	17.1	4.2	8.4	6.6
Non-ferrous metals	18.4	3.2	10.3	19.2	10.1	14.8	12.5	-7.5	1.2
Non-metallic mineral products	12.1	3.5	7.6	22.4	10.1	15.2	1.8	-0.2	0.9
Metal products	3.3	7.2	5.7	20.2	10.6	14.3	1.8	1.0	1.2
Petroleum refineries and coal products	13.1	14.1	12.7	16.8	17.1	16.7	2.4	2.9	2.5
Ferrous metals (Iron& steel)	4.7	10.2	5.3	15.5	7.8	11.0	-1.6	-1.1	-1.8
Aggregate	7.3	3.5	4.6	17.6	10.5	13.3	-0.9	0.9	-0.1

Source: Computed using the data from Annual Survey of Industries, EPW Research Foundation.

Manufacturing Industries with 8.4 per cent .Whereas Non-ferrous metals Industry recorded as -7.5 per cent of negative growth rate of labour during the post transition period.

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CHAPTER-V

ECONOMIC OPENNESS IMPACT ON INDIAN MANUFACTURING SECTOR PRODUCTIVITY-A DEA MALMQUIST PRODUCTIVITY INDEX APPROACH

CHAPTER -V

Economic Openness Impact on Indian Manufacturing Sector's Productivity Growth in Pre and Post Transition

In India major Economic Openness has been undertaken since July, 1991 with the objective of increasing productivity and competitiveness of the Indian Manufacturing Sector. The Economic Openness process heralded the liberalisation of Indian industrial sector from various controls and regulations. This also implied a movement towards the establishment of a competitive market system with optimum resource utilisation. Under this process, the firms were exposed to international competition which forced them to introduce new methods of production, import quality inputs along with modern technology to improve their efficiency. To compete in this globalized world, productivity of manufacturing sector is a crucial factor. The significance of productivity, in increasing national welfare is now universally recognized. In every country, industry or organization, the main source of economic growth is a result of an increase in productivity. Nowadays, it is widely accepted that productivity is a key performance benchmark for any firm which is involved in the manufacturing sector. This improvement in productivity is related to increased profitability, lower costs and sustainable competitiveness. Productivity [1] is defined as the efficient use of resources in the production of various goods and services. Rising productivity implies that either higher output is produced with the same amount of input or less input is required to produce the same level of output.

In this chapter, an attempt has been made to analyze the impact of Economic openness on the productivity of Indian Manufacturing Sector based on technology classification (High Technology, Medium High Technology, Low Technology and Medium Low Technology Manufacturing Sectors) by comparing pre and post transition period i.e., from 1981 to 1991 and 1991-2012, using the Malmquist Productivity Index. To present the discussion in a lucid way, the whole chapter has been divided into two broad sections. Section-I presents methodology containing non-parametric DEA

[1] There are three principal approaches to measurement of productivity growth. Those are :(i) The index number approach, (ii) parametric approach and (iii) non-parametric approach, In this study productivity growth estimated using the non-parametric approach which is based on linear programming model.

Malmquist Productivity Index (MPI) approach to compute Total Factor Productivity (TFP) growth rates. In the Section-II deals with the empirical results related to the Inter-Industries Variations in TFP growth rate of Indian Manufacturing Sector have been discussed. The Total Factor Productivity Change Index results are calculated by using Data Envelopment Analysis Programme 2.1 (DEAP) linear programme developed by Coelli et.al (1998)[2].

5.1 Methodology Framework

5.1.1. The Data Envelopment Analysis (DEA) Model

In this study, Malmquist Productivity Index methods used to calculate Total Factor Productivity (TFP) of the Indian Manufacturing Sector based on technological classification. DEA based Malmquist productivity approach has been used extensively to measure performance in various sectors.

5.1.1.1. Data Envelopment Analysis (DEA) Advantages

"The advantages of DEA briefly summarized by Majumdar (1997)[3] as follows:

- DEA is a multivariate technique that can take up multiple inputs and outputs into account. It can estimate Technical Efficiency and it is a non-parametric approach that does not require an assumption about the mathematical form of the production function.
- It is not necessary to make assumptions about the technology employed by firms.
- DEA carries out individual observation optimization because it is frontier oriented and does not estimate innermost tendencies. However, regression approaches use averaging technique and estimate a single parameter for all observations.
- DEA allows data set to be static or dynamic. When panel data is used, it estimates the optimum frontier for a firm with respect to efficiency characteristics of all Decision Making Units (DMUs) for that year.
- DEA can estimate scale efficiency without using the input prices."

[2] Coelli T.J, A Guide to DEAP Version 2.1: "*A Data Envelopment Analysis (computer program) CEAP*" working paper 96/08, Department of Econometrics, University of New England, Australia.
[3] Majumdar, S., (1997), "Incentive regulation and productive efficiency in the U.S telecommunication industry", *Journal of Business* 70, pp 547-576.

5.1.2. Malmquist Total Factor Productivity (TFP) Index

Fare et al. (1982) defined the Malmquist Production Index by distance functions that are calculated by using Data Envelopment Analysis (DEA). DEA is a special mathematical linear programming model and test to assess efficiency and productivity. It allows use of panel data to estimate changes in total factor productivity and breaking it down into two components namely, Technological Change and Technical Efficiency Change. TFP growth measures how much productivity grows or declines over period of time. When there are more outputs relative to the quantity of given inputs, then TFP has grown. TFP can grow when adopting innovations such as electronics, improved design are called "Technological Change"[4]. TFP can also grow when the industry uses their existing technology and economic inputs more efficiently; they can produce more while using the same capital, labour and technology or by increasing "Technical Efficiency Change"[5]. TFP change from one year to the next is therefore comprised of Technological Change and Technical Efficiency Change.

This study uses the output-oriented model of DEA-Malmquist to put much weight on the expansion of output quantity out of a given amount of inputs. Therefore, TFP Index is a ratio of the weighted aggregate outputs to weighted aggregate inputs, using multiple outputs and inputs. Input and output quantities of industries are sets of data used to construct a piece-wise frontier over the data points. Efficiency measures are calculated related to this frontier that represents an Efficient Technology. The best-practice industry determines the production frontier, that is, those that have the highest level of production given a level of economic inputs. Points that lie below the piece-wise frontier are considered inefficient while points that lie on or above the frontier are efficient. Since many inputs are used, and shared outputs may be produced, the Malmquist approach was developed to combine inputs and outputs and then measure changes. The Malmquist Index measures that the Total Factor Productivity change between two data points over

[4] Technological Change is the development of new products or the development of new technologies that allows methods of production to improve and results in the shifting upwards of the production frontier. More specifically, Technological Change includes a new production process which is called process of innovation and the discoveries of new products are called products of innovation.

[5] On the other hand, can make use of existing labour, capital, and other economic inputs to produce more of same product. An example is increase in skill or learning by doing. As producers gain experience at producing something they become more and more efficient at it. Labour find new ways of doing things so that relatively minor modifications to plant and procedures can contribute to higher levels of productivity

time, by calculating the ratio of distances of each data points relative to a common technology.

"DEA Malmquist TFP index is used to calculate the ratio of the distances of each observation relative to the technology frontier and measure the TFP difference between two observations. The TFP change index for the i^{th} DMU between the period t and period t+1 is defined by the Fare et al. (1994) as follows:

$$m_i\left(y_s, x_s, y_t, x_t,\right) = \left[\frac{d_i^t\left(y_i^{t+1}, x_i^{t+1}\right)}{d_i^{t+1}\left(y_i^t, x_i^{t+1}\right)} x \frac{d_i^t\left(y_i^t, x_i^{t+1}\right)}{d_i^{t+1}, \left(y_i^t, x_i^t\right)}\right]^{1/2}$$

y_i^t, x_i^{t+1} notion in the equation (1) represents the output produced by i^{th} DMU during the period t and the input used by i^{th} DMU during the period t+1, respectively. The $d_i^t\left(y_i^{t+1}, x_i^{t+1}\right)$ term in equation (1) refers to the distance between the observation at the period t+1 to the technology at the period t and $d_i^{t+1}, \left(y_i^t, x_i^t\right)$ term represents the distance between the observation at the period t to the technology at the period t+1. If m_i is greater than one it indicates an increase in the TFP change from period t to period t+1. A value of m_i less than one point to a decrease in the TFP change from period t to period t+1 Equation (1) can be expressed as equation (2).

$$m_i\left(y_s, x_s, y_t, x_t,\right) =$$

$$\underbrace{\frac{d_i^t\left(y_i^{t+1}, x_i^{t+1}\right)}{d_i^t, y_i^t, x_i^t}}_{\substack{\text{TECHNICAL EFFICIENCY CHANGE} \\ \text{(CHATCHING UP EFFECT)}}} \qquad \underbrace{x\left[\frac{d_i^t\left(y_i^{t+1}, x_i^{t+1}\right)}{d_i^{t+1}\left(y_i^{t+1}, x_i^{t+1}\right)} x \frac{d_i^t\left(y_i^t, x_i^t\right)}{d_i^{t+1}, \left(y_i^t, x_i^t\right)}\right]^{1/2}}_{\substack{\text{TECHNOLOGICAL CHANGE} \\ \text{(INNOVATION EFFECT)}}}$$

In equation (2), the first multiplier is technical efficiency change between period's t and t+1 in the output-oriented model described by Farrell (1957)"[6]. It represents the ratio of

[6] Farrell, M.J. (1957), *"The Measurement of Productive Efficiency"*, Journal of the Royal Statistical Society, Vol. 120, No.3, pp. 253-90.

the Technical Efficiency in period t to the technical efficiency in period t+1. The second multiplier in equation (2) corresponds to the technical change which is a geometric mean of the shift in the technology frontier between the period's t and t+1.

Empirical Findings

5.2. Trends in Total Factor Productivity of High Technology Manufacturing Sector

The level of productivity growth is considered to be one of the most vital determinants of growth. The measurement and understanding of *Inter-Temporal and Inter-Industry* comparison of TFP growth can guide the policy makers for the formulation of a suitable policy for the rational resource allocation and balanced regional development. The Table 5.1 and Table 5.2 provide *Inter-Temporal and Inter-Industry* comparison of Malmquist Productivity Index for the High Technology Manufacturing Sector. *Inter-Temporal* analysis reveals a cyclical fluctuation in the productivity growth of the High Technology Manufacturing Sector. The highest TFP growth rate recorded as 23.4 per cent during the year 1994- 95 and in the year 1998-99, the lowest growth rate of TFP at -31.4 per cent recorded. Besides, a glimpse at the Table 5.2 reveals that there is productivity positive in the High Technology Manufacturing Sector at the rate of 0.398 per cent. The growth rate ranges between a maximum of 1.768 per cent for the Office & Computing Equipment industry and a minimum of -1.420 per cent for the Drug & Medicines industry. Thus, there exists a variation in productivity growth of High Technology Manufacturing Sector the entire study period.

While analyzing the results at the disaggregate level, it has been found that productivity growth has improved from -4.275 per cent in pre transition period and it increased up to 2.057 per cent during post transition period. Hence, the Economic Openness seems to be imparting a positive and significant impression over the productivity performance of High Technology Manufacturing Sector. At the disaggregate level, almost all (two out of three) industries groups two industries have shown improvement in their TFP during the post transition period, except the Drug &Medicines industry, where the growth rate reflects fall in TFP growth. However, it is pertinent to mention here that during the post transition period, the industrial groups of Office & Computing Equipment and Radio, TV &Communication have exhibited a positive productivity growth.

Table 5.1: Malmquist Productivity Index of

High Technology Manufacturing Sector: An Inter-Temporal Analysis

Year	Average MPI	Growth Rate
1982-83	0.988	-1.2
1983-84	0.93	-7.5
1984-85	0.877	-14
1985-86	0.934	-7.1
1986-87	0.973	-2.8
1987-88	0.92	-8.7
1988-89	1.045	4.3
1989-90	1.117	10.5
1990-91	0.87	-14.9
1991-92	0.92	-8.7
1992-93	1.038	3.7
1993-94	0.991	-0.9
1994-95	1.305	23.4
1995-96	0.801	-24.8
1996-97	0.989	-1.1
1997-98	1.2	16.7
1998-99	0.761	-31.4
1999-00	1.033	3.2
2000-01	1.227	18.5
2001-02	0.915	-9.3
2002-03	1.176	15
2003-04	0.971	-3
2004-05	0.834	-19.9
2005-06	1.247	19.8
2006-07	0.816	-22.5
2007-08	0.902	-10.9
2008-09	1.317	24.1
2009-10	0.765	-30.7
2010-11	1.063	5.9
2011-12	0.909	-10

Source: Calculations by Data Envelopment Analysis Programme (DEAP), version 2.1

Table 5.2: Malmquist Productivity Index of
High Technology Manufacturing Sector: An Inter- Industry Change

Industry Group	Malmquist Productivity Index			Growth Rates		
	Pre Transition Period	Post Transition Period	Entire Period	Pre Transition Period	Post Transition Period	Entire Period
Office & Computing Equipment	0.905	1.081	1.018	-10.497	7.493	1.768
Drug &Medicines	1.013	0.956	0.986	1.283	-4.603	-1.420
Radio, TV &Communication	0.961	1.030	1.010	-4.058	2.913	0.990
Mean	0.959	1.021	1.004	-4.275	2.057	0.398

Source: Calculations by Data Envelopment Analysis Programme (DEAP), version 2.1.

5.2.1. Decomposition of TFP of High Technology Manufacturing Sector

The literature on MPI confirms that TFP growth can be bifurcated into two mutually exclusive and non- additive sources namely, Technical Efficiency Change and Technological Change. The Technical Efficiency Change component is a proxy of catching up whereas Technological Change represents a frontier shift .And, Tables 5.3 and 5.4 provide the inter-temporal estimates of Technical Efficiency Change and Technological Change respectively.

A broader view of the Table 5.3 explains that Technical Efficiency Change index is less than unitary for majority of the years considered under study. The behaviour of the coefficients of growth rates summarizes a mix of positive and negative pattern. The highest growth of 16.6 per cent is experienced during the year 1995-96. In the year 2011-12 the lowest growth rate found at -30.5 per cent. Table 5.4 explains On the other hand, the growth rate of technological change is found to be optimum during the year 1997-98, it was 24.0 per cent in the post transition period and minimum growth rate found -33.9 per cent in pre transition period.

The Table 5.5 provides an *Inter-Industry* analysis of Technical Efficiency Change for the High Technology Manufacturing Sector. A comparative analysis of pre and post transition period suggests that Office & Computing Equipment and Radio, TV &

Communication industries have experienced improvements in technical efficiency (from -7.181 % to 3.382 % and -2.145 % to 0.596 %) from pre transition period to post transition period respectively. At the same time, Drug &Medicines have experienced a striking decline in technical efficiency change.

Furthermore, perusal of the Table 5.6 summarizes that out of 3 industries, only 2 categories i.e. Office & Computing Equipment and Radio, TV & Communication industries have experienced Technological Change during the post transition period, rest of one industrial group i.e. Drug & Medicines have not shifted their frontier at all. A probe for examining the impact of Economic Openness on manufacturing sector has highlighted that strong positive technical change is observed for Office & Computing Equipment industry.

5.2.2. Sources of Total Factor Productivity of High Technology Manufacturing Sector

It is essential to know the sources of Total Factor Productivity growth, for a better policy framework. The analysis of the sources of the TFP growth in High Technology Manufacturing Sector reveals that (refer Tables: 5.2, 5.5, and 5.6) at an average, both Technological Change and Technical Efficiency Change are equally contributing to the TFP growth under evaluation. It has also been observed that at all aggregate level, Technologic Change is greater than Technical Efficiency Change. It means Economic Openness (technology import after introduced economic reforms) may have positive impact on this Sector.

The analysis of the impact of Economic Openness on TFP growth reveals that TFP growth has increased from -4.2 percent in pre transition period to 2.0 percent in post transition period. The main source of TFP growth is due to Technical Efficiency Change. In the Inter industrial analysis, The Office& Computing Equipment and Radio, TV &Communication industries observed that Technological Change dominates than Technical Efficiency Change. Therefore, Technological Change is the major driving force of productivity improvement of these industries. However, the Drug &Medicines industry witnessed Technical Efficiency Change is greater than Technological Change.

5.3. Trends in Total Factor Productivity of Medium High-technology Manufacturing Sector

The present segment of the analysis sheds light on the Inter Temporal and Inter Industry change witnessed by the Medium High Technology Manufacturing Sector with respect to MPI and its components. For the Medium High Technology Manufacturing Sector, cyclical fluctuations are registered in the productivity growth behaviour during the entire study period. During the year 1995-96, the productivity growth is established as the highest at 14.3 per cent reflected in the Table 5.7. However, the lowest productivity growth rate at -52.9 per cent is observed during the year 2007-08. Moreover, it is to be highlighted that the index of productivity is experienced less than unitary for a maximum number of times.

Further, in the case of Inter Industry analysis, at the Table 5.8 replicates that there is productivity positive in the Medium High Technology Manufacturing Sector at the rate of 0.398 per cent. A further comparison of pre transition period to that of post transition period suggests that there is an improvement in TFP growth rate. In the pre transition period it showed -1.937 per cent and where as in the post transition period it increased up to 2.629 per cent with a positive trend. Thus, there is an improvement in TFP growth rate in the post transition period; has suggested that the Medium High Technology Manufacturing Sector is responding positively against the Economic Openness based programmes initiated by Indian economy.

An additional investigation of Inter-Industrial analysis in the Table 5.8 of Medium High Technology Manufacturing Sector, for the entire period of the study reveals that Chemicals excl. drugs has reported the highest productivity growth rate to the tune of 5.033 followed by Professional goods (1.381 per cent) and Other transport (1.283 percent).While, the poorest growth rate (-3.627 per cent) is observed in the Non-electrical.

When compare to pre and post transition periods, the results reveals that all industries of Medium High Technology Manufacturing Sector have responded positively to the Economic Openness process. It is reported that the highest level of TFP growth rate shown in other transport industry at 1.060 per cent and the worst sufferer is Non-electrical industries.

Table 5.3: Technical Efficiency Index of High Technology Manufacturing Sector: An Inter-Temporal Analysis

Year	Efficiency Change	Growth Rate
1982-83	0.943	-6
1983-84	0.823	-21.5
1984-85	1.173	14.7
1985-86	0.937	-6.7
1986-87	1.043	4.1
1987-88	0.901	-11
1988-89	1.052	4.9
1989-90	1.042	4
1990-91	0.869	-15.1
1992-93	1.029	2.8
1993-94	0.862	-16
1994-95	1.104	9.4
1995-96	1.199	16.6
1996-97	0.869	-15.1
1997-98	1.008	0.8
1998-99	0.811	-23.3
1999-00	1.068	6.4
2000-01	1.197	16.5
2001-02	0.944	-5.9
2002-03	1.045	4.3
2003-04	1.105	9.5
2004-05	0.77	-29.9
2005-06	1.022	2.2
2006-07	0.965	-3.6
2007-08	0.957	-4.5
2008-09	1.002	0.2
2009-10	0.886	-12.9
2010-11	1.179	15.2
2011-12	0.766	-30.5

Source: Calculations by Data Envelopment Analysis Programme (DEAP), version 2.1.

Table 5.4: Technological Change Index of High Technology Manufacturing Sector: An Inter-Temporal Analysis

Year	Technological Change	Growth Rate
1982-83	1.048	4.6
1983-84	1.13	11.5
1984-85	0.747	-33.9
1985-86	0.997	-0.3
1986-87	0.933	-7.2
1987-88	1.021	2.1
1988-89	0.994	-0.6
1989-90	1.072	6.7
1990-91	1.001	0.1
1991-92	0.967	-3.4
1992-93	1.009	0.9
1993-94	1.15	13
1994-95	1.182	15.4
1995-96	0.668	-49.7
1996-97	1.138	12.1
1997-98	1.191	16
1998-99	0.938	-6.6
1999-00	0.967	-3.4
2000-01	1.025	2.4
2001-02	0.97	-3.1
2002-03	1.125	11.1
2003-04	0.879	-13.8
2004-05	1.083	7.7
2005-06	1.219	18
2006-07	0.846	-18.2
2007-08	0.942	-6.2
2008-09	1.315	24
2009-10	0.863	-15.9
2010-11	0.902	-10.9
2011-12	1.186	15.7

Source: Calculations by Data Envelopment Analysis Programme (DEAP), version 2.1.

Table 5.5: Technical Efficiency Change Index of High Technology Manufacturing Sector: An Inter- Industry Analysis

Industry Group	Technical Efficiency Index			Growth Rates		
	Pre Transition Period	Post Transition Period	Entire Period	Pre Transition Period	Post Transition Period	Entire Period
Office & Computing Equipment	0.933	1.035	1.000	-7.181	3.382	0.000
Drug &Medicines	1.000	0.997	0.998	0.000	-0.301	-0.200
Radio, TV &Communication	0.979	1.006	1.000	-2.145	0.596	0.000
Mean	0.970	1.013	1.000	-3.093	1.283	0.000

Source: Calculations by Data Envelopment Analysis Programme (DEAP), version 2.1.

Table 5.6: Technological Change Index of High Technology Manufacturing Sector: An Inter- Industry Analysis

Industry Group	Technological Change Index			Growth Rates		
	Pre Transition Period	Post Transition Period	Entire Period	Pre Transition Period	Post Transition Period	Entire Period
Office & Computing Equipment	0.970	1.045	1.017	-3.093	4.306	1.672
Drug &Medicines	1.013	0.959	0.987	1.283	-4.275	-1.317
Radio, TV &Communication	0.981	1.023	1.010	-1.937	2.248	0.990
Mean	0.988	1.008	1.005	-1.215	0.794	0.498

Source: Calculations by Data Envelopment Analysis Programme (DEAP), version 2.1.

Table 5.7: Malmquist Productivity Index of

Medium High Technology Manufacturing Sector: An Inter-Temporal Analysis

Year	Average MPI	Growth Rate
1982-83	1.002	0.2
1983-84	0.972	-2.9
1984-85	0.935	-7
1985-86	0.892	-12.1
1986-87	0.97	-3.1
1987-88	1.003	0.3
1988-89	0.977	-2.4
1989-90	1.007	0.7
1990-91	1.087	8
1991-92	1.112	10.1
1992-93	0.972	-2.9
1993-94	1.056	5.3
1994-95	1.108	9.7
1995-96	1.167	14.3
1996-97	0.908	-10.1
1997-98	0.889	-12.5
1998-99	1.127	11.3
1999-00	1.023	2.2
2000-01	0.866	-15.5
2001-02	1.112	10.1
2002-03	1.007	0.7
2003-04	1.155	13.4
2004-05	1.067	6.3
2005-06	0.98	-2.0
2006-07	0.985	-1.5
2007-08	0.654	-52.9
2008-09	1.076	7.1
2009-10	1.045	4.3
2010-11	1.102	9.3
2011-12	0.988	-1.2

Source: Calculations by Data Envelopment Analysis Programme (DEAP), version 2.1.

Table 5.8: Malmquist Productivity Index of
Medium- High Technology Manufacturing Sector: An Inter- Industry Analysis

Industry Group	Malmquist Productivity Index			Growth Rate		
	Pre Transition Period	Post Transition Period	Entire Period	Pre Transition Period	Post Transition Period	Entire Period
Professional goods	0.952	1.055	1.014	-5.042	5.213	1.381
Motor vehicles	0.990	1.012	0.996	-1.010	1.186	-0.402
Electrical machines excl.com equipment	0.982	1.000	0.986	-1.833	0.000	-1.420
Chemicals excl. drugs	1.084	1.041	1.053	7.749	3.939	5.033
Other transport	0.960	1.060	1.013	-4.167	5.660	1.283
Non-electrical	0.927	1.000	0.965	-7.875	0.000	-3.627
Mean	0.981	1.027	1.004	-1.937	2.629	0.398

Source: Calculations by Data Envelopment Analysis Programme (DEAP), version 2.1.

5.3.1. Decomposition of TFP of Medium High Technology Manufacturing Sector

As mentioned earlier, the growth in MPI could be attributed to two mutually exclusive and non additive sources, namely, Catching up Effect and Shift in Frontier. The Table 5.9 provides the inter-temporal estimates of Technical Efficiency Change in the Medium High Technology Manufacturing Sector.

A glimpse at Table 5.9 portrays the Technical Efficiency Change is less than unitary in majority of the years considered under the study. The growth rate ranges between a maximum of 17.4 per cent growth (noted in the year 1985-86) and a minimum of -38.7 per cent (witnessed in the year 2008-09). The Inter Industry analysis as provided in the Table 5.10 depicts that barring Professional goods, Motor vehicles, Other transport where in Technical Efficiency Change is positive, rest all the industries have witnessed technical efficiency regress in the Motor vehicles, Electrical machines excl.com equipment and Non-electrical for Industries during the entire study period.

A further comparison of pre and post transition period suggests that there is an improvement in Technical Efficiency Change growth rate. In the pre transition period it showed -1.317 per cent and where as in the post transition period it increased up to 0.695 per cent with a positive trend. An additional investigation of Inter-Industrial analysis reveal that Professional goods has reported the highest growth rate to the tune of 3.475 followed by Other transport (3.195 per cent).While, the poorest growth rate (-2.249 per cent) is observed in the Electrical machines excl.com equipment.

An analysis of Inter Temporal and Inter Industry results for Technological Change reported in the Tables 5.11 and 5.12. The Table 5.11 delineates the cyclical trends for Technological Change in the Medium High Technology Manufacturing Sector of the entire study period. The highest growth rate (17.3 percent) in terms of Technological Change is witnessed during the year 2001-02, while the lowest growth rate (-43.5 percent) is recorded during the year 2004-05.

The Study of Inter Industry Table 5.12 pertaining to Technological Change. The Professional goods, Electrical machines excl.com equipment and Non-electrical these three are negative and rest all industries of Medium High Technology Manufacturing Sector are positive for the entire study period. It is the Chemicals excl. Drugs industry that has observed the highest Technological Change to the tune of 4.762 per cent. Whereas the technical regress at the rate of -1.908 per cent for Non-electrical industry is found to be worst performing and closely followed by same growth rate for Professional goods industry of the Medium High Technology Manufacturing Sector.

A comparative analysis of Inter Industry change over the two pre and post transition periods reveals that there has been an improvement in Technological Change in all industries except two industries i.e. Motor vehicles and Chemicals excl. Drugs; where in the growth rate of Technological Change have actually fallen from 2.818 per cent to 0.299 per cent and 7.149 per cent to 3.939 per cent during the post transition period.

Further the close analysis of Technological Change for entire study period of Medium High Technology Manufacturing Sector reveals that the growth rate 0.299 per cent. However, this improvement could be attributed more to post transition period. The growth in Technological Change is much higher and positive during the Economic Openness than the Closed Economy. This reflects that on the front of introducing new

and advanced technology Economic Openness have been successful in making a significant indentation in the Medium High Technology Manufacturing Sector.

5.3.2. Sources of Total Factor Productivity of Medium High Technology Manufacturing Sector

At aggregate level, (refer Table: 5.8, 5.10 and 5.12) the Technological Change is greater than Technical Efficiency Change, which implies that the growth rate of TFP was due to shift in the frontier rather than improvement in efficiency. Hence, it suggested a positive impact of Economic Openness on technological advancement of the Medium High Technology Manufacturing Sector.

The analysis of the impact of Economic Openness on the growth rate of TFP reveals that there is an increase in the TFP growth rate from 1.9 percent in pre transition period to 2.7 percent in post transition period. The main source of TFP growth in Medium High Technology Manufacturing Sector is due to Technological Change. This result suggests that Economic Openness have positive impact on productivity of Medium High Technology Manufacturing Sector resulting as increase in TFP growth rate.

Disaggregate level of inter industry analysis in almost all industries are operating with positive productivity growth. The source of TFP growth an average both Technological Change and Technical Efficiency Change are equally contributing. The Source of TFP growth for Professional goods, Motor vehicles and Other Transport Industries was mainly due to Technical Efficiency Change, with an index, the growth ranging from 1.009 to 1.036. This result depicts that the growth in these industries was boosted by the enhancement of their productivity based on catching-up capability, specifically the effective use of human capital. Other industries like Chemical excluding drug, Non-electrical, Electrical machines excl.com equipment industries. The main source of TFP growth is Technology Change, with index scores of 1.041, 1.033 and 1.023 respectively. The result reflects that level of technology in these industries is still moderate and technological adoption can take place much easier.

Table 5.9: Efficiency Changes of Index of

Medium High Technology Manufacturing Sector: An Inter Temporal Analysis

Year	Efficiency Change	Growth Rate
1982-83	0.996	-0.4
1983-84	0.993	-0.7
1984-85	0.836	-19.6
1985-86	1.211	17.4
1986-87	0.983	-1.7
1987-88	0.904	-10.6
1988-89	1.037	3.6
1989-90	0.925	-8.1
1990-91	1.035	3.4
1991-92	1.109	9.8
1992-93	0.933	-7.2
1993-94	1.138	12.1
1994-95	0.987	-1.3
1995-96	1.079	7.3
1996-97	1.064	6
1997-98	0.819	-22.1
1998-99	1.069	6.5
1999-00	1.109	9.8
2000-01	1.019	1.9
2001-02	0.92	-8.7
2002-03	0.966	-3.5
2003-04	1.024	2.3
2004-05	0.975	-2.6
2005-06	1.14	12.3
2006-07	0.943	-6.0
2007-08	1.012	1.2
2008-09	0.721	-38.7
2009-10	1.077	7.1
2010-11	1.132	11.7
2011-12	1.007	0.7

Source: Calculations by Data Envelopment Analysis Programme (DEAP), version 2.1.

Table 5.10: Technical Efficiency Index of

Medium- High Technology Manufacturing Sector: An Inter- Industry Analysis

Industry Group	Efficiency Change			Growth rates		
	Pre Transition Period	Post Transition Period	Entire Period	Pre Transition Period	Post Transition Period	Entire Period
Professional goods	1.007	1.036	1.034	0.695	3.475	3.288
Motor vehicles	0.963	1.009	0.990	-3.842	0.892	-1.010
Electrical machines excl.com equipment	1.000	0.978	0.988	0.000	-2.249	-1.215
Chemicals excl. Drugs	1.007	1.000	1.003	0.695	0.000	0.299
Other transport	0.970	1.033	1.009	-3.093	3.195	0.892
Non-electrical	0.974	0.986	0.984	-2.669	-1.420	-1.626
Mean	0.987	1.007	1.001	-1.317	0.695	0.100

Source: Calculations by Data Envelopment Analysis Programme (DEAP), version 2.1.

Table 5.11: Technological Changes Index of

Medium High Technology Manufacturing Sector: An Inter-Temporal Analysis

Year	Technological Change	Growth Rate
1982-83	1.006	0.6
1983-84	0.979	-2.1
1984-85	1.118	10.6
1985-86	0.737	-35.7
1986-87	0.987	-1.3
1987-88	1.11	9.9
1988-89	0.941	-6.3
1989-90	1.088	8.1
1990-91	1.05	4.8
1991-92	1.094	8.6
1992-93	1.043	4.1
1993-94	0.928	-7.8
1994-95	1.123	11
1995-96	1.082	7.6
1996-97	0.854	-17.1
1997-98	1.086	7.9
1998-99	1.054	5.1
1999-00	0.923	-8.3
2000-01	0.85	-17.6
2001-02	1.209	17.3
2002-03	1.043	4.1
2003-04	1.127	11.3
2004-05	0.697	-43.5
2005-06	0.935	-7.0
2006-07	1.039	3.8
2007-08	0.974	-2.7
2008-09	0.906	-10.4
2009-10	0.999	-0.1
2010-11	0.923	-8.3
2011-12	1.094	8.6

Source: Calculations by Data Envelopment Analysis Programme (DEAP), version 2.1.

Table 5.12: Technological Change Index of

Medium- High Technology Manufacturing Sector: An Inter- Industry Analysis

Industry Group	Technological Change Index			Growth Rate		
	Pre Transition Period	Post Transition Period	Entire Period	Pre Transition Period	Post Transition Period	Entire Period
Professional goods	0.946	1.018	0.981	-5.708	1.768	-1.937
Motor vehicles	1.029	1.003	1.006	2.818	0.299	0.596
Electrical machines excl.com equipment	0.982	1.023	0.998	-1.833	2.248	-0.200
Chemicals excl. drugs	1.077	1.041	1.050	7.149	3.939	4.762
Other transport	0.990	1.026	1.004	-1.010	2.534	0.398
Non-electrical	0.952	1.014	0.981	-5.042	1.381	-1.937
Mean	0.995	1.021	1.003	-0.503	2.057	0.299

Source: Calculations by Data Envelopment Analysis Programme (DEAP), version 2.1.

5.4. Trends in Total Factor Productivity of Low-Technology Manufacturing Sector

Table 5.13 and 5.14 provides inter-temporal and inter-industry comparison of Malmquist Productivity Index for the Low Technology Manufacturing Sector. Inter-temporal analysis reveals that a cyclical fluctuations in the productivity growth of the Low Technology Manufacturing Sector. The highest TFP growth rate is at 23.5 per cent during the year 2004-05. And the lowest growth rate of TFP to the tune of -25.5 per cent in the year 1992-93. In the majority of the years the MPI is less than unitary, explaining the poor level of productivity. From Table 5.14 states that TFP growth rate in Low Technology Manufacturing Sector is regress at the rate of -1.626 per cent during the entire study period. Paper, paper products and printing industry growth highest TFP growth rate of 1.186 percent. However, out of four, three industries are i.e., Wood products and furniture, Textiles, apparel and leather, and Food, beverages and tobacco industries have been observed complete negative in its TFP growth for entire period.

Table 5.13: Malmquist Productivity Index of Low Technology Industry: An Inter-Temporal Analysis

Year	Average MPI	Growth Rate
1982-83	0.908	-10.1
1983-84	1.082	7.6
1984-85	1.033	3.2
1985-86	0.922	-8.5
1986-87	1.025	2.4
1987-88	0.953	-4.9
1988-89	1.071	6.6
1989-90	1.06	5.7
1990-91	1.069	6.5
1991-92	1.048	4.6
1992-93	0.797	-25.5
1993-94	1.088	8.1
1994-95	0.953	-4.9
1995-96	0.897	-11.5
1996-97	1.076	7.1
1997-98	0.83	-20.5
1998-99	1.043	4.1
1999-00	1.121	10.8
2000-01	0.968	-3.3
2001-02	0.96	-4.2
2002-03	0.978	-2.2
2003-04	0.97	-3.1
2004-05	1.308	23.5
2005-06	1.186	15.7
2006-07	0.938	-6.6
2007-08	0.989	-1.1
2008-09	1.048	4.6
2009-10	1.117	10.5
2010-11	1.209	17.3
2011-12	1.237	19.2

Source: Calculations by Data Envelopment Analysis Programme (DEAP), version 2.1.

Table 5.14: Malmquist Productivity Index of Low Technology Manufacturing Sector: An Inter- Industry Analysis

Industry Group	Malmquist Productivity Index			Growth Rate		
	Pre Transition Period	Post Transition Period	Entire Period	Pre Transition Period	Post Transition Period	Entire Period
Paper, paper products and printing	1.015	1.017	1.012	1.478	1.672	1.186
Textiles, apparel and leather	1.019	0.984	0.994	1.865	-1.626	-0.604
Food, beverages and tobacco	1.046	0.968	0.999	4.398	-3.306	-0.100
Wood products and furniture	0.968	0.909	0.935	-3.306	-10.011	-6.952
Mean	1.012	0.969	0.984	1.186	-3.199	-1.626

Source: Calculations by Data Envelopment Analysis Programme (DEAP), version 2.1.

To analyze the impact of Economic Openness on TFP growth, the comparison of pre and post transition period reveals that TFP growth in Low Technology Manufacturing Sector has regressed. It is at 1.186 per cent during pre-transition period and in post-transition period it declined to -3.199 percent. An Inter-Industrial analysis reveals that the Paper, paper products and printing industry has reported the highest TFP growth rate at 1.672 and the Wood products and furniture industry is found to be worst sufferer at rate of-10.011 during the post transition period. Among four industries, three industries are regress in productivity performance has been observed during post transition period in comparison to pre-transition period. i.e., Textiles, apparel and leather; Food, beverages and tobacco; and Wood products and furniture.

5.4.1. Decomposition of TFP of Low Technology Manufacturing Sector

A glimpse at Table 5.15 portrays that the inter-temporal estimates of Technical Efficiency Change is less than unitary in the entire study period. The growth rate ranges between a maximum of 30.0 per cent growth noted in the year2006-07 and a minimum of -56.0 per cent witnessed in the year 2004-05. The Inter-Industry analysis provided in the Table 5.16 depicts that Food, beverages and tobacco industry Technical Efficiency Change is positive, rest of all industries have witnessed no change (Paper, paper products and printing, Textiles, apparel and leather and Wood products and furniture).

A comparative analysis of pre and post transition period suggests that more or less it same in the TFP growth at aggregate level of Low Technology Manufacturing Sector. At disaggregate level, the Textiles, apparel and leather industry has experienced improvements in Technical Efficiency Change during pre transition period to post transition period respectively. And, rest of industries there is no change.

Analyses of Inter-Temporal and Inter-Industry result for Technological Change are reported in the Tables 5.17 and 5.18. The Table 5.17 describes the cyclical trend for Technological Change in Low Technology Manufacturing Sector in the entire study period. The highest growth rate is recorded at 29.4 percent in the year 2010-11; while the lowest growth rate is recorded as -52.7 percent is during the year 2006-07. The inter-industry analysis of entire study period the Paper, paper products and printing industry reporting positive level of Technological Change. Other remaining industries such as the Textiles, apparel and leather, Food, beverages and tobacco and Wood products and furniture are negative.

A comparative analysis of Inter Industry change pre and post transition periods reveals that there has been regress in Technological Change in all the industries except one industry i.e. Paper, paper products and printing. And, from the pre transition period to post transition period, the growth rates of Technical Change have increased from 1.478 per cent to 1.672 per cent.

Table 5.15: Efficiency Changes of

Low Technology Manufacturing Sector: An Inter-Temporal Analysis

Year	Efficiency Change	Growth rate
1982-83	1.115	10.3
1983-84	1.031	3
1984-85	0.977	-2.4
1985-86	1.099	9
1986-87	0.995	-0.5
1987-88	0.956	-4.6
1988-89	1.003	0.3
1989-90	1.045	4.3
1990-91	0.877	-14
1991-92	0.949	-5
1992-93	1.185	15.6
1993-94	0.976	-2.5
1994-95	0.981	-1.9
1995-96	0.951	-5.2
1996-97	1.039	3.8
1997-98	0.952	-5
1998-99	0.936	-6.8
1999-00	1.16	13.8
2000-01	0.944	-5.9
2001-02	1.011	1.1
2002-03	1.01	1
2003-04	0.975	-2.6
2004-05	0.64	-56
2005-06	0.862	-16
2006-07	1.433	30
2007-08	1.132	12
2008-09	0.899	-11
2009-10	0.949	-5
2010-11	0.853	-17
2011-12	1.045	4.3

Source: Calculations by Data Envelopment Analysis Programme, version 2.1.

5.4.2. Sources of Total Factor Productivity of Low Technology Manufacturing Sector

The results of the study reveal that(refer Table: 5.14, 5.16 and 5.18) the TFP growth of Low Technology Manufacturing Sector for the aggregate period is negative due to negative contribution from Technological Change. However, Technical Efficiency Change is positive with an index growth of 1.007.

The analysis of the impact of Economic Openness on TFP growth of Low Technology Manufacturing Sector reveals that TFP growth in Low Technology Manufacturing Sector has fallen from 1.2 percent (in pre transition period) to -3.1 percent in post transition period. The major source for productivity regress during the post transition period is due to Technological Change. The inter industry analysis reveals that all the industries under evaluation, a regress in the TFP growth rate. Technological Change is a major source of sluggishness in productivity performance during the post transition period in comparison to the pre transition period. But paper, paper products and printing industry is reporting productivity progress in the post transition period compared to pre transition period, the main source of TFP growth is due to Technological Change.

Table 5.16: Efficiency Change Index of Low Technology Manufacturing Sector: An Inter- Industry Analysis

Industry Group	Efficiency Change			Growth Rate		
	Pre Transition Period	Post Transition Period	Entire Period	Pre Transition Period	Post Transition Period	Entire Period
Paper, paper products and printing	1.000	1.000	1.000	0.000	0.000	0.000
Textiles, apparel and leather	1.000	1.008	1.001	0.000	0.794	0.100
Food, beverages and tobacco	1.034	1.021	1.026	3.288	2.057	2.534
Wood products and furniture	1.000	1.000	1.000	0.000	0.000	0.000
Mean	1.008	1.007	1.007	0.794	0.695	0.695

Source: Calculations by Data Envelopment Analysis Programme, version 2.1.

Table 5.17: Technological Changes Index of Low Technology Manufacturing Sector: An Inter-Temporal Analysis

Year	Technological Change	Growth Rate
1982-83	0.814	-22.9
1983-84	1.05	4.8
1984-85	1.058	5.5
1985-86	0.838	-19.3
1986-87	1.031	3
1987-88	0.997	-0.3
1988-89	1.068	6.4
1989-90	1.015	1.5
1990-91	1.219	18
1991-92	1.05	4.8
1992-93	0.673	-48.6
1993-94	1.115	10.3
1994-95	0.971	-3
1995-96	0.943	-6
1996-97	1.035	3.4
1997-98	0.872	-14.7
1998-99	1.114	10.2
1999-00	0.966	-3.5
2000-01	1.025	2.4
2001-02	0.949	-5.4
2002-03	0.968	-3.3
2003-04	0.994	-0.6
2004-05	1.068	6.4
2005-06	1.376	27.3
2006-07	0.655	-52.7
2007-08	0.874	-14.4
2008-09	1.165	14.2
2009-10	1.177	15.0
2010-11	1.417	29.4
2011-12	1.015	1.5

Source: Calculations by Data Envelopment Analysis Programme, version 2.1.

Table 5.18: Technological Change Index of

Low Technology Manufacturing Sector: An Inter- Industry Analysis

Industry Group	Technological Change			Growth Rate		
	Pre Transition Period	Post Transition Period	Entire Period	Pre Transition Period	Post Transition Period	Entire Period
Paper, paper products and printing	1.015	1.017	1.012	1.478	1.672	1.186
Textiles, apparel and leather	1.019	0.976	0.993	1.865	-2.459	-0.705
Food, beverages and tobacco	1.012	0.948	0.974	1.186	-5.485	-2.669
Wood products and furniture	0.968	0.909	0.935	-3.306	-10.011	-6.952
Mean	1.003	0.962	0.978	0.299	-3.950	-2.249

Source: Calculations by Data Envelopment Analysis Programme, version 2.1.

5.5. Trends in Total Factor Productivity of Medium Low Technology Manufacturing Sector

Tables 5.19 and 5.20 provide Inter-Temporal and Inter-Industry comparison of Malmquist Productivity Index for the Medium Low Technology Manufacturing Sector. The Inter-Temporal analysis reveals that cyclical fluctuation in the productivity growth. It has been observed that the highest TFP growth rate is 11.7 per cent during the year 1999-2000. In the year 1986-87, the lowest TFP growth rate is recorded as -19.6 per cent. The Inter Industries analysis of Table 5.20 depicts that the TFP growth of Medium Low Technology Manufacturing Sector is 0.695 during the entire study period. Petroleum refineries and coal products industry with the highest TFP growth at the rate of 5.749 per cent and the lowest is Metal products industry with TFP growth rate of -2.041. The comparison of pre and post-transition periods reveals that TFP growth rate in Medium Low Technology Manufacturing Sector has increase from -0.806 percent(pre-transition period) to 2.344 percent (post-transition period).

Table 5.19: Malmquist Productivity Index of

Medium Low Technology Manufacturing Sector: An Inter-Temporal Analysis

Year	Average MPI	Growth Rate
1982-83	1.027	2.6
1983-84	0.936	-6.8
1984-85	1.073	6.8
1985-86	1.115	10.3
1986-87	0.836	-19.6
1987-88	1.025	2.4
1988-89	1.008	0.8
1989-90	0.972	-2.9
1990-91	0.965	-3.6
1991-92	1.076	7.1
1992-93	1.052	4.9
1993-94	1.122	10.9
1994-95	0.97	-3.1
1995-96	1.061	5.7
1996-97	0.906	-10.4
1997-98	1.027	2.6
1998-99	1.049	4.7
1999-00	1.132	11.7
2000-01	0.852	-17.4
2001-02	1.067	6.3
2002-03	1.076	7.1
2003-04	1.014	1.4
2004-05	0.893	-12.0
2005-06	1.016	1.6
2006-07	1.115	10.3
2007-08	1.08	7.4
2008-09	1.009	0.9
2009-10	0.838	-19.3
2010-11	0.977	-2.4
2011-12	0.935	-7.0

Source: Calculations by Data Envelopment Analysis Programme, version 2.1.

Table 5.20: Malmquist Productivity Index of Medium- Low Technology: An Inter- Industry Analysis

Industry Group	Malmquist Productivity Index			Growth Rate		
	Pre Transition Period	Post Transition Period	Entire Period	Pre Transition Period	Post Transition Period	Entire Period
Rubber and plastic products	1.006	1.004	1.001	0.596	0.398	0.100
Shipbuilding and repairing	0.926	1.056	0.998	-7.991	5.303	-0.200
Other manufacturing	1.002	0.998	1.018	0.200	-0.200	1.768
Non-ferrous metals	1.024	1.014	1.018	2.344	1.381	1.768
Non-metallic mineral products	1.010	0.982	0.998	0.990	-1.833	-0.200
Metal products	0.921	1.020	0.980	-8.578	1.961	-2.041
Petroleum refineries and coal products	1.109	1.064	1.061	9.829	6.015	5.749
Ferrous metals (Iron& steel)	0.950	1.059	0.987	-5.263	5.571	-1.317
Mean	0.992	1.024	1.007	-0.806	2.344	0.695

Source: Calculations by Data Envelopment Analysis Programme, version 2.1.

However, at disaggregated Inter- Industry analysis has been observed at the productivity, an improvement among different industries namely: Shipbuilding and repairing, Metal products, Petroleum refineries and coal products, and Ferrous metals (Iron& steel).Among eight industries, three industries are regress of their productivity performance such as Rubber and plastic products, Other manufacturing and Non-ferrous metals industries during post transition period in comparison to pre transition period.

5.5.1. Decomposition of TFP of Medium Low Technology Manufacturing Sector

Tables 5.21 and 5.22 provide the Inter-Temporal estimates of Technical Efficiency Change and Technological Change, respectively. A broader view of the Table 5.21 explains that Technical Efficiency Change Index is less than unitary for majority of the years in the entire study period. The behaviour of the coefficients of growth rates summarizes a mix of positive and negative pattern. The growth rate ranges between a maximum of 39.2 per cent growth (noted in the year 2002-03) and a minimum of -83.8 per cent (witnessed in the year 1985-86) for the Medium High Technology Industry.

Table 5.21: Efficiency Changes index of

Medium Low Technology Manufacturing Sector: An Inter-Temporal Analysis

Year	Efficiency Change	Growth Rate
1982-83	1.035	3.4
1983-84	1.092	8.4
1984-85	1.05	4.8
1985-86	0.544	-83.8
1986-87	1.325	24.5
1987-88	0.921	-8.6
1988-89	1.14	12.3
1989-90	0.91	-9.9
1990-91	1.172	14.7
1991-92	1.076	7.1
1992-93	0.843	-18.6
1993-94	0.802	-24.7
1994-95	1.246	19.7
1995-96	1.004	0.4
1996-97	0.976	-2.5
1997-98	1.301	23.1
1998-99	0.992	-0.8
1999-00	0.914	-9.4
2000-01	1.115	10.3
2001-02	0.639	-56.5
2002-03	1.644	39.2
2003-04	0.95	-5.3
2004-05	0.954	-4.8
2005-06	0.759	-31.8
2006-07	1.025	2.4
2007-08	0.99	-1.0
2008-09	1.009	0.9
2009-10	1.057	5.4
2010-11	0.941	-6.3
2011-12	1.151	13.1

Source: Calculations by Data Envelopment Analysis Programme, version 2.1.

Table 5.22: Technological Changes index of

Medium Low Technology Manufacturing Sector: An Inter-Temporal Analysis

Year	Technological Change	Growth Rate
1982-83	0.992	-0.8
1983-84	0.857	-16.7
1984-85	1.022	2.2
1985-86	2.051	51.2
1986-87	0.631	-58.5
1987-88	1.113	10.2
1988-89	0.884	-13.1
1989-90	1.068	6.4
1990-91	0.823	-21.5
1991-92	1.172	14.7
1992-93	1.248	19.9
1993-94	1.4	28.6
1994-95	0.779	-28.4
1995-96	1.056	5.3
1996-97	0.928	-7.8
1997-98	0.789	-26.7
1998-99	1.057	5.4
1999-00	1.238	19.2
2000-01	0.764	-30.9
2001-02	1.67	40.1
2002-03	0.654	-52.9
2003-04	1.067	6.3
2004-05	0.935	-7.0
2005-06	1.339	25.3
2006-07	1.088	8.1
2007-08	1.091	8.3
2008-09	1.00	0.0
2009-10	0.793	-26.1
2010-11	1.039	3.8
2011-12	0.813	-23.0

Source: Calculations by Data Envelopment Analysis Programme, version 2.1

On the other hand, Table 5.22 depicts an analysis of Inter Temporal results for Technological Change is reported. The optimum growth rate of Technological Change is found with 28.6 per cent during the year 1993-94 in the post transition period, while the lowest growth rate is at -58.5 per cent is recorded during the year 1986-87 in the pre transition period.

Table 5.23: Efficiency Change Index of

Medium- Low Technology Manufacturing Sector: An Inter- Industry Analysis

Industry Group	Efficiency Change			Growth Rate		
	Pre Transition Period	Post Transition Period	Entire Period	Pre Transition Period	Post Transition Period	Entire Period
Rubber and plastic products	1.008	1.006	1.009	0.794	0.596	0.892
Shipbuilding and repairing	0.920	1.032	0.985	-8.696	3.101	-1.523
Other manufacturing	1.103	1.000	1.041	9.338	0.000	3.939
Non-ferrous metals	1.013	0.988	1.005	1.283	-1.215	0.498
Non-metallic mineral products	1.010	0.974	0.998	0.990	-2.669	-0.200
Metal products	0.990	1.005	0.993	-1.010	0.498	-0.705
Petroleum refineries and coal products	1.000	1.000	1.000	0.000	0.000	0.000
Ferrous metals (Iron& steel)	0.929	1.052	0.991	-7.643	4.943	-0.908
Mean	0.995	1.007	1.003	-0.503	0.695	0.299

Source: Calculations by Data Envelopment Analysis Programme, version 2.1

The Table 5.23 provides an inter-industry analysis of Technical Efficiency Change for the Medium Low Technology Manufacturing Sector. At disaggregate level analysis shows that except four industries namely Shipbuilding and repairing, Non-metallic mineral products, Metal products and Ferrous metals (Iron and Steel) are in efficiency regress and rest of other industries are in progress for entire study period.

A comparison analysis of pre and post transition period reveals that at efficiency front, an improvement has been noticed from 0.503 percent in pre transition period and it increased up to 0.695 percent in the post transition period. Furthermore, in the Ferrous metals (Iron and Steel) and Shipbuilding and repairing has more improvement. The Petroleum refineries and coal products industry has no Efficiency Change in pre and post transition period.

Table 5.24: Technological Change Index of Medium- Low Technology Manufacturing Sector: An Inter- Industry Analysis

Industry Group	Technological Change			Growth Rate		
	Pre Transition Period	Post Transition Period	Entire Period	Pre Transition Period	Post Transition Period	Entire Period
Rubber and plastic products	0.998	0.998	0.992	-0.200	-0.200	-0.806
Shipbuilding and repairing	1.006	1.023	1.013	0.596	2.248	1.283
Other manufacturing	0.909	0.998	0.978	-10.011	-0.200	-2.249
Non-ferrous metals	1.011	1.026	1.013	1.088	2.534	1.283
Non-metallic mineral products	1.001	1.009	1.000	0.100	0.892	0.000
Metal products	0.931	1.015	0.988	-7.411	1.478	-1.215
Petroleum refineries and coal products	1.109	1.064	1.061	9.829	6.015	5.749
Ferrous metals (Iron& steel)	1.023	1.007	0.996	2.248	0.695	-0.402
Mean	0.997	1.017	1.005	-0.301	1.672	0.498

Source: Calculations by Data Envelopment Analysis Programme, version 2.1

The Table 5.24 deals with an Inter Industries analysis of Technological Change of Medium Low Technology Manufacturing Sector depicts that Rubber and plastic products, Other manufacturing, Metal products and Ferrous metals (Iron& steel) are in regress and rest of all industries reporting positive level of Technological Change for entire study period. The Petroleum refineries and coal products industry has observed the highest Technical Change to the tune of 5.749 percent. Whereas other manufacturing industry is found to be worst performing at the rate of -2.249 percent. Furthermore, perusal of the Table 5.24 summarizes that at Medium Low Technology Manufacturing Sector rises in the rate of Technological Change from -0.301 percent during pre transition period to 1.672 percent during post transition period. An Inter Industry analysis reveals that among industries (expect Rubber and plastic products) under evaluation a positive.

5.5.2. Sources of TFP of Medium Low Technology Manufacturing Sector

The analysis of the sources of the TFP growth in Medium Low Technology Manufacturing Sector reveals that (refer Table: 5.20, 5.23 and 5.24) an average both Technological Change and Technical Efficiency Change are equally contributing TFP growth in this sector. It has also been observed that at all aggregate level, the Technological Change is greater than Efficiency Change, which implies that the growth in TFP was due to shift in the frontier rather than improvement in efficiency. Hence, the study suggests that a positive impact of Economic Openness on technological advancement of the Medium Low Technology Manufacturing Sector. The analysis of the impact of Economic Openness on TFP growth reveals that the TFP growth in Medium Low Technology Manufacturing Sector has been increased from -0.8 percent in pre transition period to 2.4 percent during post transition period. Hence at aggregated levels impact of Economic Openness is positive. The main source of TFP growth is due to Technological Change. The Inter industry analysis reveal that among all the industries, five industries are i.e., Rubber & Plastic products, Other manufacturing industry, Non-ferrous metals, Non- metal products and petroleum refineries and coal products growth rate of TFP is positive during pre transition period compare to post transition period. On and average, the Technical Efficiency Change is the key driving force of TFP growth in the pre transition period. On other hand, remaining industries are positive in growth rate during the post transition period and the main source of TFP growth is due to Technical Efficiency Change

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CHAPTER-VI

CONCLUSION AND RECOMMENDATIONS

CHAPTER - VI

Conclusion and Recommendations

In the late 1980s, the emergence of the "new growth" theories provided a rigorous analytical framework and within which liberalisation can be linked with economic growth. In particular, the impact of economic openness of any country brings technological changes in domestic technology and ultimately it leads to improvements in productivity, it also helps the production process become more efficient. The evidence of the liberalisation-productivity nexus for industrial sectors in different developing countries is mixed. The empirical evidence on the impact of Economic Openness measures on the productivity performance for Indian industries is limited.

The earlier studies suggest that, increase in Total Factor Productivity growth is an important source of industrial growth. The empirical findings from these studies yield different results. Most of these studies have concluded that the rate of TFP growth in Indian Manufacturing Sector has been very low. No rigorous empirical analysis has been undertaken to explain the poor productivity performance of Indian Manufacturing Sector (Goldar, 1986). And, also very little attention paid for the evaluation of the causes of productivity changes in Indian Manufacturing Sector. In this regard, the present study mainly focuses on the Industrial Growth and the measurement of Total Factor Productivity growth. Hence, there is need to employ an appropriate methodology for the analysing the performance of industry, particularly with respect to Total Factor Productivity and Efficiency.

In this framework, the study attempts to examine the following specific objectives:

1. To analyse the growth performance of Gross Value Added, Capital and Labour in the selected industries in India,
2. To examine the growth of Total Factor Productivity during the Pre and Post Transition period and
3. To identify the sources of Total Factor Productivity growth during the Pre and Post Transition period.

In this connection, Data Envelopment Analysis (DEA) approach-the Malmquist productivity Index (MPI) has been used to analyze TFP growth. It is a special mathematical linear programming model test to assess efficiency and productivity. It allows use of panel data to estimate changes in TFP and breaking it down into two components namely, technological change and technical efficiency change. The present study endeavours to analyze the TFP growth trends in Indian manufacturing sector based on technology classification as High Technology, Medium High Technology, Low Technology and Medium Low Technology Manufacturing Sectors at both aggregated and disaggregated inter-industry levels. Using the Malmquist Productivity Index for panel dataset of 22 major industries over a period of 31 years spanning over 1981-82 to 2011-12. The Total Factor Productivity Change Index results are calculated by using Data Envelopment Analysis Programme 2.1 (DEAP) linear programme developed by Coelli et.al (1998).

6.1. Findings of the study

6.1.1. Growth Performance Analysis of High Technology Manufacturing Sector

- A comparative analysis of *pre and post transition* period results indicated that the trend in growth rate of *GVA* during post transition period has positive in the transition period and in same way growth rate of *capital* is also positive, whereas the growth rate of *labour* is negative when compared to pre transition period.

- At disaggregate analysis results indicated that almost all industries are positive in the post transition period. The highest growth rate of GVA recorded by Radio, TV & Communication Industry and the lowest growth rate of GVA recorded by Drug & Medicines Industry in the post transition period.

- And another finding is that in almost all industries recorded a positive growth rate of *Capital* in the post transition period. The highest growth rate of capital witnessed in the Office & Computing equipment Industry and the lowest growth rate of capital is recorded by the Drug & Medicines in the post transition period when compare to pre transition period.

- At the aggregate and disaggregate level, the growth rate of *labour* was found lower than the Gross Value Added and Capital in all the industries and the growth rate was found to be less than 2 per cent during the study period.

- And further, it is observed that, the highest growth rate of *labour* was found in the Office & Computing equipment industry in the post transition period. Drug & Medicines Industry has scored the lowest growth rate of labour during transition period.

- At disaggregate industrial level of pre and post transition period comparison depicts that the trend in growth rate of labour during Post transition period have been decreased drastically in almost all industries.

However, more specifically, it is clearly visible that the growth of GVA and Capital are positive in the post transition period. The reason may be the economic openness, which made FDI flows and import of technology increased in the country but whereas, in the case of labour the results are negative. High Technology manufacturing industries are generally capital intensive based Industries this may be cause for the utilisation of labour in these Industries very low and the results are negative in the growth rate of labour.

6.1.2. Growth Performance Analysis of Medium High Technology Manufacturing Sector

- A comparative analysis of pre and post transition period results indicated that the trend in growth rate of *GVA* during post transition period has positive in the transition period. And whereas the growth rate of capital and the labour is negative in this period. Out of 6 industrial groups, 5 industries have witnessed acceleration in the growth rate of GVA during the post transition period. The highest growth rate of GVA was found in the Other Transport Industry and the lowest was recorded Non electrical Industry in the post transition period.

- Another finding is that, almost all industries are witnessed turn down in the growth rate of *capital* recorded in the post transition period. The growth rate of capital highest in the Professional goods Industry and lowest growth rate of capital

recorded by Non-electrical industry to the in the pre transition period when compare to post transition period.

- Growth rate of labour is lower than the Gross Value Added and capital in all the industries during the aggregate and disaggregate study period. In most of the industries, the growth rate was found less than two per cent during the same period.

- A pre and post transition period comparison analysis results indicated that the trend in growth rate of *labour* during post transition period has negative. Out of 6 industrial groups, 3 industries have witnessed acceleration in the growth rate of labour during the pre transition period except others such as Professional goods, Chemicals excl. Drugs and Other transport Industries. And, whereas the Electrical machines excl.com equipment, Non- electrical and Motor vehicles Industries recorded negative growth rate of labour during the post transition period.

However, the *Medium High Technology Manufacturing Sector* observed that the growth rate of GVA is positive and the growth rate of capital and labour are negative in the post transition period. It implies that in pre transition period the capital and labour growth is positive. The reason for this situation is that, the scale of operation may not be optimal in utilisation of resources. It deliberately indicates that economic openness resulted in an adverse impact on Medium High Technology Manufacturing Sector.

6.1.3. Growth Performance Analysis of Low Technology Manufacturing Sector

- A comparative analysis of pre and post transition period reveals that almost all industries growth rate of *GVA* decreased in post transition period compare to pre transition period. The highest growth rate of GVA found in the Food, beverages and Tobacco Industry to the extent of 9.8 in the pre transition period Wood products and furniture Industry found at the lowest growth rate of 1.8 per cent in the post transition period.

- A pre and post transition period comparison depicts that there has been a decrease in the rate of growth of *capital* from 17.5 per cent to 10.3 per cent during the post transition period.

- And also at disaggregate industries level, all most all industries has been witnessed decreased in the growth rate of capital in the post transition period. The highest growth rate of capital recorded in the Food, beverages and Tobacco Industry was 18.5 per cent and the lowest growth rate of capital found in the Paper, paper products and printing Industry to extent of 15.6.per cent in the same period.

- In all the industries, the growth rate of *labour* is lower than the Gross Value Added and capital during the entire study period at the aggregate level. A pre and post transition period comparison analysis suggests that the trend in growth rate of labour during post transition period resulted in negative. The highest growth rate of labour was found in the Food, beverages and Tobacco Industry in the pre transition period. Wood products and furniture Industry found at the lowest growth rate in the post transition period.

Specifically, the Economic Openness demonstrates adverse affect on GVA, Capital and Labour of Low Technology Manufacturing Sector. The reason may be that, prior to 1991, Indian Industries protected with tariffs and quantities restrictions (QRs) but after 1991 tariffs has been reduced due to economic openness. Despite the fact that, this Low Technology Manufacturing Sector basically known as labour intensive industries expected that the labour employment would be positive whereas it showed negative result.

6.1.4. Growth Performance Analysis of Medium Low Technology Manufacturing Sector

- A comparative analysis of pre and post transition periods declares that the growth rate of *GVA* and *capital* were decreased in the post transition. Whereas, in the growth rate of *labour* is positive.

- At disaggregate level results indicated Out of 8 industrial groups,3 industries have witnessed acceleration in the growth rate of *GVA* during the post transition

period and the other five was not so. The highest growth rate of GVA found in Petroleum refineries and Coal products the Industry to the extent of 14.1 in the post transition period And, the lowest growth rate of GVA was recorded with -12.1 per cent in the Shipbuilding and repairing in pre transition period.

- Inter industrial level results found, almost all industries witnessed acceleration in the growth rate of *capital* recorded in the pre transition period. The highest growth rate of capital was recorded 25.1 per cent in the Rubber and plastic products Industry in the pre transition period. The growth rate was found lowest growth rate of capital by Shipbuilding and repairing Industry to the extent of 1.1 per cent in pre transition period.

- A pre and post transition period comparison analysis suggests that the trend in growth rate of *labour* during post transition periods shown a positive result and it raised from -0.9 per cent to 0.9 per cent for Medium Low Technology Manufacturing Sector at aggregate level.

- Out of 8 industrial groups, 4 industries have witnessed acceleration in the growth rate of labour during the post transition period. The highest growth rate was found in the Other Manufacturing Industries with 8.4 per cent and whereas Non-ferrous metals Industry recorded as -7.5 per cent of negative growth rate of labour during the post transition period.

To conclude, in the Medium Low Technology Manufacturing Sector, the growth rate of GVA and capital are positive pre transition period and the growth rate of labour is negative and whereas the growth rate of labour in the post transition period is positive due to labour intensive industries are promoted.

6.2. Trends in Total Factor Productivity Growth (TFPG) and Sources of TFP Growth - Industry wise Findings

6.2.1. High -Technology Manufacturing Sector

- It has been noticed that in the High Technology Manufacturing Sector an overall experienced positive with an index of 1.004 of TFP growth during entire study period.
- The analysis of the impact of economic openness on TFP growth of High Technology Manufacturing Sector reveals that TFP growth is increased from -4.2

percent of Pre Transition period to 2.0 percent during Post Transition period. Hence, at aggregated levels, the impact of economic openness is in a desired direction as envisaged by the policy planners of India. The technological change is the main source of TFP growth in High Technology Manufacturing Sector.

- At disaggregated inter-industry levels, the analysis of pre and post transition reveals that the Office & Computing equipment and Radio, TV& Communication are efficient Industries having TFP growth equal or above one. This means that, the office Computing equipment and Radio, TV& Communication Industries were able to cause shifts in their own frontier, due to innovation in the post transition period and the remaining industry is Drug & Medicines suffered a decline in TFP growth in Post Transition period. And, Office & Computing equipment Industry registered the highest TFP growth at the rate of 8.1 per cent and the lowest is at the TFP growth rate of -4.6 per cent in Drug & Medicines.

And, more specifically, the main source of TFP growth High Technology Manufacturing Sector due to technological change. It implies that the impact of economic openness shows positive results and another important reason is after openness of economy the import of technology increased, for the reason that productivity positive in the post transition period.

6.2.2. Medium High Technology Manufacturing Sector

- The study affirms that the Medium High- Technology Manufacturing Sector experienced positive with an index of TFP growth 1.004 during entire study period. The analysis of the sources of the TFP growth in Medium High-Technology Manufacturing Sector reveals that an average both technological change and technical efficiency change are equally contributing TFP growth in sector under the study period.

- The analysis of the impact of economic openness on TFP growth of Medium High Technology Manufacturing Sector reveals that TFP growth has -1.9 percent during pre transition period and it was increased upto 2.7 percent in the post transition period. The main source of TFP growth in Medium High technology Manufacturing Sector is due to technological change.

- Disaggregate level analysis almost all industries are operating with positive productivity growth in the post transition period. The highest TFP growth was in the Professional goods and Other transport Industries. The main source of TFP growth in the post transition period was due to technical efficiency change. The other least efficient industry is Non electrical and other inefficient industries are Electrical machines excl.com equipment and Motor vehicles.

More specifically, the Medium High Technology Manufacturing Sector's TFP growth rate has been positive in post transition period. The main source it is the technology change, thereby it implies the improvement in the techniques and production process either by innovations or through technological adoptions among industries. It results in shift ascendant of the production frontier.

6.2.3. Low Technology Manufacturing Sector

- The results of the study reveal that TFP growth of Low -Technology Manufacturing Sector in this entire study period is negative with an index of 0.984. This is because of the negative contribution of technological change. However, technical efficiency change is positive with an index growth of 1.007. This implies that the Low Technology Manufacturing Sector is operating at its maximum potential output. Considering individually, some industries are still operating below of its maximum potential output.
- The analysis of the impact of economic openness on TFP growth of Low Technology Manufacturing Sector reveals that TFP growth has fallen from 1.2 percent in pre transition period) to -3.1 percent in post transition period. The major factor responsible for productivity regress during the post transition period is technological change. However, at efficiency front an improvement has been noticed during the post reform period.
- The Paper, paper products and printing Industry is reporting highest productivity progress in the post transition period compared to pre transition period. The main source of TFP growth is due to technological change. The least efficient industry is Wood products and furniture.

More specifically, this result reveals that the growth in these industries was boosted by the enhancement of their productivity -based catching-up capability,

specifically the effective use of human capital in the labour market. Even though, these industries are capital intensive (high expenses on physical asset) but not optimally benefit from technological change.

6.2.4. Medium-Low Technology Manufacturing Sector

- The findings of the study indicates that the Medium Low Technology Manufacturing Sector positive TFP growth with an index of 1.007 during entire study period. The analysis of the sources of the TFP growth reveals that an average both technological change and technical efficiency change are equally contributing TFP growth in sector under evaluation.
- The analysis of the impact of economic openness on TFP growth of Medium Low Technology Manufacturing Sector reveals that TFP growth is positive. It increased from -0.8 percent in the pre transition period to 2.4 percent during post transition period. Therefore, at aggregated level the impact of economic openness is positive. The main source of TFP growth in Medium Low technology Manufacturing Sector is due to technological change.
- The Inter industry analysis reveals that out of eight industries five industries are positive and are as follows: Rubber & Plastic products, Other Manufacturing Industry, Non-ferrous metals, Non metallic mineral products and Petroleum refineries and Coal products growth of TFP is positive during pre transition period compare to post transition period.
- This indicates that the economic openness have adverse impact on particular industries productivity growth resulting declining in TFP growth in the post transition period. On other hand remaining industries are positive growth in the post transition period, the main source of TFP growth is due to technical efficiency change.

To conclude, at all aggregate level, the technological change is greater than technical efficiency change, which implies that the growth in TFP was due to shift in the frontier rather than improvement in efficiency. Hence, the fact is that this result projects a positive impact of economic openness on technological advancement in the Medium Low-Technology Manufacturing Sector.

6.3. Recommendations and Policy implications

- The *High Technology, Medium High Technology, Low Technology and Medium-Low Technology Manufacturing Sectors* are classified on bases of technology in which the growth rate of labour was neglected. And, except the *Low Technology,* remaining all Manufacturing Sectors, the sources of growth rate of TFG mainly contributed by the technological change. It implies that technological efficiency change must be improved in these sectors. In this regard, a strategic plan must be made to improve labour efficiency, for this purpose through systematic advanced training programmes on imported technologies and continuous monitoring which increases productivity and efficiency. The country like India need to utilize human resources to the optimum level in the above said four manufacturing sectors.

- This study also suggests that Low Technology Manufacturing Sector growth of capital in post transition period indicates very low. This proclaims that there is urgent need to pay attention on this sector and sufficient investment must be allocated to improve productivity.

- Research and Development of these four sectors are very much essential to improve the quality and quantity of products, it impacts not only to increase productivity but also optimum utilization of man power for innovations which leads to all TFP growth of industries.

- This focused study on these Manufacturing Sectors recommends that each industries issue may be dealt separately with individual care to improve its productivity. The week industries need to be strengthened in the area they required. In this regard the Government should frame special policies, giving priorities to these sectors.

- In the low performed industries, FDI inflows Government need to be promoted with suitable policies.

- The Government should support the employment intensive industries along with infrastructural facilities

- For sustainability of Indian Industries, its products and also to withstand in the competitiveness of the international market, there is an urgent need to adopt available new technologies across the world.

The above research highlights and projects the existing reality of the Manufacturing Sectors classified on technology. It helps to understand various industries and its trends in growth, structure, Industrial productivity performance. This research establishes a strong foundation for further study at micro level of Indian Manufacturing Sector which will lead to accelerate in productivity, efficiency and boost up the Indian Manufacturing Sector.

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APPENDIX

ANNEXURE- I

Two- Digit Details of NATIONAL INDUSTRIAL CLASSFICATION (NIC) 1987

Industry Code No	Major Industry Groups
20-21	Food Products and other Food Products,
22	Beverages, Tobacco and Tobacco Products
23	Cotton Textiles
25	Jute, Hemp and Mesta Textiles
26	Other textiles (incl. Wearing apparel other than footwear
27	Wood and Wood Products, Furniture's and fixtures
28	Paper and paper products and printing industry
29	Leather, Leather and Fur Products (except repairs)
30	Chemicals & Chemical Products
31	Rubber, Plastic, Petroleum and Coal Products
32	Non-metallic Mineral Products
33	Basic Metal and Alloys Products
34	Metal Products and Parts (except Machinery & Transport)
35-36	Machinery and Equipments: Other than transport equipments
37	Transport Equipment and Parts
38	Other Manufacturing Industries

Source: MOSPI, New Delhi

ANNEXURE- II

NATIONAL INDUSTRIAL CLASSFICATION (NIC 87)

Three Digit Codes and Description

Industry Code Division	Group	Description of Industry
20		**Manufacture of Food Products and 21 Manufactures of Other Food Products**
	200	Slaughtering, Preparation and Preservation of Meat
	201	Manufactures of Dairy Products
	202	Canning And Preservation of Fruits and Vegetables
	203	Canning, Preserving and Processing of Fish, Crustacea
	204	Grain Mill Products
	205	Manufactures of Bakery Products
	206	Manufactures And Refining of Sugar (Vacuum Pan Sugar Factories)
	207	Production of Indigenous, Sugar, From Sugar Cane, Palm Juice, Etc.
	208	Production of Common Salt
	209	Manufactures of Cocoa, Chocolate And Sugar Confactionary
	210	Manufacture of Hydrogenated Oils, Vanaspati Ghee, Etc.
	211	Manufacture of Edible Oils, Fats, Mustard Oil, Ground Nut Oil, Etc.
	212	Tea Processing
	213	Coffee Curing, Roasting And Grinding
	214	Cashewnut Processing Like Drying, Shelling, Roasting, Salting, Etc.
	215	Processing of Edible Nuts
	216	Manufacture of Ice
	217	Manufacture of Prepared Animal And Bird Feed
	218	Manufacture of Starch
	219	Manufacture of Food Products Not Elsewhere Classified
22		**Manufacture of Beverages,Tobacco and Tobacco Products**
	220	Distilling, Rectifying and Blending Of Spirits 3
	221	Wine Industries
	222	Malt Liquors and Malt
	223	Production of Country Liquor(Arrack And Toddy Etc)
	224	Manufacture of Soft Drinks And Syrups

	225	Tobacco Stemming, Redrying and All Other Operations Connected With Preparing Raw Leaf Tobacco
	226	Manufacture of Bidi
	227	Manufacture of Cigars, Cigarettes, Cheroots And Cigarette Tobacco
	228	Manufacture of Chewing Tobacco,'Zarda'and'snuff' And Other Tobacco Products Nec(Except Pan-Masala Containing Tobacco
	229	Manufacture of Tobacco And Tobacco Products Not Elsewhere Classified
23		**Manufacture of Cotten Textiles**
	230	Cotton Ginning, Cleaning and Baling
	231	Cotton Spinning, Weawing, Shrinking, Sanforizing, Mercerising
	232	Printing, Dyeing And Bleaching of Cotton Textiles
	233	Cotton Spinning Other Than In Mills (Charkha)
	234	Production of Khadi
	235	Weaving and Finishing of Cotton Textiles In Handlooms, Other Than Khadi
	236	Weaving and Finishing of Cotton Textiles In Powerlooms
	239	Cotton Textiles Not Elsewhere Classified
24		**Manufacture of Wool, Silk and Synthetic Fibre Textiles**
	240	preparation of raw wool, silk and artificial/synthetic textile fibres for spinning
	241	wool spinning, weaving and finishing other than in mills.
	242	wool spinning, weaving and processing in mills
	243	dyeing and bleaching of woollen textiles
	244	spinning, weaving and finishing of silk textiles other than in mills
	245	spinning, weaving and processing of silk textiles in mills
	246	printing, dyeing and bleaching of silk textiles
	247	spinning, weaving and processing of man-made textiles fibres
	248	printing, dyeing and bleaching of artificial/synthetic textile fabrics
	249	silk and synthetic fibre textiles not elsewhere classified
25		**Manufacture of Jute and Vegetable Fibre Textiles(Except Cotton)**
	250	Jute and Mesta Pressing and Baling
	251	Jute and Mesta Spinning and Weaving
	252	Dyeing, Printing and Bleaching of Jute Textiles
	253	Preparing, Spinning, Weaving and Finishing Of Hemp And Other Coarse Fibre
	254	Spinning Weaving and Finishing of Jute And Mesta Textiles
	255	Spinning, Weaving and Finishing of Coir Textiles

	256	Spinning, Weaving and Finishing of Sann hemp And Other Vegetable Fibre Textiles Nec
	257	Bleaching, Dyeing and Printing of Jute And Mesta Textiles
	258	Bleaching, Dyeing and Printing of Coir Textiles
	259	Bleaching, Dyeing and Printing of Other Vegetable Fibre Textiles Nec
26		**Manufacture of Textile Products (Including Wearing Apparel)**
	260	Manufacture of Knitted or Corcheted Textile Products
	261	Manufacture of All Types of Threads Cordage Ropes, Twine Nets Etc.
	262	Embroidery Work, Zari Work And Making Of Ornamental Trimmings
	263	263 Weaving Carpets, Rugs and Other Similar Textile Products
	264	264 Manufactures of Floor Coverings of Jute, Mesta Sann-Hemp And Other Kindred Fibres And of Coir
	265	Manufacture of Raincoats, Hats, Etc.
	266	266 Manufacture of Made Up Textile Goods such as Curtains, Mosquito Nets Etc.
	267	267 Manufacture of Water-Proof Textiles, such as Oil Cloth, Tarpaulin Etc.
	268	268 Manufactures of Waterproof Textile Fabrics
	269	Manufacture of Textiles Nec Like Linoleum, Padding, .Wadding, Upholstering And Filling, Etc.
27		**Manufactures of Wood and Wood Products, Furniture and Fixtures**
	270	Sawing and Planning of Wood (Other Than Plywood)
	271	Manufacture of Veneer Sheets, Plywood and Their Products.
	273	Manufacture of Wooden and Cane Boxes Baskets and Similar Products Made From Bamboo And Reed, Etc.
	272	Manufactures of Structural Wooden Goods (Including Treated Timber)
	274	Manufacture of Wooden Industrial Goods Nec
	275	Manufacture of Cork And Cork Products
	276	Manufacture of Wooden Furniture And Fixtures
	277	Manufacture of Bamboo And Cane Furniture And Fixtures
	279	Manufacture of Products Of Wood, Bamboo, Reed, Grass And Cane
28		**Manufacture of Paper and Paper Products and Printing, Publishing and Allied Industries**
	280	Manufacture of Pulp, Paper And Paper Board, Including
	281	Manufacture of Containers And Boxes Of Paper Or Paper Board
	282	Manufacture of Paper And Paper Board Articles And Pulp Products Not

		Elsewhere Classified
	283	Manufacture of Special Purpose Paper Whether Or Not Printed Nec.
	284	Printing And Publishing of Newspapers
	285	Printing And Publishing of Periodicals, Books, Journals, Directories Atlases, Maps, Sheet
		Music, Schedules And Pamphlets, Etc.
	286	Printing of Bank Notes, Currency Notes, Postage Stamps, Security Passes, Stamp Papers And Other Similar Products
	287	Engraving, Etching and Block-Making Etc.
	288	Books Binding On Account Of Others
	289	Printing And Allied Activities Nec
29		**Manufacture of Leather and Products of Leather, Fur Substitutes of Leather**
	290	Tanning, Curing, Finishing, Embossing and Japanning of Leather
	291	Manufacture of Footwear Except of Vulcanized Or Moulded Rubber Or Plastic
	292	Manufacture of Wearing Apparel of Leather And Substitutes of Leather
	293	Manufacture of Consumer Goods of Leather And Substitutes of Leather; Other Than Apparel And Footwear
	294	Scrapping, Currying, Tanning, Bleaching And Dyeing of Fur And Other Pelts For The Trade.
	295	Manufacture of Wearing Apparel of Fur And Pelts
	296	Manufacture of Fur And Skin Rugs And Other Similar Articles
	299	Manufacture of Leather And Fur Products Not Elsewhere Classified
30		**Manufacture of Basic Chemicals and Chemical Products (Except Products of Petroleum and Coal)**
	300	Manufacture of Indutrials Organic And Inorganic Chemicals(Manufacture Of Chemicals For Laboratory And Technical Uses Is Classified In 309.4
	301	Manufacture of Fertilizers And Pesticides
	302	Manufacture of Plastics In Primary Forms; Manufacture Of Synthetic Rubber
	303	Manufacture of Paints, Varnishes, And Related Products, Artists' Colours And Ink
	304	Manufacture of Drugs, Medicines And Allied Products
	305	Manufacture of Perfumes, Cosmetics, Lotions, Hailr Dressings, Toothplastes, Soap In Anyfor,
		Detetgents, Shampoos, Shaving Products, Washing And Cleanilng

		Preparations And Other
		Toilet Preparations
	306	Production of Man-Made Fibres
	307	Manufacture of Matches
	308	Manufacture of Explosives; Ammunition And Fire-Works
	309	Manufacture of Chemical Products Nec
31		**Mfg of Ruubber,Plastic, Petroleum and Coal Products Processing of Nuclear Fuels**
	310	Tyres And Tubes Industries
	311	Manufacture of Footwear Made Primarily Of Vulcanized Ormoulded Rubber And Plastics
	312	Manufacture of Rubber Products
	313	Manufacture of Plastic Products Nec
	314	Manufacture of Refined Petroleum Products.
	315	Bottling of Natural Gas Or Liquified Petroleum Gas.
	316	Manufacture of Refined Petroleum Products N.E.C.
	317	Processing of Nuclear Fuels
	318	Manufacture of Coke Oven Products
	319	Manufacture of Other Coal And Coal Tar Products N.E.C.
32		**Manufacture of Non-Metallic Mineral Products**.
	320	Manufacture of Structural Clay Products
	321	Manufacture of Glass And Glass Products
	322	Manufacture of Earthenware And Plaster Products
	323	Manufacture of Non-Structural Ceramic Ware
	324	Manufacture of Cement, Lime And Plaster
	325	Manufacture of Mica Products
	326	Manufacture of Structural Stone Goods, Stoneware, Stone Dressing And Stone
	327	Manufacture of Asbestos Cement And Other Cement Products
	329	Manufacture of Miscellaneous Non-Metallic Mineral Products N.E.C.
	33	**Basic Metal and Alloys Industries**
	330	Manufacture of Iron And Steel In Primary/Semi-Finished Forms
	331	Manufacture of Semi-Finished Iron And Steel Products In Rerolling, Cold Rolling,Wire- Drawing Mil
	332	Manufacture of Ferro-Alloys

	333	Copper Manufacturing
	334	Brass Manufacturing
	335	Aluminium Manufacturing Er Semi-Finished Products Of Aluminium N.E.C.
	336	Zinc Manufacturing
	337	Casting of Metals
	338	Processing/Re-Rolling Of Metal Scrap soother than Iron And Steel Scraps
	339	Other Non-Ferrous Metal Industries
	34	**Manufacture of Metal Products and Parts, Except Machinery & Equipment**
	340	Manufacture of Fabricated Structural Metal Products
	341	Manufacture of Fabricated Metal Products N.E.C.
	342	Manufacture of Furniture And Fixtures Primarily Of Metal
	343	Manufacture of Hand Tools And General Hardware
	344	Forging, Pressing, Stamping And Roll-Forming Of Metal, Powder Metallurgy.
	345	Treatment Or Coating Of Metals, General Mechanical Engineering On A Sub-Contract Basis.
	346	Manufacture of Metal Cutlery, Utensils And Kitchenware
	349	Manufacture of Metal Products Except Machinery And Transport
35&36		**Manufacture of Machinery and Equipment Other Than Transport Equipment**
	350	Manufacture of Agricultural Machinery And Equipment And Parts Thereof.
	351	Manufacture of Machinery And Equipment Used By Construction And Mining Industries.
	352	Manufacture of Prime Movers, Boilers And Steam Generating Plants And Nuclear Reactors
	354	Manufacture of Industrial Machinery For Other Than Food And Textile Industries
	355	Manufacture of Refrigerators, Air-Conditioners And Fire Fighting Equipment
	356	Manufacture of General Purpose Non-Electrical Machinery/Equipment, Their Components
		and Accessories, Nec
	357	Manufacture of Machine Tools, Their Parts And Accessories
	358	Manufacture of Office Computing And Accounting Machinery And
	359	Manufacture of Special Plurpose Machinery/Equipment, Their Components And Accossories Nec
	360	Manufacture of Electrical Machinery,Apparatus, Appliance And Supplies.

	361	Manufacture of Insulated Wires And Cables
	362	Manufacture of Accumulators Primary Cells And Primary Batteries
	363	Manufacture of Electrical Lamps
	364	Manufacture of Electric Fans And Electric/Electro-Thermic Domestic Appliances And Parts Therof
	365	Manufacture of Apparatus For Radio Broadcasting Television Transmission
	367	Manufacture of Computers & Computer Basedsystems.
	368	Manufacture of Electronic Valves & Tubes & Other Electronic Components Nec
	369	Manufacture of Radiographic X-Ray Apparatus,Tubes Parts & Manufacture Of Electrical Equipment Nec
37		**Manufacture of Transport Equipment and Parts.**
	370	Ship And Boat Building
	371	Manufacture of Locomotives And Parts
	372	Manufacture of Railway/Tramway Wagons And Coaches And Other Railroadequipment Nec.
	373	Manufacture of Heavy Motor Vehicles;Coach Works.
	374	Manufacture of Motor Cars & Other Motor Vehicles Principally Designed For The Transport Of Less Than 10 Persons
	375	Manufacture of Motor-Cycles & Scooters & Parts(Three-Wheelers)
	376	Manufacture of Bicycles,Cycle-Rickshaws & Parts
	377	Manufacture of Aircraft,Space Craft & Their Parts
	378	Manufacture of Bullock-Carts,Push-Carts & Hand-Carts Etc
	379	Manufacture of Transport Equipment & Parts Nec
38		**Other Manufacturing Industries**
	380	Manufacture of Medical, Surgical Scientific & Measuring Equipment Except Optical Equipment
	381	Manufacture of Photographic,Cinematographic & Optical Goods & Equipment
	382	Manufacture of Watches And Clocks
	383	383 Manufacture of Jewellery And Related Articles
	384	384 Minting of Currency Coins
	385	385 Manufacture of Sports And Athletic Goods
	386	386 Manufacture of Musical Instruments (Manufacture Of Toy Musical Instrument Is Classified In Group 389)
	387	Manufacture of Stationery Articles Nec

	388	Manufacture of Items Solars Cells,Cookers,Air And Water Heating Systems And Other Related Items
	389	Manufacture of Miscellaneous Products Nec
	390	Repair of Agricultural Machinery/Equipment
	391	Repair of Prime-Movers,Boilers,Steam-Generating Plants And Nuclear Reactors
	392	Repair of Machine Tools
	393	Repair of Industrial Machinery Other Than Machine Tools
	394	Repair of Office, Computing And Accounting Machinery
	395	Repair of Electrical Industrial Machinery And Apparatis
	396	Repair of Apparatus For Radio-Broadcasting Or Television Transmission:Radar,Radio Remote C Telephony
	397	Repair of Locomotives And Other Railroad Equipment
	398	Repair of Heavy Motor Vehicles
	399	Repair of Machinery And Equipment Nec

Source: MOSPI, New Delhi

ANNEXURE- III

Two- Digit Details of National Industrial Classification (NIC) 1998

Industry Code No	Major Industry Groups
15	Manufacture of food products and beverages
16	Manufacture of tobacco products
17	Manufacture of textiles
18	Manufacture of wearing apparel; dressing and dyeing of fur
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery,
20	Manufacture of wood and of products of wood and cork, except furniture;
21	Manufacture of paper and paper products
22	Publishing, printing and reproduction of recorded media
23	Manufacture of coke, refined petroleum products and nuclear fuel
24	Manufacture of chemicals and chemical products
25	Manufacture of rubber and plastics products
26	Manufacture of other non-metallic mineral products
27	Manufacture of basic metals
28	Manufacture of fabricated metal products, except machinery and equipment
29	Manufacture of machinery and equipment n.e.c.*
30	Manufacture of office, accounting and computing machinery
31	Manufacture of electrical machinery and apparatus n.e.c.
32	Manufacture of radio, television and communication equipment and apparatus
33	Manufacture of medical, precision and optical instruments, watches and clocks
34	Manufacture of motor vehicles, trailers and semi-trailers
35	Manufacture of other transport equipment
36	Manufacture of furniture; manufacturing n.e.c.
37	Recycling

Source: MOSPI, New Delhi

ANNEXURE- IV

NATIONAL INDUSTRIAL CLASSFICATION (NIC) 1998

Divisions: Classification at two digit, three digit and four digit level

Industry Code	Group	Class	Description
15			**Manufacture of Food Products and Beverages**
	151		Production, processing and preservation of meat, fish, fruit vegetables, oils and fats.
		1511	Production, processing and preserving of meat and meat products.
		1512	Processing and preserving of fish and fish products
		1513	Processing and preserving of fruit and vegetables
		1514	Manufacture of vegetable and animal oils and fats
	152	1520	Manufacture of dairy product
	153		Manufacture of grain mill products, starches and starch products, and prepared animal feeds
		1531	Manufacture of grain mill products
		1532	Manufacture of starches and starch products
		1533	Manufacture of prepared animal feeds
	154		Manufacture of other food products
		1541	Manufacture of bakery products
		1542	Manufacture of sugar [manufacture of glucose and other sugars made from starches is classified in class 1532]
		1543	Manufacture of cocoa, chocolate and sugar confectionery
		1544	Manufacture of macaroni, noodles, conscious and similar farinaceous products
		1549	Manufacture of other food products n.e.c.
	155		Manufacture of beverages
		1551	Distilling, rectifying and blending of spirits; ethyl alcohol production from fermented materials
		1552	Manufacture of wines
		1553	Manufacture of malt liquors and malt
		1554	Manufacture of soft drinks; production of mineral waters
16			**Manufacture of Tobacco Products**
	160	1600	Manufacture of tobacco products
17			**Manufacture of Textiles**
	171		Spinning, weaving and finishing of textiles.
		1711	Preparation and spinning of textile fiber including weaving of textiles.
		1712	Finishing of textile.
	172		Manufacture of other textiles
		1721	Manufacture of made-up textile articles, except apparel
		1722	Manufacture of carpet and rugs
		1723	Manufacture of cordage, rope, twine and netting
		1729	Manufacture of other textiles n.e.c.
	173	1730	Manufacture of knitted and crocheted fabrics and articles
18			**Manufacture of Wearing Apparel; Dressing And Dyeing Of Fur**
	181	1810	Manufacture of wearing apparel, except fur apparel

	182	1820	Dressing and dyeing of fur; manufacture of articles of fur
19			**Tanning and Dressing of Leather; Manufacture of Luggage,Handbags Saddlery,Harness and Footwearc**
	191		Tanning and dressing of leather, manufacture of luggage handbags, saddlery & harness.
		1911	Tanning and dressing of leather
		1912	Manufacture of luggage, handbags, and the like, saddlery and harness
	192	1920	Manufacture of footwear.
20			**Manufacture Of Wood And Of Products Of Wood And Cork,Except Urniture;Manufacture Of Articles Of Straw And Plating Materials**
	201	2010	Saw milling and planing of wood
	202		Manufacture of products of wood, cork, straw and plaiting materials
			Manufacture of veneer sheets; manufacture of plywood, laminboard, particle board and other panels and boards
		2021	Manufacture of veneer sheets; manufacture of plywood, laminboard, particleboard and other panels and boards
		2022	Manufacture of builders' carpentry and joinery
		2023	Manufacturing of wooden containers
		2029	Manufacture of other products of wood, manufacture of articles of cork, straw andplaiting materials
21			**Manufacture of Paper And Paper Products**
	210		Manufacture of paper and paper product
		2101	Manufacture of pulp, paper and paper board
		2102	Manufacture of corrugated paper and paperboard and of containers of paper andpaperboard
		2109	Manufacture of other articles of paper and paperboard
22			**Publishing, Printing And Reproduction of Recorded Media**
	221		Publishing
		2211	Publishing of books, brochures, musical books and other publications
	.	2212	Publishing of newspapers, journals and periodicals
		2213	Publishing of recorded media
		2219	Other publishing [includes publishing of photos and postcards, time-tables, forms,posters or other printed matters.]
	222		Printing and service activities related to printing
		2221	Printing [Includes printing of newspapers, magazines, periodicals, journals andother material for others on a fee or contract basis]
		2222	Service activities related to printing
	223	2230	Reproduction of recorded media
23			**Manufacture of Coke, Refined Petroleum Products and Nuclear Fuel**
	231	2310	Manufacture of coke oven products
	232	2320	Manufacture of refined petroleum products
	233	2330	Processing of nuclear fuel
24	.		**Manufacture of Chemicals and Chemical Products**
	241		Manufacture of basic chemicals
		2411	Manufacture of basic chemicals except fertilizers and nitrogen compounds
		2412	Manufacture of fertilizers and nitrogen compounds
		2413	Manufacture of plastics in primary forms and of synthetic rubber.

	242		Manufacture of other chemical products
		2421	Manufacture of pesticides and other agro chemical products
		2422	Manufacture of paints, varnishes and similar coatings,printing ink and mastics
		2423	Manufacture of pharmaceuticals, medicinal chemicals and botanical products
		2424	Manufacture of soap and detergents, cleaning and polishing preparations,perfumes and toilet preparations
		2429	Manufacture of other chemical product n.e.c.
	243	2430	Manufacture of man-made fibers
25			**Manufacture of Rubber And Plastic Products**
	251		Manufacture of rubber products
		2511	Manufacture of rubber tyres and tubes; retreading and rebuilding of rubber tyres
		2519	Manufacture of other rubber products
	252	2520	Manufacture of plastic products
26			**Manufacture of Other Non-Metallic Mineral Products**
	261	2610	Manufacture of glass and glass products
	269		Manufacture of non-metallic mineral products n.e.c.
		2691	Manufacture of non-structural non-refractory ceramic ware
		2692	Manufacture of refractory ceramic products
		2693	Manufacture of structural non-refractory clay and ceramic products
		2694	Manufacture of cement, lime and plaster
		2695	Manufacture of articles of concrete, cement and plaster
		2696	Cutting, shaping and finishing of stone
		2699	Manufacture of other non-metallic mineral products n.e.c.
27			**Manufacture of Basic Metals**
	271	2710	Manufacture of Basic Iron & Steel
	272	2720	Manufacture of basic precious and non-ferrous metals
	273		Casting of metals
		2731	Casting of iron and steel
		2732	Casting of non-ferrous metals
28			**Manufacture of Fabricated Metal Products, Except Machinery and Equipments**
	281		Manufacture of structural metal products, tanks, reservoirs and steam generators
		2811	Manufacture of structural metal products
		2812	Manufacture of tanks, reservoirs and containers of metal
		2813	Manufacture of steam generators, except central heating hot water boilers
	289		Manufacture of other fabricated metal products; metal working service activities
		2891	Forging, pressing , stamping and roll-forming of metal; powder metallurgy
		2892	Treatment and coating of metals; general mechanical engineering on a fee or contract basis
		2893	Manufacture of cutlery, hand tools and general hardware
		2899	Manufacture of other fabricated metal products n.e.c.
29			**Manufacture of Machinery and Equipment N.E.C.**
	291		Manufacture of general purpose machinery
		2911	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines
		2912	Manufacture of pumps, compressors, taps and valves

		2913	Manufacture of bearings, gears, gearing and driving elements
		2914	Manufacture of ovens, furnaces and furnace burners
		2915	Manufacture of lifting and handling equipment
		2919	Manufacture of other general purpose machinery
	292		Manufacture of special purpose machinery
		2921	Manufacture of agricultural and forestry machinery
		2922	Manufacture of machine-tools
		2923	Manufacture of machinery for metallurgy: converters, ingot moulds, ladles andcasting machines; metal rolling mills and rolls for such mills
		2924	Manufacture of machinery for mining, quarrying and construction
		2925	Manufacture of machinery for food, beverage and tobacco processing
		2926	Manufacture of machinery for textile, apparel and leather production
		2927	Manufacture of weapons and ammunition
		2929	Manufacture of other special purpose machinery
	293	2930	Manufacture of domestic appliances, n.e.c.
30			**Manufacture of Office, Accounting and Computing Machinery**
	300	3000	Manufacture of office, accounting and computing machinery
31			**Manufacture of Electrical Machinery and Apparatus N.E.C.**
	311	3110	Manufacture of electric motors, generators and transformers
	312	3122	Manufacture of electricity distribution and control apparatus
	313	3130	Manufacture of insulated wire and cable
	314	3140	Manufacture of accumulators, primary cells and primary batteries
	315	3150	Manufacture of electric lamps and lighting equipment
	319	3190	Manufacture of other electrical equipment n.e.c.
32			**Manufacture of Radio, Television and Communication Equipment and Apparatus**
	321	3210	Manufacture of electronic valves and tubes and other electronic components
	322	3220	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy
	323	3230	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus, and associated goods
33			**Manufacture of Medical, Precision and Optical Instruments, Watches and Clocks**
	331		Manufacture of medical appliances and instruments and appliances formeasuring, checking, testing, navigating and other purposes except optical instruments
		3311	Manufacture of medical and surgical equipment and orthopedic appliances
		3312	Manufacture of instruments and appliances for measuring, checking, testing,navigating and other purposes except industrial process control equipment
		3313	Manufacture of industrial process control equipment
	332	3320	Manufacture of optical instruments and photographic equipment
	333	330	Manufacture of watches and clocks
34			**Manufacture of Motor Vehicles, Trailers and Semi-Trailers**
	341	3410	Manufacture of motor vehicles
	342	3420	Manufacture of bodies (coach work) for motor vehicles; manufacture of trailers and semi-trailers
	343	3430	Manufacture of parts and accessories for motor vehicles and their

			engines
35			**Manufacture of Other Transport Equipment**
	351		Building and repair of ships & boats
		3511	Building and repairing of ships
		3512	Building and repairing of pleasure and sporting boats
	352	3520	Manufacture of railway and tramway locomotives and rolling stock
	353	3530	Manufacture of aircraft and spacecraft
	359		Manufacture of transport equipment n.e.c.
		3591	Manufacture of motorcycles
		3592	Manufacture of bicycles and invalid carriages
		3599	Manufacture of other transport equipment n.e.c.
36			**Manufacture of Furniture; Manufacturing N.E.C.**
	361	3610	Manufacture of furniture
	369		Manufacturing n.e.c.
		3691	Manufacture of jewellery and related articles
		3692	Manufacture of musical instruments
		3693	Manufacture of sports goods
		3694	Manufacture of games and toys
		3699	Other manufacturing n.e.c.
37			**Recycling**
	371	3710	Recycling of metal waste and scrap
	372	3720	Recycling of non-metal waste and scrap

Source: MOSPI, New Delhi

ANNEXURE - V

Concordance between 4-Digit NIC-98 & 3-Digit NIC-87
(For Converting NIC-87 Based Data In Terms Of NIC98)

TABULATION CATEGORY D: MANUFACTURING	
NIC98	**NIC-87**
1511	200
1512	203
1513	202
1514	210+211+212
1520	201
1531	204
1532	218
1533	217
1541	205
1542	206+207
1543	209
1544+1549	213+214+215+219
1551	220+223
1552	221
1553	222
1554	216+224
1600	225+226+227+228+229
1711	231+232+233+234+235+240+241+242+244+245+247+250+251 +252+253+254+255+256
1712	236+243+246+248+257+258+259
1721	267+268
1722	263+264
1723	261
1729	262+269
1730	260
1810	265+266+292+964
1820	294+295+296
1911	290
1912	293+299
1920	291+311
2010	270
2021	271
2022	272
2023	273
2029	274+275+279
2101	280
2102	281
2109	282+283
2211+2219	285
2212	284
2213	Not defined separately in NIC-87
2221	286+289
2222	287+288
2230	Not defined separately in NIC-87
2310	318+319

2320	314+315+316
2330	317
2411	300
2412+2421	301
2413	302
2422	303
2423	304
2424	305
2429	208+307+308+309
2430	306
2511	310
2519	312
2520	313
2610	321
2691	322+323
2692+2693	320
2694	324
2695	327
2696	326
2699	325+329
2710	330+331+332
2720	333+334+335+336+338+339
2731+2732	337
2811	340
2812	341
2813+2911	352
2891	344
2892	345
2893	343+346
2899	349
2912+2913+2914+2915	356+391
2919+2923+2927+2929	354+359+393+397+399
2921	350+390
2922	357+392
2924	351
2925+2926	353
2930	355+364+388
3000	358+367
3110+3120	360+395
3130	361
3140	362
3150	363
3190	369
3210	368
3220	365+396
3230	366
3311+3312+3313	380
3320	381
3330	382
3410+3420+3430	373+374
3511+3512	370
3520	371+372
3530	377

3591	375
3592	376
3599	378+379
3610	276+277+342
3691	383+384
3692	386
3693	385
3694+3699	387+389
3710	Not defined separately in NIC-87
3720	Not defined separately in NIC-87

ANNEXURE-VI

Two- Digit Details of NATIONAL INDUSTRIAL CLASSFICATION (NIC) 2004

Industry Code No	Major Industry Groups
15	Food Products and Beverages
16	Tobacco Products
17	Textiles
18	Wearing Apparel; Dressing and Dyeing of Fur
19	Tanning and Dressing of Leather; Manufacture of Luggage, Handbags Saddlery, Harness and Footwear
20	Manufacture of Wood and of Products of Wood and Cork, Except Furniture
21	Paper and Paper Products
22	Publishing, Printing and Reproduction of Recorded Media
23	Coke, Refined Petroleum Products and Nuclear Fuel
24	Chemicals and Chemical, Products
25	Rubber and Plastic Products
26	Other Non-Metallic Mineral Products
27	Basic Metals
28	Fabricated Metal Products, Except Machinery and Equipments
29	Machinery and Equipment N.E.C.
30	Office, Accounting and Computing Machinery
31	Electrical Machinery and Apparatus N.E.C.
32	Radio, Television and Communication Equipment and Apparatus
33	Medical, Precision and Optical Instruments, Watches and Clocks
34	Motor Vehicles Travellers' and Semi-Trailers
35	Other Transport Equipment
36	Furniture
37	Recycling

Source: MOSPI, New Delhi

ANNEXURE-VII

Two- Digit Details of NATIONAL INDUSTRIAL CLASSFICATION (NIC) 2008

Industry Code No	Major Industry Groups
10	Manufacture of food products
11	Manufacture of beverages
12	Manufacture of tobacco products
13	Manufacture of textiles
14	Manufacture of wearing apparel
15	Manufacture of leather and related products
16	Manufacture of wood and products of wood
17	Manufacture of paper and paper products
18	Printing and reproduction of recorded media
19	Manufacture of coke and refined petroleum products
20	Manufacture of chemicals and chemical products
21	Manufacture of pharmaceuticals, medicinal chemical and botanical products
22	Manufacture of rubber and plastics products
23	Manufacture of other non-metallic mineral products
24	Manufacture of basic metals
25	Manufacture of fabricated metal products, except machinery and equipment
26	Manufacture of computer, electronic and optical products
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment n.e.c.
29	Manufacture of motor vehicles, trailers and semi-trailers
30	Manufacture of other transport equipment
31	Manufacture of furniture
32	Other manufacturing
33	Repair and installation of machinery and equipment n.e.c.

Source: MOSPI, New Delhi

ANNEXURE-VIII

Concordance between 4-Digit NIC-2008 & NIC 2004
(For Converting NIC-2004 based data in terms of NIC -2008)

NIC-2008	NIC-2004
1010	1511
1020	1512(p)
1030	1513(p)
1040	1514
1050	1520
1061	1531
1062	1532
1071	1541
1072	1542
1073	1543
1074	1544(p)
1075	1512(p)+1513(p)+1544(p)+1549(p)
1079	1549(p)+2429(p)
1080	1533
1101	1551
1102	0113(p)+1552
1103	1553
1104	1554
1200	1600
1311	1711(p)+1713(p)
1312	1711(p)+1713(p)
1313	1712+1714
1391	1730(p)
1392	1721(p)+1722(p)+1725(p)
1393	1722(p)+1725(p)
1394	1723(p)
1399	1724+1729
1410	1810
1420	1820(p)
1430	1730(p)
1511	1820(p)+1911
1512	1912+3699(p)
1520	1920
1610	2010
1621	2021
1622	2022
1623	2023(p)

1629	2029(p)+3699(p)
1701	2101
1702	2102
1709	2109+3699(p)
1811	2221
1812	2222
1820	2230
1910	2310
1920	1010(p)+1020(p)+2320
2011	2330(p)+2411+2429(p)
2012	2412
2013	2413
2021	2421
2022	2422
2023	2424
2029	2429(p)
2030	2430
2100	2423
2211	2511
2219	2519(p)
2220	2520(p)
2310	2610(p)
2391	2692
2392	2691(p)+2693
2393	2691(p)
2394	2694
2395	2695
2396	2696
2399	2699
2410	2711+2712+2713+2714+2715+2716+2717+2718+2719
2420	2720
2431	2731
2432	2732
2511	2811(p)
2512	2812(p)
2513	2813(p)
2520	2927(p)
2591	2891
2592	2892(p)
2593	2893(p)+2929(p)
2599	2899(p)
2610	3210(p)

2620	3000(p)
2630	3220(p)
2640	3230(p)
2651	3312(p)+3313(p)
2652	3330(p)
2660	3311(p)
2670	3312(p)+3320(p)
2680	2429(p)
2710	3110(p)+3120(p)
2720	3140(p)
2731	3130(p)
2732	3130(p)
2733	3120(p)
2740	3150(p)
2750	2930
2790	3120(p)+3130(p)+3150(p)+3190(p)
2811	2911(p)
2812	2912(p)
2813	2912(p)
2814	2913(p)
2815	2914(p)
2816	2915(p)
2817	3000(p)
2818	2922(p)
2819	2919(p)
2821	2921(p)
2822	2922(p)
2823	2923(p)
2824	2924(p)
2825	2925(p)
2826	2926(p)
2829	2929(p)
2910	3410
2920	3420(p)
2930	3430
3011	3511(p)
3012	3512(p)
3020	3520(p)
3030	3530(p)
3040	2927(p)
3091	3591
3092	3592

3099	3599(p)
3100	3610
3211	3691
3212	3699(p)
3220	3692(p)
3230	3693
3240	3694(p)
3250	3311(p)+3320(p)
3290	3699(p)
3311	2811(p)+2812(p)+2813(p)+2892(p)+2893(p)+2899(p)+
	2927(p)+2929(p)+3110(p)+3699(p)+7250(p)
3313	3220(p)+3311(p)+3312(p)+3313(p)+3320(p)
3314	2520(p)+3110(p)+3120(p)+3130(p)+3140(p)+3150(p)+3190(p)+ 3210(p)
3315	3511(p)+3512(p)+3520(p)+3530(p)+3599(p)+6303(p)
3319	1721(p)+1723(p)+2023(p)+2029(p)+2519(p)+2520(p)+
	2610(p)+2699(p)+3311(p)+3312(p)+3330(p)+3692(p)+3694(p)
3320	2813(p)+2911(p)+2912(P)+2914(p)+2915(p)+2919(p)+
	2921(p)+2922(p)+2923(p)+2924(p)+2925(p)+2926(p)+
	2929(p)+3000(p)+3110(p)+3220(p)+3311(p)+3313(p)