NEW POLICY REGIME AND ADJUSTMENT PROCESS OF MANUFACTURING SECTOR IN PUNJAB

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CERTIFICATE

Certified that the thesis entitled **"NEW POLICY REGIME AND ADJUSTMENT PROCESS OF MANUFACTURING SECTOR IN PUNJAB"** which is being submitted by Ms. Manpreet Kaur, in fulfillment of the requirement for the award of the degree of Doctor of Philosophy in the School of Management and Social Sciences, Thapar University, Patiala, is a record of the candidate's own independent and original research work carried out by her under our supervision and guidance. The matter embodied in this thesis has not been submitted in part or full to any other University or Institute for the award of any degree.

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ABSTRACT

In India, the policy regime has undergone a drastic change during the decade of 1990s after the introduction of major reforms in July 1991. After the advent of the new policy regime the manufacturing sector in Punjab is in the throes of a very significant phase of transition with severe challenges and many new opportunities. Different sub sectors of industry in Punjab have responded differently to adjust optimally in response to changed policy regime. The adjustment has been on the input, output or on the processing side. To compete in this globalised world, productivity of manufacturing sector is another crucial factor. Improvement in productivity is related to increased profitability, lower costs and sustainable competitiveness.

The present study analyses productivity trends for the Indian manufacturing and Punjab manufacturing for the time period 1980-81 to 2002-03 and also for sub periods, Period I 1980-81 to 1990-91, the pre-reform period and period II is 1991-92 to 2002-03, the post-reform period. The study analyses the trends in output (value added), inputs (labour, capital), labour productivity, capital productivity, capital intensity and total factor productivity for the Indian manufacturing sector at aggregate level and at two digit level. A detailed analysis for pre-reform period and post-reform period shows that the performance in terms of partial productivity and total factor productivity has decelerated in the post reform period in aggregate manufacturing and for most of the industrial sectors in India as well as in Punjab manufacturing.

Comparative analysis of the Indian manufacturing and Punjab manufacturing at aggregate level depicts that the total manufacturing of India grows at a higher rate in terms of capital, labour productivity and capital intensity and Punjab manufacturing grows at a higher rate in terms of rate of growth of labour and capital productivity. The growth rate of value added and total factor productivity depict similar trends for both Indian and Punjab manufacturing. An attempt has been made to trace the factors influencing productivity for Indian manufacturing and Punjab manufacturing. Ordinary least square and stepwise regression results show that coefficients for output growth variable are positive and statistically

significant in most of the industries in Indian and Punjab industries. A positive and significant relationship has also been observed between capital intensity and total factor productivity.

The present research also uses a survey technique to study the adjustment process of Punjab manufacturing of two hundred firms. The industries covered are: engineering goods, cycle and cycle parts, hosiery, machine tools, steel rerolling, sewing machine and sports goods. The data has been collected from the six major industrial centres of Punjab viz. Ludhiana, Jalandhar, Amritsar, Gobindgarh, Patiala, and Mohali. The questionnaire has covers the overall performance of the firms, the performance of employees, the impact of globalization on technology adoption, adaptation and on research and development.

The present research work has arrived at the following broad conclusions. There is a difference in the nature and quantum of this adjustment. Most of this adjustment is limited to bigger and older firms, and smaller and newer firms respond with lesser rigour to the reforms. Most of the firms of Punjab have turnover less than fifty crores. The percentage of investment by foreign companies in Punjab is generally low. Total sales and net profit rate over the past ten years has shown an increase in the manufacturing sector of Punjab. The percentage of technically skilled employees is rather low and needs to be improved. Old, medium and large sized firms have organized more training programmes for the employees during the last ten years. Opportunities created by globalization in the form of vast international markets have encouraged almost all the firms to go for new technology and about fifty percent firms are now using advanced technology. Investment and employment in research and development is very low in Punjab manufacturing. Performance of research and development activities is moderate in most of the firms.

Overall results highlight that Indian and Punjab Manufacturing sector record a deceleration in growth in the post reform period. Manufacturing sector growth has been associated with higher growth of capital and higher capital intensity. Rate of Output growth emerges as a significant determinant of productivity. Old and large firms of Punjab have performed better in terms of output growth and overall performance.

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ABBREVIATIONS

ASI	Annual Survey of Industries
CMIE	Centre for Monitoring the Indian Economy
CSO	Central Statistical Organization
DD	Double Deflation
FDI	Foreign Direct Investment
FERA	Foreign Exchange Regulation Act
GDP	Gross Domestic Product
GNR	Gross Net Ratios
IMF	International Monetary Fund
NEC	Not Elsewhere Classified
NIC	National Industrial Classification
NSSO	National Sample Survey Organization
RBI	Reserve Bank of India
R&D	Research & Development
SD	Single Deflation
SDP	State Domestic Product
SSI	Small Scale Industries
TFP	Total Factor Productivity
TFPG	Total Factor Productivity Growth
TP	Total Productivity
TRIPS	Trade Related Intellectual Property Rights
WPI	Wholesale Prices Index
WTO	World Trade Organization

Chapter 1
INTRODUCTION

1.1 New Policy Regime in India

At the time of independence, the development strategy of India focused on national self sufficiency and stressed the importance of government regulation of the economy. The main aim of the policy was to achieve economic self-sufficiency through industrialization. The emphasis was on import substitution, setting up of heavy industries and domination of the public sector. High levels of protection and higher focus on public sector lead to the economy caught in the web of bureaucracy, subsidies and price control. All these factors deadened the spirit of innovation and resulted in lower growth. "Protectionism isolated India from the rest of the world, and the India's share of world trade declined from two percent in the 1950s to less than half of one percent in the late 1980s" (World Bank, 1996).

There was a fall in the Indian economy due to the policy approach employed between 1950 and 1980. The government began borrowing money from the World Bank in 1984. The World Bank leant money on the condition that India has to adopt a liberalized strategy. So little progress towards reforms was seen in the 1980s which included deregulation and delicensing in certain industries, according a greater role to the private sector, and a gradual shift from direct physical controls to indirect controls.

Public expenditure was growing faster than revenue in the 1980s. So the central government borrowing exceeded five percent of gross domestic product (GDP). The government had to borrow to pay for the subsidies to the agriculture sector, which reached twelve percent of GDP in 1990. The subsidies were given to the farmers who were receiving below market price for their produce. The budgetary deficit increased because the savings and investment gap widened. The problem of this rapid increase in India's external debt was compounded by the political uncertainty that had gripped India at that time. This led international credit rating agencies to lower India's debt rating. This made borrowing in international markets difficult for India. There is an outflow of foreign currency deposits by non-resident Indians. Moreover the situation had been worsened by the collapse of the Soviet Union and other eastern bloc trading partners. The spike in oil prices following the Gulf war deteriorated the balance of payment situation and brought India to the verge of defaulting on its debt obligations. Finally, "in 1991, the economy was on the verge of bankruptcy, with only two weeks worth of foreign exchange reserves and a current account deficit of minus three percent of GDP"[International Monetary Fund (IMF), 1995].

The IMF had a standby arrangement facility with India in 1991 and leant $2.3 billion to help India avoid the economic crisis. The economic policies used since independence had failed and gradually a new policy approach to managing the Indian economy was being forced into place in the face of mounting international pressures. The government of India introduced major reforms in July 1991 that transitioned India from a closed, socialist economy to a more open, free-market economy. According to Srinivasan and Tendulkar (2003), the Indian government had chosen a path of economic reform in July 1991 to gradually reduce the role of the state, to provide greater and dominant role to the market in the process of economic decision making. Indian government dismantled controls and regulations related to the location of private economic activities in order to establish production units in industrial sector of the economy.

The government's new policy approach attempted to curb the trade deficit, by attracting foreign direct investment and increasing exports. The new policy regime aimed at putting the Indian economy on a sustained and rapid growth path through greater participation in international division of labour and private capital movements, greater reliance on private initiative and markets, and the consequent shift to market-friendly policy regime. The export trade was expanded in India in the new policy regime. To increase exports the rupee was devalued by nineteen percent in the new policy regime. Indian exports became cheaper in the world market due to devaluation and the demand for the Indian goods increased in the world market.

The IMF forced India to relinquish control of some public sector enterprises and to encourage private enterprises to grow. The extensive liberalisation of licensing requirements for establishing and expanding capacity was introduced in 1991. The industrial licensing system such as the "license-permit Raj" came to an end. The new policy approach extended de-licensing to almost all industries in the manufacturing sector. Foreign investors were now allowed to own major shares in companies in India.

FDI regulations have been relaxed in 1991. Prior to 1991, FDI was permitted only upto 40 percent in high priority industries. These industries are in areas in which Foreign Exchange Regulation Act (FERA) companies have already been allowed to invest on a discretionary basis. In 1991, foreign direct investors were allowed up to 51% equity stakes in high priority industries, under the "automatic approval route". Investments in other sectors were subject to scrutiny by a Foreign Investment Promotion Board (FIPB). FDI increased to $3.2 billion in 1998, an investment level twenty five times greater than when India was a protectionist country.

India had used a fixed exchange rate for the rupee before 1993. The year 1993 marked the introduction of a market determined exchange rate. With the new exchange rate, the government using monetary policy, had greater control over the economy. Capital markets had also become liberalized and more transparent to encourage foreign investors. The Indian trade policy was opened up with the conversion of import quotas to tariffs. To encourage trade, tariff was reduced from four hundred percent in 1991 to thirty five percent by 1998. Other reforms introduced were attempts to reduce the fiscal deficit, liberalisation of technology, reform of major taxes, and capital goods imports in India. End of protectionism and the rise of liberalisation affected the different sectors of the economy. The present study is an effort to study the impact of reforms on the manufacturing sector in India and Punjab.

1.2 Manufacturing Sector in India

Manufacturing is considered as the economic backbone of an industrialized nation. The economic growth of a country is based on the level of manufacturing activity. Often it is contended that a nation's strength is its manufacturing base. Manufacturing provides a considerable employment for thousands of people. Most jobs in manufacturing require skilled workers. As manufacturing sector adopts increasing levels of technology, this leads to improvement in skills of workers. Highly skilled labour force in manufacturing helps a nation to compete in the world market.

The manufacturing sector is a vital part of the Indian economy. Agriculture has been the main preoccupation of the bulk of the Indian population. But the founding fathers saw India becoming a prosperous and modern state with a good industrial base. Programs were formulated to build adequate infrastructure for rapid industrialization in the country. After independence India has achieved a good measure of self-sufficiency in manufacturing a variety of basic and capital goods.

The manufacturing sector of India makes a significant contribution to the gross domestic product, employment, capital investment, research and development (R&D), and exports. The manufacturing sector growth rate increased from 5.3 per cent in 2000-01 to 9.8 percent during 2007-08. The share of manufacturing sector in GDP increased from 15.1 per cent during 2005-06 to 15.4 per cent in 2006-07. The export orientation of the manufacturing sector has also been on the rise. The manufactured exports as a percentage of India's GDP have increased from 2.5 per cent in 1983-84 to 9.1 per cent in 2006-07.

At present, the manufacturing sector of India is exhibiting a dual characteristic. The new policy regime has opened up opportunities for growth, but at the same time has raised many apprehensions. The rising competitive pressure from the world markets is forcing Indian industries to restructure their operations. Indian industry is witnessing unprecedented consolidations, takeovers, and mergers. Currently, the Indian manufacturing sector is grappling with the problem of competition from low priced mass consumption goods from

Chinese and Asian markets and quality competition from products of advanced economies which are produced by advanced technology. The present study is an effort to find out whether the manufacturing sector of India has the capability to compete globally.

1.3 Manufacturing Sector in Punjab

Punjab, a state in northwest India, is a land of enterprise and endeavor. The state of Punjab has earned the distinction of being the “Granary of India". Development experience of Punjab economy since 1947 has remained quite impressive though there have been twists and turns. The economy of Punjab has experienced an accelerated economic growth and a steadily rising per capita income as compared to the growth experience of the Indian economy in general and the other states in particular. This remarkable achievement has been attributed to the planned development strategy adopted in Punjab.

Punjab is a progressive state of India with an average growth rate of 10 per cent. It has evolved into a land of boundless opportunities for investment, industry and employment. The percentage share of Gross State Domestic Product (GSDP) of Punjab in Gross Domestic Product of India is 3.18 (Central Statistical Organisation, Delhi, 2006-07). Services held the largest share of 39 per cent in Punjab's SDP, followed by agriculture holding a share of 38 per cent. The share of industrial sector is relatively small, accounting for a meagre 23 per cent of the SDP.

The state has been dominated by agricultural sector with a lower industrial output as compared to other states of India. A prominent feature of the industrial sector of Punjab is its small sized industrial units. There are 600 large and medium scale industrial units and 0.2 million small scale industrial units in Punjab [Government of Punjab (2006), India]. Punjab is now giving greater emphasis to the development of its industrial sector as it is well recognized that industrial sector of a state or a country at large serves as an index of its economic growth profile.

At the time of independence, Punjab had only a few hundred industrial units mainly processing foodgrains, brick kilns and cotton ginning. In 1947, the partition of India disrupted the whole economy of Punjab, and the industrial production came to a near halt. In manufacturing sector, a substantial proportion of workers were independent workers assisted by family labour and used little or no power. There were only about 1,000 registered factories (employing more than 10 workers using power; and those employing 20 or more workers without using power), which provided employment to about 50,000 people. In 1950 Punjab accounted for less than 2 percent of the total value of output by the registered sector in India, compared with 33 percent for Bombay, 27 percent for Bengal, and 12 percent for Madras (Khanna, 1983). According to the Census of India for 1951, only 7 percent of the total work force in Punjab was engaged in industries, construction, and public utilities compared with 65 percent in agriculture and allied occupations, 10 percent in commerce and transport, and 18 percent in services (India, Ministry of Home Affairs, 1951).

Manufacturing sector began to rise in the middle of 1950s, as the result of concerted efforts to create trained workers and to provide incentives to entrepreneurs as a part of the rehabilitation program for displaced persons. During the 1950s increasing agricultural output created a demand for more agroprocessing, agro-inputs, and machine goods. Further there was also increased demand from the rest of India for such products as machine goods, hosiery, knitwear, textiles, and sporting goods. These factors encouraged development of industrial sector, particularly among small-scale industries.

Punjab started producing agricultural implements, bicycles, and foundry products by the beginning of the 1960s. These developments notwithstanding, the state's industrial growth remained rather limited until the green revolution of the mid-1960s, which brought unprecedented growth in agricultural output. Due to close input, output, and consumption linkages, rapid agricultural growth was accompanied by even faster growth in the secondary and tertiary sectors of the Punjab economy.

The 1970s were characterized by rapid industrial growth in and around Gobindgarh. The steel re-rolling activities increased due to growth of market outside the state of Punjab. Further support from the government in the form of freight equalisation (for bringing in the raw materials and sending out the finished products), there being no restriction in creating capacities in rolled products etc., also favored the manufacturing units in Punjab. Gobindgarh became a centre of steel rerolling mills producing various iron products.

The period of 1980s marks a significant change. The period has been described as "a period of missed opportunities" for Punjab. The period witnessed the state of Punjab suffer significantly in terms of economic growth due to the socio-political disturbance, as a result of terrorism and the consequent non-governance in the state. However, industrial growth in Punjab during 1980s has been much faster than the national average, despite the socio-political uncertainty. The percentage of registered factories, share of total manufacturing workers, share in the total value of industrial output etc. has been on rise during this time period.

Economic policy reforms initiated in 1991 have differential impact across industrial economy of different states or regions. Some of the states or regions registered high rates of growth comparable to the newly industrializing countries, while others lagged behind. Before the new policy regime, Punjab had suffered due to policy induced barriers and constrained private sector initiatives through allocation of licenses and public sector investments in the industrial sector of the economy. The policy reforms have been welcomed purely on the basis of expected removal of barriers and constraints by the political leadership. It was expected that the reforms will enhance the FDI in the state and help in accelerating the economic growth. Import liberalisation and reduction of tariff barriers increase the competition to the small scale industry. Since the industrial sector of Punjab is a grooming ground for small scale industries, therefore, external and domestic liberalisation was expected to put substantive constraint on this sector.

The new policy regime created a sense of euphoria in the manufacturing sector of Punjab through deregulation and dereservation. This was further heightened with the reduction in import restrictions both of capital as well as consumer goods. On account of interest of foreign players to operate in Punjab, new business opportunities also emerged. Alongside a threat also emerged as liberalisation of foreign direct investment has increased competition through the entry of foreign firms in the domestic markets. With the process of reforms, diversification of industry started, while many of the established processing units in large, medium and small scale industries came under pressure.

1.4 Adjustment Process of Manufacturing Sector

In developing countries, the success of industrial sector in solving the problems of poverty, unemployment and low standard of living etc. depends on the large number of socio-economic and political factors. Among the economic factors, productivity has been considered the most significant policy variable in the formulation of growth oriented industrial strategy. The significance of productivity in increasing national welfare is universally recognized. Productivity growth has long been approved as being necessary for all economies aspiring to raise their level of competitiveness, higher standard of living and sustained growth in the long run. Productivity is the main source of economic growth in every country or industry. Moreover productivity is a key performance benchmark for firms involved in the manufacturing sectors because improvement in productivity is related to increased profitability, lower costs and sustainable competitiveness.

Productivity is the relationship between the output generated by a production or service system and the input provided to create this output. Thus productivity is defined as the efficient use of resources in the production of various goods and services. Increase in productivity implies either more output is produced with the same amount of inputs, or that less inputs are required to produce the same level of output. Verdoon (1949) had identified a positive relationship between the growth in labour productivity and growth in output. Kaldor (1967), analysing this relationship further, maintained that it was most prominent in manufacturing and largely reflected economies of scale.

In the face of intensified liberalized environment, productivity has emerged as a key indicator of successful restructuring and upgrading by firms and industries. Advocates of liberalisation argue that opening up local markets to foreign competition and foreign direct investment will help to improve the productivity of domestic industry, resulting in more efficient allocation of resources and greater overall output. The reforms initiated in 1991 added impetus allowing for greater competition and productivity. Higher productivity growth is associated with increase in capital intensity, labour productivity and capital productivity. Empirical evidence suggests that productivity in turn enhances product quality, increases workers wage, and offers returns on investment. Deregulation of industry and exposing it selectively to competition from outside were believed to ultimately raise productivity to international levels. With this view, the present study analyses the productivity trends for manufacturing sector in India and Punjab in the new policy regime.

On the whole after the advent of the new policy regime the manufacturing sector in India and Punjab is in the throes of a significant phase of transition with severe challenges and many new opportunities. Different sub-sectors of industry in Punjab have responded differently to adjust optimally in response to changed policy regime. This adjustment is on the input side, output side or on the processing side. This adjustment is basically a manipulation of several parameters to improve productivity. As such, in order to analyse the adjustment process of manufacturing sector in India and specifically Punjab due to new policy regime, there is an urgent need for conducting an in-depth study throwing light on the productivity trends, output, labour, capital, technology and research and development.

The present study is an endeavor in this direction and attempts to analyse the impact of reforms undertaken to benefit from integration of the Indian economy with the world economy. This comprehensive, in-depth study analyses the adjustment process of manufacturing sector in India in response to new policy regime in terms of productivity. A detailed analysis has been done for the adjustment process of manufacturing sector in Punjab in response to new policy regime in terms of productivity, output, labour, capital, technology and research and development.

1.5 Research Questions

1. Has new policy regime increased the productivity of Indian and Punjab manufacturing?
2. Is the policy impact on the adjustment process of Punjab manufacturing sector significantly different from that of India?
3. How far the determinants have contributed to productivity growth.
4. Is plant size associated with higher output growth?
5. Are older firms associated with higher output growth?

1.6 Objectives of the Study

The present research analyses the impact of new policy regime on the adjustment process of manufacturing sector in Punjab. The objectives of the study are outlined below:

- To review the recent changes in the policy regime in India in response to Liberalisation, Globalisation and Privatisation;
- To analyze the structural change in manufacturing sector in Punjab with special reference to productivity;
- To analyze the adjustment process of manufacturing sector in Punjab; and
- To elaborate the policy issues targeted to achieve higher growth in the manufacturing.

1.7 Significance of the Research

As India underwent major reforms in 1991, the study of its impacts on the manufacturing sector is both interesting and apposite. This study is an attempt to find out whether the reforms have provided any benefit to the manufacturing sector. Past studies about reforms related performance in Punjab have not produced uniform results, and the debate whether new policy regime has positive or negative impact on manufacturing performance continues. Further research is needed in order to shed light on the impact of reforms on productivity trends. The justification for this study is given by the fact that all the studies about the impact of reforms on manufacturing performance in Punjab have focused on the effects of reforms on only the productivity trends but this study also takes into account the adjustment process of the manufacturing sector. This study is the first to analyse the impact of reforms initiated in 1991 on the adjustment process of manufacturing sector in Punjab. The present study uses both the secondary and primary sources of data. Productivity analysis has been done at the aggregate level for Punjab manufacturing. With a view to studying inter industrial pattern of productivity trends, analysis has also been done at two digit and three digit level of disaggregation.

Besides examining the performance of Punjab manufacturing, this study also analyses the impact of new policy regime on the performance of Indian manufacturing. With the results from both industry and firm level data, this research throws some light on reforms-related manufacturing performance. The results are important not only for India and Punjab, but also for other developing countries with similar reforms strategies, and the results are of interest for economic policy-makers to use as a guide for future liberalisation policy formulation both in India and other countries.

1.8 Research Design

In the present study both secondary data and primary data have been used in order to achieve the objectives of the study. The present study analyses productivity trends for Indian manufacturing and Punjab manufacturing for the time period 1980-81 to 2002-03. Productivity analysis has been conducted at the aggregate level for Indian and Punjab manufacturing. With a view to study the inter-industrial pattern of productivity growth an analysis has been conducted at disaggregate level, i.e., at two digit and three digit level industries.

For time series analysis, secondary data of registered manufacturing sector have been obtained from the Annual Survey of Industries (ASI), published by the Central Statistical Organization (CSO), Government of India. The gross measure of value added has been obtained from net value added and depreciation data as given in the Annual Survey of Industries. The data on gross value added has been deflated by industry specific deflators.

Labour input is represented by total number of persons engaged and capital input is measured by estimates of gross fixed capital at replacement cost at constant prices. Perpetual inventory method has been used for estimating capital series. The returns to labour are measured by the total of wages, salaries and benefits (total emoluments) and the returns to capital are measured as value added minus the return to labour on the assumption that return to two factors of production exhaust the value added in the process of production.

To examine the impact of new policy regime on the manufacturing sector in India and Punjab, the entire period 1980-81 to 2002-03 is divided into two sub periods. Period I is 1980-81 to 1990-91, the pre-reform period and period II is 1991-92 to 2002-03, the post-reform period. The study analyses the trends in output (value added), inputs (labour, capital), labour productivity, capital productivity, capital intensity and total factor productivity for Indian manufacturing sector at aggregate level and at two digit level for the period 1980-81 to 2002-03 as well as for sub periods, period I, 1980-81 to 1990-91 and period II, 1991-92 to 2002-03. A detailed analysis of growth rates of output (value added), inputs (labour and capital), labour productivity, capital productivity, capital intensity and total factor productivity for Punjab manufacturing sector has been carried out for aggregate level and for two digit and three digit manufacturing industries for the entire period 1980-81 to 2002-03 as well as for the two sub periods, period I, 1980-81 to 1990-91 and period II, 1991-92 to 2002-03.

An attempt has been made to trace the factors influencing productivity for Indian manufacturing and Punjab manufacturing at two digit industry level. Ordinary least square and stepwise regression techniques have been used for analyzing the factors affecting productivity. A comparative study of productivity in the manufacturing sector in India and Punjab has been undertaken at two digit level to examine the better performer in the new policy regime.

Primary data has been collected from selected manufacturing firms of Punjab by using a self structured questionnaire. The sample size consists of two hundred firms. The questionnaire has been divided into two parts. First part is organization profile and the second part covers research questions. The main part, research questions, has four sections. Section A covers the overall performance of the firms. In section B, the performance of employees has been analysed. Section C studies the impact of globalisation on technology adoption and adaptation and the section D deals with research and development. Stratified random sampling technique has been used for collecting data. The industries covered are: engineering goods, bicycle and bicycle parts, hosiery, steel rerolling, sewing machine and sports goods. The data has been collected from the six major industrial centres of Punjab. These are Ludhiana, Jalandhar, Amritsar, Gobindgarh, Patiala and Mohali. Analysis has been done on the basis of age, size and type of organization. The statistical tools used to analyse the data are tabular analysis, chi square test and factor analysis.

1.9 Sequence of Chapters

In order to present discussion in a lucid style, the present study has been divided into eight chapters. Chapter one is introductory in nature providing a brief overview of the new policy regime in India. The manufacturing sector in India and the manufacturing sector in Punjab is discussed in this chapter. It also covers the need and importance of productivity in manufacturing industries and the adjustment process of manufacturing sector. The outline of the study along with its objectives, significance and research design has been covered in this chapter.

Chapter 2 reviews the empirical literature related to the impact of reforms and manufacturing performance. This chapter presents results from different empirical studies about performances before and after reforms in the manufacturing sector in India and Punjab. The review helps to know emphasis and direction of research being done, the time periods of the studies, the scope and limitations of studies conducted, the conclusions drawn from these studies and objectives fulfilled and benefits accrued. It helps to identify the gaps in the earlier studies and avoid duplication of results and focus emphasis on the right direction.

Chapter 3 discusses the methodology of the study. In this chapter methodology used for both secondary data and primary data analysis has been described. The chapter deals with the conceptual issues with regards to meaning and measurement of productivity. It discusses the different methodologies adopted in India and abroad to determine factor productivity. It also includes population of the study, variables, measuring instrument, methods of data collection and methods of data analysis.

Chapter 4 maps out a growth profile of the Indian manufacturing industries for the period 1980-81 to 2002-03. An attempt has been made to examine the growth rates of output and inputs. This chapter provides an estimation of productivity trends at aggregate level as well as at two digit level of disaggregation with a view to understanding productivity phenomenon overtime. Having analysed the general trends of productivity in Indian manufacturing, an attempt has been made to isolate the main factors associated with productivity growth in the manufacturing sector. Ordinary least square regression and stepwise regression are run between total factor productivity and factors affecting productivity.

Chapter 5 analyses the productivity performance of Punjab manufacturing sector for the period of 1980-81 to 2002-03. The analysis has been done for the growth rates of output (value added) and inputs (labour and capital). Productivity trends have been estimated at aggregate level as well as at two digit and three digit level of disaggregation. The chapter also contains ordinary least square regression and stepwise regression models used to analyse the factors associated with productivity growth in the manufacturing sector in Punjab.

In Chapter 6 a comparison has been made between the Indian manufacturing and Punjab manufacturing in terms of productivity. The analysis has been done for twenty two industrial groups of the organized manufacturing sector in India and Punjab for the period 1980-81 to 2002-03 for aggregative level as well as for disaggregative level.

Chapter 7 presents the results of the survey based on the questionnaire. The chapter begins with a short presentation of the firm characteristics of the participated respondents and is followed by a presentation of results of the survey.

Finally chapter 8 presents the conclusion, policy implications, limitations of the study and recommendations for further research.

Chapter 2
REVIEW OF LITERATURE

2.1 Introduction

A comprehensive literature research covering all aspects of new policy regime and adjustment process of manufacturing sector has been used to uncover all available materials applicable to the Indian manufacturing sector and Punjab manufacturing sector. This broad approach has been taken because there was only very small amount of material available which is directly applicable to the Punjab manufacturing sector. The research findings have been evaluated and new avenues explored with the aim to successfully understand the impact of new policy regime on the manufacturing sector in Punjab.

The objective of this chapter is three fold. First, an attempt has been made to review the earlier studies on new policy regime and adjustment process of manufacturing sector in India. Secondly it aims to review the earlier studies on the new policy regime and adjustment process of manufacturing sector in Punjab where little work has been done and there exists an ample scope for study. Finally observations derived from the review of studies are presented.

2.2 New Policy Regime and Adjustment Process of Manufacturing Sector in India

Many explanatory and interesting studies have been undertaken in India as well as in other countries of the world to analyse the impact of new policy regime on the adjustment process of manufacturing sector. Different authors have used different indicators to find out the impact of reforms on the manufacturing sector. Some salient features and broad findings of individual studies on new policy regime and adjustment process of manufacturing sector have been highlighted below:

In the studies by Ahluwalia (1985, 1991) for the period 1959 to 1989, total factor productivity (TFP) growth for registered manufacturing has been estimated. In this study the measure of TFPG used is derived from a Translog production function under the assumptions of competitive equilibrium.

$$\Delta \log TFP(t) = \Delta \log V(t)[(S_L(t) + S_L(t-1))/2]\Delta \log L(t) - [((1-S_L)(t))] + (1-S_L(t-1)))/2]\Delta \log K(t) \qquad \text{.... (2.1)}$$

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

The principal source of data used in this study is ASI. The gross measure of value added is obtained from net value added and depreciation data given in ASI. Labour input is the total number of persons employed. Capital input is measured by the estimates of gross fixed capital stock at replacement cost at constant prices using perpetual inventory accumulation method.

For estimating gross fixed capital stock at purchase prices, Hashim and Dadi's Gross Net Ratios (GNR) were used. GNR for land was assumed to be unity. To convert the gross value of fixed capital stock at purchase prices to current prices, Gross Net Ratios of Hashim and Dadi available for two-digit industry groups were used. Wholesale Price Index (WPI) of machinery and machine tools with base 1970-71 was used to obtain capital stock at constant prices. The returns to labour are measured by the total emoluments while returns to capital are measured as value added minus the returns to labour. This is done on the basis of the assumption that returns to the two factors exhaust the value added in the process of production.

The results of the study depicts that total factor productivity growth was -0.4 per cent per annum for the registered manufacturing. During the two decades of the sixties and the seventies, total factor productivity in the manufacturing sector decelerates at a rate of 0.5 per cent per annum. However, there is also a finding that in the first half of the eighties, there is an improvement in productivity growth. The dominant source of the acceleration in total factor productivity has been the growth of value added which rose from 5 per cent per annum during the period 1965-80 to 7.0 per cent per annum in 1980-89.

An important feature of the improvement in Total Factor Productivity Growth (TFPG) in the eighties was that it largely reflected improvements in labour productivity measured in terms of output per worker. Capital productivity was -0.5 per cent per annum in the period 1980-81 to 1988-89 while for the period 1959-60 to 1979-80 the rate of capital productivity was -2.8 per cent per annum. The capital-labour ratio increased at a rate of 5.1 per cent in the period 1959-60 to 1979-80 and it was 8.0 per cent per annum in the period 1980-81 to 1988-89. Ahluwalia’s study shows that the period of eighties is different as increase in labour productivity does not only reflect rising capital-labour ratios but represents productivity increases as reflected in strong performance with respect to total factor productivity growth. There is, however, another side of the view which is that the trend of employment in organized manufacturing sector actually shows a decline in eighties at an annual rate of - 0.5 per cent.

In productivity growth, the consumer goods sector was the leader in the turnaround after 1979-80. The consumer non durables sector experienced total factor productivity growth of the order of 5.2 per cent per annum in the first half of eighties. This was in sharp contrast to its negative growth in TFP in the earlier two decades. The consumer durables sector which has a smaller weight of around 4 per cent in total value added in manufacturing also showed a rapid growth in TFP of 6.6 per cent per annum in the first half of eighties. Even the intermediate goods sector had been the worst performer earlier showed significant improvement, although its TFPG continued to be relatively low, i.e., 1.4 per cent per annum. In capital goods sector, productivity growth improved considerably from 1.7 per cent per annum to 3.4 per cent per annum. According to Ahluwalia the reorientation of industrial policy framework which allowed for better utilization of existing capacities and which emphasized the importance of infrastructure, had a significant effect on productivity. Employment during this period declined as industry adjusted to the over manning of the previous decade and a half, and increasing use was made of contract labour to bypass the labour laws.

Along with growth accounting estimates of TFPG, Ahluwalia's study also estimated production functions. The Translog Production functions have been estimated for the manufacturing sector and its use based sub-sectors, i.e., intermediate goods, capital goods, consumer goods and consumer non durables sectors. The analysis shows that there has been negligible and insignificant growth in TFP in manufacturing over the period from 1959-60 to 1982-83 and there is a distinct shift after 1982-83. The estimates for the manufacturing sector as a whole also suggest that the returns to scale are not constant and that technical progress has a capital saving bias. Among the use based sectors, the growth rate of TFPG remains the same as in the case of growth accounting estimates; the two larger use based sectors (i.e. intermediate goods and consumer non durables) have performed much worse than the two smaller sectors. The upward shift of TFPG was recognized in all sectors except in capital goods sector.

A comparison of productivity growth performance in the manufacturing sector of India with other developing economies suggests that India is far behind others. The far Eastern Tigers, i.e., Hong Kong, Korea, Singapore, Taiwan, and Indonesia have much better growth in TFP than India's negative/negligible growth in TFP over the two decades of sixties and seventies. China is the only economy whose productivity growth is as bad as India's. High growth in China up to early eighties is mainly due to much larger investment but not due to high productivity growth.

The adverse effect of the protective trade regime on productivity growth of manufacturing sector is found to be significant. The analysis of the study shows that the higher the degree of import substitution in an industry the lower is its growth in TFP. The econometric analysis on the basis of relationship between capital-labour ratio and TFPG shows that the higher the capital-labour ratio in an industry, the lower is its growth in total factor productivity. The limitations of the study are in fact some of the limitations of the ASI data. The survey data are subject to problems of variations in response and in coverage.

A survey was undertaken by the National Productivity Council (NPC) during May-June 1994. The objective of the survey was to assess the impact of economic reforms on the performance of Indian organizations. The survey reveals some important facts about the ongoing economic reforms in India. The study shows that the reforms encouraged exports from the country. The managers of enterprises were found to enjoy more functional autonomy. The labour productivity of a large number of organizations increased during the reform period. The survey reveals that reforms have brought significant improvement in labour productivity. 85 per cent of the organizations responded that their labour productivities improved in the post-reform period. Nearly 48 per cent of the responded companies recorded impressive, i.e., above 3 per cent per annum improvement in labour productivity during the period while another 28 percent reported moderate, i.e., 0.5 to 3 per cent per annum increase in labour productivity. In 9 percent of companies labour productivity increased marginally, i.e., upto 0.5 per cent per annum and in another nine per cent it remained constant. Labour productivity declined in 6 per cent of organizations.

A study by Balakrishnan and Pushpangandan (1994) argued that appropriate measurement of value added is a prerequisite for the estimation of productivity. The study attempts to construct a standard measure of productivity for Indian manufacturing after accounting for changes in relative price of material inputs. The time period of study is 1970-71 to 1988-89. The ASI was not published for the year 1972-73. For continuity the value of 1972-73 were estimated as a simple average for 1971-72 and 1973-74. Gross value added had been used in this study.

For Value Added Single Deflation (VASD), this figure has been deflated by the index of the price of output. In case of Value Added Double Deflation (VADD), the value of inputs has been deflated by the price of inputs and the resulting value deducted from the real output (nominal output deflated by the price of output). WPI of manufacture (1970-71=100) is treated as the price of output. The material price index is a weighted index of whole sale prices of major input groups, the weights having been calculated from the matrix of input-output transactions published by CSO. Inputs were grouped according to the availability of wholesale price indices that could be used to represent them most closely. The implied weights were used to contract a weighted average input price. Perpetual inventory method was used for generation of capital stock. The year 1960 was taken as benchmark year. To adjust for age structure, the estimate for each year has been inflated using current to purchase price ratio to obtain gross fixed capital at replacement cost in 1960 price. The investment figures were obtained using the following formula:

$$I_t = (B_t - B_{t-1} + D_t) / R_t \qquad \text{.... (2.2)}$$

where B is the book value of the fixed capital, D is depreciation and 'R' is an appropriate deflator for fixed capital. The capital stock was calculated as follows:

$$K_t = K_0 + \sum_{t=1}^{T} I_t \qquad \text{.... (2.3)}$$

where I_t is investment in t year and K_0 is the capital stock in benchmark year. As the study is motivated by the argument that appropriate measurement of productivity requires commencement from estimates of value added, adjusted for changes in the relative price of raw material inputs, so the focus is on the difference in estimated productivity arrived at by single deflation (SD) and double deflation (DD) methods respectively. Ahluwalia has argued that there is a turnaround in total factor productivity growth in 1980. Balakrishnan and Puspangadan's analysis confirms a 'turnaround' if TFP estimates are derived from the VASD series. If TFP index is derived by DD, there is absence of an increase in the growth rate of TFP. The results indicate that productivity growth in the 1980s may actually have been slower than in the earlier decade.

Dholakia and Dholakia (1994) analyse TFPG for Indian manufacturing for the period 1970-71 to 1988-89. The study uses DD method for deflating data. The basic problem in estimating real value added by DD method is the estimation of an appropriate price index for material inputs. The weights attached to each input play a significant role in the determination of over all input price index. This study gives three alternative series of weights i.e. Balakrishnan and Puspangadan (1994), WPI (1970-71) and CSO (1973-74). Registered manufacturing industries differ significantly from one another and the researchers consider the set of weights estimated by them using 1973-74 input-output matrix adjusted for only registered manufacturing sector to be the most appropriate for estimating TFPG in registered manufacturing sector in India. Dholakia and Dholakia estimated real value added in manufacturing sector and computed growth rates using the three alternative sets of weights.

The study depicts that the annual growth of real value added in the Indian registered manufacturing sector when measured through SD method shows remarkable acceleration during the 1980s as compared to the 1970s (from 3 per cent to 8 percent). However, if the same is measured through DD method, the acceleration in growth rate is found to be (i) much higher in 1980s as compared to 1970s (3.5 per cent to 11.2 per cent) when the weights for the 19 input groups based on WPI (1970-71) are used; (ii) negligible during the 1980s as compared to the 1970s (7.5 per cent to 8.1 per cent) when weights for the whole manufacturing sector as considered by Balakrishnan and Puspangandan (1994) are used; and (iii) lower in magnitude but significant during the 1980s with 9.8 percent growth as compared to 5.9 per cent during the 1970s when weights for only the registered manufacturing sector as estimated by Dholakia and Dholakia are used. Therefore the estimate of TFPG by using DD method is sensitive to the weights used.

Thus the study reveals that the estimate of TFPG for the decade of 1970s is negative. It is around - 1.5 to - 1.7 per cent when SD method is used to measure the real value added in the Indian registered manufacturing sector. During the eighties TFPG with SD method turns out to be around 1.9 to 2 per cent. Therefore, when SD method is used TFPG shows remarkable acceleration of about 3.5 to 3.6 percentage points during the 1980s as compared to the 1970s. On the other hand, when DD method is used to measure value added in Indian registered manufacturing sector using WPI (1970-71) weights, there is an acceleration in TFPG of about 5.8 percentage points from 1970s to 1980s but when weights for the whole manufacturing sector alone are used, there is deceleration in TFPG of 0.8 percentage points from 1970s to 1980s. But when weights for registered manufacturing sector only are used there is a much subdued acceleration of about 2.3 percentage points in TFPG from 1970s to 1980s. So the study reports that a refinement in the method used by Balakrishnan and Puspangadan confirms the turnaround in TFPG in Indian registered manufacturing since 1980.

The study also reveals that the DD method would provide different answers for different base years for constant prices, whereas the SD method gives a unique answer. Technically also the method of DD required dealing at the most disaggregated level which is often not feasible. Even when the DD method is feasible with complete disaggregation available, the possibility of negative real value added still remains. Thus the study suggests the use of SD method as is commonly used to get real value of an aggregate defined in terms of difference between two other aggregates.

The study by Rao (1996) analyses four critical issues: (a) the method of growth accounting at aggregate manufacturing level; (b) biases imposed by particular methods of aggregation; (c) the econometric indentifiability of production function at any level of aggregation and (d) the interpretation of measured productivity growth. Rao estimated TFP for the organized manufacturing sector of India for the period 1973-74 to 1992-93. Manufacturing output used in this study is total output "less the output of" electricity, gas, water and repairs using WPI 1970-71 as base. Labour input used is the number of employees. Unlike in previous studies, total productive capital inclusive of both fixed and working capital is used in this study.

Real productive capital is measured as the sum of working capital deflated by manufacturing WPI at (1960-61) prices and fixed capital at replacement values (1960-61) prices. Fixed capital series is computed using perpetual inventory method. For material price index, Rao used the original set of weights proposed by Balakrishnan and Puspangadan. It involves 19 items and their weights are based on input-output tables for 1973-74. The main conclusion of the study is that there was a transition in the early 1980s from a high positive rate of growth (5.5) in 1973-74 to 1980-81 in productivity to a significant negative rate (2.2) in 1981-82 to 1992-93. Real value of output shows an exponential rate of 6.9 per cent annum for the year 1973-74 to 1992-93 which is 8 per cent in 1973-74 to 1980-81 and 7 per cent in 1981-82 to 1992-93. The exponential growth rate of real value added is 6.1 per cent for the study period but 10.6 per cent for period one and only 2.3 per cent for period two. Rao also attempts to analyse the trends in Indian industry on the basis of disaggregation by dividing the organized manufacturing into sub-sectors by criteria of ownership (public versus private) and enterprise size (small versus large). Rao's study tries to eliminate some potential sources of aggregation bias and also sheds light on the public/private and small/large dichotomies that have featured among the main lines of Indian debate about industrial performance and policy. Growth accounting estimates yield biased estimates of productivity at aggregate level when factor prices are not identical across included production units.

The main conclusions of disaggrergated productivity growth for the period 1973-1993 are that, for the period as a whole, total factor productivity grew at an annual average rate of 2.3 per cent in public sector, 2.2 per cent in the private large sector and 2.4 per cent in the small sector. During the period 1973-1981, the respective growth rates were 3.7, 5.9 and 10.0 per cent for the respective sub-sectors. In period II, i.e., 1982-1993, the rankings were reversed with small and private large sector registering annual rates of decline of 5.3 and 2.0 per cent respectively and the public sector recording 1.8 per cent growth per annum. The deceleration in productivity growth observed in the three sectors is reversed with SD measure while TFP by DD does conform to the chief result of a deceleration in productivity growth between the two periods though the magnitude and in some cases the sign and significance of the growth rates are hardly the same.

For the manufacturing as a whole the contribution of productivity growth to value added growth was 38 per cent for the entire period and 61 per cent and 124 per cent respectively for period I and period II. Productivity growth contributed a larger share of value added growth in the public sector, i.e., 46 per cent than in the private sector, 37 per cent for private large and 31 per cent for the small sector. Rao also estimates the supply-side interpretation of accounting based on growth decompositions and furnishes some evidences in support of external economies and demand side influences on measured productivity. The elasticity of productivity growth with respect to output growth in aggregate manufacturing is 5.1 for private-large, 5.7 for the public and 4.8 per cent for aggregate manufacturing sector. Elasticity with respect to own output growth is smaller-at 3.7 for private large sector and 2.8 for the public sector-than the corresponding elasticity with respect to aggregate output growth. Three conclusions emerge from these relationships: (a) Verdoorn’s law holds for organized Indian manufacturing as a whole over the period; (b) Verdoorn’s link is stronger for the public and private-large sectors than for the small sector; and (c) the ‘law’ apparently weakened between period one and period two in small sectors but grew in strength for public sector TFP growth.

The study by Srivastava (1996) focuses on the empirical measurement of total factor productivity during the eighties. The study is based on a panel of public limited companies. The study covers the period 1980-81 to 1989-90. The data has been collected from Reserve Bank of India (RBI) consisting of 15,607 observations and 2439 firms. This study analyses the impact of reforms on productivity and competition for the Indian manufacturing sector in the eighties. At aggregate level, labour productivity increased during the period at an average annual rate of 9 per cent whereas capital productivity decreased at annual average rate of approximately 6 per cent. This was accompanied by 16 per cent annual rate of increase in capital intensity. Average TFPG rate estimates are higher during the period 1985-86 to 1988-89. Estimates for period 1985-86 to 1988-89 are between 0.10 per cent to 2.00 per cent whereas the estimates for the earlier period (1980-81 to 1984-85) are generally negative. A closer look at the annual TFPG rates suggests that a significant rise in TFPG rates occurred in 1987.

The estimates of total factor productivity growth at two digit level for different sectors are generally quite low with the model value being around 0.5 per cent. The only exceptions to this are the food product and beverages and tobacco products sectors. The sectors having higher productivity growth rate during the latter half of the eighties are paper products, rubber, plastics and petroleum products, chemical products, basic metals and alloys and non-metallic mineral products. This study finds that for each of these sectors, the ratio of increase in capital intensity during the whole period is slower than the average. With the exception of non metallic mineral products sector for each of these sectors, the proportion of imported raw material used is higher during the post 1985 period. For three out of the five sectors for which higher productivity growth is observed during the post 1985 period, i.e., in sectors rubber, plastic and petroleum products, chemical products and basic metals and alloys, there is an increase in the share of exports in the total sales during post 1985 period. Therefore relying on econometric estimates of pre and post-reform productivity growth, the study finds evidence of significantly higher productivity growth ratio after mid eighties both at aggregate and at two digit sector levels. The time period covered by the study is small, a longer time period would have helped in arriving at more definite conclusions. The study is restricted to only public limited companies.

The study by Neogi and Ghosh (1998) tries to see the impact of liberalisation on the performance of four selected industry groups, namely, (i) chemicals, (ii) textiles, (iii) non-metallic mineral products and (iv) electrical machinery. The study uses firm level data for the time period 1989-94. The performance indicators chosen to analyse the impact of economic reform on the firms were growth of value added, capital intensity, labour productivity and total factor productivity. The estimates of technical efficiencies of selected industrial groups have been obtained using frontier production model with the help of corrected ordinary least square (COLS) method. The results show that productivity growth and efficiency levels have not improved as per expectation during the post-reform period and the distribution of efficiency is skewed. The TFP growth has fallen sharply during the post reform period in all except in case of chemical industry. The relationship between labour productivity and capital intensity shows a general downfall of efficiency of firms during the study period. The level of technical efficiency for all the industries was found to be very low and no significant improvement has been observed during the post-reform period. The time period covered by this study is too small.

The study by Sengupta (1998) examines the performance of inorganic fertilizers industry in India. Analysis of cost functions and Cobb-Douglas production function have been made to study the performance of the industry. The data has been collected from the ASI and economic surveys. The results of the study reveal that the fertilizers industry is subject to law of increasing costs. The findings get further support from the examination of the production function, which reveals that the average productivity of labour exceeds its marginal productivity. Analysis of shifting cost functions further highlight that the firm belonging to this industry expand capacities, even before fully exploiting the existing capacity conforming to the oligopolistic behavioural tendency of the firms belonging to the fertilizers industry.

The study by Khanna (1999) reveals that the economic reforms in India, initiated in 1991, were based on the premise that macro-economic crisis was a result of micro-economic inefficiencies that distort the structure of incentives to producers. The study shows that the most important feature of the industrial reforms in India has been to ease the entry of FDI in several sectors of the economy. Though, the new policy demarcates the areas where foreign investment will be welcome, the government reserves the right to approve any investment in these areas on 'case by case' basis. The use of foreign brands has been permitted in India. Joint ventures with Indian firms also were cleared by the RBI on a 'Fast track'. Foreign trading firms have been allowed to work in India. The majority of ownership in most areas has been allowed and former FERA companies with foreign equity below 40 percent have been permitted to raise it to 51 percent. Further, the study reveals that restrictions on location, size, mergers and acquisitions and anti-monopoly restrictions (under the Monopolies and Restrictive Trade Practices (MRTP) Act) have been withdrawn. Technology imports and payments for technology or license fee and for hiring of foreign technicians have been eased. Price controls were confined to limited number of goods, mainly essential drugs.

Balakrishnan et al. (2000) investigated the growth of productivity in Indian manufacturing over the period 1988-89 to 1997-98. Data for a panel of 2,300 firms spread over five industry groups at the two digit level of the NIC 1987, yielding over 11,009 observations was assembled from the data base on electronic medium of the Centre for Monitoring the Indian Economy (CMIE). On the basis of the record of tariff reduction since 1991, the industry groups chosen were machinery, transport equipment and parts, textiles, textile products and chemicals. The results of the study show a significant decline in the growth rate of TFP after 1991-92.

The study by Trevedi et al. (2000) uses the two digit industry level data to analyse productivity in major manufacturing industries in India. The industries have been selected on the basis of their contribution to India's export earnings and the availability of consistent time-series data. The time-span covered by this study is 1973-74 to 1997-98. The whole period is divided into five sub periods i.e., 1973-1980, 1980-1985, 1985-1990, 1990-1995 and 1995-1998. The focus on industries with large contribution to manufactured exports is primarily because exports hold the key to managing the external sector of an economy.

In this study, the levels and growth rates of labour productivity, capital productivity and also capital intensities have been reported. In view of the controversy about the 'separability of material inputs', the total productivity (TP) and the total factor productivity (TFP) indices have been estimated within the growth accounting framework. The Translog index has been used. The real value added and the TFP indices have been estimated by both single and double deflation methods. These productivity indices have been calculated using the two alternative series of capital stock, *viz*., capital stock series derived by using investment deflator and capital stock series obtained by using wholesale price index for machine and machine tools.

The results shows that an increasing trend in labour productivity has been witnessed in the case of most of the industry groups across the five sub-periods of the study. The leading performers were chemical, machinery and transport equipment and textile industries, if both the levels and the growth rates of labour productivity are considered. Labour productivity has risen at a higher rate than capital productivity. The international comparisons of labour productivity indicate that Indian industry has witnessed higher growth rates of labour productivity as compared with some of the industrialized countries. However, the level of labour productivity in India is abysmally low and its convergence with the international standards seems to be a difficult proposition in the near future. This indicates the extent of the productivity gap.

The rates of growth of TP, TFP (SD method) and TFP (DD method) in manufacturing sector were 1.0 per cent, 2.6 per cent and 4.4 per cent per annum, respectively, during the period 1973-74 to 1997-98. The rates of growth of multifactor productivity were higher for the selected manufacturing sector as compared with the manufacturing sector as a whole. Textile, machinery and transport equipment and chemical industries were the better performers whereas metal and leather industries were the worst performers. As regards chemicals and machinery and transport equipment industries, they seem to have been adversely affected by the import liberalisation process, which has resulted in the input prices rising faster than the output prices. Leather industry presents a peculiar picture. Growth in output of this industry can be attributed solely to 'perspiration' rather than 'inspiration'. However, this industry has performed rather well in terms of its contribution to exports. The study shows that in all the industries, barring the metal industry, input prices have risen faster than output prices.

Balasubramanyam and Mahambare (2001) study the impact of the reforms on methods of financing investment and productive efficiency of the major industries in India's manufacturing sector using the firm level panel data published by the CMIE. The data covers the four year period from 1988-89 to 1991-92 for the pre-reform period and the six year period from 1992-93 to 1997-98 for the post-reform period. The production function approach has been used to analyse the impact of reforms on productive efficiency of the manufacturing sector. In particular, a Cobb-Douglas type production function of the following form has been used in this study.

$$Y_{it} = Ae^{\lambda(i,t,X_{it})} L_{it}^{\alpha} K_{it}^{\beta} \mu_{it}^{e_t} \qquad \text{.... (2.4)}$$

where i *(firm) = 1,2…2417*, *t (time) = 1,2…10*, *Y* is real gross value added, *L* and *K* are labour and capital inputs while α and β are average wage and capital share respectively in the value added , λ is the rate of disembodied Hicks-neutral technical change, *A* is a scale factor, which can include once and for all shifts in the level of output, μ is a random error term and, X_{it} is a vector of financial variables that are expected to influence productivity. Here, X_{it} consists of the debt-equity ratio of firms in the sample. The production function is linearised by taking logarithms and converted into a ratio form by dividing through by labour which gives the following estimating equation:

$$\ln (Y_{it} / L_{it}) = a + \lambda_1 t + \lambda_2 (DE_{it}) + (\alpha + \beta - 1) In(L_{it}) + \beta In(K_{it} / L_{it}) + \varepsilon_{it} \qquad \text{.... (2.5)}$$

where *a* is logarithm of *A* and the coefficient of L_t tests for the assumption of constant returns to scale in the production function. If the standard theory understates the role of capital and if increasing returns exist, then the sum of the elasticities exceeds one and the coefficient of L_t

will be positive. Contrary to expectations, average TFP growth is negative (-0.03) in the post-reform period. Whereas in the pre-reform period TFP growth was positive for Indian and foreign firms. Government firms continue to show a decline in TFP growth in the post-reform period. Indian owned firms exhibit increasing returns to scale in the post-reform period. The impact of the reforms on the productive efficiency of the manufacturing sector appears to be mixed. There are signs that the reforms have had the desired effect. New firms unencumbered by the distortions of an earlier era have performed much better than the old firms. In general, the post-reform period appears to be one of turbulence and disequilibrium. Firms which have been shielded from competitive forces cannot be expected to adjust to a new era of competition in the short-term, especially when entry for new firms is free and exit for ailing firms is blocked. The statistical results of the study reflect the state of flux in the Indian manufacturing sector.

Bhavani (2002) examined the ongoing changes in the business environment and the possible ways of improving the competitive strength and commercial viability of Indian small scale units in the changing scenario. This study covers the policy changes introduced in the nineties onward era. The study shows that liberalisation has exposed all industrial units to market competition to a greater extent. Globalisation intensifies market competition by allowing imports and multinational corporations to operate in India relatively easily. The study reveals that Indian industrial units especially the smaller ones need to improve their productivity and quality and to reduce costs. For this, substantial improvements will be needed in technology such as mechanization, organization and information and the revamping of policy measures to promote the growth of small units through collective efforts, ending their isolated mode of operation.

The study analyses some of the selected industries, namely, garments, electronics and auto components. The new economic policy in India has made it inevitable for these industries to integrate with the global industry. All the external support including policy assistance has a meaning only when individual units are encouraged. To play a meaningful role, it is essential for both industry associations and government agencies to change their attitudes and to infuse trust and confidence in the small units.

The study by Thomas (2002) focuses on performance of Indian manufacturing in the 1980s and 1990s. The study is based on an analysis of data from ASI for the period from 1979-80 to 1997-98. The country's industrial policy framework began to be liberalized in the 1980s, and this process gained further momentum in the 1990s. The study shows that in the two decades under study and particularly in the 1990s, India's manufacturing sector grew at respectably high rates. Growth of registered manufacturing was generating employment in the 1990s compared to the "jobless growth" of the 1980s. However, there are definite signs of a slow down in manufacturing performance after 1995-96. Performance in growth should be seen against the small size of Indian manufacturing in terms of its share in the country's economy or compared to the manufacturing sectors in other developing economies. Chemical and related industries increased their relative importance and emerged as the major value adder in India's manufacturing, during the two decades under study. On the other hand, textile and allied industries have lost their shares in total value added; but, along with food industries, they continue to be the major source of factory employment.

Growth performance varied greatly across the different industries. Manufacture of chemicals and food products had consistently high rates of value added growth in the 1980s and 1990s; had the largest numbers of new jobs generated in the 1990s; and also had reasonably large shares of total manufacturing investment. On the other hand, cotton and jute textiles had low rates of growth and suffered considerable loss of jobs in the 1980s. This trend continued to decelerate in the 1990s without any significant addition of new jobs. The fast growth in the manufacture of transport equipment in the 1990s is probably a reflection of the recent boom in demand for passenger vehicles. Large scale investment has moved into the production of basic metals and alloys like iron, steel, aluminum, etc. These two industries were the fastest growing segments of the Indian manufacturing industries in the 1990s, after their less than average (for factory sector) growth in the earlier decade. But neither of them could significantly add new jobs. Quite dissimilar was the experience of several labour intensive industries, particularly the manufacture of textile products and of beverages and tobacco products. Their growth rates fell considerably in the 1990s from the impressive performance of the earlier decade. Irrespective of this and of the insignificantly small infusion of new capital into them, these industries were major generators of employment in the 1990s. The two western states of Maharashtra and Gujarat constitute the leading industrial region in the country; these two states together hold a share of more than a third of the total value added in the country. They had high rates of value added growth in the two decades, and had substantially large shares of India's manufacturing investment directed to them. Chemical and related industries in India are heavily concentrated in these two states.

The three southern states, Tamil Nadu, Andhra Pradesh and Karnataka together come next in importance in Indian manufacturing. Tamil Nadu and Andhra Pradesh had, among all Indian states, the largest addition in manufacturing jobs in the 1980s and 1990s. During the last two decades, the southern states displaced Maharashtra and Gujarat to become the major centre of India's cotton textile industry. The eastern states, particularly West Bengal and Bihar, have lost their relative importance in Indian manufacturing. Large numbers of manufacturing jobs were lost in West Bengal and Maharashtra in the 1980s; but this was compensated in the 1990s by the creation of new jobs in Maharashtra and, to a lesser extent, in West Bengal. Madhya Pradesh and Uttar Pradesh had reasonably fast rates of value added growth and received large shares of investment during the two decades.

Overall the study shows the growth experience of Indian manufacturing in the liberalizing decades of 1980s and 1990s: respectable rates of growth, but signs of deceleration after 1995-96; employment generating in the factory sector in the 1990s unlike in the previous decade; and significant variations in growth across industries and regions. The continuing deceleration in textile and related industries and the small size of investment moving into them is a worrisome feature, as these industries continue to be the major sources of employment in the manufacturing sector. Also it is doubtful if the fast growing industries in the 1990s - manufacture of food products, chemicals and transport equipment, and particularly the latter two - can sustain their high growth rates, given that the domestic demand for these industries can reach saturation levels faster.

Balakrishnan and Babu (2003) investigated the trajectory of growth and its relationship to distribution in Indian industry in the 1990s. The study found that there is a faster rate of growth of output across manufacturing since 1991. There is also a rise in employment, though perhaps not commensurate with the increase in the rate of growth of output. There is an increase in growth rate of output in the nineties mainly due to investment. The share of investment in output having increased very substantially overall and pretty much across the board in Indian manufacturing. To the extent that the share of investment replicates response to a regime change, the rise in its share signals the success of reforms in energizing the supply side of the economy. The significant rise in investment represents a rise in the rate of profit which provided the incentive to invest a higher return on capital. An increase in the share of profit has eased the financial constraints of the firms. Distribution as the share of profits in output enters the growth dynamic in this way. The study also examined distribution from the perspective of the allocation of the gains from the change in the policy regime since 1991. Nevertheless, the acceleration is not particularly impressive for what is often hailed as the most significant policy regime shift since 1950. There is a hefty risk in investment, however, though without a corresponding increase in its efficiency. And distribution has shifted sharply with labour's share declining.

The study by Das (2003) examined the productivity performance of Indian manufacturing under various trade regimes. Using data from the Annual Survey of Industries, total factor productivity growth rates have been computed for the period from 1980-81 to 1999-00 and for the four sub periods, i.e., 1980-85, 1986-90, 1991-95 and 1996-00 corresponding to the 4 phases of trade reforms. The study has used NIC-87 code. The results at the three-digit level of disaggregation indicate average TFP growth of 0.08 percent per annum for 75 industries for the entire period. The TFP growth rates for individual industries are either negative or in the 0 to 2 percent range.

Analysis at the level of the three use based sectors, i.e., intermediate goods, capital goods and consumer goods sectors shows that capital goods sector is the only one to register a positive growth (1.39 percent per annum) throughout the period, the intermediate and consumer goods sectors both record negative growth in TFP during the entire period. Comparison across the phases of trade reforms shows that in all the three use based sectors, TFP growth performance is best either in the third phase (1991-95) [capital as well as consumer goods sector] or the second phase (1986-90) [intermediate goods sector]. There is a marked fall in the growth rate of TFP in Indian manufacturing in the 1990s as compared to the 1980s. In addition, for all three use-based sectors, the TFP growth in the second half of the 1990s (1996-00) is lower than the first half of the 1990s (1991-95).

The results indicate that productivity performance seemed to worsen as the pace of trade reform gathered momentum. This is evident from the TFP growth recorded by the industries in successive phases of trade reform. The experience of the eighties on the productivity front seemed to have provided assurance of the potential that existed after reforms in trade and industrial policy. The worsening of TFP growth rate in the 1990s for a vast majority of industries seems perplexing, as this was the phase when substantial and far-reaching trade reforms encompassing the lowering of both tariff and non-tariff barriers were initiated. Two possible explanations for the slow down in TFP growth may be offered. First industrial production in the years 1990-91 and 1991-92 was constrained by factors like import compression, tight-money policy, inflationary pressures and fiscal contraction initiated by the government as part of the macroeconomic stabilization programs. These led to recessionary trend in the manufacturing sector. Second, mergers began to pick up only towards the end of the 1995 and constraints operate in the functioning of the labour markets, particularly the exit policies that ought to supplement the trade liberalisation attempts. In addition, it should be noted that available evidence from various countries shows that the beneficial impact of trade liberalisation on productivity can take considerable time to show up after structural adjustment and industrial restructuring has taken place.

The study by Bala Subrahmanya (2004) analyses the impact of globalisation and domestic economic reforms on small scale industry. The overall performance and contribution of small scale industry is described in terms of its absolute growth in units, employment, production and exports. Linear least square lines have been fitted, based on the time-series data for the annual growth rates of these four variables for two periods of time i.e. 1978-79 to 1990-91 (pre-globalisation period) and 1990-91 to 2002-03 (post-globalisation period). The results depict that the growth of small scale industrial units, production and exports has come down. As a result, less impressive growth in its contribution to national income and exports, though not in terms of employment, in the 1990s. Lack of reliable and stable economic infrastructure, reduced growth of credit inflow and technological obsolescence, would have led to inferior quality and low productivity of the small scale industry in India. The study recommends that the focus must be on technology development and strengthening of financial infrastructure in order to make Indian small scale industry internationally competitive.

Nagraj (2005) compares the performance of the manufacturing sectors in China and India using independent estimates of China's industrial output over the past half century at a disaggregated level. The study finds that China's industrial growth rate is close to one and is half times that of India's over the entire period with the gap widening gradually. But the growth rate of India has been more stable. The share of capital goods in China has steadily gone up, while in India it has stagnated since the mid-1980s. China has been facing the problem of huge excess capacity, misallocation of resources and a gross wastage of capital because of high capital output ratio. The industrial progress of China is based on somewhat shaky micro economic and institutional foundation. In comparison, India's relatively strong foundations and domestic entrepreneurial capital seem to have the potential to improve performances, with a sounder micro economic environment. With a substantial increase in public investment in infrastructure and agriculture, revival of long term industrial finance and easier access to credit for small enterprises, the Indian industrial sector would, in the long run, possibly be in a better position to close the performance gap with China.

Pant and Manoranjan (2005) analyse the working of competition in India's manufacturing sector by using firm level data for the period 1989-2001. The study examined the impact of greater competition on profit mark-up over the last decade by using simple econometric models. The econometric analysis of the factors determining mark-up depicts that trade openness by itself does not act to reduce the profit mark-up. The study also analyses the degree of competitiveness defined as the Lerner price-cost margin. The analysis shows that the estimated margins in general are high over the 1990s across all industries and in most of the industries considered, these margins have been increasing over the second half of the 1990s. The market by itself does not bring competitive outcomes. The regulatory agencies probably have an important role to ensure a level playing field.

The study by Sharma and Upadhyay (2005) presents a review of the total factor productivity studies in Indian manufacturing sector. The analysis shows that studies like Rao (1996), Srivastava (1996), and Pradhan and Barik (1998) found unanimous results regarding the productivity estimates in the decades of the 70s and 80s. They find positive growth rate of TFP in the 70s and negative growth rate in the 80s. This implies a declining trend in the productivity performance of Indian manufacturing. On the other hand, results presented by studies like Trivedi et al. (2000) and Goldar (2000) on TFP estimates for almost the same period are entirely in disagreement with the studies of Rao, Srivastava, and Pradhan and Barik. Both the studies provide empirical evidence of rapid TFP acceleration in the decade of the eighties, though the same pace could not be maintained in the 90s when TFP growth slowed down.

Within the ambit of studies using single deflation method to obtain the real value added in order to derive a measure for output, most of the studies are unanimous on the TFP findings in Indian manufacturing during the decade of the eighties. Ahluwalia (1991), Goldar (1986, 2000), Rao (1996), Gangopadhyaya and Wadhwa (1998) and Trivedi et al. (2000) find acceleration in growth rate of TFP in Indian manufacturing during the decade of the eighties. Whereas analysis done by Baghel and Pendse (1997) does not reveal a significant gain in TFP in Indian manufacturing during this period. Dholkia and Dholkia (1994), Trivedi et al. (2000) and Goldar (2000), have found that growth rate of TFP in Indian manufacturing was quite high in the 80's. Balakrishnan and Pushpangadan (1994) and Rao (1996), on the other hand, have found negative growth rate in the 80's as against significantly positive and high rate in the 70's.

TFP estimates being highly sensitive to the methodologies adopted for the estimation can well be expected to differ with different methodologies. However, the overall analysis reveals that the studies based on similar methodologies have also come up with contradictory findings. To sum up Pradhan and Barik (1998), Balakrishnan and Pushpangadan (1994) and Rao's (1996) results, though based on different methodologies, are in agreement with each other whereas the findings of Ahluwalia (1991), Goldar (1986 and 2000), Dholkia and Dholkia (1994) and Gangopadhyay and Wadhwa (1998) and Trivedi et al. (2000), which follow different approaches, are in line with each other. The survey done in this study reveals that the studies using the growth accounting method can provide the collective measure of the TFP. In order to obtain the estimates for the different components of TFP, the researchers have used the econometric approach.

The study by Bhaumik et al. (2006) uses the 3-digit industry level data from India to explain inter-industry and spatial variation in entry and to examine the possible impact of entry on growth of TFP in the manufacturing sector. The time period covered is 1984-97 and the source of data is ASI. The empirical results suggest that during the 1980s industry level factors largely explained variations in entry rates. But following the economic federalism brought about by the post 1991 reforms, variations in entry rates during the 1990s were explained largely by state level institutional and legacy factors. In addition, variations in entry across industries and states in the post-1991 period were largely explained by unobserved state-level factors, thereby highlighting the importance of institutional factors and governance in an era of economic federalism.

The study shows that there was an increase in TFP over the years, but most noticeably between 1991 and 1997. At the same time, however, the distribution of TFP was much more unequal during the 1992-97 period than in the 1984-91 period. The study also finds evidence to suggest that net entry during the 1985-91 period was positively associated with TFP growth, and much of the impact was direct or instantaneous, i.e., arising from entry of firms that are more productive, on average, than the incumbents (and perhaps exit of firms that are the least productive among the incumbents). TFP growth was not affected by the reforms of the 1980s, but was positively affected by the reforms of the 1990s. The study does not identify whether the increase in TFP can be attributed more to entry of foreign firms or to entry of new domestic firms, or to improvement in productivity of incumbent domestic firms in the face of growing competition.

The study by Butt et al. (2007) analyses the effect of human resource practices such as pay, promotion and training on job satisfaction. In this study an attempt has also been made to examine the difference between male and female job satisfaction level. The sample of this study consisted of 150 employees of both private and public sector service organizations in the vicinity of twin cities of Rawalpindi and Islamabad in Pakistan. A questionnaire was used to gather data regarding above mentioned variables and demographic characteristics of the respondents. The study shows that female employees are more satisfied with their jobs as compared to male employees. The job turnover due to pay, promotion and training in female employees is less than male employees. From the results it is evident that there is a significant difference between male and female employees' job satisfaction level. The results of correlation and regression analysis point out that all three independent variables i.e. pay, promotion and training have positive and significant relationship with job satisfaction and people consider them important for increased level of job satisfaction.

The study by Lee et al. (2007) compares the real output and labour productivity of Chinese and Indian manufacturing from 1980 to 2002. The objectives of the study are to set this direct comparison, within the general context of the economic policy reform process followed in each country and to compare and contrast the organisation and structure of both countries' manufacturing sectors. The analysis shows that since 1980, real value added and labour productivity growth for Chinese manufacturing has been well above Indian levels.

2.3 New Policy Regime and Adjustment Process of Manufacturing Sector in Punjab

Limited work has been done on analyzing the impact of new policy regime on the adjustment process of manufacturing sector in Punjab. A few studies covering some aspects of the Punjab manufacturing have been discussed below:

Singh (1987) has calculated the partial and total factor productivity for the manufacturing sector in Punjab. The time period covered by the study is 1967-68 to 1981-82. The study is based on the ASI data. The author has studied the manufacturing sector (census sector as reported in ASI) and has calculated both the partial and total factor productivity indices. While the labour productivity and the capital intensity showed a rising trend, the capital productivity showed a falling trend. Total factor productivity as measured by Kendrick, Solow and Translog indices showed a declining trend.

Bhardwaj (1990) studies the structure and growth of hosiery industry in Punjab over the period 1975-76 to 1980-81. The industry had growing demand for its products both in domestic and international markets. The small scale units have been engaged in solving the problem of unemployment, increasing the level of per capita income, national income and exploration of natural resources. The study suggests a great need to develop the industry on modern lines with expansion of units, modernization of spinning and knitting units etc.

The study by Ghuman (2004) examines the impact of economic liberalisation on the industrial development of Punjab. In this study an attempt has also been made to compare Punjab's industrial development with that in other states of the country wherever possible. In this study a perusal of investment, particularly of the FDI figures, suggests that reality is far from the rhetoric. Punjab, for example, received FDI worth Rs. 24216.74 million only between August 1991 and October 2003. It works out to be 0.84 percent of the all India FDI. In contrast states like Maharashtra (17.36 %), Delhi (11.96 %), Tamil Nadu (8.55 %), Karnataka (8.27 %), Gujarat (6.50 %), Andhra Pradesh (4.61 %), and West Bengal (3.20 %) received much higher share of FDI. The study shows that the share of neighboring state namely, Haryana was also more than that of Punjab. It is not only that fresh investment is not finding Punjab its destination in a big way, but a couple of industries in the state fail to face the onslaught of liberalisation and are on the verge of extinction.

Two indicators of industrial development, namely the share of industrial sector in the state income and growth of industrial sector clearly show that industry in Punjab has failed to reap the benefits of economic liberalisation. The share of industrial sector in Net State Domestic Product was 14.78 per cent on the eve of economic liberalisation. It improved slightly but experienced a dip in the recent past. For example it declined to 13.74 per cent in 1999-2000 from 14.36 percent in the previous year. The declining trend continued and the share of industrial sector has come down 13.46 percent during 2001-02.

A comparison of the rate of growth of industrial sector during the 8th five year plan (7.34 per cent per annum) and the 9th five year plan (5.46 per cent per annum) also reveals that industrial sector has suffered set back during the recent years of the post-reform phase. In addition to common factors such as lack of natural resources, Punjab being a land locked state far away from ports, and national markets, and hostile international border, the major post-reform factors which are causing slow process of industrialisation include absence of new industrial policy (for about 12 years) patterned on the philosophy of economic liberalisation, lack of techno-ecnomic survey aiming to identify industries having locational advantages and quality of governance.

Singh (2004) studies the impact of economic reforms on productivity growth in manufacturing sector of Punjab. The main source of secondary data in this study is the summary results related to factory sector of ASI. Also data from CMIE had been used. The time period covered in this study is 1983-84 to 1998-99. In this study total factor productivity is calculated by the three indices that are: a) Kendrick Index b) Solow Index and c) Translog Index. Growth rates of labour productivity, capital productivity and capital intensity have also been calculated in this study. Period from 1983-84 to 1990-91 is descripted as pre-reform period and 1991-92 to 1998-99 as post-reform period. This division of period is done to analyse the impact of economic reforms on the productivity growth of manufacturing sector in Punjab.

The findings of the study show that labour productivity increased in the manufacturing sector of Punjab. It is found that the growth rate of labour productivity is more pronounced in the post-reform period. The average annual growth rates of capital productivity reveals that it shows a declining trend in the manufacturing sector of Punjab for the entire study period. But growth rate of capital productivity is positive in post-reform period and negative for the pre-reform period. The results suggest that efficiency of capital input had declined in the manufacturing sector of Punjab in the pre-reform period but post-reform period shows some increase in efficiency of capital input.

The estimates of average annual growth rates of capital intensity reveal that it has increased. This result indicates that the process of capital deepening has taken place in the manufacturing sector of Punjab during both pre and post-reform period. The comparative analysis of average annual growth of Kendrick, Solow and Translog indices suggests that the overall factor use efficiency in the manufacturing sector of Punjab has declined during the post-reform period, which shows that there emerged technological retrogression in Punjab.

Singh (2005) examines the industrial growth experience of Punjab economy during the period of 1980-81 to 2001-02, that is a decade before and a decade after the initiation of economic reforms. The analysis has been done for registered manufacturing, unregistered manufacturing and all manufacturing sector of Punjab at aggregate level. The analysis shows that there is a deceleration in the rate of growth of manufacturing sector of Punjab in the nineties. Both the registered and unregistered industrial sector show lower rate of growth during the 1991-2001 period as compared to pre-reform period i.e. 1980-1990. Analysis on the basis of sectoral composition of value of output of industrial sector of Punjab reveals that the share of the organized manufacturing sector has increased during the period 1980-81 to 2000-01 and on the other hand, unorganized industrial sector recorded decrease in the relative share during the same period which clearly showed the declining importance of the unorganized sector in the industrial sector of Punjab economy.

The share of registered number of factories in the organized industrial sector of Punjab declined sharply in the post-reform period compared to the pre-reform period. Accumulation of capital which is the major source of increase in the capacity to produce more output in the economy has shown reduction in the relative share of Punjab in the national average. Share of fixed capital decreased from 4.24 per cent in 1990-91 to 2.06 per cent in 2000-01 which clearly indicates dwindling of the relative productive capacity of Punjab's industrial sector in the post-reform period. Somewhat similar trends can be observed from the share of other indicators such as emoluments, value of output and net value added except the number of employees which showed higher labour intensity of the organized industrial sector of Punjab. The estimated rates of growth of both employment and enterprises shows that post-reform employment and enterprises growth in the unorganized sector of the Punjab economy recorded deceleration.

The empirical evidence clearly shows a downturn in industrial growth in the post-reform period compared to that of the pre-reform period. The study shows that the factors that have contributed to the deceleration of industrial growth in Punjab were lower investment-GSDP ratio, lower plan expenditure and lower quality of human capital and infrastructure. Identified factors that have led to the deceleration of industrial growth in Punjab were making the state scarce in economic activities and lack of private corporate investment in Punjab, both of domestic and foreign.

Gupta and Bawa (2006) study the growth performance of small scale industry in Punjab in the pre-liberalisation and post-liberalisation period. In this study the compound annual growth rate of number of units, fixed investment, employment and production has been analysed to understand the impact of liberalisation on the performance of the small scale industry of Punjab. The study is based on the secondary data covering the period 1977-78 to 2001-02. The data related to the number of units, fixed investment, employment and production at aggregate level for 17 small scale industries at two digit level and total small industries development organisation (SIDO) units has been collected from 'Directorate of Industries', Punjab. The data for the period 1977-78 to 2001-02 has been divided into two sub-periods: pre-liberalisation (1977-78 to 1991-92) and liberalisation period (1991-92 to 2001-02). The basic findings of the study are that in absolute terms over the period of time, the number of small-scale units, fixed investment, employment and production increased. But the analysis of growth performance of above mentioned four variables during pre-liberalisation, liberalisation and overall period has revealed the true state of small-scale sector in Punjab. During the entire period of 1977-78 to 2001-02, all the four variables have depicted significant growth in case of individual groups as well as all the small-scale units taken together.

The comparative picture of pre-liberalisation and post-liberalisation periods demonstrates that the economic reforms and liberalisation process has resulted in slow growth of small-scale sector. During the liberalisation period, group wise fixed investment and production has resulted in two different impacts. In certain industries growth performance resulted in positive impact, whereas, in others it was negative. The analysis shows that the liberalisation has resulted in jobless growth because along with acceleration in growth of production, the rate of growth of employment has gone down drastically. In case of total small-scale units, except production, the other variables have depicted deceleration in growth performance during liberalisation period as compared to pre-liberalisation period. On the employment front, individually, group wise as well as small-scale industry as a whole, growth rate of employment has shown steep deceleration during liberalisation period.

The study by Raikhy and Nanda (2006) on 'Impact of World Trade Organization (WTO) Regime on Punjab Industry' studies implications of WTO agreements for industry in India (and hence Punjab) by presenting a perceptive profile of many current issues from the point of view of Punjab's industrialists. The study is based on both primary and secondary data. Secondary data were obtained from the Directorate of Industries, Punjab, different publications of the Economic and Statistical Organization and Planning Board of the state. As WTO provisions largely affect the exporters, therefore primary data were collected from the manufacturer exporters/merchant exporters etc. with the help of a questionnaire. A sample size of 110 units of the exporters of the state was determined and random sampling method was used to select the sample units from Amritsar, Jalandhar, Ludhiana and Phagwara, which has more than 90 percent of the exporting units. In this study tabular analysis has been used to analyse the data.

The results of the study show that the growth in a number of Small Scale Industries (SSI) in the state rapidly decelerated during nineties as compared to eighties. The share of industrial output of SSI decreased till 1991 and of large and medium scale industries increased. But afterwards, the share of SSI in output started increasing and rose from 36.12 percent in 1990-91 to 47.32 percent in 2003-04. The change in output may be termed as structural retrogression.

The study depicts that there is a deceleration of industrial growth during nineties indicated negative impact of policy changes during nineties which includes policies of liberalisation, withdrawal of freight equalization scheme and WTO policy regime. Industry in India (and Punjab), especially SSI, developed under competition restricting policies, which included reservation of certain product lines, high import duties and promotional measures. As a result, the industry lagged behind in modernization and technological upgradation. The surveys of 110 manufacture exporters/merchant exporters of the state revealed that majority of the units were set-up in the past 20 years.

The examination of determinants of competitiveness of the sample firms showed that product quality was the major factor, followed by fulfillment of international standards and input quality and availability. Cost advantage and infrastructure did not emerge important components of competitiveness. Sample units were lacking in information about Trade Related Intellectual Property Rights (TRIPS). Sample firms reported no effect of TRIPS agreement on them. The dominant strategy adopted by the sample firms to face increased international competition was improvement of product quality, followed by change in managing and marketing practices and technological upgradation.

The measures taken by the government to improve their competitiveness included provision of telecommunications, banking facilities and excise duty exemption/reduction. Sample units reported facing of many internal problems, which included severe power cuts, transport difficulties, raw material problems, shortage of skilled labour and government policy irritants. They suggested that provision should be made for quality raw material at concessional rates, training facilities for labour, reduction in freight charges on exports, provision of shipping facilities, provision of finance at low rate of interest and simplification of law and procedures etc.

Singh and Jain (2006) examine the growth profile of Punjab's unorganised industry by looking first at its size structure, followed by nature and growth of industrial activity and the factor use pattern. In this study the main source of data is two National Sample Survey Organization (NSSO) Rounds (51st and 56th) in 1994-95 and 2000-01. The 51st Round of

NSSO is based on the NIC 1987 whereas the NIC 1998 laid the basis for NSSO's 56th round. Owing to the concerns for maintaining comparability within these two rounds, each round has been looked thoroughly and relevant adjustments with each round have been made. Reclassification has also made the industrial codes in the 51st Round on the basis of Part-III of CSO (1998).

In examining the size distribution of unorganised industry in terms of number of persons employed (L), the study follows the same norms as the NSSO. The study has classified the unorganised industry into three categories viz. Own Account Manufacturing Enterprise (OAME), Non-Directory Manufacturing Establishments (NDME) and Directory Manufacturing Establishments (DME). OAMEs are the manufacturing enterprises that use the services of household members (Hh_L) only and do not employ any hired worker whereas NDMEs and DMEs are the establishments and refer to such manufacturing enterprises, which along with Hh_L employ hired labour (H_L) in their production process. If $1 \leq H_L \leq 5$, the NSSO identifies a manufacturing unit as NDME but if $6 \leq H_L \leq 10$, the manufacturing unit is identified as DME.

The unorganised manufacturing sector continued to survive and thrive in an era of liberalisation mainly due to its direct or indirect linkages with organised sector units. Many Indian states have witnessed a spurt in unorganised manufacturing activity though at different pace during the 1990s. Punjab's unorganised industry has emerged distinctly along side its counterparts in other major Indian states by recording a relatively high expansion in unorganised manufacturing activity. There has been a growth in both the number of units and the number of workers. Along with this, it also accounted for relatively high capital intensity.

The analysis of the size structure reveals that these are the OAMEs which dominate in terms of number of units and workers. The establishments (NDMEs and DMEs), on the other hand, dominate the structure of Punjab's unorganised industry in terms of output, gross value added and the usage of fixed capital. The analysis has also been done for the size structure across manufacturing units differing in terms of investment in plant and machinery. The analysis shows that the small units constitute a majority of the unorganised manufacturing units.

These units provide employment to a large set of people but do not contribute much in terms of output and gross value added. However, these units, in comparison to their large counterparts, contribute a relatively high proportion of the gross value added in their gross output.

The analysis of inter-industry pattern of growth shows that the textiles, food products and beverages, fabricated metals, other non-metallic minerals, manufacturing of other transport equipments especially the bicycle industry are some industry groups whose significance has grown in Punjab's unorganised manufacturing sector during the 1990s, but the industry groups like the manufacturing of machinery and equipments have recorded a decline.

The analysis of factor use pattern in this study has been done by analysing the labour mix, factor allocation and factor productivity. The analysis of labour mix shows that barring a few industry groups like the manufacturing of textile products, leather products, other non-metallic minerals etc., the labour mix is highly dominated by male workers. Further, the hired workers constitute a significant proportion of total workers. The results of degree of casualisation in Punjab's unorganised industry reveal that it is mainly an urban phenomenon. While the factor allocation pattern analysis shows that the technique of production has become more capital intensive with growth in the use of both fixed capital per unit and fixed capital per worker. The analysis of factor productivity demonstrates the inefficiencies of Punjab's unorganised industry. The level of labour productivity is quite high, which is essentially the result of capital-deepening process. On the other hand, the productivity of capital has remained very low.

2.4 Observations Based on the Review

The empirical work that has studied the impact of new policy regime on the adjustment process of manufacturing sector has so far failed to produce any conclusive evidence. Some of the studies show that reforms positively benefit manufacturing performance while other studies reveal that reforms have negative impact on the manufacturing performance. The following issues emerge from review of studies:
Almost all studies conducted so far are either too aggregative or wherever some disaggragation has been achieved, it does not reflect the underlying process of impact of new policy regime on manufacturing productivity. Little attention has been paid in these studies to the explanation of the observed productivity changes. So what exactly determines productivity is still an uncovered area. Most of the studies have been done at the all India level, such a comprehensive study at the Punjab level has not been undertaken earlier. Adjustment process of manufacturing in response to new policy regime is a relatively less researched area.

The exhaustive literature review highlights that most of the studies are done only on Indian manufacturing sector and that to at the aggregate and two digit level. Productivity analysis and adjustment process of Punjab manufacturing sector is a less researched area and no such study has been done at the aggregate, two digit and three digit level of disaggregation. The present research also makes a comparison of the impact of policy regime on the adjustment process of Indian and Punjab manufacturing. Such a comparative study has not been undertaken earlier. To cover the impact of reforms on the adjustment process of Punjab manufacturing, firm level analysis has been done for two hundred manufacturing firms. The analysis has been done to see the impact of reforms on the basis of size, age and organizational structure. The basic aim of the present survey analysis has been to see whether the plant size is associated with higher output growth. Is the same is true for old and experienced firms.

Hence from the review presented, it may be inferred that there is an ample scope for research in this field. The above review of the studies regarding manufacturing performance, though not very exhaustive, has served as the basis for the present study.

2.5 Chapter Summary

The reforms were undertaken in India to increase the productivity and efficiency and ready to face the global challenges. Many studies have tried to cover the impact of reforms on Indian manufacturing. The study by Trivedi et al. (2000) depicts that growth rate of TFP was positive in the 1990s, but it was lower than in the 1980s. In the nineties onwards era also no conclusive evidence can be drawn as Goldar's study (2000) claims that the decade of the 80's has been a period of rapid TFP growth in the Indian manufacturing. However according to the study the pace could not be maintained in the subsequent years. The results of the study Balakrishnan et al. (2000) show a significant decline in the growth rate of TFP after 1991-92. The study by Balasubramanyam and Mahambare (2001) shows that average TFP growth is negative in the post-reform period. Whereas in the pre-reform period TFP growth was positive for Indian and foreign firms.

The study by Thomas (2002) shows the growth experience of Indian manufacturing in the liberalizing decades of 1980s and 1990s: respectable rates of growth, but signs of deceleration after 1995-96 and significant variations in growth across industries and regions. The results of the study by Das (2003) indicate that productivity performance seemed to worsen as the pace of trade reform gathered momentum. This is evident from the TFP growth recorded by the industries in successive phases of trade reform. The study by Bala Subrahmanya (2004) depict that the growth of small scale industrial units, production and exports has come down in post reform period. The study by Bhaumik et al. (2006) shows that there was an increase in TFP over the years, but most noticeably between 1991 and 1997.

All these studies have been done at the all India level, moreover the results about the impact of the 1991 reforms on the productivity growth of manufacturing sector are mixed. No conclusive evidence can be drawn from these studies. The reason may be the differences in the methodologies used in different studies and the issues related with the measurement of inputs especially the capital.

At Punjab level very few studies has been done and even the results of such studies are not same. The study by Ghuman (2004) depicts that two indicators of industrial development, namely the share of industrial sector in the state income and growth of industrial sector clearly show that industry in Punjab has failed to reap the benefits of economic liberalisation. The study by Singh (2005) shows that there is a deceleration in the rate of growth of manufacturing sector of Punjab in the nineties. Both the registered and unregistered industrial sector show lower rate of growth during the 1991-2001 period as compared to pre-reform period i.e. 1980-1990. Gupta and Bawa (2006) study depicts that during the entire period of 1977-78 to 2001-02, all the four variables, the number of small-scale units, fixed investment, employment and production have depicted significant growth in case of individual groups as well as all the small-scale units taken together but the economic reforms and liberalisation process has resulted in slow growth of small-scale sector.

Hence no conclusive evidence can be drawn from the above studies as these empirical studies give mixed results and suggest the need for further investigation of the impact of new policy regime on the productivity and adjustment process of Indian and Punjab manufacturing. An investigation of the issue at the firm level may add to our knowledge of the issue and shed light on the disparate set of results produced by the extant studies.

Chapter 3
DETERMINANTS OF PRODUCTIVITY: A THEORETICAL UNDERPINNING

3.1 Conceptualization of Productivity

Productivity is an important concept in the context of the growth of a nation's economy. Productivity is essential to raise the living standards of the nation. The concept and measurement of productivity is often misunderstood and misused even by trained economists. The actual methods of estimation and their accuracy remain the subject of debate. The concept of productivity is often vaguely defined and poorly understood. Different meanings, definitions, interpretations and concepts have emerged as experts working in various areas of operations have looked at it from their own perspectives (Sardana and Vrat, 1987).

Although there is no consensus on the definition of productivity, yet everyone accepts it to be a measure of performance. No amount of economic juggling can alter the fact that in the long run, our solvency depends on the productivity of our industries. Productivity is the key feature of economic dynamism in these days. Kuznets (1966) had pointed out that the rapid growth in industrial productivity was an essential element in the development and structural transformation of newly developed economies. Productivity is a word which is used broadly to express the overall efficiency relating to performance of industries. Smith, A. (1776) referred to efficiency and specification, what in current nomenclature amounts to the concept of productivity.

Helms (1996) defines productivity as "a measurement that tells you how well you are doing as a producer or how well a machine, an acre of land or the country as a whole is doing". Productivity is a technical concept concerning the efficiency with which we convert the inputs into output (Felipe, 1997).

In a broader sense, productivity means goods and services produced in relation to the resources utilized in producing the same. Productivity means utilizing appropriate resources, avoiding wastage, producing more with same constituents while maintaining quality. Higher productivity implies that more output is achieved with the same input or that the same output is achieved with less input. So, higher productivity means more efficient use of input resources. Thus, productivity becomes a path of progress and rising productivity becomes a condition of material progress.

Section 3.1.1 and 3.1.2 critically review the methodologies adopted in India to determine the factor productivities.

The methods used by most Indian studies may be classified into following categories:

(a) Partial factor productivity;

(b) Methodologies based on production functions:

   (i) Kendrick's total factor productivity method based on linear production function;

   (ii) Methods based on non-linear production functions such as: Log linear regression form; Solow methodology and

3.1.1 Partial Productivity

Partial productivity measurement is probably the most commonly used technique. Productivity, when defined with respect to any one input ignoring other factors of production in the output-input ratio is termed as partial productivity. Partial measures relate output to one class of input (Parsons, 2000). Partial productivity shows the relative efficiency of the factor used, the effect of factor substitution as well as of changing productive efficiency.

Partial productivity is classifiable according to factors as:

(a) Capital Productivity

(b) Labour Productivity

(c) Capital Intensity

3.1.1 (a) Capital Productivity

Capital Productivity is defined as the ratio of output to capital resources expended. In determining the performance of the economy much attention has been paid, of late, to the value of capital-output ratios. The concept of capital used in this study relates to gross fixed capital. Capital includes plant, equipment, buildings and construction.

The ideas of capital consumption allowance, average life of capital goods, net stock, calculations regarding replacement amount of capital, gross stock, rates of depreciation, correction of historical costs of components, replacement, cost accumulated expenditure on investment etc. have come up from time to time to transform capital as an input measure, which can be used as a meaningful denominator in productivity measurement. The statistics available of capital input are not free from inherent defects and vary from one source to another, so much so that the results show a marked difference and often lead to dubious outcomes and misguide the researchers.

Capital productivity has been measured in the present research for Indian manufacturing and Punjab manufacturing for the time period 1980-81 to 2002-03.

3.1.1 (b) Labour Productivity

A number of variables combine to affect changes in productivity. But it is necessary that a particular yardstick of input factor be chosen that manifests in all types of production. It is generally believed that the number of workers or man hours worked should be taken as an input factor in production. When output is divided by number of workers or man hours the result is termed as labour productivity.

Several points are made in favor of the choice of labour man hours or in favor of the number of workers employed in calculation of productivity. Labour force is one of the most important resources in any country. Adequate supply of efficient and skilled labour is a great asset. Another argument in favor of this measure is that labour is more readily measurable than other input factors and that it possesses a universal element common to all plants, processes and industries. So this universality provides a common basis for measuring and comparing the relative productivity, not only in different units but also of different sectors of a country.

This definition of labour productivity, despite its simplicity and widespread usage, has not removed confusion either from analysis of interpretation and the reasons for it are manifold. It is difficult to extricate the deep rooted notion from the mind of common man, inexperienced in the technique and methodology of productivity analysis, that labour productivity data measure the productivity of labour and not the productivity of all the combined input factors. It would be difficult to envisage a situation in which a country can achieve higher standards of labour productivity despite its comparatively low standard of labour efficiency. Siegel (1961) says, “Labour productivity indices do not reveal changes in the intrinsic efficiency of labour, but rather the changing effectiveness with which labour is utilized in conjunction with other factors. As such labour productivity is not a measure of specific contribution of labour or of any one factor of production. It reflects the cumulative influence of operation of a large number of interrelated influences such as technological improvements, the degree of efficiency achieved in different processes, the rate of operation, the availability of supply and the flow of materials and components, employer-employee relations, the skill and effort of workers as well as the efficiency of management.

In the present study labour productivity has been measured for Indian manufacturing and Punjab manufacturing for the time period 1980-81 to 2002-03.

3.1.1 (c) Capital Intensity

Capital intensity is measured as the ratio of gross fixed capital to labour. The use of tools and machinery makes labour more effective. So rising capital intensity pushes up the productivity of labour. A society that is more capital intensive tends to have a higher standard of living over the long run than the one with low capital intensity. Capital intensity is computed in this study for the time period 1980-81 to 2002-03.

3.1.2 Total Factor Productivity

The expression of productivity as a ratio between output and any single input factor like number of workers or man-hours consumed, invested capital or units of horse power consumed, is subject to limitations. In these partial productivity indices, output is compared with only one input at a time without recognition of the changes in other inputs. Thus, a rise of labour productivity may be caused by substitution of capital for labour or by the technological change, economies of scale, better management, education and so on. This problem can be resolved by analyzing total factor productivity growth which identifies the contribution to an increase in output, of influences other than increases in the factor inputs.

Total factor productivity is defined as the rate of transformation of total input into total output. Tinbergen (1942) and Stigler (1947) introduced the concept of TFP into the economics literature. Solow (1957) gave a useful frame of reference for the main empirical approaches to measuring TFP. His productivity estimates were computed using what has come to be known as the growth accounting approach.

Diewert and Lawrence (1999) define the TFP index in general as the ratio of an index of output growth divided by an index of input growth. They argue that the growth rate for individual outputs and inputs are weighted together using revenue and cost shares respectively. Changes in the TFP index show how the amount of total output that can be produced from a unit of total input has changed over time.

Total factor productivity growth encompasses the effect not only of technical progress but also of learning by doing, better utilization of capacities, improved skills of labour etc. TFP is a composite measure of technological change. The important measures of total factor productivity are:

3.1.2 (a) Kendrick Index

John W. Kendrick developed a total factor productivity index using a linear production function. Kendrick index is an arithmetic index where factor inputs are combined arithmetically by base year fixed weights.

$$P = \frac{V_n}{a_0 L_n + b_0 K_n} \qquad \text{.... (3.1)}$$

where P is the productivity index, V_n is the value added during period n using the amounts of labour and capital L_n and K_n respectively. a_0 and b_0 stand for base year efficiency of labour and of capital. Kendrick assumed that a_0 and b_0 are appropriately measured by the wage rate and the rental rate during the base period respectively.

Wage Rate during base period = $\frac{W_0}{L_0}$ .... (3.2)

Where W_0 = Wage bill during base period,

L_0 = persons employed during base period

Rental rate during base period = $\frac{V_0 - W_0}{K_0}$ .... (3.3)

Where V_0 = Value added during base period,

W_0 = Wage bill during base period and

K_0 = Fixed capital stock during base period

Kendrick developed this productivity index to estimate changes in national productivity overtime in the United States' economy. The assumption of perfect competition, perfect substitutability between labour and capital, constant returns to scale and profit maximization are implied. This measure involves comparing "what the output of period II would have cost at the factor prices and unit factor requirement of I (real output) with what they did cost in constant I factor prices, but at the II level of productive efficiency (real input). Alternatively, we are comparing the actual real output of II with what the output of the factors would have been in II had the productive efficiency of I real input, prevailed.” (Kendrick, 1961).

The arithmetic index of Kendrick has its own limitations. Domar (1962) has pointed out that an arithmetic combination of input implies that marginal productivities vary only due to other factors and not due to variations in capital and labour. In the Neo classical scheme of things, it would imply the assumption that capital and labour increase in approximately the same proportion and their ratio remains constant. For relative rate of growth of the index, it may be useful to use ratio concept throughout and combine inputs and output geometrically. Beri (1962), Sinha and Sawhney (1970), Banerji (1975) have used this method to arrive at total factor productivity index.

3.1.2 (b) Domar Index

The total factor productivity index of Domar is a geometric index.
The Domar index corresponds to the following manipulative production function:

$$V_t = P_t \ L_t^{\alpha} K_t^{\beta} \quad \text{.... (3.4)}$$

Where P_t is total factor productivity. The rate of change is obtained by taking logarithms of the variables.

$$Log\ V = Log\ P + \alpha\ Log\ L + \beta\ Log\ K \quad \text{.... (3.5)}$$

Differentiating with respect to time we get:

$$\frac{1}{V}\frac{dV}{dt} = \frac{1}{P}\frac{dP}{dt} + \alpha\frac{1}{L}\frac{dL}{dt} + \beta\frac{1}{K}\frac{dK}{dt} \quad \text{.... (3.6)}$$

This can be expressed as:

$$\frac{P^{\cdot}}{P}=\frac{V^{\cdot}}{V}-\left(\alpha\frac{L^{\cdot}}{L}+\beta\frac{K^{\cdot}}{K}\right) \quad .... (3.7)$$

Where dots denote time derivative. Thus, the rate of total factor productivity is given by the difference between the rate of change of output and weighted sum of the rates of change of capital and labour. The Domar index also assumes fixed weights like the Kendrick index. Despite its merits, the geometric index is not as commonly used as the arithmetic index. Domar calculated single factor productivity and total factor productivity growth rates for U.S.A, Canada, U.K., Germany and Japan for 1948-60. The total factor productivity was the highest for Germany and Japan and the lowest for U.K.

3.1.2 (c) Solow Index

Solow's methodology is based on Cobb-Douglas production function. The production function is homogenous of degree one in capital and labour and the factors are rewarded according to their marginal products. Technical change is assumed to be neutral in the sense that marginal rate of substitution between capital and labour is unchanged with change in output. The functional form is:

$$V/L = A\ (t)\ (K/L)^{b} \quad .... (3.8)$$

Where *V/L* is output per person, *K/L* is capital per person and A and b are constants. Expressing the above relation in log form:

$$Log V / L = \log A(t) + b \log(K / L) \quad .... (3.9)$$

Putting this in incremental form:

$$d(V / L) / V / L = dA(t) / A(t) + bd(K / L) / K / L \quad .... (3.10)$$

$$\text{or } dA(t) / A(t) = d(V / L) / V / L - bd(K / L) / K / L \quad ....$$

(3.11)

$d(V/L)/V/L$ is the rate of change in output per person, $d(K/L)/K/L$ is rate of change of capital per person and b is capital's share of output. Therefore, the rate of change of total factor productivity is the difference between the rate of change of output per person and a rate of change of capital per person multiplied by capital's share of output. This yields $dA(t)/A(t)$ series from which *A(t)* series can be computed by assuming the initial value of *A(t)* as one. A whole series of technical change can be derived from:

$$A(t+1) = A(t)(1+\Delta A(t)/A(t)) \text{ assuming that } A(0) = 1 \quad .... (3.12)$$

Banerji (1975), Mehta (1980), Goldar (1986) and Ahluwalia (1985) used this index to arrive at total factor productivity index. In this model, the effects of technical progress (as represented by time term) and capital accumulation are separated. The basic procedure is to estimate the contributions made to the growth of output by the increases in inputs of labour and capital over a period of multiplying the observed increased in inputs by observed factor prices and deducting the residual from over all growth in output. The residual is attributed to technical change.

3.2 Determinants of Productivity

It is significant to enquire what factors govern the temporal, spatial and cross-sectional changes in productivity in the manufacturing industries. For this, the important determinants of productivity have been analysed. A study of such factors helps in analysing the conditions which retard and stimulate productivity, and also in discovering the nature and character of the relationship that exists between different determinants of productivity. A study of determinants of productivity helps in analysing which variables influence productivity the most and should be varied in order to have an immediate effect on productivity.

For interpretation of the productivity data and for the formulation of business policies, it is essential to know what influences do the individual determinants exercise on overall productivity. But the factors affecting productivity are so numerous and inextricably interwoven that the task of evaluating the influence of each individual factor on overall productivity of individual units is beset with almost insuperable difficulties. Such a large number of factors affects productivity that it is difficult to say whether increased productivity is the result of more efficient utilization of plant and machinery or of the application of the process of production or of more intensive efforts of the workers and management. Although long term advances in industrial productivity usually stem from the steady application of science and technology to the productive process and from increased efficiency and skill of workers but other factors such as the degree of plant utilization, size and stability of production, location of plant, the degree of integration and rationalization and standardization of work and material layout are by no means less important. Indeed, under the complex production system, the influence of the individual factors is often blurred in the overall picture and no rough and ready method is available by which these complex and interrelated influences could separated and their influence measured in quantitative terms.

So a multiplicity of factors governs the rise and fall in industrial productivity. Mehta (1955) observes that the factors affecting productivity are so numerous, complex and inter-related that it is difficult to arrange them in any logical or systematic sequence. Indeed Balakrishna's (1958) description of productivity as an elusive concept that does not lend itself either to clear cut definition or easy computation would seem to be real.

The objective of this part of the study is to find out the relationship between growth in total factor productivity and growth in other variables like rate of growth of output, capital-labour ratio, rate of growth of investment, scale variable, rate of growth of factories and total emoluments. It is hypothesized that productivity is dependent on these variables. The variables used in the model are discussed below:

1. Rate of Growth of Output

Rate of growth of output is an important determinant of productivity as productivity is measured as a ratio of output to input. The higher rate of growth of output should lead to higher labour productivity of the industry. The movements in labour productivity have normally a specific relationship with movements in output. Verdoorn (1949) examined the empirical relationship by estimating the equation of the form:

$$P = \alpha + \beta Q \qquad \text{.... (4.1)}$$

Where P is the Productivity growth and Q is the output growth and α and β are parameters. The equation (4.1) was later popularized as Verdoorn's law. He observed a constant long run relationship between output growth and productivity growth. Kennedy (1971) observed a strong correlation coefficient between output growth and productivity growth for Irish manufacturing industry for the period (1946-66). Goldar (1986) has also examined the determinants of productivity in Indian manufacturing sector for the period 1960-70 and found that the one per cent higher growth in output is associated with 0.4 per cent higher growth in TFP. Ahluwalia (1991) estimates the relationship between growth in value added and TFPG. The growth in value added has a positive and statistically significant impact on productivity growth. The elasticity of total factor productivity with respect to value added is 0.37.

In the present study, output is measured by the growth rate of output at constant prices. There are a number of reasons for expecting a positive association between growth in output and growth in productivity. The faster an industry grows, the more the opportunity it has to explore the benefits or an expanding level of operations. The expansion of the industry explores the economies of scale. So an increase in inputs leads to a higher increase in output. In situations where there is excess capacity in an industry, the expansion in scale of operations allows the utilization of this capacity and thus increases efficiency of the factors. Besides the effect of better utilization of capacity and economies of scale, there is also the effect of learning by doing on productivity performance. Adoption and adaptation of new technologies takes time. In the course of absorption of technology, learning by doing has a positive impact on productivity growth.

2. Capital Intensity

Capital intensity is the capital-labour ratio of the industry. Capital is the fixed capital employed and labour is given by the total persons engaged. The most immediate factor affecting output per worker is the amount of machinery available. It is quite evident that the worker helped by machine will produce more than the workers operating with little or no machinery. The need to employ more or less machinery is determined by a number of factors such as size of the plant, the state of technological advancement, the nature and character of products, the size of the market, the availability of capital and human resources and the possibility of substituting one by the other. The quality, size of the machinery, as well as the application of modem techniques in general are of equal importance.

In the U.S. several empirical studies undertaken by the National Bureau of Economic Research, the U.S. Bureau of Labour Statistics and the National Industrial Conference Board show that rapid increases in the output per man hour in American industry are associated with the technical improvements and their application to productive processes. Although, it is difficult to measure quantitatively the degree of relationship between technical change and productivity, yet a number of empirical studies bears ample testimony to the fact that the technological advances have made significant contribution towards the rapid rise in industrial productivity. Higher capital intensity involves more embodied technical progress and scope for learning by doing. Empirical studies on the technology-productivity nexus analysed on American industries by Terlechky (1974), Scherer (1982, 1983) and Griliches (1984) have shown that technological advancement is a major source of productivity improvement. Similar conclusions have been presented in the studies of Odagiri (1985) for Japanese industries and Cuneo and Mainsesse (1984) for French industries.

3. Investment

Composition of capital affects productivity. Investment is taken as the change in the capital stock. Investment figures have been obtained using the formula:

$$I_t = (B_t - B_{t-1} + D_t) / R_t \quad .... (4.2)$$

Where B is the book value of fixed capital, D is the depreciation and R is an appropriate deflator for fixed capital. For R wholesale price index of machinery (base 1993-94 = 100) has been used. Productivity can be increased by increasing the use of capital goods, machinery and equipment.

4. Growth in Number of Factories

The next variable taken in the present study is growth in number of factories over the period. The source of data for this variable is the Annual Survey of Industries. This variable captures the effect of increase in the number of factories on productivity during the period of study. The study by Ahluwalia (1991) reveals that the growth of factories in an industry is negatively related to total factor productivity growth. This probably reflects an adverse impact on productivity growth of the phenomenon of fragmentation stemming from the policies of protection of the small scale sector.

5. Scale Variable

Scale variable is measured as the capital stock per factory (an average of two points of time during the period). Ahluwalia's (1991) scale variable, 'capital stock per factory' is an average of the value for two points (1959-60) and 1975-76) during the period (1959-60 to 1979-80). The estimated regression coefficient for scale variable is positive but not statistically significant in Ahluwalia's study. In the present study, scale variable is measured as the average of capital stock per factory taken for two points 1982-83 and 1997-98 during the period. The source of data is the Annual Survey of Industries.

6. Total Emoluments

Total factor productivity also depends on the efficiency of labour. The ability of the worker, the willingness, and the system of wage payment influence the efficiency of labour. The attitude and behavior of the workers are influenced partly by the system and partly by his morale, feeling of responsibility and trade union practices and attitudes. The system of wage payments exerts an important influence on the worker's urge to produce more. The source of data for this variable is the Annual Survey of Industries.

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

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6) \qquad \text{.... (4.3)}$$

Where X_1 is output growth;

X_2 is capital intensity;

X_3 is investment;

X_4 is growth in number of factories;

X_5 is scale variable and

X_6 is total emoluments.

The present study uses ordinary least square regression and stepwise regression techniques to fit in the above mentioned model. The time period for the analysis is 1980-81 to 2002-03. The dependent variable is total factor productivity growth. Total factor productivity is a comprehensive measure of productive efficiency in the manufacturing sector. An effort is made to explain the factors affecting total factor productivity growth at aggregate and two digit level industries.

Goldar and Kumari (2003) examine the impact of import liberalisation on productivity growth of Indian manufacturing industry for the period 1981-82 to 1997-98. A comparison is made between the growth rates in TFP in Indian industry in the 1990s, i.e., the post-reform period with that in the 1980s. This is followed by an econometric analysis of inter-temporal and inter-industry variations in the productivity growth rates, aimed at assessing the effect of import liberalisation on productivity growth in Indian Industry in the 1990s. Another aspect that receives specific attention in the econometric analysis is the effect of capacity utilization on measured productivity growth. The basic source of data used for the productivity estimates is the ASI.

The estimates obtained indicted that during the 1990s, a decade of major industrial and trade reforms, there was a deceleration in TFP growth in manufacturing. However, a closer examination revealed that: (a) Capacity utilization was a significant factor influencing productivity growth in manufacturing industries; and (b) there was an increase in capacity utilization in manufacturing in the 1980s and a fall in the 1990s. After making corrections for changes in capacity utilization, the TFP growth estimates for the 1990s were found to be about the same as in previous decade. Multiple regression analysis was carried out to study the factors influencing TFP growth in manufacturing industries. The results showed a significant favorable effect of tariff reforms on industrial productivity. The results also indicated that slower growth of agriculture in the 1990s and gestation lags in investment project might have had an adverse effect on TFP growth in Indian manufacturing in this period.

The study by Milner et al. (2007) explores the impact of trade policy reforms on TFP growth in the Indian manufacturing sector. The industry data at two-digit and three-digit level is obtained from the ASI covering the period 1984-85 to 1997-98. The classification scheme followed from 1984-85 to 1987-88 is NIC 1970, with the later years following the NIC 1987. A concordance is made between these two classifications. The base estimates are for the three-digit level on a year-to-year basis and the results are also aggregated at the two-digit level over a seven-year period, corresponding to pre and post-reform period. In this study the pre-reform period is taken as the years 1984/85–1990/91 and the post-reform period from 1991/92–1997/98. In this study, growth accounting methodology is used for estimating TFP growth. The results are based on Cobb-Douglas and Translog production functions. The picture at the disaggregated level shows that for 12 of the 17 industry categories, the results are in line with the overall manufacturing sector average, with TFP growth being higher in the post-reform period. There are, however, five two-digit industries where productivity growth is lower in the post-reform period. The three-digit estimates for each year over the pre and post-reform period shows that for the whole pre-reform period, the majority (0.53) of three digit industries experienced TFP regression, while for the post-reform, the majority (0.69) of industries experienced TFP growth.

There are a few studies done at all India level to explore the impact of policy reforms on TFP growth in the Indian manufacturing sector. However no such study has been done for Punjab Manufacturing. The present study is a step in this direction to find out the impact of reforms on the adjustment process of Punjab by taking into account the productivity differences at the two digit and three digit level. An attempt has also been made to find out the determinants influencing productivity at the all India and Punjab level.

Chapter 4
RESEARCH METHODOLOGY

In the macroeconomic context, productivity refers to the rate at which output is generated from the employed resources. Increasing the quantum of physical inputs deployed in the production process can increase output. However, every nation has constraints on physical inputs. For example, advanced countries like the USA and Japan face severe shortages of labor. The problem of physical input constraints is more severe in developing countries like India. In India, capital inputs are scarce and therefore costlier, due to lower per capita income, lower savings rate, and income inequalities. Both the public and private sectors find it increasingly burdensome to mobilize capital resources on a continuous basis to support their growth needs. Although labor is abundant in India, there are even labor input limitations because of structural deficiencies such as an imbalance between skill availability and skill requirements and because of poorer productivity. Accelerating the rate at which output is generated from the employed resources is an imperative for India, i.e., productivity growth must occur. Productivity growth in developing countries acquires even more significance. Today, TFP is considered an important source of output growth worldwide due to rapid progress in science and technology and various efficiency-enhancing measures. This highlights the importance of the present study in this changing globalised scenario.

Research design constitutes the blueprint for the collection, measurement and analysis of data. This chapter includes the methodology that was followed in conducting the present research and the rationale behind it. The present research consisted of two sources of data: the Secondary Data as well as the Primary Data. The chapter is divided into three sections. Section 4.1 discusses the methodology used for secondary data analysis. In this section the model and methodological issues in the measurement of productivity have been discussed. Section 4.2 discusses the methodology used for primary data analysis. Section 3.3 contains the chapter summary.

4.1 Methodology used for Secondary Data Analysis

4.1.1 Data Sources and Concordance

The basic source of data used in the present work for the productivity estimates is the Annual Survey of Industries (ASI) which is published by the Central Statistical Organization (CSO), Government of India. Most of the earlier studies [e.g Goldar (1986), Ahluwalia (1991) and Rao (1996)] have also used this as the principal database. This survey is being conducted every year since 1959 by the National Sample Survey Organization and processed by the Central Statistical Organization. The Annual Survey of Industries related to the registered sector of manufacturing. Registered factory is one which is registered under section 2 m (i) and 2 m (ii) of the factory Act 1948. The sections 2 m (i) and 2 m (ii) refer to any premises including the precincts thereof (a) wherein ten or more workers are working or were working on any day of preceding twelve months and in any part of which manufacturing process is carried on with the aid of power; or (b) wherein twenty or more workers are working or were working on any day of the preceding twelve months and in which or in any part of which a manufacturing process is carried on without the aid of power.

The National Industrial Classification (NIC) 1998 has been followed to classify factories from the Annual Survey of Industries covering the period 1980-81 to 2002-03. It may be noted that till 1997-98 the classification of industries followed in the ASI was based on the national industrial classification 1987 (NIC-1987). The switch to the NIC-1998 from the year 1998-99 necessitated some matching of the NIC-1987 with NIC-1998. So for this purpose, a concordance is made between NIC 1998 and NIC 1987 using the concordance table published by the CSO. We treated the NIC-1998 as the base and accordingly carried out data adjustment at the two digit and three digit industries level. Some industries have to be merged (341+342+343) to build a comparable series for pre 1998 and post 1998 periods. Rest of industries have been adjusted using the procedure outlined in the CSO document (1998) to arrive at comparable series.

4.1.2 Time Period Covered in the Study

The time period covered in the present study is 1980-81 to 2002-03. However along with the secondary data, primary data has also been collected from manufacturing firms of Punjab in the year 2007. Secondary data in 2005 was available till 2003 only and this latest data was taken for analysis. Since secondary data for was available till 2003 only. So far understanding the structural adjustment of Punjab manufacturing primary data was collected in 2007 to cover the latest scenario of Punjab manufacturing through a survey of two hundred manufacturing firms.

The 1991 reforms were a major step towards liberalisation, privatisation and globalisation. Deregulation of industry and exposing it selectively to competition from outside were the steps believed to ultimately raise productivity to international levels. To examine the impact of new policy regime on the productivity of manufacturing sector of India and Punjab, the entire period is divided into two sub periods. Period one is 1980-81 to 1990-91, the pre-reform period and period two is 1991-92 to 2002-03, the post-reform period. Keeping this in mind the present study attempts to examine the trends in productivity for Indian manufacturing as well as for Punjab manufacturing in the two periods to see whether there has been an improvement in the post-reform period, the period associated with liberalisation, privatization and globalization.

Productivity analysis has been done at the aggregate level for the Indian manufacturing and Punjab manufacturing. With the view to study inter-industrial pattern of productivity growth, analysis has been done at two digit and three digit level of disaggregation. Productivity has been estimated for twenty two 2-digit manufacturing industries for India and for Punjab. A detailed analysis of productivity has been done at the three digit level for manufacturing sector in Punjab. Two digit industrial classification codes and three digit industrial classification codes are given by the National Industrial Classification (NIC), India. Three digit industrial classification is the sub-class of two digit industrial classification. For example the code given to the industrial group food products and beverages is 15. At three digit level this group has further codes namely Production, processing and preservation of meat, fish, fruits, vegetables, oils and fats (151), Dairy product (152), Grain mill products, starches and starch products, and prepared animal feeds (153), Other food products (154), Beverages(155).

The study analyses the trends in output (value added), inputs (labour, capital), labour productivity, capital productivity, capital intensity and total factor productivity for Indian manufacturing sector and Punjab manufacturing sector for the period 1980-81 to 2002-03 as well as for sub periods, period I, 1980-81 to 1990-91 and period II, 1991-92 to 2002-03.

4.1.3 Translog Index

In the present study, the Translog index of total factor productivity has been used for the measurement of total factor productivity. The Translog index of Total Factor Productivity (TFP) is a discrete approximation to the Divisia index of technical change. It has the advantage that it does not make rigid assumptions about elasticity of substitution between factors of production (as for instance done by the Solow index).

Translog index of total factor productivity growth is based on the transcendental logarithmic production function characterized by constant returns to scale. Translog production function is a flexible functional form imposing relatively few apriori restrictions on the properties of underlying technology. It does not assume a Hicks neutral or constant rate of technological change. The elasticity of input is allowed to vary with the level of inputs. The functional form is written as:

$$\log V = \alpha_0 + \alpha_L(\log L) + \alpha_K(\log K) + \alpha_t t + 1/2\beta_{LL}(\log L)^2 + 1/2\beta_{KK}(\log K)^2 + \beta_{LK}(\log L)(\log K) + \beta_{Lt}(\log L)t + \beta_{Kt}(\log K)t + 1/2\beta_{tt}t^2 \quad \text{.... (3.13)}$$

Where α 's and β 's are the parameters of the production function. The condition of homotheticity in a Translog production function is:

$$\beta_{KK} + \beta_{LK} = 0 \; ; \; \beta_{LK} + \beta_{LL} = 0 \qquad .... (3.14)$$

Constant returns to scale require: $\alpha_K + \alpha_L = 1$, in addition to restriction given in 3.14.

When we consider data at two discrete points of time T and $T-1$, the average rate of technical change g can be expressed as:

$$\log V(T) - \log \overline{V}(T-1) = \overline{V}_K[\log K(T) - \log K(T-1)] + \overline{V}_L[\log L(T) - \log L(T-1)] + \overline{g} \qquad .... (3.15)$$

Where: $\overline{V}_K = 1/2[V_K(T) + V_K(T-1)]$ and $\overline{V}_L = 1/2[V_L(T) + V_L(T-1)]$

V_K and V_L are income shares of the factors capital and labour respectively:

$$\overline{g} = 1/2[g(T) + g(T-1)] \qquad .... (3.16)$$

The above expression for the average rate of technical change g is referred to as the translog index of technical change.

Growth rate has been estimated from the following equation.

$$Y = ab^t \qquad .... (3.17)$$

Taking logarithm of both the sides, the equation can be written as:

$$\log Y = \log a + t \log b \qquad .... (3.18)$$

In this equation the time variable is independent and the concerned variable is dependent variable.

4.1.4 Variables of the Study

4.1.4.1 Measurement of Output

In measuring output an important choice arises between value added and gross output. The choice hinges on whether one believes the production function to be separable in factor input and material inputs. In the literature, researchers exhibit a strong preference for using value added as the measure of production. Griliches and Ringstad (1971) advance the following arguments in its favor:

It facilitates comparison of results for different industries with different material intensities; it facilitates aggregation of output across industries, and inclusion of 'material' as an argument in the production function leads to the problem of dominant variable. In such a formulation almost all variations in output tend to get explained by 'material' thereby obscuring relations of greater interest. Ark (1996) explains that the value added remains a useful concept particularly because it is simple, avoids the need for estimates of intra-industry transactions, and bears closer resemblance to primary statistics such as production census and representative firm data.

It has been shown that functional separabilitiy, fixed intermediate input proportion and constant relative intermediate goods prices are three possible hypotheses which, if satisfied, may lead to a justification of the use of 'value added'. Danny and May (1978) test these hypotheses for Canadian manufacturing and reject each of the three. Denison (1969) regards both gross and net measures as legitimate for productivity analysis. Denison, however, prefers the net measure as "gross product is larger by the value of capital consumption." There is no reason to wish to maximize capital consumption. It may however be pointed out that from the data available it is extremely difficult to make a proper estimate of capital consumption. The figures on depreciation presented in the ASI are at the rates allowed by income tax authorities and are seldom representative of the true capital consumption.

Gross value added at constant prices is taken as the measure of output in the present work. Many studies in Indian context viz. Ahluwalia (1985, 1991), Balakrishnan and Pushpangadan (1994), Dholakia and Dholakia (1994), Gangopadhyaya and Wadhwa (1998), Trivedi, et al. (2000) and Goldar (2000) have considered gross value added as a measure of output while calculating the TFP. The gross measure of value added is obtained from the value added and the depreciation data as given in the Annual Survey of Industries.

Nominal value added has to be converted into real value added. This conversion can be done with either single deflation or double deflation method. In the case of the former, nominal value added is deflated by the output price index, i.e., both nominal output and nominal material inputs are deflated by the output price index. This is called the SD method. The other alternative is to deflate the nominal output by output price index and the nominal material inputs by the input price index, i.e., the DD method.

The present study uses single deflation method as getting suitable deflators for materials considering its severe heterogeneity is a rather difficult task. Bruno (1978) and Diewert (1978) analyse the biases inherent in using single and double deflated value added in place of the correct output in production function and TFP studies. Regarding the measurement of TFP, Bruno points out that the use of single deflated value leads to a biased estimate. The method of double deflation requires dealing at the most disaggregated level which is often not feasible CSO (1980); CSO (1989). Any grouping or aggregation can lead to serious errors. The estimates of real value added are highly sensitive to the set of weights which are used to arrive at the overall input price index. Moreover, Dholakia and Dholakia (1994) point out that even if we consider the case where double deflation method is feasible with complete disaggregation available, the possibility of negative real value still remains. Studies viz. Ahluwalia (1985, 1991), Goldar (1986), Baghel and Pendse (1997), Gangopadhyaya and Wadhwa (1998) have computed the value added by single deflation method.

4.1.4.2 Capital Input

In spite of its important place in economic theory, capital is the most difficult concept to deal within empirical context. There are statistical and conceptual problems involved in its measurement. The problem of defining and measuring capital is hardly settled as yet. Productivity analysis and growth would not be possible unless one agrees on some definition and method of measuring capital in practice. Considerable differences are observed with regard to the measurement of capital input. The difference in total factor productivity estimates between studies may be attributed largely to the difference in capital estimates.

According to Du Plooy and Jackson (1995), capital is made up of many inputs - they include land and buildings, plant and equipment, and inventories. Capital is the stock of all the goods in a firm at any moment of time whether they be fixed assets like machines and buildings or circulating assets like consumable stores.

4.1.4.2 (a) Approaches to Measurement of Capital

In theory, value of capital is defined as the discounted future income stream to be derived from it. This is a forward looking concept. The significance of a stock of capital good lies in its earning power. Capital can also be defined as quality of labour time expended in the past. This is a backward looking concept of capital. The capital stock of particular year is measured by the amount of resources that would have been required in the base year to produce the capital goods. Similarly, gross additions to the capital stock and capital consumption are valued in terms of base year costs for the particular capital goods added or consumed. By this method, if two machines had the same cost in the base year in whose prices the estimated capital series is expressed they are considered to embody the same amount of capital regardless of the differences in their ability to contribute towards production. The method is not so simple as the changes in prices of capital goods lead to various conceptual and practical problems. In a situation of changing prices, a price index for capital goods would be required for deflation purpose.

Replacement Cost

Replacement cost is often used as a reference to the value of capital. Replacement cost concept again has two variants (i) replacement cost new; and (ii) replacement cost written down. Replacement cost new amounts to the cost of new equipment of similar type, while the replacement cost written down is based on the vague notion of decline in productive capacity and its measurement.

Depreciation

Depreciation is the decline in value of capital goods with age at a given point of time. The estimates of depreciation depend on the relative efficiencies of capital goods of different ages. For estimating capital, important choices arise with regard to depreciation and obsolescence.

Kendrick (1956) argues that while making an estimate of capital, we have to take into account the fact that the capital embodied in a specific asset goes on declining over time due to depreciation and obsolescence and argues that obsolescence should be charged at the time the capital good is discarded and that it should be handled as a deduction from gross capital formation rather than as an addition to capital consumption.

Ruggles and Ruggles (1961) question the relevance of such considerations when backward looking concept of capital is taken. When efficiency improvements have been excluded from the measurement of capital stock, it seems inappropriate that decrease in efficiency through ageing should be so carefully taken into account. For a consistent estimate of capital, no allowance should be made for depreciation during the life of a machine (and 100 per cent charge be made on retirement) despite the fact that producers may for financial reasons and in order to derive a more meaningful profit figure, amortize the cost of a machine over its life.

There are essentially three options available for dealing with the issue of depreciation.

(a) Exogenously determined Depreciation Rates: In exogenously determined depreciation rates one can rely on meaningful depreciation rates estimated in other studies. King and Fullerton (1984) calculate depreciation rates of U.K., Sweden, Germany and the U.S.A. The estimates for manufacturing machinery range from 7.9 per cent for the U.K. to 13.31 per cent for the U.S.A. and for buildings from 2.5 percent for the U.K. to 4.56 per cent for Germany. Depreciation rates at a more disaggregate level are available for the U.S.A. in Hulten and Wykoff (1981).

(b) Endogenously determined Depreciation Rates: Another possibility is to make an attempt to estimate depreciation rates based on information contained in the data. Making the assumptions: (a) all the firms' capital stock has useful life L_t ; (b) firms use straight line depreciation and (c) the depreciation rate $\delta_t = 2/L_t$; it can be shown (Salinger and Summers 1981) that,

$$L_t = GFA_t \,/\, DEP_t \qquad \text{.... (3.19)}$$

Where DEP_t is depreciation provision in year t. Instead of L_t.

$L = \Sigma_t L_t/T$ and $\delta = 2/L$ can be used.

(c) The One Horse-Shay Model: In this model it is assumed that economic deterioration is zero during the life of the machine. The rationalization for the approach is that machines do not really deteriorate during their useful life and are kept in their initial conditions with expenditure on repair and maintenance. Hashim and Dadi (1973) point out that a large amount of expenditure is incurred by business firms on repair and maintenance, when the main object is to keep the assets in more or less in similar productive capacity. Such maintenance cost is treated as current cost and is deducted from gross value of output to obtain gross value added. Hashim and Dadi (1973) argue that since the main objective of such expenditures is to keep the productive capacity of capital assets more or less intact, such expenditure should be treated as reinvestment. In such a situation there is no need to subtract depreciation from gross capital stock so as to correct for capital consumption.

The One Horse Shay Method has been used to obtain series for gross capital stock at replacement cost and at base year prices. In the present work, value of gross fixed capital stock at constant prices has been taken as the measure of capital input. The use of gross figures is justified in developing countries. Many analysts have favored the gross stock over the net stock on the ground that the net value declines much more rapidly than does the ability of a capital good to contribute to production. Barna (1961) revealed that capital goods in United Kingdom are generally maintained in good condition until a decision is made to scrap them. As against this, Denison (1967) points out that the use of gross stock involves the other extreme assumption that the ability of a capital good to contribute to production remains constant throughout its service life.

According to Leontief (1953) "Recent information indicates that the undepreciated coefficients correspond much more closely to the incremental coefficient than do the depreciated ones." Hence, gross capital output ratio would be more relevant for forecasting the incremental capital requirements. Domar (1961) has also argued in favor of gross capital figures as, "working with net investment and net stock of capital in the conventional sense one loses sight of gross investment as a major vehicle of technological progress…… Hence, gross figures may be more meaningful with some unknown deduction of a smaller magnitude than conventional depreciation to account for the deterioration of existing capital."

However, even unknown deductions of smaller magnitude are not needed if we consider the point that a large amount of expenditure is incurred to keep the assets in more or less similar productive capacity. Sinha and Sawhney (1970), Banerji (1975) and others point out that the figures on depreciation reported by CMIE and ASI are calculated at the rates allowed by income tax authorities and they seldom represent the true capital consumption. Working capital has been excluded from the measure of capital input. On this question, Sinha and Sawhney (1970) argue that "while the importance of working capital to industrial productivity cannot be denied, the inventory and cash holdings are more often determined by supply and market expectation than technological pipeline requirements and have, therefore, far less bearing on productivity than fixed investment". Rosen (1959) also points out that the relationship between working capital and output is less influenced by technological factors than the relationship between fixed capital and output.

Perpetual inventory method has been used in the present study for estimating capital. This method has been used in a number of countries for estimating the capital series. In the Indian context this method has been used in various studies like Ahluwalia (1991), Balakrishnan and Pushpangadan (1994) and Rao (1996). Investment is the net addition to capital stock within the country in the form of plant, machinery, building and other capital goods. The investment figures are obtained using the formula:

$$I_t = (B_t - B_{t-1} + D_t) / R_t \qquad \text{.... (3.20)}$$

Where B is the book value of fixed capital, D is the depreciation and R is an appropriate deflator for fixed capital. For R, wholesale prices index of machinery (base 1993-94=100) has been used. Capital stock for any year may be calculated as follows:

$$K_t = K_0 + \sum_{t=1}^{T} I_t \qquad \text{.... (3.21)}$$

Where I is investment in year t and K_0 is capital stock for bench mark year, i.e., 1980-81.

The figures on fixed capital available in ASI are the book values of fixed assets. The use of undeflated book value amounts is inaccurate. The book values are deflated by a price index. The weakness of using deflated data is that it does not take into account assets of different vintages brought at different points of time. Therefore, perpetual inventory method has been used. For this, replacement cost for the benchmark year is required. The relationship between book value and replacement value of fixed capital has been examined by Mahalanobis (1955). This study shows that every type of capital good has a certain life after which it must be replaced. Consider any particular type of capital good. Let its average life be T years. Also consider that any particular item of the given type has been in use for a certain period, say, t years. Then it has (T-t) years of useful life still left. If the stock of capital goods includes a large number of items of the given type then there would be one item which still has a useful life of t years left then the combined useful life of the two items taken together is (T-t)/t or equal to T years. Thus the average life is 1/2(T) for each item. So this argument would be valid for all items under the simplified conditions mentioned above. Therefore, the average useful life at any time is half of the total life so that as a first approximation the current book value should be half of the replacement value. Hence the replacement value of capital can be taken as double the book value.

Mahalanobis made a rough check. It was found that the estimate of replacement value is actually double the present value of total paid-up-capital. Mahalanobis (1955) cited a survey of small scale industries conducted during 1952-53 in which the replacement value of plant and machinery was found to vary from 2 to 6 times the book value. Mahalanobis also estimated replacement value of capital stock of a number of enterprises using the relationship between investment and output available for a number of projects. He noted that the ratio of replacement value of book value varied from 2 to 4 times. On the basis of studies cited above, Mahalanobis decided to use double the book value as a reasonable estimate of current replacement value.

Banerji (1975) has also taken double the book value in 1946 as a measure of replacement value at 1946 prices of fixed assets for the year. Hashim and Dadi (1973) calculated gross net ratios for various three digit ASI industries separately for three categories of assets: (a) building and construction; (b) plant and machinery and (c) other assets for 1960 separated into the above mentioned categories. They derive gross fixed assets at purchase prices for the year 1960. Then defining gross addition to fixed assets in year t, denoted by A_t as:

$$A_t = B_t - B_{t-1} + D_t \qquad \text{.... (3.22)}$$

Where B_t and D_t denote book value of fixed assets and depreciation in year t. Then purchase prices for preceding and subsequent years are derived. Let G_{60} denote fixed assets at purchase prices for 1960 and G_{63} that for the year 1963; then the relation between G_{60} and G_{63} can be written as:

$$G_{63} = G_{60} + A_{61} + A_{62} + A_{63} \quad .... (3.23)$$

The ratio of replacement value to book value of fixed assets from their estimate turns out to be 8.7. Roy Chaudhry (1977) has also doubled the value of fixed capital stock at book value for the benchmark year to estimate the replacement cost figure.

A study by Balakrishnan and Pushpangdan (1994) estimated capital stock for 1960 for three digit industries for the census sector using gross-net ratios from Hashim and Dadi for various three digit industries. The gross net ratio for land in this study is assumed to be unity. Where the gross net ratio is not given, it has been taken to be twice the book value of fixed capital. The ratio of the value of fixed capital at replacement cost to its book value in this study in 1960 (2.42) was used to arrive at an estimate of fixed capital at replacement cost in the sample sector. Chaudhuri's (1996) estimate of aggregate net fixed capital stock from ASI for 1959 is Rs. 1,08,960.5 lakh and aggregate replacement cost estimates for 1959 at 1959 prices is Rs. 2,11,473.3 lakh which is almost double the book value.

Hence, considering the above empirical evidence and on the basis of studies explained above, it may be decided to use double the book value as a reasonable estimate for the current replacement value of assets at any given time. Once estimation of fixed capital stock for 1980-81 is done the rest of the series of the fixed capital is worked out by first estimating real investment in fixed assets in subsequent years and then by adding such investment to the benchmark estimate. Assuming constant returns to scale, the share of capital is obtained as one minus the share of labour.

4.1.4.3 Labour Input

Labour is the single most important input to many production processes. Various arguments have been put forward while specifying a measure of labour input. Regarding the measurement of labour there are three alternatives available: (a) man hours; (b) workers and (c) employees. Total number of hours worked is not a satisfactory measure if a mix of skilled and unskilled workers is employed in a production process. Hours of work contributed by highly skilled workers usually contribute more to production than the unskilled workers. Denison (1961) disfavors taking man hours as a measure of labour input, as reduction in man hours per week leads to an increase in labour input per hour. Thus, measuring labour by the number of employees is more satisfactory.

The present study uses the total persons engaged data from the Annual Survey of Industries for the period 1980-81 to 2002-03. For recent issues, it is reported in the ASI under the head "persons engaged", for earlier issues it is reported as "number of employees". Total persons engaged as a measure of labour input include both workers and persons other than workers. This relates to all persons engaged by the factory for wages or not in work directly connected or indirectly with the manufacturing process. It includes administrative, technical, clerical staff as also labour used in production of capital assets for factory's own use. It has been argued that such workers are as much important for getting the work done as the workers who operate the machines and therefore their services should be taken into account in the measurement of labour input. The share of total emoluments in value added is taken as the share of labour.

4.1.5 Deflators for the Variables in Nominal Values

A major task in developing productivity measures is to develop measures of output and inputs in real or physical terms. For making price corrections to the reported data on output and intermediate input, suitable deflators have been constructed with the help of the official series on wholesale price indices (Index Numbers of Wholesale Prices in India, prepared by the Office of the Economic Adviser, Ministry of Industry, Government of India). For deflation purpose, the base (1993-94=100) has been taken in the present research. The data on gross value added and total emoluments has been deflated using the industry specific wholesale price indices. The data on capital has been deflated using the wholesale price index of machinery.

4.1.6 Regression Model

Little attention has been paid in earlier studies to the explanation of observed productivity change especially for the Punjab economy. Taking the two digit industry level productivity growth for the period 1980-81 to 2002-03, an attempt has been made to explain sector wise differences in productivity growth using regression models for Indian and Punjab manufacturing. Ordinary least square regression and stepwise regression models have been used for analyzing the factors affecting productivity.

Ordinary least squares is a method of fitting data. The best fit in the least-squares sense is that instance of the model for which the sum of squared residuals has its least value, a residual being the difference between an observed value and the value given by the model. Stepwise regression is a method of computing OLS regression in stages. In stage one, the independent best correlated with the dependent is included in the equation. In the second stage, the remaining independent with the highest partial correlation with the dependent, controlling for the first independent, is entered. This process is repeated, at each stage partialling for previously-entered independents, until the addition of a remaining independent does not increase R-squared by a significant amount (or until all variables are entered).

4.1.7 Hypotheses

It is broadly hypothesized that the output, capital, labour and entrepreneur has adjusted itself in response to new policy regime and the adjustment has been targeted to improving performance of the organization. To be more specific we can list some of the main hypotheses as follows:

- Productivity has improved in the post-1991 period, the period of new policy regime for Indian as well as Punjab Manufacturing
- The impact of new policy regime on the adjustment process of Punjab manufacturing sector is significantly different from that of India.
- Rate of output growth is an important determinant of productivity.

- Large scale firms have performed better in the post-reform period.
- Old firms have responded positively to the liberalisation, privatisation and globalisation.

4.2 Methodology used for Primary Data Analysis

This section covers the methods of data collection, population of the study, the design of survey, survey measuring instrument, and methods of data analysis.

4.2.1 Methods of Data Collection, Population and Sample

4.2.1.1 Data Collection

A survey technique has been used to collect data from selected manufacturing firms of Punjab. Data collection was began by searching for information on manufacturing firms of Punjab from several sources as; Directorate of Industries, Punjab, Ludhiana Management Association, Ludhiana Machine Tool Manufacturers Association, Patiala Management Association etc. Data sources of manufacturing firms of Punjab provide important information of the firm's name, addresses, telephone number, e mail addresses for the researcher to send questionnaire. Data has been collected by conducting personal interviews at firm offices.

4.2.1.2 The Time Frame in the Data Collection Process

The names of Punjab manufacturing firms from the data sources before sending the questionnaire to the selected firms has been searched for the time 15th March 2007 to 1st April, 2007. The process of data collection has completed in six months. The data has been collected between 2nd April, 2007 and 30th September, 2007 by personally interviewing the respondents.

4.2.1.3 Population and Sample

The term population refers to the total number of people, objects, or events that are relevant to the research aspect being studied (Riley et al., 2000). The population for the survey is all the large scale, medium scale and small scale industries of Punjab. There are total number of 600 large and medium scale industrial units and 0.2 million small scale industrial units in Punjab [Government of Punjab (2006), India]

A total of two hundred firms are included in the sampling frame. In the total sample of 200 firms, 59 are large scale, 39 are medium scale and 102 are small scale firms. The large and medium scale industries constitute 16.34 percent of the total and the small scale industries are 0.05 percent of the total small scale units of Punjab. The dominant industries of Punjab have been selected for the survey. The sample is a representative sample covering all the major manufacturing units. These are: engineering goods, bicycle and bicycle parts, hosiery, steel rerolling, sewing machine and sports goods. These industries have been chosen for the study for their significant role in the Punjab economy and also for their high export potential. The data has been collected from all the major industrial centres of Punjab. These are Ludhiana, Jalandhar, Amritsar, Gobindgarh, Patiala, and Mohali.

4.2.2 The Design of Survey

A self structured questionnaire tested for reliability and validity, has been used as a tool for collecting data after setting questions related to the objectives. The questions have been compiled on the basis of the information gained from the review of earlier studies.

A pilot study has been conducted before finalizing the questionnaire which has been administrated to the firms. The aim of the pilot study has been to pre-test the questionnaire before sending it to the selected 200 firms.

4.2.2.1 The Questionnaire

After developing the research questions, the questions have been grouped into sections.

Table 4.1 shows the structure of questionnaire. The details of questionnaire are shown in Appendix I. There are two parts; (1) Organization Profile (2) Research Questions. The main part is the research questions which is separated into four sections; Section A: Overall Performance, Section B: Employees, Section C: Impact of Globalisation on Technology Adoption and Adaptation, and Section D: Research and Development.

Table 4.1 The Structure of Questionnaire

Parts	Contents	Pages
1	Organizational profile	1
2	Research Questions Section A: Overall Performance Section B: Employees Section C: Impact of Globalisation on Technology Adoption and Adaptation Section D: Research and Development	1-3

The first part contains the organization name, address, survey respondent's name and designation, respondent's e-mail/address and the address to which the questionnaire is to be returned. The second part relates to the goals of study. The questions have been grouped into four sections and each section linked to research objective, new policy regime and adjustment process of manufacturing sector in Punjab. The questions have been prioritized logically in each section. Most questions have multiple choices. The question topics and number of questions in each section are shown in table 4.2 below.

Table 4.2 The Number of Questions and Question Topics in Questionnaire

	Section	Number of questions
A	**Overall Performance** Type of firm, Establishment year, Selling, Type of organization, Present turnover, Market share, Investment as percentage of total expenditure, Gross value of plant and machinery, Investment by foreign companies, Investment in new machinery and equipment, Investment in computer hardware and software, Accreditation/certification of the firm, Total sales, Net profit rate	14
B	**Employees** No. of Employees, Technically skilled employees, Training programme organized, Percentage of male employees, Other benefits to employees, Percentage of labourers after 1991 reforms, Work orientation and attitude of the workers	10
C	**Impact of Globalisation on Technology Adoption and Adaptation** Impact of Globalization, Prioritize the expectations of your firm after adoption and adaptation of new technology, Technology adoption, Role of government, Important barriers to new technology adoption, Technology adaptation: Preparedness of your firm for new technology adaptation	25
D	**Research and Development** Investment in R&D, Impact of innovation activity undertaken by the firm, No. of Trademarks of your firm, Percentage of staff employed in R&D activities, Performance of R&D activities in the firm	12

4.2.2.2 Pilot Survey

In the present study a concerted effort has been made to make sure that the questionnaire contains a representative sample of the subject matter under study. To increase the validity of the questionnaire and to pre-test the data collection procedure, a pilot study has been conducted. This procedure has been performed to reduce confusion and misunderstanding by the respondents answering the survey. Twenty five firms were contacted to participate in the pilot study. The aim has been to prepare final questionnaire and to note the level of difficulty for each question. The validity of the questionnaire has been ensured through continuous discussions with the researcher's study supervisors with experts from the area from Punjab, Chandigarh and Delhi. They were asked to provide their comments regarding the content and readability of the survey. The respondents from the pilot survey noted those questions which are difficult to answer or unclear in intention and suggested guidelines to improve these questions. Based on the experts comments and guidance, the format of the questionnaire has been modified, some questions have been deleted, others expanded, and still others added. After the pilot study, further refinement has been made according to the comments received to prepare the final questionnaire for the survey.

4.2.2.3 Reliability Test

A measure is reliable to the degree that it provides consistent results. Reliability is concerned with estimates of the degree to which a measurement is free of random or unstable error (Cooper and Schindler, 1998). At the heart of all 'methods' of calculating reliability lies the relationship between the number of items in the survey and the strength of the correlation between them. If the item statements are poorly designed and the attitude in question not clearly defined in the mind of the researcher then the outcome will be an unreliable test (Riley et al., 2000).

The Cronbach's Coefficient Alpha is the frequently used inter-item consistency reliability measure. Cronbach's Alpha (α) is computed for a scale based on a given set of items (Saraph et al., 1989). Cronbach's Coefficient Alpha ranges in value from 0 to 1. It is used to explain the reliability of factors extracted from dichotomous (that is, questions with two possible answers) or multi-point formatted questionnaires or scales. The higher the score, the more reliable the generated scale is (Reynaldo and Santos, 1999).

The reliability of the questionnaire has been tested according to Cronbach's Coefficient Alpha measurements in this study. Reliabilities less than 60% are considered to be poor, those in the 70% range, to be acceptable, and those over 80% to be good. The closer the reliability coefficient gets to 100% the better it is.

The Reliability Coefficient Cronbach's Alpha (α) of each of the component of manufacturing sector adjustment is shown in Table 4.3.

Table 4.3 Reliability Coefficients

Manufacturing sector adjustment components	Items in Scale	Cronbach's Alpha
Overall Performance	13	0.721
Employees	10	0.806
Impact of Globalisation on Technology Adoption and Adaptation	25	0.718
Research and Development	12	0.880

The reliability coefficient alpha for all the four components is above 70% and even for two elements is above 80% which is good. These values indicate that the reliability of the questionnaire is high.

4.2.3 The Statistical Methodology

The statistical methodology has been initiated with the identification of data and measurement scales, data sampling, data analysis and data presentation. These are outlined below:

4.2.3.1 Identification of Data and Measurement Scale

Categorical data and numerical data are the two main types of data. Mainly categorical data type has been used in the questionnaire. The establishment year of the firm was the only numerical data type question in the questionnaire. The following table shows the examples of categorical and numerical data:

Table 4.4 Examples of Categorical and Numerical Data

Data type	Questions	Responses
Categorical	1. Type of firm	Large Scale ☐ Medium Scale ☐ Small Scale ☐
	2. No. of Employees	0-50 ☐ 50-100 ☐ 100-200 ☐ 200-400 ☐ >400 ☐
	3. How do you rate the work orientation and attitude of the workers of your firm?	Very Poor 1 Poor 2 Moderate 3 Good 4 Very Good 5
Numerical	1. Year of Establishment	_______

This present study uses two measurement scales that is nominal scale and ordinal scale. In the ordinal scale the ordering of data is from the lowest to highest or the highest to lowest. On the other hand the nominal scale is static. The table below shows the examples of nominal and ordinal scales:

Table 4.5 Examples of Nominal and Ordinal Scales

Data type	Questions	Responses
Nominal	1. Accreditation/Certification of the firm	Yes ☐ No ☐
Ordinal	1. How do you rate the Performance of R&D activities in your firm	Very low ☐ Low ☐ Moderate ☐ High ☐ Very high ☐
	2. Availability of better technology stimulated new technology adoption	Strongly Disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree ☐

4.2.3.2 Data Sampling

To select the firms for the survey a stratified random sampling technique has been used. A sample size of two hundred firms has been selected for the survey.

4.2.3.3 Data Analysis

The data from returned questionnaires has been stored on computer. The statistical programme, SPSS version 15, has been used to analyse the data. The functions used are as follows; (1) Tabular Analysis, (2) Chi Square test and (3) Factor Analysis. All significance levels are set to 1% and 5% level.

4.2.3.4 Data Presentation

Data presentation has been used to explain the results of the data analysis. This has been done with the interpretation and explanation of the results of the data analysis. Techniques such as tables and figures have been used to explain the results.

4.3 Chapter Summary

The aim of this chapter is to clarify the methodology of the research as well as to outline the logic and methodology in undertaking the study. The achievement of the research goals and the research methodology needed to be utilized by fundamental statistical methods. The present research is based on both the secondary sources and primary sources of data. In analyzing the secondary data the main objective of the present study is to analyse productivity trends in Indian manufacturing and Punjab manufacturing industries for the period 1980-81 to 2002-03. To examine the impact of new policy regime on the manufacturing sector, the whole period is divided into two sub-periods, pre-1991 and post-1991period.

Productivity at the aggregate level gives an overall picture. With the view to study inter industrial pattern of productivity growth, analysis is done at two digit and three digit level of disaggregation. For the time series analysis the secondary data about registered manufacturing units has been compiled from the Annual Survey of Industries (ASI), published by the CSO, Government of India. For making price corrections to the reported data on output and intermediate input, suitable deflators have been constructed with the help of the official series on wholesale price indices (Index Numbers of Wholesale Prices in India, prepared by the Office of the Economic Adviser, Ministry of Industry, Government of India).

The gross measure of value added is obtained by adding depreciation to net value added. Labour input is represented by total persons engaged and capital input is measured by estimates of gross fixed capital stock at replacement cost at constant prices. Perpetual inventory method has been used in the present research for estimating capital series. The returns of labour are measured by the total of wages, salaries and benefits (total emoluments) and returns to capital are measured as value added minus the returns to labour on the assumption that returns to two factors of production exhaust the value added in the process of production.

Growth rates of value added, capital and labour have been calculated. In the study, the focus is on the empirical measurement of (a) partial productivity (b) total factor productivity. Partial factor productivities measure the ratio of output to one of the inputs setting aside interdependence of the use of other inputs. Labour productivity is measured as a ratio of value added to number of persons employed. Capital productivity is measured as a ratio of value added to gross fixed capital. Capital intensity is measured as a ratio of gross fixed capital to labour.

An increase in factor inputs often may not bring about proportionate increases in their productivities. Sometimes an increase in one factor may influence the productivity of other factors, for example; labour efficiency tends to improve with the adoption of improved technology. Therefore, the measurement of productivity by single factor input (capital or labour) would not be sufficient to interpret the trends of productive efficiency. As total factor productivity takes into account the productive efficiencies of both capital as well as labour, therefore, total factor productivity is a more comprehensive measure to understand the overall trends in productivity of both capital as well as labour. Trends in partial factor productivity, however, do provide an inference about the movement of total factor productivity index because it is a composite index of labour and capital productivity indices.

The concept of total factor productivity is defined as the ratio of output to a weighted combination of inputs. Various total factor productivity indices are in vogue and they differ from each other with regard to the weighing scheme involved in their computation. The most important among these is Translog Index. The Translog Index of TFP has been used for the measurement of TFP in the present research. For analyzing the determinants of productivity, ordinary least square and stepwise regression models have been used in the study.

Primary data has been gathered through a questionnaire. The questionnaire has been developed, modified and then administrated to the firms. The main method of data collection was personal interview and the list of Punjab manufacturing firms selected from several data sources in order to acquire sufficient number of respondents. The sample size of the study consists of 200 firms. The research targets has been focused on dominant industries of Punjab; engineering goods, bicycle and bicycle parts, hosiery, steel rerolling, sewing machine and sports goods The data has been collected from the six major industrial centres of Punjab viz. Ludhiana, Jalandhar, Amritsar, Gobindgarh, Patiala, and Mohali.

The questionnaire has been divided into two parts; (1) Organization Profile (2) Research Questions. The research questions have been composed of four sections i.e. Section A: Overall Performance, Section B: Employees, Section C: Impact of Globalisation on Technology Adoption and Adaptation and Section D: Research and Development. Before using the questionnaire, it has been tested in a pilot study to increase the validity of the questionnaire and to note the level of difficulty for each question. As a result, some questions have been improved by the recommendations and evaluations by the respondents. The reliability of the questionnaire has been tested according to Cronbach's Coefficient Alpha (α), which indicated the reliability of the questionnaire to be high. Fundamental statistical methods have been used in all processes of the research methodology. The computer programmes, especially MS Excel and SPSS, has been used for the analysis of data.

Chapter 5

NEW POLICY REGIME AND PRODUCTIVITY TRENDS OF MANUFACTURING SECTOR IN INDIA

5.1 Introduction

Liberalisation, Privatisation and Globalisation are causing a transition in the world economy and Indian manufacturing is no exception. The last decade following the reforms has seen revolutionary changes in the state of manufacturing in India. At the time of this mega change industry was in developing stage, which was to be followed by the matching growth of tertiary sector. The industries earlier nurtured in a protected and subsidized environment have been suddenly opened to face market and the global competitors. The period of nineties has seen Indian companies developing core competencies in terms of technologies and managing the dynamism and opportunities that have come by over the years. These reforms were aimed at making Indian industry more efficient and technologically modern. This efficiency improvement, technological up-gradation, and enhancement of competitiveness were expected to enable the Indian industry to achieve rapid growth.

In this liberalized world, productivity is essential for the survival of the industrial sector of India. Productivity plays an important role in accelerating the pace of economic growth. Productivity growth has traditionally been regarded as one of the main sources of income growth, along with capital accumulation and the deepening of human capital development. These factors and the historically established positive relationship between productivity, employment and earnings have made productivity improvement as an important policy lever for economic development.

With this view, in the present chapter an attempt has been made to examine the growth and adjustment process of the organized manufacturing sector in India in response to new policy regime by analyzing the trends in value added, labour, capital and trends in partial productivity and total factor productivity. The analysis has been conducted at aggregate level for the time period 1980-81 to 2002-03. Analysis has also been conducted at the disaggregate level, i.e., at two digit level to view the productivity phenomenon overtime and across industries. Further the analysis has also been done for the two sub periods, i.e., pre-reform period and post-reform period, to view the changes in output growth, factor inputs, partial factor productivity and total factor productivity. An attempt has been made to trace the factors influencing productivity for Indian manufacturing by using ordinary least square and stepwise regression techniques.

Hypotheses

- Productivity has improved in the post-1991 period, the period of new policy regime for Indian.
- Rate of output growth is an important determinant of productivity.

5.2 Aggregative Analysis

The growth rates of output, capital, labour, partial productivity and total factor productivity in Indian manufacturing has been presented at aggregate level in the table below. A comparison has been made between the pre-reform period and the post-reform period.

Table 5.2.1: Growth Rates of Value Added, Capital, Employment and Productivity Trends in India Manufacturing

	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
Value Added	7.78	6.67	4.38
Capital	6.05	4.34	4.63
Employment	0.65	0.23	-0.81
Labour Productivity	7.09	6.43	5.24
Capital Productivity	1.64	2.23	-0.23
Capital Intensity	5.36	4.11	5.48
Total Factor Productivity	1.24	1.53	0.44

Computed

For Indian manufacturing sector, the overall long term growth of 7.78 per cent per annum in value added during 1980-81 to 2002-03 is associated with a rapid growth of capital (6.05 per cent per annum) and a low growth of employment (0.65 per cent per annum). The entire growth of output is accounted for by the growth in factor inputs (mainly the capital). Comparing the annual growth rates during 1980-81 to 1990-91 with those of 1991-92 to 2002-03, the post-reform period, it is found that there is a decline in growth rate of value added from 6.67 per cent per annum in period I to 4.38 per cent per annum in period II. Growth rate of capital slightly increases in the post-reform period while growth rate of labour decelerates in the post-reform period.

Labour productivity for the whole period is 7.09 per cent per annum while capital productivity is 1.64 per cent per annum for the same period. Capital intensity for the entire period increased at an annual rate of 5.36 per cent per annum. Estimates for the sub-periods reveal differences in the growth rates. Labour productivity increases at higher rate, i.e., at 6.43 per cent per annum in the pre-reform period as against 5.24 per cent per annum in the post-reform regime. Capital Productivity shows a rising trend in the first period of the analysis and it decreases in the second period. Capital intensity increases at a higher rate, i.e. at 5.48 per cent per annum in the post-reform regime as against 4.11 per cent per annum in the pre-reform period.

The estimate of total factor productivity growth for the registered sector of Indian manufacturing is 1.24 per cent per annum over the period 1980-81 to 2002-03. The estimated growth rate of TFP for the period 1980-81 to 1990-91 is 1.53 per cent per annum. The TFP estimates indicate a significant growth in TFP in Indian manufacturing in the pre-reform period. Besides there is a clear indication of a fall in the rate of growth of TFP in the new policy regime as compared to the growth rate in the pre-reform period. The estimated growth rate of TFP in Indian manufacturing for the post-reform period is 0.44 per cent per annum as against 1.53 per cent per annum for the pre-reform period.

This finding of a decline in TFP growth in Indian manufacturing in the new policy regime is in concurrence with the TFP estimates of Goldar and Kumari (2003) and Trivedi et al.

(2000). As can be seen from table 4.1.2., Goldar and Kumari (2003) and Trivedi et al. (2000) report a deceleration of TFP growth in Indian manufacturing in the 1990s. Furthermore, this finding is in agreement with the results presented by Balakrishnan et al. (2000) and Srivastava (2000). Balakrishnan et al. (2000) investigated the growth of productivity in Indian manufacturing over the period 1988-89 to 1997-98. Using Centre for Monitoring Indian Economy database, in this study the data for about 2300 firms registered with the Bombay Stock Exchange had been collected. The results of the study show a significant decline in the growth rate of TFP after 1991-92. Srivastava (2000) has estimated productivity growth and technical efficiency in manufacturing firms in India for the period 1980-81 to 1996-97. Using data for about three thousand companies for the period 1980-81 to 1996-97, the study depicts a decline in the rate of productivity growth in the 1990s as compared to the 1980s. So the results of the present analysis are in agreement with the results of earlier studies. Overall, for aggregate manufacturing, the new policy regime is associated with lower labour productivity, capital productivity and lower total factor productivity growth.

Table 5.2.2: Total Factor Productivity Growth in India Manufacturing: Alternative Estimates

Sr. No.	Study	Period	TFP Growth Rate (per cent per annum)
1.	Current	1980-81 to 2002-03 1980-81 to 1990-91 1991-92 to 2002-03	1.24 1.53 0.44
2.	Goldar, B. and Kumari, A. (2003)	1981–82 to 1997–98 1981–82 to 1990–91 1990–91 to 1997–98	1.40 1.89 0.69
3.	Trivedi, Prakash, and Sinate (2000)	1981–82 to 1997–98 1981–82 to 1990–91 1990–91 to 1997–98	1.00 1.26 0.63

5.3 Sectorwise Analysis

Analysis: Trends in Value Added

Table 5.3.1: Growth Rates of Value Added

Industry code	Value Added			
	Industry Name	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
15	Food Products and Beverages	11.12	12.76	8.76
16	Tobacco Products	11.29	21.22	3.98
17	Textiles	5.74	7.54	5.86
18	Wearing Apparel; Dressing and Dyeing of Fur	16.01	10.72	9.61
19	Tanning and Dressing of Leather, Luggage, Handbags Saddlery, Harness and Footwear	12.58	11.03	3.24
20	Wood and Products of Wood and Cork, Except Furniture; Articles of Straw and Plating Materials	11.66	6.13	14.86
21	Paper and Paper Products	7.01	7.15	3.41
22	Publishing, Printing and Reproduction of Recorded Media	6.03	3.65	2.21
23	Coke, Refined Petroleum Products and Nuclear Fuel	7.89	4.99	7.05
24	Chemicals and Chemical Products	13.26	15.33	8.35
25	Rubber and Plastic Products	1.88	1.75	5.56
26	Other Non-Metallic Mineral Products	8.2	9.25	2.8
27	Basic Metals	7.59	8.4	5.53
28	Fabricated Metal Products, Except Machinery and Equipments	10.67	8.28	5.62
29	Machinery and Equipment N.E.C	2.36	-1.56	2.96
30	Office, Accounting and Computing Machinery	3.37	1.88	-1.58
31	Electrical Machinery and Apparatus N.E.C.	1.99	-0.81	-2.49
32	Radio, Television and Communication Equipment and Apparatus	6.29	4.95	2.64
33	Medical, Precision and Optical Instruments, Watches and Clocks	11.57	1.59	10.78
34	Motor Vehicles, Trailer and Semi-Trailers	6.89	6.09	5.9
35	Other Transport Equipment	5.91	4.62	3.7
36	Furniture	13.63	3.51	14.98

Computed

Growth rates of value added (Table 5.3.1) have been higher for sixteen industrial groups in the pre-reform phase while six groups depict higher growth in the post-reform phase. The highest growth in value added is recorded for the wearing apparel; dressing and dyeing of fur (18), followed by furniture (36) and chemicals and chemical products (24). For nine industrial groups, growth rate of value added is more than 10 percent for the entire period of the analysis. Rubber and plastic products sector (25) depicts the lowest growth rate (1.88) for the total period. Two sectors, namely machinery and equipment n.e.c (29), and electrical machinery and apparatus n.e.c. (31), show negative rate of growth of value added in the pre-reform period. Office, accounting and computing machinery (30) and electrical machinery and apparatus n.e.c. (31) depict negative growth rate of value added in the post-reform period.

Trends in Capital

Table 5.3.2: Growth Rates of Capital

Industry code	Capital			
	Industry Name	**1980-81-2002-03**	**1980-81-1990-91**	**1991-92-2002-03**
15	Food Products and Beverages	7.25	4.97	7.23
16	Tobacco Products	6.35	4.82	6.06
17	Textiles	6.79	3.37	6.81
18	Wearing Apparel; Dressing and Dyeing of Fur	13.74	7.14	13.40
19	Tanning and Dressing of Leather, Manufacture of Luggage, Handbags Saddlery, Harness and Footwear	9.94	4.43	8.27
20	Wood and Products of Wood and Cork, Except Furniture; Articles of Straw and Plating Materials	5.98	3.52	7.07
21	Paper and Paper Products	6.55	3.78	6.76
22	Publishing, Printing and Reproduction of Recorded Media	6.38	3.52	7.02
23	Coke, Refined Petroleum Products and Nuclear Fuel	10.28	7.08	11.33
24	Chemicals and Chemical Products	10.63	10.86	8.59
25	Rubber and Plastic Products	7.68	3.24	10.57
26	Other Non-Metallic Mineral Products	9.66	9.65	8.94
27	Basic Metals	6.33	3.91	4.73
28	Fabricated Metal Products, Except Machinery and Equipments	7.48	3.80	6.86
29	Machinery and Equipment N.E.C	4.75	3.86	5.67
30	Office, Accounting and Computing Machinery	7.28	8.17	3.88
31	Electrical Machinery and Apparatus N.E.C.	5.41	3.09	5.02
32	Radio, Television and Communication Equipment and Apparatus	13.51	12.93	8.46
33	Medical, Precision and Optical Instruments, Watches and Clocks	9.88	5.25	10.37
34	Motor Vehicles, Trailer and Semi-Trailers	8.42	5.06	10.75
35	Other Transport Equipment	3.39	1.30	3.63
36	Furniture	10.30	3.89	13.86

Computed

Growth rates of capital are higher for only four industrial groups in the pre-reform phase while eighteen industrial groups depict higher growth in the post-reform phase. The highest growth in capital is recorded for wearing apparel; dressing and dyeing of fur (18), followed by radio, television and communication equipment and apparatus (32) and chemicals and chemical products (24). Five industrial groups report more than ten percent growth rate of value added. Other transport equipment sector (35) depicts the lowest growth rate for the entire period of the analysis. Overall the rate of growth of capital has been higher for the most of the sectors for the entire period. This shows that in Indian manufacturing sector, still more of capital input is being used.

Trends in Labour

Table 5.3.3: Growth Rates of Labour

Industry code	Labour			
	Industry Name	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
15	Food Products and Beverages	0.77	-2.06	0.74
16	Tobacco Products	1.77	1.39	0.23
17	Textiles	-1.46	-1.96	-2.48
18	Wearing Apparel; Dressing and Dyeing of Fur	9.25	5.54	9.46
19	Tanning and Dressing of Leather, Manufacture of Luggage, Handbags Saddlery, Harness and Footwear	5.77	9.81	2.26
20	Wood and Products of Wood and Cork, Except Furniture; Articles of Straw and Plating Materials	-0.07	-1.54	1.23
21	Paper and Paper Products	1.63	-0.004	1.46
22	Publishing, Printing and Reproduction of Recorded Media	-1.20	-1.16	-3.32
23	Coke, Refined Petroleum Products and Nuclear Fuel	0.55	0.90	0.62
24	Chemicals and Chemical Products	3.09	3.15	2.58
25	Rubber and Plastic Products	0.86	-1.36	3.65
26	Other Non-Metallic Mineral Products	2.11	4.80	1.07
27	Basic Metals	0.95	3.54	-1.43
28	Fabricated Metal Products, Except Machinery and Equipments	3.50	4.98	2.17
29	Machinery and Equipment N.E.C	-0.95	-0.86	-0.82
30	Office, Accounting and Computing Machinery	-2.44	0.03	-4.86
31	Electrical Machinery and Apparatus N.E.C.	-0.97	0.14	-3.97
32	Radio, Television and Communication Equipment and Apparatus	5.19	12.33	-1.41
33	Medical, Precision and Optical Instruments, Watches and Clocks	6.36	6.65	5.32
34	Motor Vehicles, Trailer and Semi-Trailers	4.96	0.64	13.62
35	Other Transport Equipment	-0.20	-1.02	-1.33
36	Furniture	5.41	1.75	6.99

Computed

Analysis: Partial Productivity

After analyzing the growth rates in value added, labour and capital for the manufacturing sector, analysis has been done for productivity indices.

Labour Productivity

A look at labour productivity (Table 5.3.4) depicts that thirteen sectors show growth rate more than 6 per cent per year for the entire period. So the picture is good on the labour productivity front.

Detailed industry wise trends are given below:

i. **Industries Having High Rate of Growth** - Two sectors, i.e., food products and beverages (15), wood and products of wood and cork, except furniture, articles of straw and plating materials (20) have depicted a higher growth rate of labour productivity for the entire period. The growth rate for food products and beverages (15) group has fallen sharply in the post- liberalized era.

ii. **Industries Having Medium Rate of Growth** - Fifteen industrial groups have growth rate of labour productivity between 4-10 per cent.

iii. **Industries Having Low Rate of Growth** - Five industrial groups namely rubber and plastic products (25), machinery and equipment n.e.c (29), electrical machinery and apparatus n.e.c. (31), radio, television and communication equipment and apparatus (32), and motor vehicles, and trailer and semi-trailers (34) have less than 4 percent growth rate of labour productivity.

Table 5.3.4: Growth Rates of Labour Productivity

Industry code	Labour Productivity			
	Industry Name	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
15	Food Products and Beverages	10.27	15.13	7.96
16	Tobacco Products	9.36	19.56	3.75
17	Textiles	7.31	9.69	8.55
18	Wearing Apparel; Dressing and Dyeing of Fur	6.19	4.90	0.13
19	Tanning and Dressing of Leather, Manufacture of Luggage, Handbags Saddlery, Harness and Footwear	6.44	1.12	0.95
20	Wood and Products of Wood and Cork, Except Furniture; Articles of Straw and Plating Materials	11.74	7.80	13.47
21	Paper and Paper Products	5.30	7.15	1.93
22	Publishing, Printing and Reproduction of Recorded Media	7.32	4.87	5.71
23	Coke, Refined Petroleum Products and Nuclear Fuel	7.30	4.06	6.39
24	Chemicals and Chemical Products	8.91	4.91	5.62
25	Rubber and Plastic Products	1.00	3.15	1.84
26	Other Non-Metallic Mineral Products	5.96	4.24	1.71
27	Basic Metals	6.57	4.70	7.06
28	Fabricated Metal Products, Except Machinery and Equipments	6.93	3.14	3.38
29	Machinery and Equipment N.E.C	3.35	-0.71	3.81
30	Office, Accounting and Computing Machinery	5.95	1.85	3.45
31	Electrical Machinery and Apparatus N.E.C.	2.99	-0.95	1.55
32	Radio, Television and Communication Equipment and Apparatus	1.04	-6.56	4.11
33	Medical, Precision and Optical Instruments, Watches and Clocks	4.90	-4.75	5.19
34	Motor Vehicles, Trailer and Semi-Trailers	1.84	5.41	-6.80
35	Other Transport Equipment	6.13	5.70	5.09
36	Furniture	7.80	1.72	7.46

Computed

Trends in labour productivity for the two sub-periods depict that labour productivity has been higher for twelve sectors in the second period of the analysis, i.e., the post-reform period. For the entire period, labour productivity is higher for wood and products of wood and cork, except furniture, articles of straw and plating materials (20). Following this are: food products and beverages sector (15) and tobacco products (16). Overall labour productivity in the manufacturing sector of India has improved in the post-reform era.

Capital Productivity

After having a view of labour productivity, analysis has been done for evaluating the performance of Indian capital productivity (Table 4.2.5). Generally it is felt that growth in output is accounted almost for the higher growth of inputs, especially capital in the developing countries. Most of the earlier studies depict that Indian manufacturing has not performed well on the capital productivity front.

Table 5.3.5: Growth Rates of Capital Productivity

Industry code	Capital Productivity			
	Industry Name	**1980-81-2002-03**	**1980-81-1990-91**	**1991-92-2002-03**
15	Food Products and Beverages	3.61	7.43	1.42
16	Tobacco Products	1.61	8.37	-1.96
17	Textiles	-0.98	4.03	-0.89
18	Wearing Apparel; Dressing and Dyeing of Fur	1.99	3.34	-3.35
19	Tanning and Dressing of Leather, Luggage, Handbags Saddlery, Harness and Footwear	2.41	6.32	-4.64
20	Wood and Products of Wood and Cork, Except Furniture; Articles of Straw and Plating Materials	5.36	2.53	7.27
21	Paper and Paper Products	0.43	3.24	-3.14
22	Publishing, Printing and Reproduction of Recorded Media	-0.33	0.13	-4.50
23	Coke, Refined Petroleum Products and Nuclear Fuel	-2.17	-1.95	-3.84
24	Chemicals and Chemical Products	1.49	-2.39	-0.23
25	Rubber and Plastic Products	-5.39	-1.44	-4.53
26	Other Non-Metallic Mineral Products	-1.33	-0.37	-5.64
27	Basic Metals	1.19	4.32	0.76
28	Fabricated Metal Products, Except Machinery and Equipments	2.97	4.31	-1.17
29	Machinery and Equipment N.E.C	-2.28	-5.22	-2.56
30	Office, Accounting and Computing Machinery	-3.65	-5.81	-5.26
31	Electrical Machinery and Apparatus N.E.C.	-3.25	-3.78	-7.15
32	Radio, Television and Communication Equipment and Apparatus	-6.36	-7.07	-5.36
33	Medical, Precision and Optical Instruments, Watches and Clocks	1.54	-3.48	0.37
34	Motor Vehicles, Trailer and Semi-Trailers	-1.41	0.98	-4.38
35	Other Transport Equipment	2.44	3.28	0.06
36	Furniture	3.02	-0.37	0.98

Computed

A detailed analysis of trends in capital productivity is given below:

i. **Industries Having High Rate of Growth** - Only one sector i.e. wood and products of wood and cork, except furniture; articles of straw and plating materials (20) reports a higher productivity, i.e., 5 percent rate of growth. The sector has performed better in the second period of analysis, i.e., the post liberalized period.

ii. **Industries Having Medium Rate of Growth** - There are the five sectors namely food products and beverages (15), tanning and dressing of leather, luggage, handbags saddlery, harness and footwear (19), fabricated metal products, except machinery and equipments (28), other transport equipment (35) and furniture (36) having capital productivity between 2-5 percent.

iii. **Industries Having Low Rate of Growth** - Six sectors, namely, tobacco products (16), wearing apparel, dressing and dyeing of fur (18), paper and paper products (21), chemicals and chemical products (24), basic metals (27) and medical, precision and optical instruments, watches and clocks (33) have growth rate between 0-2 per cent per annum.

iv. **Industries Having Negative Rate of Growth** - Ten sectors depict a negative rate of growth of capital productivity.

Trends in the capital productivity for the two sub-periods depicts that capital productivity is higher in the pre-reform period. Capital productivity is higher in fifteen sectors in the first period of the analysis. For the entire period, six sectors depict growth rate between 0-2 percent which is, infact, very low. In the post-reform period there are sixteen sectors depicting a negative growth rate.

Capital Intensity

Table 5.3.6: Growth Rates of Capital Intensity

Industry code	Capital Intensity			
	Industry Name	**1980-81-2002-03**	**1980-81-1990-91**	**1991-92-2002-03**
15	Food Products and Beverages	6.43	7.17	6.45
16	Tobacco Products	4.51	3.38	5.82
17	Textiles	8.37	5.44	9.53
18	Wearing Apparel; Dressing and Dyeing of Fur	4.11	1.51	3.60
19	Tanning and Dressing of Leather, Manufacture of Luggage, Handbags Saddlery, Harness and Footwear	3.94	-4.89	5.87
20	Wood and Products of Wood and Cork, Except Furniture; Articles of Straw and Plating Materials	6.06	5.14	5.77
21	Paper and Paper Products	4.84	3.79	5.23
22	Publishing, Printing and Reproduction of Recorded Media	7.67	4.74	10.69
23	Coke, Refined Petroleum Products and Nuclear Fuel	9.67	6.12	10.64
24	Chemicals and Chemical Products	7.31	7.48	5.86
25	Rubber and Plastic Products	6.75	4.66	6.67
26	Other Non-Metallic Mineral Products	7.39	4.63	7.79
27	Basic Metals	5.33	0.36	6.25
28	Fabricated Metal Products, Except Machinery and Equipments	3.84	-1.12	4.60
29	Machinery and Equipment N.E.C	5.76	4.76	6.54
30	Office, Accounting and Computing Machinery	9.96	8.14	12.99
31	Electrical Machinery and Apparatus N.E.C.	6.44	2.94	9.37
32	Radio, Television and Communication Equipment and Apparatus	7.90	0.54	10.01
33	Medical, Precision and Optical Instruments, Watches and Clocks	3.31	-1.31	4.80
34	Motor Vehicles, Trailer and Semi-Trailers	3.29	4.39	-2.53
35	Other Transport Equipment	3.60	2.35	5.03
36	Furniture	4.64	2.10	6.42

Computed

Capital intensity is higher for only three industrial groups in the pre-reform phase while nineteen industrial groups depict higher growth in the post-reform phase. Detailed industry wise trends are given below:

i. **Industries Having High Rate of Growth** - Seven sectors have high rate of growth of capital intensity i.e. above 7 per cent per annum.

ii. **Industries Having Medium Rate of Growth** - Ten sectors have growth rate of capital intensity between 4-7 per cent per annum.

iii. **Industries Having Low Rate of Growth** - Five sectors namely tanning and dressing of leather, luggage, handbags saddlery, harness and footwear (19), fabricated metal products, except machinery and equipments (28), medical, precision and optical instruments, watches and clocks (33), motor vehicles, trailer and semi-trailers (34) and other transport equipment (35) have low rate of growth.

The highest growth rate of capital intensity has been recorded by office, accounting and computing machinery (30), followed by coke, refined petroleum products and nuclear fuel (23) and textiles (17). Motor vehicles, trailer and semi-trailers (34) depicts the lowest growth rate (3.29) during the entire period of the analysis. Overall rate of growth of capital intensity has been higher during the new policy regime.

Trends in Total Factor Productivity

A view of the total factor productivity is necessary for having true picture of Indian manufacturing as partial productivity alone does not give a complete view. Detailed analysis of trends in total factor productivity (Table 5.3.7) at two digit level brings out the fact that the total factor productivity indices for Indian manufacturing in general are low. Growth rates of total factor productivity have been higher for sixteen industrial groups in the pre-reform phase while six industrial groups depict higher growth in the post-reform phase. Although out of these six, two sectors have negative rate of growth but the rate of decline is less as compared to the pre-reform period.

Detailed analysis for total factor productivity is given below:

(i) **Industries Having High Rate of Growth -** Only two industries out of twenty two have growth rate above 2 percent. These are: wood and products of wood and cork, except furniture, articles of straw and plating materials (20) and tobacco products (16).

(ii) **Industries Having Medium Rate of Growth -** Most of the industries i.e. ten industries depict growth rate between zero to one percent.

(iii) **Industries Having Low Rate of Growth –** For three industries, growth rate is less than one percent.

(iv) **Industries Having Negative Rate of Growth** - Seven industries fall in this category. This number is quite large and efforts should be taken to improve their performance.

Table 5.3.7: Growth Rates of Total Factor Productivity

Industry code	Total Factor Productivity			
	Industry Name	**1980-81-2002-03**	**1980-81-1990-91**	**1991-92-2002-03**
15	Food Products and Beverages	1.88	3.58	0.96
16	Tobacco Products	2.06	5.68	-0.07
17	Textiles	1.16	2.79	1.85
18	Wearing Apparel; Dressing and Dyeing of Fur	1.09	1.40	-0.82
19	Tanning and Dressing of Leather, Manufacture of Luggage, Handbags Saddlery, Harness and Footwear	1.15	1.68	-1.28
20	Wood and Products of Wood and Cork, Except Furniture; Articles of Straw and Plating Materials	2.86	2.07	3.01
21	Paper and Paper Products	0.88	2.00	-0.60
22	Publishing, Printing and Reproduction of Recorded Media	1.16	1.10	-0.14
23	Coke, Refined Petroleum Products and Nuclear Fuel	-0.41	-0.37	-1.23
24	Chemicals and Chemical Products	1.39	-0.53	0.35
25	Rubber and Plastic Products	-1.93	-0.02	-1.88
26	Other Non-Metallic Mineral Products	0.16	0.63	-1.73
27	Basic Metals	0.88	1.60	0.69
28	Fabricated Metal Products, Except Machinery and Equipments	1.51	1.45	0.16
29	Machinery and Equipment N.E.C	-0.06	-1.43	-0.18
30	Office, Accounting and Computing Machinery	-0.42	-1.31	-1.38
31	Electrical Machinery and Apparatus N.E.C.	-0.63	-1.22	-2.28
32	Radio, Television and Communication Equipment and Apparatus	-2.21	-3.36	-1.63
33	Medical, Precision and Optical Instruments, Watches and Clocks	1.06	-1.64	0.64
34	Motor Vehicles, Trailer and Semi-Trailers	-0.08	1.21	-2.15
35	Other Transport Equipment	1.48	1.89	0.46
36	Furniture	1.97	0.39	1.11

Computed

For the entire period, the highest growth of total factor productivity has been recorded for wood and products of wood and cork, except furniture; articles of straw and plating materials (20). This has been followed by tobacco products (16) and furniture (36). The machinery sector represented by sub-group (29-32) has performed badly on total factor productivity front. Machinery and equipment n.e.c, office, accounting and computing machinery, electrical machinery and apparatus n.e.c., and radio, television and communication equipment and apparatus (29-32) depict negative growth for the entire period as well as for the two sub periods.

Overall, trends in growth rates of total factor productivity for the two sub-periods depict that growth rates of total factor productivity have been higher in the first period of the analysis i.e. the pre-reform period. In most of the industries, the post-reform period has been associated with deceleration in productivity.

5.4 Determinants of Productivity in Indian Manufacturing

In this section an attempt is made to explain the factors affecting total factor productivity growth at aggregate and two digit level industries. The present study uses ordinary least square regression and stepwise regression techniques to fit in the model. The time period for the analysis is 1980-81 to 2002-03. The dependent variable is total factor productivity growth.

5.4.1 Aggregative Analysis

Entire manufacturing

Regression results of the entire manufacturing sector in India are depicted by the equation:

$$y = 0.85x_1^{**} + 0.46x_2 + 0.72x_3 + 0.019x_4 - 0.086x_5 + 0.066x_6$$

$$t = (2.96) \quad (0.007) \quad (0.33) \quad (0.040) \quad (0.13) \quad (0.48)$$

$$R^2 = 0.93 \quad (\overline{R}^2 = 0.90)$$

Total factor productivity is positively associated with all the independent variables except with the scale variable. The regression coefficient for output is statistically significant at 1 percent level. The model explains 90 percent of the variations in total factor productivity.

Stepwise regression depicts a positive and significant relationship between output and total factor productivity. The model explains 92 percent of the variations in growth.

$$y = 0.73x_1^{**}$$
$$t = \quad (5.89)$$
$$R^2 = 0.92 \qquad (\overline{R}^2 = 0.92)$$

5.4.2 Sectorwise Analysis

Food Products and Beverages

Regression equation for food products and beverages sector is:

$$y = 0.084x_1^{**} + 0.56x_2^{**} + 0.073x_3 + 0.024x_3 - 0.013x_5^{**} - 0.045x_6$$
$$t = \quad (4.42) \quad (5.24) \quad (0.17) \quad (1.78) \quad (5.82) \quad (1.06)$$
$$R^2 = 0.95 \qquad (\overline{R}^2 = 0.93)$$

Total factor productivity is positively related to output growth, capital intensity, investment and growth in the number of factories. Total factor productivity is negatively related to scale variable and total emoluments. Regression coefficient for output growth, capital intensity and scale variable are statistically significant at 1 percent level. Out of the total variation in total factor productivity, 93 percent is explained by the model.

Stepwise regression analysis has selected output to be a significant determinant of total factor productivity.

$$y = 0.056x_1^{**}$$
$$t = \quad (6.05)$$
$$R^2 = 0.80 \qquad (\overline{R}^2 = 0.79)$$

The model explains 79 percent variations in total factor productivity.

Tobacco Products

Regression equation for tobacco products sector is:

$$y = 0.067x_1^{**} + 0.033x_2 + 0.054x_3 + 0.026x_4^{**} - 0.015x_5^{**} + 0.089x_6^{**}$$
$$t = \quad (3.42) \quad (0.94) \quad (0.25) \quad (3.47) \quad (2.83) \quad (3.29)$$
$$R^2 = 0.92 \qquad (\overline{R}^2 = 0.86)$$

Total factor productivity is directly related to all the variables except the scale variable. Regression coefficient for output, growth in the number of factories, scale variable and total emoluments are statistically significant at 1 percent level. The explanatory variation of the model is 86 percent.

Stepwise regression model depicts total emoluments to be the most important and significant determinant of total factor productivity.

$$y = 0.060x_6^{**}$$
$$t = \quad (6.23)$$
$$R^2 = 0.80 \qquad (\overline{R}^2 = 0.79)$$

The explanatory variation of the model is 79 percent.

Textiles

The results for textiles sector are:

$$y = 0.042x_1^{**} + 0.15x_2^{*} - 0.75x_3 - 0.058x_4^{**} - 0.026x_5^{**} + 0.022x_6$$
$$t = \quad (4.34) \quad (2.39) \quad (0.46) \quad (6.07) \quad (3.58) \quad (1.00)$$
$$R^2 = 0.98 \quad (\overline{R}^2 = 0.97)$$

The model explains 97 percent of total variation in total factor productivity. Total factor productivity is positively related to output, capital-labour ratio and total emoluments. It is negatively related to investment, growth in the number of factories and scale variable. Regression coefficients for output, growth in the number of factories and scale variable are significant at 1 percent level and regression coefficient for capital-labour ratio is significant at 5 percent level.

Stepwise regression has picked up output, capital-labour ratio, growth in the number of factories and scale variable as the determinants of total factor productivity. The value of adjusted R^2 is 0.97.

$$y = 0.037x_1^{**} + 0.15x_2^{**} - 0.061x_4^{**} - 0.034x_5^{**}$$
$$t = \quad (5.28) \quad (2.59) \quad (6.91) \quad (3.62)$$
$$R^2 = 0.97 \quad (\overline{R}^2 = 0.97)$$

Wearing Apparel; Dressing and Dyeing of Fur

The regression equation for wearing apparel; dressing and dyeing of fur sector is:

$$y = 0.081x_1 + 0.064x_2 + 0.043x_3 - 0.51x_4 - 0.066x_5^{*} - 0.088x_6$$
$$t = \quad (1.78) \quad (1.95) \quad (0.50) \quad (0.029) \quad (2.05) \quad (0.35)$$
$$R^2 = 0.79 \quad (\overline{R}^2 = 0.71)$$

Output growth, capital-labour ratio and investment are positively related to total factor productivity. Growth in the number of factories, scale variable and total emoluments are negatively related to total factor productivity. Regression coefficient for scale variable is statistically significant at 5 percent level. The model explains 71 percent of the variation in total factor productivity.

Stepwise regression selects output and total emoluments as important determinants of productivity.

$$y = 0.076x_1^{**} - 0.078x_6^{**}$$
$$t = \quad (5.46) \qquad (3.99)$$
$$R^2 = 0.73 \qquad (\overline{R}^2 = 0.70)$$

The explanatory variation of the model is 70 percent.

Tanning and Dressing of Leather, Luggage, Handbags, Saddlery, Harness and Footwear

The regression equation for this sector is:

$$y = 0.096x_1^{**} + 0.073x_2^{**} + 0.048x_3 + 0.082x_4^{**} - 0.064x_5^{**} + 0.061x_6^{**}$$
$$t = \quad (7.06) \qquad (3.11) \qquad (1.03) \qquad (2.76) \qquad (3.88) \qquad (4.13)$$
$$R^2 = 0.92 \qquad (\overline{R}^2 = 0.88)$$

Total factor productivity has a positive association with all the independent variables except with that of scale variable. Regression coefficients for all variables except for investment are statistically significant at 1 percent level. The model explains 88 percent of variations in total factor productivity.

The significant determinant picked by stepwise regression is output.

$$y = 0.084x_1^{**}$$
$$t = \quad (7.69)$$
$$R^2 = 0.78 \qquad (\overline{R}^2 = 0.77)$$

The model explains 77 percent variations in total factor productivity.

Wood and Products of Wood and Cork, Except Furniture; Articles of Straw and Plating Materials

The regression equation for this sector is:

$$y = 0.046x_1^{**} + 0.039x_2^{**} + 1.71x_3^{*} + 0.055x_4^{**} - 0.017x_5^{*} + 0.068x_6$$
$$t = \quad (5.62) \quad (2.81) \quad (2.44) \quad (3.05) \quad (2.44) \quad (1.67)$$
$$R^2 = 0.95 \quad (\overline{R}^2 = 0.94)$$

The regression indicates that total factor productivity is positively associated with all the independent variables except with the scale variable. The regression coefficients for output, capital intensity and growth in the number of factories are statistically significant at 1 percent level. Regression coefficient for investment and scale variable are statistically significant at 5 percent level. The model explains 94 percent variation in total factor productivity.

Stepwise regression analysis highlights the fact that output and capital intensity are the most important determinants of total factor productivity. The explanatory variation of the model is 91percent.

$$y = 0.021x_1^{**} + 0.087x_2^{**}$$
$$t = \quad (6.75) \quad (3.08)$$
$$R^2 = 0.92 \quad (\overline{R}^2 = 0.91)$$

Paper and Paper products

Regression equation for paper and paper products sector is:

$$y = 0.037x_1^{**} - 0.018x_2 + 0.046x_3 + 0.18x_4 - 0.014x_5 - 0.052x_6$$
$$t = \quad (5.90) \quad (0.50) \quad (0.54) \quad (1.08) \quad (1.80) \quad (0.12)$$
$$R^2 = 0.88 \quad (\bar{R}^2 = 0.84)$$

Total factor productivity is positively associated with output, investment and growth in the number of factories. The regression depicts that total factor productivity is negatively associated with capital intensity, scale variable and total emoluments. The model explains 84 percent of variations in the dependent variable. The regression coefficient is statistically significant at 1 percent level for output.

Stepwise regression has selected output and capital intensity as the determinants of productivity.

$$y = 0.016x_1^{**} - 0.040x_2^{**}$$
$$t = \quad (6.35) \quad (5,42)$$
$$R^2 = 0.84 \quad (\bar{R}^2 = 0.82)$$

The model explains 82 percent variations in total factor productivity.

Publishing, Printing and Reproduction of Recorded Media

Regression equation for publishing, printing and reproduction of recorded media sector is:

$$y = 0.086x_1^{**} + 0.065x_2^{*} - 0.051x_3 + 0.077x_4^{**} - 0.038x_5^{**} + 0.96x_6$$
$$t = \quad (7.12) \quad (2.56) \quad (0.40) \quad (4.58) \quad (3.83) \quad (1.04)$$
$$R^2 = 0.97 \quad (\bar{R}^2 = 0.96)$$

The model depicts a positive relationship of total factor productivity with output, capital intensity, growth in the number of factories and total emoluments. Investment and scale variable are negatively related to total factor productivity. Regression coefficients for output, growth in the number of factories and scale variable are statistically significant at 1 percent level. The model explains 96 percent of the variation in the dependent variable.

Stepwise regression analysis has selected output, capital intensity, growth in the number of factories and scale variable to be significant determinants of total factor productivity.

$$y = 0.057x_1^{**} + 0.043x_2^{**} + 0.049x_4^{**} - 0.041x_5^{**}$$
$$t = \quad (6.10) \quad (5.22) \quad (5.91) \quad (3.39)$$
$$R^2 = 0.97 \quad (\overline{R}^2 = 0.96)$$

Coke, Refined Petroleum products and Nuclear Fuel

Regression equation for coke, refined petroleum products and nuclear fuel sector is:

$$y = 0.043x_1^{**} + 0.024x_2 + 0.080x_3^{**} - 0.051x_4^{*} - 0.016x_5^{*} + 0.029x_6$$
$$t = \quad (3.79) \quad (0.99) \quad (3.42) \quad (2.34) \quad (2.07) \quad (0.53)$$
$$R^2 = 0.89 \quad (\overline{R}^2 = 0.85)$$

Ordinary least square regression model underscores the fact that total factor productivity is positively related to output, capital intensity, investment and total emoluments. Growth in the number of factories and scale variable shows a negative relationship with total factor productivity. Regression coefficients for output and investment are statistically significant at 1 percent level. Regression coefficients for growth in the number of factories and scale variable are statistically significant at 5 percent level. The model explains 85 percent of the variations in total factor productivity.

Stepwise regression analysis has selected output, capital intensity and growth in the number of factories to be significant determinants of total factor productivity. Productivity is positively related to output and growth in the number of factories and is negatively related to capital intensity.

$$y = 0.033x_1^{**} - 0.027x_2^{**} + 0.052x_4^{**}$$
$$t = \quad (5.60) \quad (3.10) \quad (2.85)$$
$$R^2 = 0.84 \quad (\bar{R}^2 = 0.82)$$

The model explains 82 percent variations in total factor productivity.

The explained variation of the model is 97 percent.

Chemical and Chemical Products

Regression equation for chemical and chemical products sector is:

$$y = 0.86x_1^{**} + 0.016x_2 + 0.94x_3^{**} - 0.063x_4^{*} + 0.046x_5^{*} - 0.062x_6$$
$$t = \quad (6.82) \quad (0.20) \quad (3.16) \quad (2.10) \quad (2.26) \quad (0.13)$$
$$R^2 = 0.88 \quad (\bar{R}^2 = 0.84)$$

Total factor productivity growth is positively related to output, capital intensity, investment and scale variable and is negatively related to growth in the number of factories and total emoluments. Regression coefficient for output is significant at 1 percent level and regression coefficient for scale variable is significant at 5 percent level. The explanatory variation of the model is 84 percent. No variable has been selected by stepwise regression for chemical and chemical products sector.

Rubber and Plastic Products

Regression results for the rubber and plastic products sector are:

$$y = 0.091x_1^{**} + 0.037x_2 - 0.022x_3^{*} - 0.054x_4^{**} + 0.43x_5^{*} + 0.084x_6$$
$$t = \quad (5.04) \quad (0.72) \quad (2.11) \quad (5.02) \quad (2.56) \quad (0.26)$$
$$R^2 = 0.98 \quad (\bar{R}^2 = 0.97)$$

Total factor productivity is positively associated with output, capital intensity, scale variable and total emoluments. It is negatively associated with investment and growth in the number of factories. Regression coefficients for output and growth in the number of factories are statistically significant at 1 percent level. Regression coefficients for investment and scale variable are statistically significant at 5 percent level. The model explains 97 percent of the total variations in total factor productivity.

Stepwise regression has picked up output, growth in the number of factories and scale variable as the determinants of total factor productivity. The explained variation of the model is 97 percent.

$$y = 0.065x_1^{**} - 0.068x_4^{**} + 0.27x_5^{**}$$
$$t = \quad (7.59) \quad (2.03) \quad (7.11)$$
$$R^2 = 0.98 \quad (\overline{R}^2 = 0.97)$$

Other Non-Metallic Mineral Products

Regression equation for other non-metallic mineral products sector is:

$$y = 0.066x_1^{**} + 0.046x_2^{**} - 0.084x_3^{*} - 0.76x_4 - 0.038x_5^{**} + 0.091x_6^{**}$$
$$t = \quad (4.75) \quad (4.70) \quad (2.05) \quad (1.03) \quad (7.47) \quad (4.63)$$
$$R^2 = 0.94 \quad (\overline{R}^2 = 0.91)$$

The results of regression depict a positive relationship of total factor productivity with output, capital intensity and total emoluments. Investment, growth in the number of factories and scale variable are negatively related to total factor productivity. Regression coefficients for output, capital intensity, scale variable and total emoluments are statistically significant at 1 percent level. Regression coefficient for investment is statistically significant at 5 percent level. The model explains 91 percent of the variations in total factor productivity.

Stepwise regression selects output, capital intensity, scale variable and total emoluments as important determinants of productivity. The explanatory variation of the model is 90 percent.

$$y = 0.058x_1^{**} + 0.046x_2^{**} - 0.023x_5^{**} + 0.077x_6^{**}$$
$$t = \quad (5.84) \quad (8.52) \quad (4.64) \quad (4.61)$$
$$R^2 = 0.92 \quad (\overline{R}^2 = 0.90)$$

Basic Metals

Regression results for the basic metals sector are as follows:

$$y = 0.087x_1^{**} + 0.043x_2 - 0.053x_3 + 0.044x_4^{*} - 0.062x_5 + 0.076x_6$$
$$t = (5.53) \quad (1.36) \quad (1.60) \quad (2.43) \quad (0.085) \quad (1.01)$$
$$R^2 = 0.92 \quad (\overline{R}^2 = 0.88)$$

Total factor productivity is positively associated with output, capital intensity, growth in the number of factories and total emoluments and is negatively associated with investment, and scale variable. Regression coefficient for output is statistically significant at 1 percent level and regression coefficient for growth in the number of factories is statistically significant at 5 percent level.

Output growth emerges to be the most important determinant of total factor productivity in stepwise regression model. Explanatory power of the total factor productivity variable comes to be 83 percent.

$$y = 0.052x_1^{**}$$
$$t = \quad (7.23)$$
$$R^2 = 0.83 \quad (\overline{R}^2 = 0.83)$$

Fabricated Metal Products, Except Machinery and Equipments

The regression equation for this sector is:

$$y = 0.069x_1^{**} + 0.084x_2^{**} - 0.41x_3 - 0.036x_4 - 0.027x_5 + 0.34x_6$$
$$t = \quad (2.88) \quad (2.85) \quad (0.97) \quad (0.23) \quad (1.61) \quad (0.094)$$
$$R^2 = 0.91 \quad (\bar{R}^2 = 0.88)$$

Total factor productivity is positively related to output, capital intensity and total emoluments. It is negatively associated with investment, growth in the number of factories and scale variable. Regression coefficients for output and capital intensity are statically significant at 1 percent level. The model explains 88 percent of the variations in the dependent variable.

Stepwise regression selects output, capital intensity and scale variable as important determinants of productivity.

$$y = 0.058x_1^{**} + 0.036x_2^{**} - 0.028x_5^{**}$$
$$t = \quad (6.55) \quad (3.35) \quad (2.62)$$
$$R^2 = 0.90 \quad (\bar{R}^2 = 0.89)$$

The model explains 89 percent of the variation in total factor productivity.

Machinery and Equipment N.E.C.

The explained variation of the model is 95 percent. The regression equation for the sector is:

$$y = 0.076x_1^{**} + 0.039x_2^{**} - 0.28x_3 + 0.46x_4^{**} - 0.032x_5^{**} + 0.051x_6$$
$$t = \quad (5.13) \quad (4.83) \quad (1.43) \quad (8.23) \quad (6.57) \quad (0.77)$$
$$R^2 = 0.97 \quad (\bar{R}^2 = 0.95)$$

Output, capital intensity, growth in the number of factories and total emoluments are positively related to total factor productivity. Investment and scale variable are negatively related to total factor productivity. Regression coefficients for output, capital intensity, growth in the number of factories and scale variable are statistically significant at 1 percent level.

Stepwise regression has picked up output, capital intensity, scale variable and total emoluments as the determinants of total factor productivity. The explained variation of the model is 95 percent.

$$
\begin{aligned}
&y = 0.038x_1^{**} + 0.037x_2^{**} + 0.41x_5^{**} - 0.040x_6^{**} \\
&t = \quad (6.11) \quad (4.63) \quad (5.31) \quad (7.48) \\
&R^2 = 0.96 \quad (\overline{R}^2 = 0.95)
\end{aligned}
$$

Office, Accounting and Computer Machinery

The regression equation for office, accounting and computer machinery sector is:

$$
\begin{aligned}
&y = 0.018x_1^{**} - 0.012x_2 - 0.043x_3 - 0.011x_4^{*} + 0.36x_5 + 0.054x_6 \\
&t = (6.20) \quad (0.86) \quad (0.66) \quad (2.18) \quad (1.53) \quad (1.96) \\
&R^2 = 0.86 \quad (\overline{R}^2 = 0.81)
\end{aligned}
$$

Total factor productivity is positively related to output, scale variable and total emoluments. It is negatively associated with capital intensity, investment and growth in the number of factories. The regression coefficient for output is significant at 1 percent level and regression coefficient for growth in the number of factories is significant at 5 percent level. The model explains 81 percent of the variations in total factor productivity.

Stepwise regression has selected output and capital intensity as the determinants of productivity. The value of adjusted R^2 is 0.79 .

$$y = 0.011x_1^{**} - 0.017_2^{**}$$
$$t = \quad (7.69) \quad (6.63)$$
$$R^2 = 0.81 \quad (\overline{R}^2 = 0.79)$$

Electrical Machinery and Apparatus N.E.C.

The regression equation for this sector is:

$$y = 0.80x_1^{**} + 0.030x_2^{**} + 0.067x_3 + 0.46x_4^{**}{}_4 - 0.015x_5^{**} + 0.025x_6$$
$$t = \quad (4.68) \quad (3.80) \quad (0.16) \quad (6.30) \quad (6.68) \quad (0.76)$$
$$R^2 = 0.98 \quad (\overline{R}^2 = 0.97)$$

The model explains 97 percent of total variation in total factor productivity. Total factor productivity has a positive association with all the independent variables except with that of scale variable. Regression coefficients for output, capital intensity, growth in the number of factories and scale variable are significant at 1 percent level.

Stepwise regression analysis depicts that output, capital intensity, growth in the number of factories and scale variable are the important determinants of total factor productivity. The model explains 97 percent variation in total factor productivity.

$$y = 0.56x_1^{**} + 0.028x_2^{**} + 0.42x_4^{**} - 0.038x_5^{**}$$
$$t = \quad (6.31) \quad (3.89) \quad (7.60) \quad (6.95)$$
$$R^2 = 0.98 \quad (\overline{R}^2 = 0.97)$$

Radio, Television and Communication Equipment and Apparatus

Regression equation for radio, television and communication equipment and apparatus sector is:

$$y = 0.046x_1^{**} + 0.013x_2 - 0.022x_3 - 0.016x_4^{**} - 0.035x_5^{**} - 0.059x_6$$
$$t = \quad (5.25) \quad (0.81) \quad (1.31) \quad (2.68) \quad (2.76) \quad (0.20)$$
$$R^2 = 0.98 \quad (\overline{R}^2 = 0.98)$$

Total factor productivity is positively related with output and capital intensity. The variables investment, growth in the number of factories, scale variable and total emoluments enter with a negative sign in the regression. The regression coefficients for output, growth in the number of factories and scale variable are statistically significant at 1 percent level. The model explains 98 percent of the variations in the dependent variable.

Stepwise regression analysis has selected output, capital intensity, growth in the number of factories and scale variable to be significant determinants of total factor productivity. The explanatory variation of the model is 98 percent.

$$y = 0.087x_1^{**} + 0.022x_2^{**} - 0.031x_4^{**} - 0.014x_5^{**}$$
$$t = \quad (7.56) \quad (2.10) \quad (4.23) \quad (5.41)$$
$$R^2 = 0.98 \quad (\overline{R}^2 = 0.98)$$

Medical, Precision and Optical Instruments, Watches and Clocks

Regression results for the medical, precision and optical instruments, watches and clocks sector is:

$$y = 0.092x_1^{**} + 0.015x_2 + 0.81x_3 + 0.046x_4^{**} - 0.013x_5^{*} + 0.039x_6$$
$$t = \quad (5.28) \quad (1.02) \quad (0.36) \quad (2.05) \quad (2.30) \quad (1.16)$$
$$R^2 = 0.79 \quad (\overline{R}^2 = 0.71)$$

The model depicts a positive relation between total factor productivity and all the independent variables except for the scale variable. Regression coefficients for output and growth in the number of factories are statistically significant at 1 percent level. Regression coefficient for scale variable is statistically significant at 5 percent level. The model explains 71 percent of the variations in total factor productivity.

Stepwise regression has selected output, growth in the number of factories and scale variable as the determinants of productivity. The value of adjusted R^2 is 0.72.

$$y = 0.063x_1^{**} + 0.051x_4^{**} - 0.032x_5^{*}$$
$$t = \quad (6.18) \quad (3.02) \quad (2.25)$$
$$R^2 = 0.76 \quad (\overline{R}^2 = 0.72)$$

Motor Vehicles, Trailer and Semi-trailer

Regression equation for motor vehicles, trailers and semi-trailers sector is:

$$y = 0.020x_1^{**} + 0.014x_2 + 0.94x_3 + 0.46x_4 + 0.077x_5 - 0.081x_6$$
$$t = \quad (2.33) \quad (0.25) \quad (0.19) \quad (1.38) \quad (0.33) \quad (0.38)$$
$$R^2 = 0.56 \quad (\overline{R}^2 = 0.39)$$

Total factor productivity has a positive association with all the independent variables except with that of total emoluments. Regression coefficient for output is statistically significant at 1 percent level. The explanatory variation of the model is 39 percent.

The significant determinants picked by stepwise regression are output and growth in the number of factories. The value of adjusted R^2 is 0.50.

$$y = 0.058x_1^{**} + 0.014x_4^{**}$$
$$t = \quad (2.96) \quad (4.88)$$
$$R^2 = 0.55 \quad (\overline{R}^2 = 0.50)$$

Other Transport Equipment

The regression equation for other transport equipment sector is:

$$y = 0.029x_1^{**} + 0.044x_2^{**} - 0.013x_3 - 0.082x_4 + 0.72x_5^{**} + 0.48x_6$$
$$t = \quad (6.02) \quad (2.82) \quad (0.74) \quad (0.85) \quad (3.24) \quad (1.38)$$
$$R^2 = 0.97 \quad (\overline{R}^2 = 0.96)$$

Total factor productivity is positively related with output, capital intensity, scale variable and total emoluments. It is negatively related with investment and growth in the number of factories. Regression coefficients for output, capital intensity and scale variable are statistically significant at 1 percent level. The model explains 96 percent of the total variations in total factor productivity.

Stepwise regression analysis depicts that output and growth in the number of factories are the most important determinants of total factor productivity.

$$y = 0.035x_1^{**} + 0.67x_4^{**}$$
$$t = \quad (7.18) \quad (3.70)$$
$$R^2 = 0.95 \quad (\overline{R}^2 = 0.95)$$

The model explains 95 percent of the variations in total factor productivity.

Furniture

The regression equation for this sector is:

$$y = 0.31x_1 + 0.22x_2 + 0.053x_3 + 0.096x_4 - 0.084x_5^{**} + 0.092x_6^{*}$$
$$t = \quad (1.85) \quad (1.55) \quad (0.56) \quad (1.75) \quad (3.17) \quad (2.58)$$
$$R^2 = 0.79 \quad (\overline{R}^2 = 0.71)$$

The results of regression indicate that total factor productivity has a positively association with all the independent variables except with the scale variable. The regression coefficient for scale variable is statistically significant at 1 percent level and regression coefficient for total emoluments is statistically significant at 5 percent level. The model explains 71 percent of the variations in total factor productivity.

The analysis of stepwise regression depicts a positive and significant relationship between total factor productivity and output. The explanatory variation of the model is 60 percent.

$$y = 0.17x_1^{**}$$
$$t = \quad (5.79)$$
$$R^2 = 0.62 \qquad (\overline{R}^2 = 0.60)$$

5.5 Chapter Summary

In the present chapter an attempt has been made to analyse the adjustment process of manufacturing sector in India in response to the new policy regime in terms of productivity. At aggregative level, an overall long term growth of 7.78 per cent per annum in value added during 1980-81 to 2002-03 has been associated with rapid growth of capital (6.05 percent per annum) and low growth of employment (0.65 percent per annum). Labour productivity for the whole period increases at an annual rate of 7.09 per cent per annum while capital productivity increased at a rate of 1.64 per cent per annum. Capital intensity for the entire period increases at a rate of 5.36 per cent per annum. The growth of value added and labour decelerated in the post-reform period. Capital shows higher growth in the second period of the analysis but it has not transformed into productivity growth. Labour productivity declines in the post-reform period. Capital productivity also decelerates and become negative in the post-reform period.

The estimate of total factor productivity growth of Indian manufacturing is 1.24 per cent per annum over the entire period 1980-81 to 2002-03. Total factor productivity growth has been higher during the pre-reform period than during the second period of the analysis, i.e., the post-reform period. The estimate of pre-reform phase is 1.53 per cent per annum while in the post-reform phase total factor productivity decreases to 0.44 per cent per annum. For total manufacturing sector, both partial productivity and total factor productivity decelerate in the post-reform period. So the aggregative analysis depicts a deceleration in productivity growth in Indian manufacturing in the new policy regime.

A disaggregative analysis has been conducted to study the inter-industry trends in Indian manufacturing. The results of disaggregative analysis depict that value added has been the highest for wearing apparel; dressing and dyeing of fur (18), followed by furniture (36) and chemicals and chemical products (24) for the entire period. Growth rates of value added have been higher for sixteen industrial groups in the pre-reform phase while six groups depict higher growth in the post-reform period. Growth rates of labour have been higher for fourteen industrial groups in the pre-reform phase. Eight groups depict higher growth in the post-reform phase. Growth rates of capital have been higher for only four industrial groups in the pre-reform phase while eighteen industrial groups depict acceleration in the post-reform phase.

Analysis of the partial productivities depicts a higher growth of labour productivity in the second period of analysis, i.e., the post-reform phase in twelve out of twenty-two sectors while capital productivity is higher in the first period of analysis, i.e., the pre-reform phase in fifteen out of twenty-two sectors. Capital intensity has been higher for only three industrial groups in the pre-reform phase while nineteen industrial groups depict higher growth in the post-reform phase. Growth rates of total factor productivity are higher for the sixteen industrial groups in the pre-reform phase while six industrial groups depict higher growth in the post-reform phase. So analysis at disaggregative level shows that labour productivity, capital productivity and total factor productivity have decelerated for most of the industrial sectors in the new policy regime. The results highlight that the productivity has not improved in the post-1991 period, the period of new policy regime for Indian. Thus the hypothesis is rejected. The results of this study are corroborated by several studies covering the period of 1991 reforms [Balakrishnan, et al. (2000), Goldar and Kumari (2003) and Das (2003), Trivedi, Prakash, and Sinate (2000), Srivastava (2000)].

The regression results show that the coefficients for output growth variable are positive and statistically significant for almost all the industries. The results highlight that the hypothesis is accepted as the rate of output growth emerges as an important determinant of productivity.

A positive and significant relationship has been observed between capital intensity and total factor productivity in ten out of twenty two industries. The results of regression depict a significant and positive relationship between total factor productivity and growth in the number of factories in eight industries.

Regression coefficients of investment are significant in wood and products of wood and cork, except furniture, articles of straw and plating materials (20), coke, refined petroleum products and nuclear fuel (24), rubber and plastic products (25) and other non-metallic mineral products (26). Investment is positively related to total factor productivity for twelve industries. The regression coefficients of total emoluments are positive and significant for tobacco products (16), tanning and dressing of leather, luggage, handbags saddlery, harness and footwear (19), other non-metallic mineral products (26) and furniture (36). Scale variable enters in many industries with a negative sign.

Chapter 6

NEW POLICY REGIME AND PRODUCTIVITY TRENDS IN PUNJAB MANUFACTURING SECTOR

6.1 Introduction

In the present chapter, the adjustment process of manufacturing sector in Punjab in response to new policy regime in terms of productivity has been analysed. The study covers a period of twenty three years from 1980-81 to 2002-03. Productivity trends are calculated for the aggregate manufacturing sector as well as for two digit and three digit level of disaggregation. The growth rates of inputs (capital, labour) and output (value added) have also been analysed. To analyse the impact of new policy regime on the productivity of the manufacturing sector, analysis has been done for the pre-reform period and post-reform period.

This chapter is divided into three sections. In section 6.1, the findings at the level of aggregate date are discussed. The analysis of growth rates of factor inputs (labour, capital), value added, labour productivity, capital productivity, capital intensity and total factor productivity is carried out for aggregate manufacturing sector for the entire period 1980-81 to 2002-03 as well as for the sub periods, i.e., pre-reform period and post-reform period. In section 6.2, a detailed analysis is done at two digit and three digit level of industries. Section 6.3 presents the summary of the chapter.

Hypothesis

- Productivity has improved in the post-1991 period, the period of new policy regime for Punjab Manufacturing.
- Rate of output growth is an important determinant of productivity.

6.2 Aggregative Analysis

The table below (Table 6.2) shows the growth rates of output, inputs (capital, labour), partial productivity and total factor productivity in Punjab manufacturing at aggregate level for the time period 1980-81 to 2002-03. A comparison has been made between the pre-reform period and the post-reform period to see whether there is an increase in productivity in manufacturing sector in Punjab in the new policy regime.

Table 6.2: Growth Rates of Value Added, Capital, Employment and Productivity Trends in Punjab Manufacturing

	1980-81- 2002-03	1980-81-1990-91	1991-92-2002-03
Value Added	7.91	9.65	3.04
Capital	5.21	4.91	1.92
Employment	3.01	5.46	1.29
Labour Productivity	4.76	3.98	1.72
Capital Productivity	2.57	4.52	1.10
Capital Intensity	2.14	-0.52	0.62
Total Factor Productivity	1.25	1.71	0.46

Computed

The analysis depicts that the growth rate of 7.91 per cent per annum in output (value added) in manufacturing sector during 1980-81 to 2002-03 is associated with a 5.21 per cent per annum capital growth rate and 3.01 per cent per annum employment growth rate in Punjab manufacturing sector. Comparing the pre-reform period, i.e., 1980-81 to 1990-91 with 1991-92 to 2002-03, the post-reform period, the analysis reveals that there is a sharp decline in growth rate of value added from 9.65 per cent per annum in period I to 3.04 per cent per annum in period II. Labour productivity for the entire period is 4.76 per cent per annum while capital productivity is 2.57 per cent per annum. Capital intensity for the whole period increased at an annual rate of 2.14 per cent per annum. Analysis of sub-periods depict that labour productivity increases at a higher rate, i.e., at a 3.98 per cent per annum in the pre-reform period as against 1.72 per cent per annum in the post-reform period. Capital productivity also shows a rising trend in the first period of the analysis and it decreases in the second period. Capital intensity growth rate which is negative (-0.52 per cent per annum) in the pre-reform period becomes positive (0.62 per cent per annum) in the post-reform regime. The estimate of total factor productivity growth in Punjab manufacturing is 1.25 per cent per annum over the total period, 1980-81 to 2002-03. Total factor productivity growth decelerates during the new policy regime. Estimates of pre-reform phase are 1.71 per cent per annum while in the post-reform phase total factor productivity decreases to 0.46 per cent per annum. Overall estimates obtained indicated that during the new policy regime there is a deceleration in labour productivity, capital productivity and total factor productivity growth in the manufacturing sector in Punjab.

6.3 Sectorwise Analysis

Food Products and Beverages Sector

Table 6.3.1: Growth Rates of Value Added, Capital and Labour in Food Products and Beverages Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
151	Production, processing and preservation of meat, fish, fruits, vegetables, oils and fats.	11.52	12.82	9.95	8.28	6.35	4.42	2.70	8.21	-1.52
152	Dairy product	14.47	18.35	20.36	6.57	9.25	2.57	4.41	10.53	3.94
153	Grain mill products, starches and starch products, and prepared animal feeds	9.78	14.15	6.16	7.29	6.58	6.62	3.88	7.85	5.19
154	Other food products	13.97	19.11	4.11	7.76	7.28	5.64	2.14	-1.16	5.09
155	Beverages	6.81	16.34	-3.11	11.45	11.65	11.09	4.53	7.71	7.04
15	Food Products and Beverages	13.53	14.51	12.62	7.77	6.96	6.51	3.73	6.12	5.39

Computed

The growth rates of value added, capital and labour are presented in table 6.3.1. The industrial output has grown at a rate of 14.15 per cent per annum in the pre-reform period as against 12.62 per cent per annum in the post-reform period. The rate of growth of capital input is 7.77 per cent per annum for the entire period and the rate of growth is also higher in the first period of analysis. The nineties onwards period shows a decline in employment. Most of the industries covered in this group depict a higher growth of value added in pre-reform period and declining growth rate of employment in the post-reform period.

An analysis of partial productivities highlights that the labour productivity has grown at the rate of 9.44 per cent per annum for the entire period. Growth of labour productivity has been 6.86 per cent per annum in post-reform era as against 7.90 per cent per annum in the pre-reform era. The rate of growth of capital productivity has been 5.73 per cent per annum in period II as against 7.06 per cent per annum in period I. Capital intensity for this group is 3.90 per cent per annum for the entire period of analysis. This growth rate of capital intensity is higher in the post-reform era.

As per the performance of individual industries in this group, two industries namely production, processing and preservation of meat, fish, fruits, vegetables, oils and fats (151), and dairy products (152) show rising labour productivity in the new policy regime and three industries namely grain mill products, starches and starch products, and prepared animal feeds (153), other food products (154) and beverages (155) show declining trend in labour productivity in the new policy regime. On capital productivity front, out of five, one industry, i.e., dairy product (152) shows rise in the new policy regime, one industry, i.e., production, processing and preservation of meat, fish, fruits, vegetables, oils and fats (151) show declining trend and three industries, i.e., grain mill products, starches and starch products, and prepared animal feeds (153), other food products (154) and beverages (155) show negative growth rate during the new policy regime. Two industries depict higher growth in capital intensity in the post-reform era.

Table 6.3.50: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Electrical Machinery and Apparatus N.E.C. Sector

Year	Labour Productivity						Capital Productivity						Capital Intensity					
	Industry Code						Industry Code						Industry Code					
	311	313	314	315	319	31	311	313	314	315	319	31	311	313	314	315	319	31
1980-81	0.44	0.16	0.41	0.31	0.10	0.85	0.25	0.48	0.37	0.35	0.19	0.35	0.17	0.33	1.12	0.09	0.55	0.24
1981-82	0.53	0.10	0.36	0.36	0.10	0.68	0.32	0.27	0.34	0.33	0.18	0.27	0.16	0.38	1.07	0.11	0.56	0.26
1982-83	0.46	0.14	0.35	0.33	0.10	0.77	0.27	0.27	0.35	0.32	0.17	0.25	0.17	0.53	1.01	0.10	0.57	0.30
1983-84	0.53	0.18	0.34	0.70	0.08	0.96	0.31	0.32	0.36	0.67	0.08	0.30	0.17	0.56	0.95	0.11	1.10	0.32
1984-85	0.42	0.21	0.30	0.26	0.08	0.87	0.20	0.28	0.31	0.19	0.10	0.22	0.21	0.74	0.96	0.13	0.79	0.41
1985-86	0.31	0.15	0.27	0.30	0.06	0.58	0.16	0.18	0.30	0.22	0.13	0.17	0.19	0.88	0.91	0.14	0.46	0.35
1986-87	0.58	0.16	0.25	0.29	0.07	0.74	0.30	0.23	0.28	0.23	0.20	0.24	0.19	0.68	0.92	0.13	0.35	0.31
1987-88	0.27	0.14	0.20	0.57	0.09	0.70	0.17	0.25	0.26	0.21	0.25	0.23	0.16	0.54	0.76	0.27	0.35	0.31
1988-89	0.79	0.15	0.17	0.25	0.06	0.78	0.40	0.19	0.24	0.14	0.17	0.21	0.20	0.78	0.71	0.17	0.38	0.37
1989-90	0.38	0.11	0.14	0.44	0.07	0.58	0.25	0.16	0.22	0.17	0.18	0.18	0.15	0.66	0.64	0.26	0.40	0.32
1990-91	0.33	0.08	0.11	0.59	0.06	0.54	0.17	0.12	0.19	0.13	0.16	0.14	0.19	0.66	0.58	0.44	0.39	0.38
1991-92	0.53	0.10	0.13	1.24	0.13	0.89	0.28	0.13	0.20	0.28	0.25	0.21	0.19	0.71	0.63	0.44	0.52	0.42
1992-93	0.55	0.11	0.12	0.89	0.26	1.05	0.26	0.14	0.20	0.19	0.36	0.23	0.21	0.78	0.61	0.46	0.74	0.47
1993-94	0.65	0.30	0.12	1.28	0.53	1.95	0.31	0.31	0.20	0.20	0.47	0.33	0.21	0.98	0.61	0.64	1.14	0.58
1994-95	0.63	0.09	0.08	1.51	0.83	1.43	0.24	0.10	0.17	0.25	0.44	0.24	0.26	0.87	0.49	0.60	1.89	0.60
1995-96	0.57	0.08	0.08	0.05	0.91	1.11	0.20	0.10	0.19	0.01	0.52	0.21	0.28	0.80	0.41	0.57	1.74	0.54
1996-97	0.73	0.04	0.07	0.34	0.88	1.11	0.26	0.04	0.19	0.05	0.44	0.20	0.28	0.86	0.39	0.61	2.00	0.56
1997-98	1.14	0.02	0.07	0.61	0.82	1.25	0.45	0.01	0.20	0.06	0.48	0.21	0.25	1.16	0.38	1.08	1.73	0.58
1998-99	0.92	0.00	0.07	0.98	1.05	1.32	0.31	0.02	0.20	0.30	0.56	0.22	0.29	0.97	0.36	0.33	1.89	0.60
1999-00	0.82	0.01	0.07	1.33	0.62	1.23	0.29	0.01	0.17	0.32	0.51	0.19	0.28	1.28	0.38	0.41	1.22	0.66
2000-01	0.82	0.12	0.07	1.56	0.50	1.35	0.29	0.11	0.21	0.30	0.43	0.19	0.28	1.16	0.34	0.52	1.15	0.70
2001-02	0.94	0.06	0.08	2.78	1.11	1.43	0.34	0.06	0.22	0.43	0.42	0.19	0.28	1.05	0.39	0.64	2.62	0.75
2002-03	0.91	0.13	0.09	1.68	0.92	1.40	0.33	0.07	0.21	0.23	0.40	0.16	0.27	1.86	0.44	0.72	2.30	0.85
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity																		
1980-81-2002-03	4.12	-8.35	-8.34	7.20	16.39	3.65	1.23	-12.83	-2.98	-3.03	7.46	-1.55	2.86	5.14	-5.53	10.55	7.70	5.28
1980-81-1990-91	-1.92	-3.34	-11.66	2.69	-4.54	-3.20	-2.20	-9.14	-5.96	-10.34	2.08	-6.26	0.29	6.39	-6.06	14.54	-6.48	3.26
1991-92-2002-03	5.61	-10.43	-4.04	8.81	13.20	1.81	2.32	-15.69	0.65	7.26	2.58	-3.14	3.22	6.23	-4.66	1.45	10.35	5.10

Computed

Industry code description: Appendix B

The growth rates of total factor productivity are presented in table 6.3.3. Productivity for the food products and beverages sector as a whole increases at a rate of 2.10 per cent per annum. The rate of growth of total factor productivity is higher in the pre-reform period as compared to that in the post-reform period. It is surprising that the two industries namely production, processing and preservation of meat, fish, fruits, vegetables, oils and fats (151) and dairy products (152) show a comparatively higher growth rate of total factor productivity in the new policy regime.

Table 6.3.3: Growth Rates of Total Factor Productivity in Food Products and Beverages Sector

Year	Total Factor Productivity					
	Industry Code					
	151	152	153	154	155	15
1980-81	1.00	1.00	1.00	1.00	1.00	1.00
1981-82	0.96	1.10	1.03	1.29	0.66	1.03
1982-83	1.09	1.17	0.97	1.07	0.63	1.02
1983-84	0.93	1.20	1.15	1.51	0.66	1.15
1984-85	1.38	1.31	0.91	1.65	0.73	1.20
1985-86	1.16	1.18	1.14	1.54	0.79	1.16
1986-87	0.95	1.15	1.14	1.44	0.90	1.07
1987-88	0.87	1.24	1.18	1.53	0.96	1.15
1988-89	1.15	1.36	1.21	1.64	0.89	1.26
1989-90	1.29	1.35	1.27	1.67	0.91	1.32
1990-91	1.25	1.45	1.20	1.62	0.97	1.30
1991-92	1.13	0.95	1.28	1.59	1.25	1.22
1992-93	1.12	1.39	1.34	1.78	0.89	1.35
1993-94	1.28	1.47	1.41	1.02	0.63	1.46
1994-95	1.05	1.45	1.08	1.30	0.71	1.48
1995-96	1.08	1.36	1.31	1.91	0.81	1.36
1996-97	1.00	1.48	1.16	1.77	0.72	1.33
1997-98	1.47	1.58	1.19	1.91	0.72	1.48
1998-99	1.83	0.94	1.37	1.59	0.84	1.58
1999-00	1.00	1.80	1.51	1.92	0.90	1.56
2000-01	1.17	1.90	1.23	1.69	0.91	1.49
2001-02	1.74	1.98	1.20	1.88	0.88	1.63
2002-03	1.16	1.94	1.32	1.83	0.84	1.54
Growth Rates of Total Factor Productivity						
1980-81-2002-03	1.30	2.21	1.24	2.08	0.38	2.10
1980-81-1990-91	1.83	2.82	2.48	4.27	2.93	2.65
1991-92-2002-03	1.93	4.58	0.06	-0.21	-0.22	1.83

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

On the basis of analysis of food products and beverages sector we conclude that output growth rate has remained almost stagnant for the periods under observation. The output growth rate is more in the pre-reform period as compared to the post-reform period. Both labour and capital inputs also behave in the same manner. In both the cases the annual growth rates are higher in the pre-reform period as compared to those in the post-reform period. Labour productivity and capital productivity have also slowed down in the post-reform period. Even total factor productivity growth rate has slowed down in the post-reform period. All these indicators point to the fact that this sector shows a sluggish performance in the changed policy regime.

Tobacco Products Sector

Table 6.3.4: Growth Rates of Value Added, Capital and Labour in Tobacco Products Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
16	Tobacco Products	10.84	14.40	6.29	11.59	7.97	11.73	4.30	6.54	3.96

Computed

Table 6.3.4 presents growth rate of value added and factor inputs. An analysis of this sector is indicative of the fact that there has been a rapid growth in the value added, i.e., at a rate of 10.84 per cent per annum for the entire sector, and the rate of growth of industrial output is higher in the pre-reform era. Analysis of factor inputs for this sector shows that capital input has grown at a rate of 11.59 per cent per annum and labour at a rate of 4.30 per cent per annum for the entire period. The growth rate of capital is 11.73 per cent per annum in the post-reform period as compared to 7.97 per cent per annum in the pre-reform period. The rate of growth of employment is 3.96 per cent per annum in the post-reform period as against 6.54 per cent per annum in the pre-reform period.

Table 6.3.5: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Tobacco Products Sector

Year	Labour Productivity	Capital Productivity	Capital Intensity
	Industry Code	Industry Code	Industry Code
	16	16	16
1980-81	0.05	0.23	0.23
1981-82	0.09	0.27	0.33
1982-83	0.14	0.39	0.37
1983-84	0.08	0.32	0.24
1984-85	0.09	0.32	0.27
1985-86	0.10	0.34	0.28
1986-87	0.11	0.45	0.24
1987-88	0.13	0.46	0.28
1988-89	0.11	0.40	0.27
1989-90	0.13	0.36	0.37
1990-91	0.16	0.52	0.32
1991-92	0.32	0.90	0.36
1992-93	0.19	0.44	0.42
1993-94	0.14	0.23	0.62
1994-95	0.17	0.26	0.66
1995-96	0.21	0.35	0.61
1996-97	0.24	0.35	0.69
1997-98	0.21	0.27	0.79
1998-99	0.22	0.26	0.83
1999-00	0.23	0.28	0.82
2000-01	0.25	0.30	0.83
2001-02	0.26	0.30	0.86
2002-03	0.27	0.30	0.89
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity			
1980-81-2002-03	6.27	-0.67	6.99
1980-81-1990-91	7.37	5.96	1.34
1991-92-2002-03	2.25	-4.87	7.48

Computed, Note: Two digit industry code description: Appendix B

An analysis of partial productivities highlights that both labour productivity and capital productivity are shrinking overtime. Labour productivity as against rate of growth of 7.37 per cent per annum in pre-reform period has come down to 2.25 per cent per annum in post-reform period. Similarly, capital productivity growth rate has become negative, and is - 4.87 per cent per annum in post-reform period while it was 5.96 per cent per annum in the former period. Capital intensity in post-reform period registers a sharp increase. It is 7.48 per cent per annum in post-reform period as against 1.34 per cent per annum in pre-reform period.

Table 6.3.6: Growth Rates of Total Factor Productivity in Tobacco Products Sector

Year	Total Factor Productivity
	Industry Code
	16
1980-81	1.00
1981-82	1.09
1982-83	1.25
1983-84	1.14
1984-85	1.15
1985-86	1.18
1986-87	1.29
1987-88	1.31
1988-89	1.25
1989-90	1.23
1990-91	1.37
1991-92	1.62
1992-93	1.32
1993-94	1.07
1994-95	1.12
1995-96	1.24
1996-97	1.25
1997-98	1.14
1998-99	1.14
1999-00	1.17
2000-01	1.19
2001-02	1.20
2002-03	1.20
Growth Rates of Total Factor Productivity	
1980-81-2002-03	0.15
1980-81-1990-91	2.27
1991-92-2002-03	-1.21

Computed
Note: Two digit industry code description: Appendix B

For this sector as a whole, productivity grows at a meager rate of 0.15 per cent per annum for the entire period. On splitting the periods, it is found that the growth rate of total factor productivity which is 2.27 per cent per annum in the pre-reform period come down and become negative to 1.21 per cent per annum in the post-reform period.

On the basis of analysis of this sector we conclude that this sector has not experienced any appreciable technological progress. Detailed analysis of this group is indicative of the fact that the growth rate of value added declines in the post-reform period. As far the employment growth is concerned, there has been a slowdown in the post-reform period. Growth rate of capital shows an increase in the post-reform period. The slowdown in the growth in value added in post-reform period is accompanied by a decline in the growth rate of labour productivity and capital productivity. Total factor productivity growth rate also declines in the post-reform period. All these indicators point towards a declining overall productivity in the new policy regime.

Textiles Sector

Table 6.3.7: Growth Rates of Value Added, Capital and Labour in Textiles Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
171	Spinning, weaving and finishing of textiles	8.19	15.47	0.63	12.24	14.75	5.18	1.87	7.28	-3.12
172	Other textiles	5.19	15.30	13.99	9.98	12.52	13.87	5.92	1.93	11.89
173	Knitted and crocheted fabrics and articles	16.96	20.00	9.65	10.74	8.28	9.73	8.07	13.48	7.37
17	Textiles	7.64	14.93	-0.59	9.41	9.24	6.70	0.03	3.79	-3.17

Computed

Value added in this sector has grown at a rate of 7.64 per cent per annum, and capital and labour have grown at a rate of 9.41 per cent per annum and 0.03 per cent per annum respectively for the entire period. The growth rates of value added, capital and employment show a decline in the post-reform period as compared to pre-reform period, as can be seen from table 5.2.7. Value added has grown at a rate of 14.93 per cent per annum in pre-reform period as against negative rate of -0.59 per cent per annum in the post-reform period. All the three industries in this sector show a decline in value added in the latter period of the analysis. Capital input has grown at a rate of 9.24 per cent per annum in pre-reform period as against 6.70 per cent per annum in the post-reform period. Labour input has grown at a rate of 3.79 per cent per annum in pre-reform period while the growth rate is - 3.17 per cent per annum in the post-reform period.

Table 6.3.8: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Textiles Sector

Year	Labour Productivity				Capital Productivity				Capital Intensity			
	Industry Code				Industry Code				Industry Code			
	171	172	173	17	171	172	173	17	171	172	173	17
1980-81	0.36	0.18	0.22	0.23	0.32	0.08	0.08	0.17	0.11	0.11	0.43	0.13
1981-82	0.37	0.29	0.32	0.26	0.31	0.09	0.09	0.20	0.12	0.12	0.37	0.13
1982-83	0.33	0.48	0.30	0.27	0.23	0.14	0.08	0.17	0.14	0.20	0.37	0.16
1983-84	0.40	0.53	0.35	0.29	0.26	0.18	0.10	0.18	0.16	0.18	0.36	0.17
1984-85	0.38	0.99	0.32	0.35	0.21	0.22	0.12	0.18	0.18	0.29	0.41	0.19
1985-86	0.44	0.65	0.29	0.37	0.24	0.23	0.14	0.19	0.18	0.20	0.36	0.20
1986-87	0.50	2.44	0.31	0.37	0.25	0.31	0.20	0.18	0.19	0.54	0.35	0.21
1987-88	0.59	1.28	0.27	0.40	0.23	0.27	0.22	0.17	0.26	0.37	0.34	0.24
1988-89	0.65	1.18	0.39	0.43	0.24	0.19	0.17	0.22	0.27	0.54	0.35	0.20
1989-90	0.64	0.51	0.42	0.66	0.33	0.18	0.18	0.32	0.19	0.25	0.23	0.20
1990-91	0.64	0.57	0.57	0.67	0.34	0.28	0.23	0.31	0.19	0.20	0.24	0.21
1991-92	0.82	0.68	0.55	0.81	0.28	0.26	0.16	0.26	0.29	0.26	0.35	0.32
1992-93	0.61	0.43	0.63	0.59	0.20	0.13	0.15	0.18	0.30	0.35	0.42	0.33
1993-94	0.91	0.55	1.27	0.90	0.10	0.14	0.26	0.25	0.87	0.38	0.49	0.37
1994-95	1.08	0.49	1.18	1.04	0.24	0.21	0.24	0.24	0.45	0.24	0.49	0.43
1995-96	0.84	0.51	1.09	0.79	0.17	0.15	0.18	0.17	0.49	0.33	0.60	0.46
1996-97	1.01	0.49	1.13	1.10	0.19	0.15	0.20	0.23	0.52	0.32	0.56	0.49
1997-98	0.93	0.07	1.15	0.89	0.15	0.01	0.17	0.15	0.62	0.70	0.66	0.58
1998-99	0.85	0.19	1.14	0.77	0.12	0.05	0.16	0.10	0.69	0.40	0.70	0.78
1999-00	1.54	0.57	1.24	1.36	0.19	0.15	0.20	0.17	0.81	0.38	0.61	0.79
2000-01	0.96	1.10	0.84	0.84	0.13	0.38	0.20	0.12	0.71	0.29	0.41	0.69
2001-02	1.04	0.77	0.78	0.92	0.13	0.21	0.17	0.12	0.78	0.36	0.45	0.76
2002-03	1.18	0.65	1.00	1.05	0.13	0.19	0.18	0.12	0.88	0.34	0.55	0.85
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity												
1980-81-2002-03	6.21	-0.69	8.22	7.61	-3.61	-1.06	3.47	-1.61	10.18	3.84	2.47	9.38
1980-81-1990-91	7.63	13.11	5.74	10.73	0.63	10.53	12.29	5.20	6.96	10.38	-4.59	5.26
1991-92-2002-03	3.87	1.87	2.12	2.66	-4.32	0.10	-0.07	-6.84	8.56	1.77	2.20	10.20

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

As seen from table 6.3.8, this group, as a whole, has not performed well in terms of partial productivities. Labour productivity growth rate is 7.61 per cent per annum for the entire period. Furthermore, the growth rate registers a fall in the post-reform period. Capital productivity shows a negative trend rate of -1.61 per cent per annum for the group. Capital intensity is higher in the post-reform period. As per the performance of individual industries in this group, the picture is not very good. Out of the three, two industries show negative capital productivity rate. In labour productivity, the industry other textiles (172) show negative rate of growth for the whole period.

Table 6.3.9: Growth Rates of Total Factor Productivity in Textiles Sector

Year	Total Factor Productivity			
	Industry Code			
	171	172	173	17
1980-81	1.00	1.00	1.00	1.00
1981-82	0.99	1.18	1.23	1.06
1982-83	0.88	1.23	1.19	1.04
1983-84	0.94	1.30	1.27	1.06
1984-85	0.87	1.39	1.19	1.10
1985-86	0.93	1.37	1.20	1.12
1986-87	0.97	1.53	1.23	1.10
1987-88	0.95	1.41	1.18	1.10
1988-89	0.97	1.22	1.33	1.18
1989-90	1.08	1.15	1.51	1.36
1990-91	1.08	1.27	1.63	1.35
1991-92	1.06	1.26	1.51	1.31
1992-93	0.92	1.00	1.51	1.16
1993-94	0.78	1.08	1.77	1.32
1994-95	1.07	1.13	1.74	1.33
1995-96	0.93	1.08	1.64	1.18
1996-97	1.00	1.07	1.68	1.31
1997-98	0.91	0.31	1.63	1.16
1998-99	0.83	0.62	1.60	1.01
1999-00	1.04	1.09	1.68	1.25
2000-01	0.88	1.46	1.62	1.08
2001-02	0.89	1.23	1.57	1.10
2002-03	0.91	1.17	1.62	1.12
Growth Rates of Total Factor Productivity				
1980-81-2002-03	-0.22	-1.54	2.05	0.42
1980-81-1990-91	1.06	1.21	3.21	2.69
1991-92-2002-03	-0.62	0.02	0.10	-1.56

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

Growth rates of total factor productivity are presented in Table 6.3.9. The growth rate of total factor productivity is 0.42 per cent per annum for the sector for the entire period. The growth rate shows a negative trend for the post-reform period. The growth rate has slowed down to -1.56 per cent per annum in the post-reform period from 2.69 per cent per annum in the pre-reform period. The poor performance of spinning, weaving and finishing of textiles (171) and other textiles (172) on productivity front could be due to deceleration in capital productivity in the post-reform period.

An analysis of results of this sector shows a decline in value added, capital and employment in the post-reform period. Capital productivity growth shows a negative trend for the entire period and for the post-reform period. Labour productivity growth rate also registers a decline. All these are pointers to the fact that this sector has shown poor productivity performance in the new policy regime.

Wearing Apparel; Dressing and Dyeing of Fur Sector

Table 6.3.10: Growth Rates of Value Added, Capital and Labour in Wearing Apparel; Dressing and Dyeing of Fur Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
181	Wearing apparel, except fur apparel	13.82	13.37	1.35	1.91	1.74	1.00	7.98	15.76	-1.35
18	Wearing Apparel; Dressing and Dyeing of Fur	17.48	20.52	9.83	11.28	6.90	10.20	7.43	12.46	8.00

Computed

Value added in this group records a rate of growth of 17.48 per cent per annum. The rate of growth is higher in the pre-reform period. Capital input has increased at an annual rate of 11.28 per cent per annum. The rate of growth of capital is higher in the post-reform period as compared to pre-reform period. Employment has increased at an annual rate of 7.43 per cent per annum. On splitting the period, it is found that the rate of growth of employment has declined from 12.46 per cent per annum in the pre-reform period to 8.00 per cent per annum in the new policy regime.

Table 6.3.11: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Wearing Apparel; Dressing and Dyeing of Fur Sector

Year	Labour Productivity		Capital Productivity		Capital Intensity	
	Industry Code		Industry Code		Industry Code	
	181	18	181	18	181	18
1980-81	0.46	0.41	0.07	0.14	0.70	0.29
1981-82	0.32	0.51	0.06	0.15	0.54	0.35
1982-83	0.24	0.48	0.05	0.17	0.49	0.28
1983-84	0.28	0.60	0.06	0.17	0.45	0.36
1984-85	0.16	0.55	0.04	0.18	0.39	0.31
1985-86	0.17	0.43	0.05	0.17	0.35	0.26
1986-87	0.27	0.57	0.09	0.24	0.30	0.23
1987-88	0.28	0.54	0.11	0.24	0.26	0.23
1988-89	0.23	0.36	0.10	0.18	0.23	0.20
1989-90	0.22	0.24	0.11	0.11	0.20	0.21
1990-91	0.37	0.48	0.20	0.22	0.19	0.22
1991-92	0.30	0.65	0.25	0.22	0.12	0.30
1992-93	0.63	0.85	0.42	0.22	0.15	0.38
1993-94	0.49	1.19	0.27	0.26	0.18	0.46
1994-95	0.83	1.19	0.50	0.26	0.17	0.46
1995-96	0.61	1.05	0.38	0.18	0.16	0.58
1996-97	0.57	1.14	0.36	0.22	0.16	0.51
1997-98	0.51	1.13	0.32	0.17	0.16	0.65
1998-99	0.62	0.95	0.34	0.17	0.18	0.55
1999-00	0.60	1.18	0.34	0.20	0.18	0.58
2000-01	0.76	0.87	0.36	0.22	0.21	0.39
2001-02	0.59	0.74	0.32	0.18	0.18	0.40
2002-03	0.55	0.90	0.35	0.19	0.16	0.48
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity						
1980-81-2002-03	5.40	8.50	11.68	1.06	-5.62	3.58
1980-81-1990-91	-2.06	4.23	11.44	2.12	-12.11	-4.94
1991-92-2002-03	2.74	1.69	0.35	-2.10	2.37	2.04

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

An analysis of trends of partial productivities [Table 6.3.11] shows that the labour productivity has increased at a higher rate in the pre-reform period. For the group as a whole the growth of labour productivity is 8.50 per cent per annum. The rate of growth of capital productivity decreases to -2.10 per cent per annum in the post-reform period from 2.12 per cent per annum in pre-reform period. For the sector as whole capital productivity is 1.06 per cent per annum. Capital intensity in period II registers an increase as compared to period I. The wearing apparel, except fur apparel (181) industry as covered under this sector shows high labour productivity rate and declining capital productivity rate during the new policy regime.

Table 6.3.12: Growth Rates of Total Factor Productivity in Wearing Apparel; Dressing and Dyeing of Fur Sector

Year	Total Factor Productivity	
	Industry Code	
	181	18
1980-81	1.00	1.00
1981-82	0.91	1.03
1982-83	0.80	1.08
1983-84	0.89	1.08
1984-85	0.68	1.10
1985-86	0.73	1.07
1986-87	0.95	1.23
1987-88	1.00	1.21
1988-89	0.93	1.08
1989-90	0.94	0.88
1990-91	1.20	1.17
1991-92	1.21	1.21
1992-93	1.49	1.25
1993-94	1.33	1.34
1994-95	1.58	1.34
1995-96	1.46	1.21
1996-97	1.44	1.28
1997-98	1.39	1.20
1998-99	1.44	1.18
1999-00	1.43	1.26
2000-01	1.48	1.21
2001-02	1.41	1.13
2002-03	1.42	1.17
Growth Rates of Total Factor Productivity		
1980-81-2002-03	3.28	0.78
1980-81-1990-91	1.88	0.48
1991-92-2002-03	0.48	-0.86

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

Table 6.3.12 depicts total factor productivity growth in this sector. This sector records a growth rate of 0.78 per cent per annum for the entire period. This rate of growth of productivity is 0.48 per cent per annum in the pre-reform period which declines to -0.86 per cent per annum in the post-reform period. The wearing apparel, except fur apparel (181) industry covered under this sector, shows a declining rate of growth in the post-reform period.

An overall analysis of this group shows a deceleration in output and labour growth rate in the post-reform period. The growth rate of capital registers an increase in the post-reform period. This increase in capital has not been transformed into increase in productivity. Growth rates of labour productivity and total factor productivity also declines in the post-reform period. All this is indicative of fact that this sector has not responded positively to the new policy regime.

Tanning and Dressing of Leather, Luggage, Handbags Saddlery, Harness and Footwear Sector

Table 6.3.13: Growth Rates of Value Added, Capital and Labour in Tanning and Dressing of Leather, Luggage, Handbags Saddlery, Harness and Footwear Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
191	Tanning and dressing of leather, luggage handbags, saddlery and harness	11.45	18.93	3.87	9.16	7.25	7.73	3.11	10.57	0.17
192	Footwear	5.96	-0.15	3.85	1.12	-1.77	3.06	-0.35	-2.49	4.61
19	Tanning and Dressing of Leather, Luggage, Handbags Saddlery, Harness and Footwear	6.60	3.53	2.89	1.73	-1.19	3.59	0.40	0.38	3.27

Computed

Trends for various summary statistics for this sector are presented in Table 6.3.13, 6.3.14 and 6.3.15. This sector shows a rate of growth of 6.60 per cent per annum in value added for the entire period. The rate of growth of value added is 3.53 per cent per annum in the pre-reform period as against 2.89 per cent per annum in the post-reform period. An analysis of the input structure underscores the fact that capital input has grown at the rate of 1.73 per cent per annum and employment has grown at a rate of 0.40 per cent per annum for the entire period. The capital input has grown at a rate of 3.59 in the post-reform period, as against a negative rate of growth of -1.19 per cent per annum in the pre-reform period. The rate of growth of employment is also higher in the post-reform period.

An analysis of partial productivity shows that labour productivity growth rate for the entire period is 6.17 per cent per annum. This growth rate is 3.14 per cent per annum in the pre-reform period which declines and becomes negative to -0.37 per cent per annum in the post-reform period. The rate of growth of capital productivity is higher in the pre-reform period as compared to post-reform period. Capital intensity grows at a rate of 1.32 per cent per annum for the entire period of analysis. As far as the performance of three digit industries in this group is concerned, both the industries tanning and dressing of leather, luggage handbags, saddlery and harness (191) and footwear (192), show a declining rate of growth of labour productivity and capital productivity in the post-reform period.

Table 6.3.14: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Tanning and Dressing of Leather, Luggage, Handbags Saddlery, Harness and Footwear Sector

Year	Labour Productivity			Capital Productivity			Capital Intensity		
	Industry Code			Industry Code			Industry Code		
	191	192	19	191	192	19	191	192	19
1980-81	0.18	0.24	0.38	0.16	0.43	0.75	0.11	0.57	0.50
1981-82	0.17	0.33	0.36	0.14	0.56	0.69	0.12	0.59	0.52
1982-83	0.32	0.33	0.27	0.26	0.80	0.71	0.12	0.41	0.38
1983-84	0.22	0.34	0.37	0.19	0.62	0.77	0.11	0.55	0.48
1984-85	0.35	0.21	0.29	0.29	0.54	0.81	0.12	0.39	0.36
1985-86	0.17	0.23	0.11	0.13	0.55	0.32	0.13	0.41	0.36
1986-87	0.29	0.14	0.36	0.27	0.31	0.84	0.17	0.46	0.43
1987-88	0.27	0.19	0.18	0.29	0.56	0.57	0.09	0.35	0.31
1988-89	0.24	0.18	0.34	0.43	0.50	1.10	0.09	0.37	0.30
1989-90	0.37	0.61	0.50	0.50	0.89	1.04	0.09	0.68	0.48
1990-91	0.56	0.49	0.64	0.61	0.66	1.30	0.09	0.74	0.49
1991-92	0.67	0.78	0.63	0.58	0.97	1.13	0.12	0.80	0.55
1992-93	0.44	0.52	0.69	0.25	0.81	1.41	0.17	0.64	0.49
1993-94	0.63	0.68	0.63	0.36	0.93	1.18	0.17	0.73	0.53
1994-95	0.60	0.72	0.92	0.41	0.97	1.80	0.14	0.74	0.51
1995-96	0.73	0.70	0.78	0.19	1.45	1.66	0.39	0.48	0.47
1996-97	0.83	0.71	0.71	0.21	1.44	1.49	0.39	0.49	0.48
1997-98	0.64	0.62	0.95	0.19	1.22	1.95	0.33	0.51	0.48
1998-99	0.54	1.11	1.56	0.27	1.67	2.96	0.20	0.66	0.53
1999-00	3.55	0.78	1.03	1.06	1.22	1.85	0.33	0.63	0.56
2000-01	0.56	0.76	0.40	0.31	1.24	0.90	0.18	0.61	0.45
2001-02	0.55	0.44	0.63	0.16	0.74	1.14	0.35	0.60	0.55
2002-03	0.76	0.59	0.63	0.22	0.94	1.10	0.35	0.63	0.57
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity									
1980-81-2002-03	8.09	6.33	6.17	1.68	4.79	4.79	5.87	1.47	1.32
1980-81-1990-91	7.56	2.39	3.14	13.51	1.65	4.77	-3.00	0.73	-1.56
1991-92-2002-03	3.69	-0.73	-0.37	-3.58	0.76	-0.68	7.55	-1.48	0.31

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

Total factor productivity indices for the group are given in the table 6.3.15. This sector experiences a growth rate of total factor productivity of 1.95 per cent per annum for the entire period. The growth rate of total factor productivity is 1.75 per cent per annum in the pre-reform period as compared to negative rate of growth of - 0.54 per cent per annum in the post-reform period. The two industries, tanning and dressing of leather, luggage handbags, saddlery and harness (191) and footwear (192) also show negative rate of growth of total factor productivity in the post-reform period.

Table 6.3.15: Growth Rates of Total Factor Productivity in Tanning and Dressing of Leather, Luggage, Handbags Saddlery, Harness and Footwear Sector

Year	Total Factor Productivity		
	Industry Code		
	191	192	19
1980-81	1.00	1.00	1.00
1981-82	0.95	1.12	0.97
1982-83	1.23	1.26	0.96
1983-84	1.07	1.16	1.01
1984-85	1.27	1.08	1.01
1985-86	0.93	1.09	0.60
1986-87	1.11	0.85	1.04
1987-88	1.25	1.08	0.83
1988-89	1.22	1.04	1.11
1989-90	1.41	1.36	1.15
1990-91	1.57	1.24	1.25
1991-92	1.58	1.42	1.21
1992-93	1.32	1.31	1.29
1993-94	1.48	1.39	1.22
1994-95	1.50	1.41	1.40
1995-96	1.34	1.52	1.35
1996-97	1.39	1.52	1.30
1997-98	1.33	1.45	1.42
1998-99	1.37	1.63	1.61
1999-00	2.03	1.48	1.43
2000-01	1.44	1.48	1.03
2001-02	1.27	1.24	1.18
2002-03	1.41	1.36	1.17
Growth Rates of Total Factor Productivity			
1980-81-2002-03	1.79	1.76	1.95
1980-81-1990-91	3.68	0.82	1.75
1991-92-2002-03	-0.09	-0.05	-0.54

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

An analysis of this group is indicative of the fact that value added growth rate has remained almost same for the period under observation. As compared to the pre-reform period, the labour and capital input growth rates register an increase in the post-reform period. While capital intensity growth rate registers a small increase in the post-reform period, labour productivity growth rate registers a deceleration in this period. Capital productivity growth also shows a negative trend in the post-reform period. Total factor productivity growth rate also behaves in the similar manner. All these factors point out that this sector has not experienced any appreciable technological progress.

Wood and Products of Wood and Cork except Furniture; Articles of Straw and Plating Materials Sector

Table 6.3.16: Growth Rates of Value Added, Capital and Labour in Wood and Products of Wood and Cork, Except Furniture; Articles of Straw and Plating Materials Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
201	Saw milling and planing of wood	12.68	11.13	12.84	6.74	5.01	8.54	5.62	6.43	15.41
202	Products of wood, cork, straw and plaiting materials	13.76	7.16	16.85	10.04	5.07	13.01	3.53	-4.55	11.63
20	Wood and Products of Wood and Cork, Except Furniture; Articles of Straw and Plating Materials	11.00	8.50	16.53	7.87	7.11	10.76	1.49	-6.56	9.51

Computed

Table 6.3.16 presents the growth rates in value added, capital and labour respectively. An analysis of this sector depicts that there has been a rapid growth in value added, i.e., at a rate of 11.00 per cent per annum for the entire sector, and that there has been an acceleration in the rate of growth of industrial output in the post-reform period. The growth rate is 16.53 per cent per annum in the post-reform period as against 8.50 per cent per annum in the pre-reform period. Analysis of factor inputs of this sector shows that capital grows at a rate of 7.87 per cent per annum for the entire period, the rate of growth is higher in the post-reform period of analysis. Employment has grown at a rate of 1.49 per cent per annum, the rate being higher for the post-reform period. Value added as well as capital and labour grows at a higher rate in the post-reform era. The same is true for both the three digit industries, saw milling and planing of wood (201) and products of wood, cork, straw and plaiting materials (202) covered in this sector.

Table 6.3.17: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Wood and Products of Wood and Cork, Except Furniture; Articles of Straw and Plating Materials Sector

Year	Labour Productivity			Capital Productivity			Capital Intensity		
	Industry Code			Industry Code			Industry Code		
	201	202	20	201	202	20	201	202	20
1980-81	0.12	0.16	0.11	0.11	0.25	0.21	0.10	0.06	0.05
1981-82	0.07	0.14	0.10	0.07	0.17	0.14	0.10	0.08	0.07
1982-83	0.08	0.15	0.10	0.08	0.15	0.13	0.10	0.10	0.07
1983-84	0.08	0.13	0.11	0.08	0.12	0.11	0.10	0.10	0.10
1984-85	0.05	0.14	0.13	0.06	0.11	0.10	0.09	0.13	0.13
1985-86	0.05	0.13	0.12	0.06	0.12	0.10	0.08	0.11	0.11
1986-87	0.05	0.15	0.14	0.06	0.09	0.09	0.08	0.16	0.15
1987-88	0.10	0.28	0.23	0.11	0.14	0.15	0.09	0.20	0.15
1988-89	0.25	0.32	0.30	0.25	0.15	0.21	0.10	0.20	0.14
1989-90	0.11	0.38	0.36	0.13	0.26	0.15	0.08	0.15	0.25
1990-91	0.10	0.42	0.38	0.10	0.26	0.19	0.10	0.16	0.20
1991-92	0.37	0.42	0.35	0.14	0.15	0.13	0.26	0.27	0.26
1992-93	0.13	0.44	0.39	0.10	0.19	0.20	0.14	0.23	0.20
1993-94	0.28	0.68	0.29	0.21	0.22	0.14	0.14	0.31	0.20
1994-95	0.30	0.69	0.38	0.21	0.26	0.16	0.14	0.26	0.24
1995-96	0.35	0.60	0.38	0.20	0.26	0.16	0.18	0.24	0.23
1996-97	0.15	0.46	0.41	0.14	0.23	0.18	0.11	0.20	0.23
1997-98	0.18	0.59	0.42	0.17	0.25	0.17	0.11	0.23	0.24
1998-99	0.22	0.69	0.41	0.17	0.20	0.19	0.13	0.34	0.21
1999-00	0.21	0.82	0.61	0.22	0.31	0.25	0.10	0.27	0.25
2000-01	0.25	0.81	0.60	0.22	0.26	0.25	0.11	0.31	0.24
2001-02	0.22	0.74	0.59	0.19	0.29	0.23	0.11	0.26	0.26
2002-03	0.19	0.71	0.62	0.21	0.23	0.24	0.09	0.30	0.25
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity									
1980-81-2002-03	6.69	9.89	9.37	5.57	3.38	2.91	1.07	6.29	6.28
1980-81-1990-91	4.42	12.27	16.11	5.83	1.99	1.30	-1.33	10.07	14.62
1991-92-2002-03	-2.22	4.68	6.41	3.96	3.40	5.22	-5.95	1.24	1.14

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

In terms of partial productivity measures, [Table 6.3.17], the most notable development in this sector is that the capital productivity is higher in the post-reform period. The rate of growth of capital productivity is 5.22 per cent per annum in the post-reform period as compared to 1.30 per cent per annum pre-reform period. Labour productivity growth rate is 9.37 per cent per annum for the entire period, the rate of growth is higher in the pre-reform period. Capital intensity is also higher in the first period of analysis.

As per the individual industries in this group, the rate of growth in labour productivity is above five per cent per annum in both the industries, saw milling and planing of wood (201) and products of wood, cork, straw and plaiting materials (202) for the entire period. But the growth rate of labour productivity is lower in the post-reform period. In case of capital productivity, the industry saw milling and planing of wood (201) shows declining growth rate in the post-reform period and the industry products of wood, cork, straw and plaiting materials (202) show higher growth rate in the same period.

Considering the period as a whole the group shows a growth rate of 2.51 per cent per annum in total factor productivity [Table 6.3.18]. On splitting the period it is found that the growth rate of total factor productivity is higher in the pre-reform period as compared to the post-reform period. Both the industries covered under this sector viz. saw milling and planing of wood (201) and products of wood, cork, straw and plaiting materials (202) also show higher growth rate of total factor productivity in the pre-reform period.

Table 6.3.18: Growth Rates of Total Factor Productivity in Wood and Products of Wood and Cork, Except Furniture; Articles of Straw and Plating Materials Sector

Year	Total Factor Productivity		
	Industry Code		
	201	202	20
1980-81	1.00	1.00	1.00
1981-82	0.80	0.91	0.89
1982-83	0.83	0.89	0.89
1983-84	0.82	0.81	0.89
1984-85	0.67	0.82	0.93
1985-86	0.65	0.83	0.92
1986-87	0.65	0.81	0.94
1987-88	0.93	1.02	1.15
1988-89	1.32	1.07	1.29
1989-90	1.00	1.24	1.23
1990-91	0.94	1.26	1.30
1991-92	1.42	1.12	1.20
1992-93	1.04	1.19	1.32
1993-94	1.37	1.28	1.18
1994-95	1.38	1.35	1.26
1995-96	1.40	1.32	1.28
1996-97	1.08	1.25	1.30
1997-98	1.15	1.32	1.31
1998-99	1.22	1.28	1.30
1999-00	1.23	1.42	1.50
2000-01	1.30	1.42	1.49
2001-02	1.24	1.36	1.51
2002-03	1.24	1.30	1.52
Growth Rates of Total Factor Productivity			
1980-81-2002-03	2.67	2.53	2.51
1980-81-1990-91	2.04	3.14	3.92
1991-92-2002-03	-0.40	1.32	2.26

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

An analysis of this group reveals a rise in the rate of growth of output in the new policy regime. The surge in value added is accompanied by an increase in growth of intermediate inputs in the new policy regime. Capital productivity improves in the new policy regime. Labour productivity growth rate is lower in the post-reform period. In terms of productivity, the sector shows some deceleration in the post-reform era but overall rate of growth of total factor productivity for the sector for the total period of analysis is rather good.

Paper and Paper Products Sector

Table 6.3.19: Growth Rates of Value Added, Capital and Labour in Paper and Paper Products Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
21	Paper and Paper Products	7.66	11.70	3.71	9.61	13.84	7.14	4.62	13.62	1.03

Computed

This group, as a whole, shows a high growth in value added in the pre-reform period, i.e., 11.70 per cent per annum but the growth rate shows a sharp decline in the post-reform period that is 3.71 per cent per annum. Employment for the sector, as a whole, shows a growth rate of 4.62 per cent per annum with the rate being lower in the post-reform period. Capital input has a high growth rate of 9.61 per cent per annum and here also the growth rate is lower in the second period.

Table 6.3.20 presents the indices of labour productivity, capital productivity and capital intensity. Labour productivity for the entire period depicts a growth rate of 9.19 per cent per annum, the growth rate being less for the post-reform period. The slower growth in labour productivity in the post-reform period could be the consequence of slower growth of value added in the same period. Capital productivity shows a negative trend for the sector, as a whole, with the trend increasing at a higher rate in the post-reform period. The rate of growth of capital intensity is higher in the new policy regime.

Table 6.3.20: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Paper and Paper Products Sector

Year	Labour Productivity	Capital Productivity	Capital Intensity
	Industry Code	Industry Code	Industry Code
	21	21	21
1980-81	1.24	0.50	0.25
1981-82	0.67	0.26	0.26
1982-83	1.00	0.23	0.43
1983-84	0.67	0.10	0.68
1984-85	0.48	0.11	0.42
1985-86	0.56	0.14	0.40
1986-87	0.58	0.15	0.38
1987-88	0.52	0.17	0.30
1988-89	0.67	0.22	0.30
1989-90	0.93	0.27	0.35
1990-91	0.88	0.25	0.36
1991-92	1.07	0.24	0.44
1992-93	0.78	0.18	0.43
1993-94	1.05	0.19	0.55
1994-95	1.09	0.18	0.61
1995-96	1.25	0.24	0.53
1996-97	1.29	0.21	0.62
1997-98	0.83	0.12	0.70
1998-99	1.19	0.12	0.96
1999-00	0.67	0.08	0.87
2000-01	1.12	0.15	0.75
2001-02	0.92	0.11	0.82
2002-03	2.35	0.33	0.72
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity			
1980-81-2002-03	9.19	-1.78	4.78
1980-81-1990-91	12.14	-1.87	0.19
1991-92-2002-03	2.66	-3.20	6.05

Computed
Note: Two digit industry code description: Appendix B

Total factor productivity growth for the sector shows a negative growth rate of -0.93 per cent per annum for the entire period. Growth rate which is already negative in the first period deteriorates further in the post-reform period.

Table 6.3.21: Growth Rates of Total Factor Productivity in Paper and Paper Products Sector

Year	Total Factor Productivity
	Industry Code
	21
1980-81	1.00
1981-82	0.71
1982-83	0.70
1983-84	0.49
1984-85	0.64
1985-86	0.67
1986-87	0.70
1987-88	0.64
1988-89	0.65
1989-90	0.74
1990-91	0.71
1991-92	0.73
1992-93	0.60
1993-94	0.65
1994-95	0.64
1995-96	0.74
1996-97	0.70
1997-98	0.60
1998-99	0.52
1999-00	0.54
2000-01	0.57
2001-02	0.64
2002-03	0.63
Growth Rates of Total Factor Productivity	
1980-81-2002-03	-0.93
1980-81-1990-91	-1.01
1991-92-2002-03	-1.42

Computed

Note: Two digit industry code description: Appendix B

An analysis of the paper and paper products sector highlights that value added which is above 11 per cent per annum in the pre-reform period sharply declines to 3.71 per cent per annum in the post-reform period. Rate of growth of capital is higher in the pre-reform period as compared to post-reform period. Growth rate of labour also declines sharply in the post-reform period. Growth rates of labour productivity and capital productivity also behave in the similar manner. Overall this sector has not responded positively to the new policy regime and shows a poor performance.

Publishing, Printing and Reproduction of Recorded Media Sector

Table 6.3.22: Growth Rates of Value Added, Capital and Labour in Publishing, Printing and Reproduction of Recorded Media Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
221	Publishing	2.17	9.14	5.62	4.72	2.30	8.11	-2.17	2.13	1.65
222	Printing and service activities related to printing	17.48	9.44	16.57	11.29	2.58	18.36	10.56	3.05	16.06
22	Publishing, Printing and Reproduction of Recorded Media	2.83	9.12	1.45	2.35	1.31	3.55	5.05	2.27	8.77

Computed

The growth rates of value added, capital and labour are presented in table 6.3.22. Value added depicts an annual growth rate of 2.83 per cent per annum for the entire period and there is a sharp decline in the growth rate in the new policy regime. Capital grows at a rate of 2.35 per cent per annum for the entire period. The rate of growth of capital in new policy regime is higher than in the pre-reform period. Employment has grown at a rate of 5.05 per cent per annum for the entire period, the rate being higher for the post-reform period. Printing and service activities related to printing (222) industry is associated with higher growth of value added, labour and capital as compared to industry publishing (221) in the new policy regime.

An analysis of partial productivities highlights that the labour productivity has grown at a slow rate of 0.47 per cent per annum for the entire period under study. Growth of labour productivity has declined from 7.71 per cent per annum in the pre-reform period to -2.03 per cent per annum in the post-reform period. Capital productivity has been -2.12 per cent per annum for the entire period. The rate of growth of capital productivity has been -6.73 per cent per annum in the post-reform period as against 6.70 per cent per annum in the pre-reform period hence depicting a sharp decline. The sector has performed poorly on partial productivity basis. Capital intensity has grown at a rate of 2.64 per cent per annum for the entire period.

Table 6.3.23: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Publishing, Printing and Reproduction of Recorded Media Sector

Year	Labour Productivity			Capital Productivity			Capital Intensity		
	Industry Code			Industry Code			Industry Code		
	221	222	22	221	222	22	221	222	22
1980-81	0.21	0.37	0.27	0.16	0.39	0.17	0.13	0.94	0.16
1981-82	0.23	0.23	0.13	0.12	0.19	0.12	0.19	1.21	0.10
1982-83	0.31	0.10	0.26	0.15	0.29	0.16	0.20	0.36	0.17
1983-84	0.35	0.15	0.22	0.18	0.26	0.18	0.19	0.59	0.12
1984-85	0.37	0.40	0.37	0.25	0.24	0.25	0.14	1.69	0.14
1985-86	0.37	0.27	0.36	0.27	0.17	0.27	0.13	1.55	0.13
1986-87	0.32	0.29	0.31	0.23	0.21	0.23	0.14	1.43	0.14
1987-88	0.33	0.26	0.32	0.23	0.46	0.23	0.14	0.58	0.14
1988-89	0.31	0.54	0.40	0.31	0.60	0.32	0.10	0.89	0.13
1989-90	0.56	0.34	0.32	0.24	0.45	0.25	0.23	0.74	0.13
1990-91	0.46	0.33	0.45	0.23	0.43	0.24	0.20	0.76	0.19
1991-92	0.56	0.55	0.26	0.21	0.63	0.23	0.26	0.88	0.11
1992-93	0.46	0.41	0.20	0.12	0.64	0.15	0.37	0.64	0.13
1993-94	0.47	0.52	0.48	0.27	0.70	0.29	0.18	0.73	0.16
1994-95	0.61	0.94	0.66	0.19	0.90	0.22	0.32	1.05	0.30
1995-96	0.47	0.56	0.49	0.22	0.85	0.26	0.21	0.66	0.19
1996-97	0.21	0.86	0.20	0.06	0.57	0.11	0.33	1.50	0.18
1997-98	0.80	1.27	0.34	0.17	0.70	0.22	0.47	1.81	0.16
1998-99	0.33	0.54	0.11	0.01	0.40	0.09	1.77	0.90	0.12
1999-00	0.85	0.49	0.27	0.10	0.30	0.14	0.88	0.98	0.19
2000-01	0.68	0.71	0.38	0.39	0.44	0.14	0.17	1.05	0.27
2001-02	0.63	0.55	0.19	0.16	0.19	0.08	0.40	0.84	0.24
2002-03	0.78	0.52	0.39	0.22	0.32	0.15	0.35	0.86	0.25
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity									
1980-81-2002-03	4.44	6.27	0.47	-2.43	2.45	-2.12	7.04	0.67	2.64
1980-81-1990-91	6.87	6.20	7.71	6.68	6.69	6.70	0.17	-0.46	0.95
1991-92-2002-03	3.91	0.44	-2.03	-2.30	-9.77	-6.73	6.36	1.98	5.04

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

Table 6.3.24: Growth Rates of Total Factor Productivity in Publishing, Printing and Reproduction of Recorded Media Sector

Year	Total Factor Productivity		
	Industry Code		
	221	222	22
1980-81	1.00	1.00	1.00
1981-82	0.97	0.73	0.75
1982-83	1.10	0.46	0.98
1983-84	1.16	0.64	0.96
1984-85	1.24	0.87	1.15
1985-86	1.26	0.70	1.16
1986-87	1.19	0.76	1.09
1987-88	1.20	0.92	1.11
1988-89	1.23	1.11	1.22
1989-90	1.32	0.95	1.11
1990-91	1.27	0.94	1.17
1991-92	1.29	1.12	1.05
1992-93	1.14	1.08	0.89
1993-94	1.28	1.15	1.25
1994-95	1.27	1.30	1.26
1995-96	1.25	1.22	1.23
1996-97	0.86	1.15	0.85
1997-98	1.42	1.25	1.12
1998-99	0.54	1.06	0.68
1999-00	1.29	1.01	1.00
2000-01	1.79	1.36	1.38
2001-02	1.25	0.69	0.94
2002-03	1.46	0.67	1.28
Growth Rates of Total Factor Productivity			
1980-81-2002-03	0.53	1.77	0.36
1980-81-1990-91	2.54	3.73	3.00
1991-92-2002-03	0.95	-3.42	0.22

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

Considering the period as a whole, the growth rate of total factor productivity is also very low and is 0.36 per cent per annum. The growth rate of total factor productivity is lower in the post-reform period as compared to pre-reform period. The growth rate falls sharply from 3.00 per cent per annum in the pre-reform period to 0.22 per cent per annum in the post-reform period. The two industries namely publishing (221), and printing and service activities related to printing (222) as covered under this sector also show a deceleration in the growth rate in the post-reform period.

The overall analysis of this sector shows that value added has sharply declined in the post-reform period. Capital and labour input growth rates are higher in the post-reform period. The slowdown in the growth in value added in the post-reform period is accompanied by a decline in labour productivity and capital productivity. Total factor productivity has been 0.22 per cent per annum in the post-reform period as against 3.00 per cent per annum in the pre-reform period. So the sector as a whole has performed badly during the new policy regime.

Coke, Refined Petroleum Products and Nuclear Fuel Sector

Table 6.3.25: Growth Rates of Value Added, Capital and Labour in Coke, Refined Petroleum Products and Nuclear Fuel Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
231	Coke oven products	-2.03	-3.15	2.84	2.65	4.10	1.39	-1.81	10.98	-2.85
232	Refined petroleum products	-1.10	4.22	-0.62	6.76	8.03	5.78	3.98	2.02	8.64
23	Coke, Refined Petroleum Products and Nuclear Fuel	-1.57	0.92	0.60	1.90	7.15	4.32	5.31	6.33	4.45

Computed

Table 6.3.25 presents the growth rates of factor inputs and value added. The growth rate of value added is negative for the entire period. Value added growth rate is negative for both the three digit industries as covered in this group but coke oven products (231) industry shows an improvement in the post-reform era while refined petroleum products (232) industry has performed well in the earlier period. Lower value added growth in refined petroleum products (232) industry is associated with improvement in labour growth in the new policy regime. Capital input has grown at the rate of 1.90 per cent per annum for the entire period. The rate of growth of capital is 4.32 per cent per annum in the new policy regime as against 7.15 in the pre-reform period. Employment has grown at the rate of 5.31 per cent per annum for the entire period. The rate of growth is higher in the pre-reform period as compared to new policy regime.

Table 6.3.26: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Coke, Refined Petroleum Products and Nuclear Fuel Sector

Year	Labour Productivity			Capital Productivity			Capital Intensity		
	Industry Code			Industry Code			Industry Code		
	231	232	23	231	232	23	231	232	23
1980-81	0.31	0.63	0.50	0.19	0.38	0.30	0.17	0.17	0.17
1981-82	0.34	0.25	0.30	0.23	0.18	0.21	0.15	0.14	0.14
1982-83	0.60	0.41	0.50	0.42	0.22	0.30	0.14	0.19	0.17
1983-84	0.35	0.33	0.34	0.30	0.20	0.24	0.12	0.16	0.14
1984-85	0.44	0.60	0.53	0.29	0.34	0.32	0.15	0.17	0.16
1985-86	0.42	0.78	0.61	0.32	0.49	0.42	0.13	0.16	0.15
1986-87	0.43	0.64	0.59	0.18	0.41	0.33	0.25	0.16	0.18
1987-88	0.18	0.45	0.33	0.17	0.29	0.25	0.11	0.15	0.13
1988-89	0.11	0.45	0.24	0.15	0.23	0.20	0.07	0.20	0.12
1989-90	0.12	0.39	0.22	0.15	0.16	0.15	0.08	0.25	0.14
1990-91	0.13	0.58	0.27	0.14	0.16	0.15	0.09	0.36	0.17
1991-92	0.11	0.48	0.26	0.10	0.15	0.13	0.12	0.32	0.20
1992-93	0.13	0.40	0.26	0.08	0.13	0.12	0.15	0.30	0.23
1993-94	0.38	0.32	0.34	0.15	0.11	0.13	0.25	0.28	0.27
1994-95	0.39	0.32	0.35	0.13	0.10	0.11	0.29	0.31	0.30
1995-96	0.37	0.26	0.29	0.10	0.10	0.10	0.35	0.26	0.28
1996-97	0.37	0.27	0.29	0.08	0.10	0.09	0.47	0.27	0.31
1997-98	0.33	0.28	0.29	0.08	0.10	0.09	0.42	0.27	0.30
1998-99	0.39	0.23	0.28	0.19	0.09	0.12	0.20	0.25	0.23
1999-00	0.41	0.21	0.29	0.30	0.10	0.15	0.14	0.22	0.19
2000-01	0.33	0.17	0.20	0.11	0.07	0.08	0.30	0.23	0.25
2001-02	0.22	0.17	0.18	0.10	0.07	0.08	0.21	0.25	0.24
2002-03	0.34	0.18	0.20	0.08	0.07	0.07	0.40	0.25	0.27
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity									
1980-81-2002-03	-0.22	-4.88	0.47	-4.56	-7.37	-6.53	4.55	2.68	3.35
1980-81-1990-91	-12.73	2.16	-5.81	-6.96	-3.53	-5.09	-6.20	5.90	-0.76
1991-92-2002-03	5.85	-8.52	-3.57	1.43	-6.05	-3.69	4.36	-2.63	0.12

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

For the entire period the growth rate of labour productivity shows a mild positive trend. However, the group as a whole shows a negative rate of growth of labour productivity in both the periods. The capital productivity growth rate has been negative for the entire period and for both the sub periods. The growth rate of capital intensity improves in the new policy regime. The performance of coke oven products (231) industry is better than the industrial group refined petroleum products (232) in terms of labour productivity, capital productivity and capital intensity. This industry (231) shows higher growth rate of labour productivity, capital productivity and capital intensity in the new policy regime.

Table 6.3.27: Growth Rates of Total Factor Productivity in Coke, Refined Petroleum Products and Nuclear Fuel Sector

Year	Total Factor Productivity		
	Industry Code		
	231	232	23
1980-81	1.00	1.00	1.00
1981-82	1.07	0.94	0.81
1982-83	1.32	0.79	1.00
1983-84	1.15	0.73	0.88
1984-85	1.18	0.97	1.03
1985-86	1.20	1.11	1.13
1986-87	1.05	1.03	1.05
1987-88	0.89	0.98	0.87
1988-89	0.77	0.96	0.73
1989-90	0.70	0.94	0.68
1990-91	0.75	0.92	0.75
1991-92	0.84	0.89	0.72
1992-93	0.97	0.85	0.71
1993-94	1.25	0.84	0.79
1994-95	1.23	0.81	0.78
1995-96	1.16	0.80	0.71
1996-97	1.10	0.77	0.70
1997-98	1.08	0.76	0.69
1998-99	1.28	0.72	0.74
1999-00	1.36	0.69	0.78
2000-01	1.27	0.67	0.91
2001-02	1.09	0.67	0.85
2002-03	1.19	0.65	0.89
Growth Rates of Total Factor Productivity			
1980-81-2002-03	0.71	-1.71	-1.01
1980-81-1990-91	-4.76	0.72	-2.74
1991-92-2002-03	2.07	-2.86	1.84

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

Total factor productivity growth [Table 6.3.27] of coke, refined petroleum product and nuclear fuel sector is negative for the entire period. The group as a whole has higher productivity in the post-reform period as compared to pre-reform period, when total factor productivity growth is negative. Coke oven products (231) industry shows a higher productivity growth than that of refined petroleum products (232) industry.

An analysis of this sector depicts that the rate of growth of value added is negative for this sector. Capital and labour inputs also grow at a higher rate in the pre-reform period. Labour productivity growth rate is negative for both the sub periods. Capital productivity is negative for the entire period and also for the two sub-periods. Total factor productivity growth is also negative for the entire period and for pre-reform period. Hence overall this sector fails to record any appreciable rise in output, inputs and productivity in the new policy regime and is amongst the poor performers on productivity front.

Chemical and Chemical Products Sector

Table 6.3.28: Growth Rates of Value Added, Capital and Labour in Chemicals and Chemical Products Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
241	Basic chemicals	15.07	14.42	16.32	16.90	19.28	14.91	-0.35	-1.05	12.58
242	Other chemical products	10.94	10.44	13.11	8.47	9.61	6.03	9.40	10.33	9.35
24	Chemicals and Chemical Products	8.79	5.49	7.77	7.55	12.13	4.23	4.60	12.34	3.01

Computed

The growth rates of value added and factor inputs are presented in table 6.3.28. Value added in this group depicts an annual growth rate of 8.79 per cent per annum for the entire period. An analysis of sub periods shows that the rate of growth of value added is higher during the post-reform period. Capital grows at a rate of 7.55 per cent per annum. The rate of growth in post-reform period is 4.23 per cent per annum as against 12.13 per cent per annum in the pre-reform period. The rate of growth of labour also sharply declines from 12.34 per cent per annum in the pre-reform period to 3.01 per cent per annum in the post-reform period. The industries, basic chemicals (241) and other chemical products (242) as covered under this sector depict a high growth rate of value added and capital input. The industry basic chemicals (241) report a negative rate of growth of employment for the entire period.

Table 6.3.29: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Chemicals and Chemical Products Sector

Year	Labour Productivity			Capital Productivity			Capital Intensity		
	Industry Code			Industry Code			Industry Code		
	241	242	24	241	242	24	241	242	24
1980-81	0.23	0.22	0.06	0.23	0.15	0.09	0.10	0.15	0.12
1981-82	0.26	0.22	0.08	0.28	0.14	0.11	0.09	0.16	0.12
1982-83	0.22	0.26	0.12	0.23	0.13	0.14	0.10	0.20	0.12
1983-84	0.37	0.27	0.16	0.29	0.15	0.14	0.13	0.18	0.14
1984-85	0.33	0.36	0.13	0.33	0.16	0.13	0.10	0.22	0.12
1985-86	0.45	0.26	0.11	0.43	0.14	0.12	0.10	0.19	0.11
1986-87	0.33	0.30	0.10	0.37	0.13	0.15	0.09	0.22	0.08
1987-88	0.36	0.35	0.12	0.29	0.17	0.12	0.13	0.21	0.11
1988-89	0.17	0.41	0.11	0.15	0.19	0.10	0.12	0.22	0.11
1989-90	1.44	0.19	0.16	0.16	0.14	0.12	0.24	0.13	0.14
1990-91	1.61	0.18	0.16	0.19	0.14	0.13	0.19	0.13	0.13
1991-92	2.32	0.25	0.24	0.27	0.15	0.15	0.25	0.17	0.15
1992-93	2.45	0.20	0.17	0.20	0.12	0.11	0.25	0.17	0.16
1993-94	2.96	0.47	0.36	0.26	0.25	0.19	0.24	0.19	0.19
1994-95	2.61	0.47	0.37	0.19	0.21	0.19	0.23	0.22	0.20
1995-96	2.69	0.31	0.27	0.18	0.16	0.15	0.29	0.19	0.18
1996-97	1.59	0.18	0.44	0.14	0.09	0.25	0.28	0.21	0.18
1997-98	1.71	0.12	0.19	0.13	0.05	0.13	0.27	0.22	0.14
1998-99	1.50	0.40	0.29	0.14	0.28	0.16	0.56	0.14	0.18
1999-00	2.03	0.41	0.48	0.48	0.33	0.28	0.53	0.13	0.17
2000-01	1.91	0.26	0.23	0.18	0.21	0.15	0.58	0.12	0.16
2001-02	2.51	0.37	0.33	0.18	0.25	0.17	0.58	0.15	0.20
2002-03	2.83	0.55	0.57	0.35	0.35	0.27	0.73	0.16	0.21
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity									
1980-81-2002-03	15.48	1.40	8.07	-1.57	2.28	3.11	10.11	-0.86	2.82
1980-81-1990-91	15.63	0.11	5.98	-4.08	0.76	0.92	7.07	-0.65	-0.18
1991-92-2002-03	3.32	3.44	4.62	1.22	6.68	3.39	11.62	-3.04	1.19

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

Table 6.3.29 depicts trends in partial productivities and capital intensity growth rates. Labour productivity in this sector has increased at a rate of 8.07 per cent per annum. The growth rate is slightly lower in the post-reform period as compared to that in the earlier period. Capital productivity has increased at an annual rate of 3.11 per cent per annum for the sector as a whole. The rate of growth of capital productivity is 3.39 per cent per annum in the post-reform period as compared to 0.92 per cent per annum in the pre-reform period. Capital intensity records an acceleration in the post-reform period as compared to pre-reform period.

As per the performance of individual industries in this group, basic chemicals industry (241) shows a growth rate of above fifteen per cent per annum in the labour productivity and an increase in the capital intensity as well for the entire period. The growth rate of basic chemicals (241) is lower in the post-reform period for both labour productivity and capital intensity. In terms of capital productivity both the industries, basic chemicals (241) and other chemical products (242), show higher growth rate in the post-reform period.

Table 6.3.30 depicts total factor productivity growth in this sector. The most notable development in this sector is that the total factor productivity growth accelerates in the post-reform period. The overall rate of growth for the group as a whole is 1.34 per cent per annum. The increase in total factor productivity from 0.57 per cent per annum in the pre-reform period to 1.19 per cent per annum in the post-reform period reflect an improvement in the performance of this sector. Basic chemicals (241) industry shows comparatively higher productivity growth than the other chemical products (242) industry for the entire period in the group.

Table 6.3.30: Growth Rates of Total Factor Productivity in Chemicals and Chemical Products Sector

Year	Total Factor Productivity		
	Industry Code		
	241	242	24
1980-81	1.00	1.00	1.00
1981-82	1.08	0.99	1.08
1982-83	0.99	1.00	1.21
1983-84	1.15	1.04	1.21
1984-85	1.17	1.11	1.15
1985-86	1.29	1.01	1.13
1986-87	1.21	1.02	1.22
1987-88	1.15	1.11	1.14
1988-89	0.85	1.16	1.07
1989-90	1.32	0.99	1.15
1990-91	1.38	0.97	1.18
1991-92	1.55	1.03	1.28
1992-93	1.43	0.94	1.14
1993-94	1.55	1.27	1.39
1994-95	1.42	1.21	1.39
1995-96	1.40	1.07	1.29
1996-97	1.28	0.83	1.50
1997-98	1.26	0.63	1.21
1998-99	1.24	1.24	1.31
1999-00	1.81	1.31	1.55
2000-01	1.36	1.12	1.28
2001-02	1.43	1.21	1.34
2002-03	1.75	1.36	1.56
Growth Rates of Total Factor Productivity			
1980-81-2002-03	1.87	0.55	1.34
1980-81-1990-91	1.82	0.28	0.57
1991-92-2002-03	0.48	1.78	1.19

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

The overall analysis of this group indicates that output growth is quite satisfactory. Furthermore, the output growth rate registers an increase in the new policy regime. The growth rates of capital and labour inputs are higher in the pre-reform period as compared to those in the post-reform period. Growth of productivity of labour has slowed down in the post-reform era. Capital productivity and capital intensity shows a rise in the post-reform period. Rate of growth of total factor productivity has also increased in the new policy regime. All these facts point out that this sector is a growing sector.

Rubber and Plastic Product Sector

Table 6.3.31: Growth Rates of Value Added, Capital and Labour in Rubber and Plastic Products Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
251	Rubber products	16.38	16.04	5.69	6.40	10.47	5.79	8.57	4.79	2.84
252	Plastic products	5.92	-10.30	15.83	5.19	3.27	10.38	4.33	-2.55	14.98
25	Rubber and Plastic Products	13.17	7.62	6.61	7.79	4.33	3.62	6.10	8.89	6.52

Computed

Table 6.3.31 presents the growth rates in value added, capital and labour respectively. The sector experiences a rapid growth of value added, i.e., 13.17 per cent per annum for the entire period. The growth rate is higher in the pre-reform period as compared to that in the post-reform period. The analysis of the input structure underscores the fact that capital input has grown at the rate of 7.79 per cent per annum and employment at the rate of 6.10 per cent per annum for the entire period. The capital input has grown at a rate of 3.62 per cent per annum in post-reform period as against 4.33 per cent per annum in the pre-reform period and the labour input has grown at a rate of 6.52 per cent per annum in the post-reform period as against 8.89 per cent per annum in the pre-reform period. The plastic products (252) industry shows a higher growth rate of value added, capital and labour in the post-reform period.

An analysis of partial productivities highlights that labour productivity has grown at a rate of 4.99 per cent per annum for the entire period. Growth of labour productivity registers a deceleration in the post-reform period as compared to pre-reform period. The growth rate of capital productivity is 6.67 per cent per annum for the entire period. The growth rate is negative in the pre-reform period. There is a slight improvement in growth rate of capital productivity in the post-reform period. The growth rate of capital intensity is negative for the entire period.

Table 6.3.32: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Rubber and Plastic Products Sector

Year	Labour Productivity			Capital Productivity			Capital Intensity		
	Industry Code			Industry Code			Industry Code		
	251	252	25	251	252	25	251	252	25
1980-81	0.10	0.99	0.22	0.07	0.23	0.11	0.17	0.44	0.21
1981-82	0.12	0.44	0.14	0.13	0.08	0.09	0.13	0.54	0.16
1982-83	0.19	0.40	0.22	0.13	0.11	0.10	0.20	0.36	0.23
1983-84	0.14	1.88	0.35	0.10	0.33	0.14	0.20	0.57	0.24
1984-85	0.71	0.36	0.61	0.05	0.08	0.06	1.35	0.46	1.10
1985-86	0.85	1.26	1.05	0.06	0.23	0.08	1.89	0.55	1.25
1986-87	0.15	1.23	0.24	0.06	0.18	0.07	0.29	0.70	0.32
1987-88	1.24	0.40	1.00	0.06	0.06	0.06	1.91	0.72	1.57
1988-89	0.18	0.09	0.14	0.09	0.02	0.06	0.21	0.39	0.24
1989-90	0.22	0.39	0.23	0.10	0.05	0.09	0.21	0.83	0.24
1990-91	0.30	0.62	0.31	0.15	0.07	0.14	0.20	0.89	0.23
1991-92	0.43	0.81	0.44	0.22	0.10	0.20	0.19	0.80	0.22
1992-93	0.41	0.60	0.42	0.21	0.07	0.19	0.19	0.84	0.22
1993-94	0.51	0.54	0.51	0.22	0.06	0.20	0.23	0.83	0.25
1994-95	0.54	0.78	0.55	0.21	0.11	0.20	0.25	0.70	0.28
1995-96	0.60	0.75	0.61	0.27	0.12	0.24	0.22	0.63	0.25
1996-97	0.78	2.32	0.76	0.60	0.10	0.45	0.13	0.55	0.17
1997-98	0.88	0.69	0.87	0.36	0.10	0.31	0.25	0.68	0.28
1998-99	0.74	0.28	0.73	0.28	0.14	0.25	0.27	0.48	0.29
1999-00	0.84	2.92	0.90	0.38	0.27	0.36	0.22	0.57	0.25
2000-01	0.55	1.03	0.60	0.23	0.24	0.23	0.24	0.43	0.26
2001-02	0.48	0.48	0.48	0.18	0.08	0.16	0.27	0.59	0.30
2002-03	0.55	0.63	0.56	0.19	0.10	0.17	0.29	0.64	0.32
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity									
1980-81-2002-03	7.01	0.54	4.99	7.78	0.08	6.67	-2.00	0.83	-1.57
1980-81-1990-91	10.48	6.15	3.16	0.88	-13.14	-1.17	5.42	5.98	4.37
1991-92-2002-03	4.55	4.55	2.89	-0.09	5.30	0.09	2.87	-3.99	2.80

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

Table 6.3.33: Growth Rates of Total Factor Productivity in Rubber and Plastic Products Sector

Year	Total Factor Productivity		
	Industry Code		
	251	252	25
1980-81	1.00	1.00	1.00
1981-82	1.03	0.98	0.81
1982-83	1.26	0.95	1.00
1983-84	1.14	1.18	1.19
1984-85	1.78	0.92	1.89
1985-86	1.03	1.02	1.96
1986-87	0.74	0.92	1.49
1987-88	1.21	0.92	1.91
1988-89	0.84	0.90	0.92
1989-90	0.93	0.87	1.15
1990-91	1.07	0.87	1.29
1991-92	1.23	0.82	1.45
1992-93	1.22	0.87	1.43
1993-94	1.27	0.93	1.48
1994-95	1.27	0.94	1.49
1995-96	1.35	0.96	1.56
1996-97	1.63	1.18	1.77
1997-98	1.48	0.88	1.67
1998-99	1.38	1.00	1.59
1999-00	1.49	1.27	1.72
2000-01	1.29	1.00	1.54
2001-02	1.20	0.98	1.40
2002-03	1.24	0.96	1.45
Growth Rates of Total Factor Productivity			
1980-81-2002-03	1.29	0.21	1.63
1980-81-1990-91	-1.82	-1.63	2.87
1991-92-2002-03	0.29	1.66	0.31

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

For this sector as a whole, productivity grows at a rate of 1.63 per cent per annum for the entire period. On splitting the periods, it is found that the growth rate decelerates in the post-reform period. The growth rate which is 2.87 per cent per annum in the pre-reform period, declines to 0.31 per cent per annum in the post-reform period.

On the basis of analysis of this sector it can be concluded that output growth rate decelerates in the post-reform period as compared to pre-reform period. Both labour and capital inputs also behave in the similar manner. In both the cases, the annual growth rates are higher in the pre-reform period as compared to post-reform period. The growth rate of capital productivity shows a slight improvement in the post-reform period. As capital intensity growth rate registers a deceleration in the post-reform period, labour productivity growth rate also decelerates in the same period. Further, total factor productivity has also slowed down in the post-reform era. All these indicators point towards the fact that this sector has not performed well in the new policy regime.

Other Non-Metallic Mineral Products Sector

Table 6.3.34: Growth Rates of Value Added, Capital and Labour in Other Non-Metallic Mineral Products Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
269	Non-metallic mineral products n.e.c.	10.88	15.01	16.52	12.25	11.90	19.78	4.78	5.63	15.86
26	Other Non-Metallic Mineral Products	14.12	15.11	17.63	15.47	15.38	21.77	2.28	6.68	4.97

Computed

The group experiences a high growth in value added and capital. The growth rate of value added is 14.12 per cent per annum for the entire period. There is acceleration in the growth rate of value added in the post-reform period, i.e., 17.63 per cent per annum in the post-reform period as compared to 15.11 per cent per annum in pre-reform period. Employment increases at an annual rate of 2.28 per cent per annum, the increase is more pronounced in the first period. Capital grows at a rate of 15.47 per cent per annum for the entire period. The rate of growth is quite high (21.77 per cent per annum) in the post-reform period as compared to 15.38 per cent per annum in the pre-reform period.

Table 6.3.35: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Other Non-Metallic Mineral Products Sector

Year	Labour Productivity		Capital Productivity		Capital Intensity	
	Industry Code		Industry Code		Industry Code	
	269	26	269	26	269	26
1980-81	0.14	0.14	0.20	0.19	0.07	0.08
1981-82	0.18	0.18	0.21	0.20	0.09	0.09
1982-83	0.16	0.19	0.06	0.19	0.27	0.10
1983-84	0.17	0.20	0.07	0.19	0.22	0.10
1984-85	0.20	0.19	0.07	0.07	0.30	0.27
1985-86	0.30	0.32	0.12	0.15	0.24	0.22
1986-87	0.24	0.24	0.10	0.11	0.24	0.21
1987-88	0.27	0.27	0.17	0.19	0.16	0.15
1988-89	0.24	0.24	0.16	0.17	0.15	0.14
1989-90	0.32	0.32	0.16	0.18	0.20	0.18
1990-91	0.36	0.36	0.17	0.19	0.22	0.19
1991-92	0.40	0.44	0.14	0.19	0.28	0.23
1992-93	0.39	0.39	0.14	0.15	0.29	0.26
1993-94	0.32	0.50	0.11	0.18	0.28	0.28
1994-95	0.43	0.60	0.13	0.20	0.33	0.30
1995-96	0.90	0.86	0.09	0.10	1.00	0.87
1996-97	1.80	1.07	0.27	0.16	0.67	0.68
1997-98	0.31	1.53	0.04	0.11	0.76	0.85
1998-99	0.22	1.23	0.05	0.09	0.47	0.94
1999-00	0.23	1.20	0.06	0.09	0.35	0.90
2000-01	0.44	1.13	0.09	0.04	0.50	0.93
2001-02	0.58	1.30	0.14	0.09	0.41	1.04
2002-03	0.62	1.16	0.15	0.09	0.41	0.96
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity						
1980-81-2002-03	5.81	11.57	-1.22	-3.48	7.13	12.89
1980-81-1990-91	8.88	7.90	2.78	-0.24	5.93	8.15
1991-92-2002-03	0.57	11.81	-2.72	-9.06	3.38	16.00

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

The indices of partial productivities and capital intensity are shown in Table 6.3.35. As capital intensity records a stronger acceleration in the post-reform period as compared to pre-reform period, there is understandably a strong acceleration in the growth of labour productivity. On capital productivity front, the picture is not good as the growth rate shows a negative trend for the sector, as a whole, with further deceleration in the post-reform period.

Table 6.3.36: Growth Rates of Total Factor Productivity in Other Non-Metallic Mineral Products Sector

Year	Total Factor Productivity	
	Industry Code	
	269	**26**
1980-81	1.00	1.00
1981-82	1.06	1.07
1982-83	0.80	1.07
1983-84	0.86	1.08
1984-85	0.89	0.88
1985-86	1.12	1.15
1986-87	1.03	1.03
1987-88	1.17	1.17
1988-89	1.13	1.13
1989-90	1.19	1.20
1990-91	1.23	1.23
1991-92	1.20	1.27
1992-93	1.19	1.19
1993-94	1.11	1.28
1994-95	1.20	1.33
1995-96	1.23	1.18
1996-97	1.67	1.35
1997-98	0.79	1.43
1998-99	0.86	1.29
1999-00	0.93	1.30
2000-01	1.13	1.26
2001-02	1.31	1.29
2002-03	1.35	1.26
Growth Rates of Total Factor Productivity		
1980-81-2002-03	0.93	1.33
1980-81-1990-91	3.02	1.78
1991-92-2002-03	-0.29	0.25

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

Total factor productivity growth rates of this sector are reported in table 6.3.36. The rate of growth of productivity is 1.33 per cent per annum for the entire period. The growth rate is higher in the pre-reform period as compared to post-reform period. The growth rate of total factor productivity is 1.78 per cent per annum in the pre-reform period as compared to 0.25 per cent per annum in the post-reform period. The non-metallic mineral products n.e.c. (269)

industry as covered under this sector shows a negative rate of growth of total factor productivity in the post-reform period.

Detailed analysis of this group is indicative of the fact that increase in value added is mainly due to increase in capital input. As far as employment growth in concerned, there has been a slowdown in the new policy regime. Labour productivity and capital intensity growth rates register an increase in the new policy regime. Capital productivity growth shows a negative trend for the entire period as well as for both the sub periods. The translog index of total factor productivity shows a deceleration in the new policy regime. All these factors point out that this sector failed to record any appreciable technological progress.

Basic Metals Sector

Table 6.3.37: Growth Rates of Value Added, Capital and Labour in Basic Metals Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
271	Basic Iron and Steel	2.49	7.23	-1.15	5.40	3.94	3.61	-2.27	-1.40	-2.47
272	Basic precious and non-ferrous metals	7.49	8.12	5.65	4.35	3.07	4.77	4.07	9.70	-0.48
273	Casting of metals	4.12	2.53	4.72	4.17	0.77	2.39	6.30	9.03	7.43
27	Basic Metals	3.47	8.63	-3.04	6.12	4.42	3.75	-0.67	0.36	-2.00

Computed

The overall growth rate of value added is 3.47 per cent per annum for this sector. In terms of value added the rate of growth is 8.63 per cent per annum in the pre-reform period. But the post-reform period is characterized by a negative growth of -3.04 per cent per annum. An analysis of the input structure highlights that the rate of growth of both capital and labour has deteriorated over time. The rate of growth of capital is 3.75 per cent per annum in the post-reform period as against 4.42 per cent per annum in the pre-reform period. Labour input growth rate is -2.00 per cent per annum in the post-reform period as against 0.36 per cent per annum in pre-reform.

Table 6.3.38: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Basic Metals Sector

Year	Labour Productivity				Capital Productivity				Capital Intensity			
	Industry Code				Industry Code				Industry Code			
	271	272	273	27	271	272	273	27	271	272	273	27
1980-81	0.44	0.72	1.14	0.44	0.24	0.18	0.19	0.24	0.18	0.39	0.59	0.18
1981-82	0.40	0.72	1.19	0.40	0.21	0.19	0.21	0.21	0.19	0.37	0.57	0.19
1982-83	0.34	0.68	1.05	0.34	0.17	0.19	0.20	0.17	0.20	0.35	0.52	0.20
1983-84	0.63	0.72	1.02	0.63	0.26	0.21	0.23	0.26	0.24	0.34	0.44	0.24
1984-85	0.51	0.60	0.79	0.50	0.20	0.19	0.21	0.20	0.25	0.32	0.38	0.25
1985-86	0.56	0.63	0.68	0.56	0.23	0.20	0.20	0.23	0.25	0.31	0.33	0.25
1986-87	0.46	0.52	0.70	0.46	0.19	0.20	0.21	0.19	0.25	0.27	0.33	0.25
1987-88	0.67	0.50	0.65	0.67	0.30	0.20	0.21	0.30	0.22	0.24	0.31	0.22
1988-89	0.57	0.56	0.69	0.57	0.22	0.23	0.22	0.22	0.26	0.25	0.31	0.26
1989-90	0.88	0.71	0.71	0.85	0.28	0.32	0.24	0.31	0.31	0.22	0.29	0.27
1990-91	1.08	0.71	0.71	1.00	0.30	0.32	0.25	0.33	0.36	0.22	0.28	0.30
1991-92	1.19	0.93	0.93	1.13	0.28	0.37	0.30	0.31	0.43	0.25	0.31	0.36
1992-93	0.81	0.63	0.63	0.78	0.19	0.16	0.13	0.20	0.42	0.38	0.47	0.39
1993-94	1.04	0.70	0.70	0.97	0.19	0.24	0.17	0.20	0.56	0.29	0.42	0.48
1994-95	0.92	0.74	0.74	0.89	0.17	0.21	0.14	0.18	0.54	0.36	0.54	0.50
1995-96	0.91	0.85	0.85	0.91	0.17	0.27	0.18	0.19	0.52	0.31	0.47	0.48
1996-97	0.76	0.81	0.90	1.37	0.13	0.26	0.19	0.27	0.59	0.32	0.47	0.52
1997-98	0.71	0.67	1.11	0.84	0.10	0.27	0.35	0.15	0.69	0.25	0.31	0.54
1998-99	1.11	1.58	0.29	0.96	0.12	0.29	0.11	0.13	0.89	0.55	0.27	0.73
1999-00	1.08	1.20	0.66	1.08	0.17	0.29	0.22	0.20	0.62	0.41	0.30	0.55
2000-01	1.38	1.05	0.88	0.54	0.18	0.29	0.31	0.08	0.78	0.36	0.28	0.66
2001-02	1.33	1.47	0.40	1.25	0.18	0.28	0.15	0.19	0.74	0.52	0.27	0.67
2002-03	0.83	1.19	0.83	0.80	0.10	0.28	0.30	0.11	0.84	0.42	0.28	0.71
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity												
1980-81-2002-03	4.87	3.29	-2.05	4.17	-2.77	2.03	-0.05	-2.50	7.85	1.23	-2.01	6.84
1980-81-1990-91	8.75	-1.43	-5.96	8.24	3.16	4.90	1.75	4.03	5.42	-6.04	-7.58	4.05
1991-92-2002-03	1.35	6.17	-2.52	-1.07	-4.59	1.81	2.27	-6.55	6.23	4.28	-4.69	5.86

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

Table 6.3.38 presents the indices of labour productivity, capital productivity and capital intensity. Labour productivity for the entire period depicts a growth rate of 4.17 per cent per annum. There is a decline in rate of growth from 8.24 per cent per annum in the pre-reform period to -1.07 per cent per annum in the post-reform period. Labour productivity for basic precious and non-ferrous metals (272) industry is higher in the post-reform era while it declines in the other two industries, i.e., basic iron and steel (271) and casting of metals (273) covered in this group. Capital productivity shows a negative trend for the entire period. The growth rate has become negative in the post-reform period as against being positive in the pre-reform period. The growth rate of capital intensity is higher in the post-reform period.

Table 6.3.39: Growth Rates of Total Factor Productivity in Basic Metals Sector

Year	Total Factor Productivity			
	Industry Code			
	271	272	273	27
1980-81	1.00	1.00	1.00	1.00
1981-82	0.94	1.01	1.03	0.94
1982-83	0.85	1.00	1.00	0.86
1983-84	1.08	1.04	1.02	1.08
1984-85	0.98	0.98	0.95	0.98
1985-86	1.03	1.01	0.91	1.03
1986-87	0.94	0.97	0.93	0.94
1987-88	1.13	0.97	0.91	1.13
1988-89	1.02	1.02	0.93	1.02
1989-90	1.15	1.15	0.96	1.17
1990-91	1.19	1.15	0.98	1.22
1991-92	1.17	1.23	1.07	1.21
1992-93	1.01	0.94	0.78	1.02
1993-94	1.03	1.06	0.86	1.05
1994-95	0.99	1.03	0.81	1.00
1995-96	1.00	1.12	0.90	1.03
1996-97	0.88	1.10	0.93	1.18
1997-98	0.81	1.09	1.14	0.95
1998-99	0.92	1.24	0.59	0.92
1999-00	1.03	1.20	0.93	1.07
2000-01	1.06	1.18	1.07	0.70
2001-02	1.06	1.22	0.73	1.06
2002-03	0.82	1.18	1.05	0.84
Growth Rates of Total Factor Productivity				
1980-81-2002-03	-0.26	0.93	-0.58	-0.33
1980-81-1990-91	2.06	1.00	-0.74	2.22
1991-92-2002-03	-1.24	1.32	0.14	-2.35

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

Total factor productivity indices for the group are given in table 6.3.39. The sector experiences a negative annual growth of -0.33 per cent per annum in total factor productivity for the entire period of analysis. The group as a whole has higher productivity in the first period as compared to the second period, i.e., new policy regime, when total factor productivity growth becomes negative. Basic precious and non-ferrous metals (272) industry is an exception. It has a positive rate of growth of total factor productivity for the entire period as well as for the sub periods and the growth also improves in the latter period.

An analysis of this industrial group highlights the fact that value added growth rate which is positive and above eight percent in the pre-reform period becomes negative in the post-reform period. Capital input growth rate is higher in the pre-reform period as compared to that in the post-reform period. There is a strong decrease in the growth of labour in the period 1991-92 to 2002-03. The slowdown in the growth in value added in post-reform period is accompanied by a decline in labour productivity and capital productivity. Total factor productivity also decelerates in the post-reform period. So the performance of the basic metals sector is not good in the new policy regime.

Fabricated Metal Products, Except Machinery and Equipments Sector

Table 6.3.40: Growth Rates of Value Added, Capital and Labour in Fabricated Metal Products, Except Machinery and Equipments Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
281	Structural metal products, tanks, reservoirs and steam generators	6.45	7.09	-4.13	7.65	6.55	5.16	2.38	-1.40	3.12
289	Other fabricated metal products; metal working service activities	15.32	12.64	10.53	9.57	4.46	11.07	5.22	0.91	8.83
28	Fabricated Metal Products, Except Machinery and Equipments	12.76	11.08	3.83	9.57	4.47	11.08	2.98	0.24	2.32

Computed

Output in this sector grows at a rate of 12.76 per cent per annum. The output growth rate is 11.08 per cent per annum in the pre-reform period as compared to 3.83 per cent per annum in the post-reform period. Employment has grown at a rate of 2.98 per cent per annum, the rate being higher for the post-reform period. Capital grows at a rate of 9.57 per cent per annum for the entire period, the rate of growth is higher in the post-reform period. The industrial group, i.e., other fabricated metal products, metal working service activities (289) shows higher growth rate of value added, capital and labour input as compared to structural metal products, tanks, reservoirs and steam generators (281).

Growth rates of partial productivity and capital intensity are given in table 6.3.41. The growth rate of labour productivity for this sector is 9.50 per cent per annum. The growth rate sharply decline to 1.48 per cent per annum in the post-reform period as compared to 10.81 per cent per annum in the pre-reform period. Growth rate of capital productivity for the entire period is 3.68 per cent per annum. Capital productivity growth rate has decelerated in the second period. As against the annual rate of growth of capital productivity of 5.89 per cent per annum in the pre-reform period, the growth rate is - 4.13 per cent per annum in the post-reform period. The two industries, structural metal products, tanks, reservoirs and steam generators (281) and other fabricated metal products; metal working service activities (289) as covered under this sector show a deceleration in labour productivity, capital productivity and capital intensity in the post-reform period.

Table 6.3.41: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Fabricated Metal Products, Except Machinery and Equipments Sector

Year	Labour Productivity			Capital Productivity			Capital Intensity		
	Industry Code			Industry Code			Industry Code		
	281	289	28	281	289	28	281	289	28
1980-81	0.14	0.14	0.14	0.17	0.12	0.14	0.08	0.11	0.09
1981-82	0.16	0.23	0.20	0.18	0.18	0.18	0.09	0.13	0.11
1982-83	0.18	0.21	0.19	0.16	0.14	0.15	0.12	0.14	0.12
1983-84	0.29	0.26	0.28	0.22	0.17	0.21	0.13	0.15	0.14
1984-85	0.22	0.13	0.17	0.18	0.08	0.12	0.12	0.17	0.14
1985-86	0.26	0.15	0.21	0.24	0.09	0.16	0.11	0.16	0.13
1986-87	0.22	0.15	0.16	0.13	0.08	0.10	0.17	0.18	0.16
1987-88	0.26	0.16	0.20	0.18	0.10	0.14	0.14	0.16	0.14
1988-89	0.28	0.54	0.44	0.15	0.33	0.26	0.18	0.16	0.17
1989-90	0.27	0.48	0.44	0.19	0.29	0.30	0.15	0.16	0.15
1990-91	0.43	0.57	0.48	0.21	0.32	0.30	0.20	0.18	0.16
1991-92	0.43	0.45	0.48	0.27	0.20	0.26	0.16	0.23	0.18
1992-93	0.49	0.71	0.67	0.24	0.31	0.34	0.21	0.23	0.20
1993-94	0.53	1.06	0.90	0.23	0.38	0.39	0.23	0.28	0.23
1994-95	0.58	0.61	0.65	0.25	0.27	0.32	0.23	0.22	0.21
1995-96	1.28	0.88	1.18	0.46	0.33	0.49	0.28	0.26	0.24
1996-97	0.58	0.84	0.92	0.29	0.33	0.41	0.20	0.26	0.23
1997-98	0.34	0.92	0.81	0.13	0.38	0.34	0.27	0.24	0.24
1998-99	0.34	0.92	0.98	0.13	0.33	0.30	0.26	0.28	0.33
1999-00	0.34	0.94	1.01	0.15	0.34	0.31	0.23	0.27	0.33
2000-01	0.30	0.74	0.70	0.13	0.29	0.24	0.24	0.26	0.28
2001-02	0.28	0.77	0.74	0.11	0.24	0.21	0.25	0.32	0.35
2002-03	0.28	0.64	0.67	0.11	0.23	0.20	0.26	0.28	0.33
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity									
1980-81-2002-03	3.98	9.59	9.50	-1.11	5.24	3.68	5.15	4.14	5.61
1980-81-1990-91	8.60	11.62	10.81	0.51	7.82	5.89	8.06	3.52	4.65
1991-92-2002-03	-7.03	1.57	1.48	-9.38	-0.49	-4.13	2.60	2.06	5.85

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

Total factor productivity growth rates of this sector are reported in table 6.3.42. This sector shows a productivity growth of 1.93 per cent per annum for the period under consideration. The group as a whole has higher productivity in the pre-reform period as compared to the post-reform period when total factor productivity growth becomes negative. Other fabricated metal products; metal working service activities (289) industry show a higher productivity growth than that of structural metal products, tanks, reservoirs and steam generators (281) industry in the group.

Table 6.3.42: Growth Rates of Total Factor Productivity in Fabricated Metal Products, Except Machinery and Equipments Sector

Year	Total Factor Productivity		
	Industry Code		
	281	289	28
1980-81	1.00	1.00	1.00
1981-82	1.04	1.18	1.13
1982-83	1.04	1.12	1.08
1983-84	1.22	1.22	1.22
1984-85	1.11	0.89	0.99
1985-86	1.22	0.97	1.10
1986-87	1.03	0.96	0.94
1987-88	1.15	0.99	1.07
1988-89	1.12	1.52	1.37
1989-90	1.16	1.47	1.41
1990-91	1.27	1.52	1.42
1991-92	1.34	1.34	1.38
1992-93	1.33	1.54	1.50
1993-94	1.33	1.65	1.58
1994-95	1.37	1.48	1.48
1995-96	1.66	1.59	1.68
1996-97	1.41	1.58	1.60
1997-98	1.12	1.63	1.53
1998-99	1.13	1.59	1.52
1999-00	1.15	1.60	1.52
2000-01	1.09	1.52	1.41
2001-02	1.06	1.46	1.37
2002-03	1.05	1.43	1.35
Growth Rates of Total Factor Productivity			
1980-81-2002-03	0.41	2.27	1.93
1980-81-1990-91	1.55	3.26	2.80
1991-92-2002-03	-2.89	0.03	-0.73

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

An overall analysis of this sector shows that value added declines sharply in the post-reform period. The growth rates of labour and capital input are higher in the post-reform period than in the pre-reform period. The period 1991-92 to 2002-03 is marked by shrinkage in growth of labour productivity and capital productivity. Total factor productivity growth is negative in the post-reform period as compared to it being positive in the pre-reform period. The industries covered under this group also show deceleration in terms of overall productivity and partial productivity in the new policy regime.

Machinery and Equipment N.E.C. Sector

Table 6.3.43: Growth Rates of Value Added, Capital and Labour in Machinery and Equipment N.E.C. Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
291	General purpose machinery	-0.18	-0.60	-5.89	4.65	4.35	2.91	-0.43	3.50	-3.75
292	Special purpose machinery	6.46	-3.37	12.15	5.68	3.89	9.09	0.80	-0.50	3.02
293	Domestic appliances, n.e.c.	4.11	-9.28	21.07	2.62	1.17	3.16	0.79	2.79	2.40
29	Machinery and Equipment N.E.C	5.40	-3.42	10.00	0.55	0.96	1.43	5.15	3.55	7.51

Computed

The growth rates of value added, capital and labour are presented in table 6.3.43. Value added in this group records a rate of growth of 5.40 per cent per annum. There is an appreciable increase in the growth rate of value added in the post-reform period. The rate of growth which is -3.42 per cent per annum in the pre-reform period reversed by 10.00 per cent per annum in the post-reform period. Employment has grown at a rate of 5.15 per cent per annum, the rate being higher for the post-reform period. Capital grows at a rate of 0.55 per cent per annum for the entire period, the rate of growth is higher in the new policy regime, but capital grows at a lower rate for this group. Out of the three, two industries show high growth rates of value added, capital and labour in the new policy regime.

An analysis of partial productivities highlights that labour productivity has grown at a rate of 4.82 per cent per annum and capital productivity has grown at a rate of 0.24 per cent per annum for the entire period. A note-worthy development of this sector is that labour productivity and capital productivity growth rate which has been negative for the pre-reform period registers a positive growth rate of 8.45 per cent per annum and 2.32 per cent per annum respectively in the post-reform period. Capital intensity also records a higher growth rate in the post-reform period. Out of the three, two industries namely special purpose machinery (292) and domestic appliances, n.e.c. (293) show higher growth rates of labour productivity and capital productivity for the post-reform period.

Table 6.3.44: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Machinery and Equipment N.E.C. Sector

Year	Labour Productivity				Capital Productivity				Capital Intensity			
	Industry Code				Industry Code				Industry Code			
	291	292	293	29	291	292	293	29	291	292	293	29
1980-81	0.40	0.55	1.15	0.56	0.31	0.30	0.25	0.30	0.13	0.18	0.46	0.19
1981-82	0.46	0.79	0.82	0.70	0.36	0.40	0.19	0.35	0.13	0.20	0.42	0.20
1982-83	0.45	0.82	0.75	0.73	0.31	0.35	0.18	0.32	0.15	0.23	0.42	0.23
1983-84	0.52	0.49	0.85	0.53	0.35	0.16	0.22	0.19	0.15	0.30	0.39	0.27
1984-85	0.43	0.42	0.74	0.45	0.27	0.14	0.19	0.16	0.16	0.29	0.39	0.27
1985-86	0.44	0.65	0.69	0.60	0.32	0.30	0.17	0.28	0.14	0.22	0.40	0.21
1986-87	0.32	0.55	0.49	0.48	0.23	0.22	0.13	0.20	0.14	0.25	0.39	0.23
1987-88	0.34	0.45	0.65	0.43	0.26	0.16	0.13	0.17	0.13	0.28	0.50	0.25
1988-89	0.34	0.54	0.19	0.43	0.24	0.16	0.12	0.16	0.14	0.35	0.16	0.27
1989-90	0.32	0.52	0.45	0.45	0.22	0.18	0.08	0.18	0.14	0.28	0.60	0.25
1990-91	0.33	0.51	0.32	0.44	0.22	0.17	0.08	0.17	0.15	0.30	0.39	0.27
1991-92	0.50	0.62	0.27	0.55	0.26	0.18	0.06	0.18	0.19	0.34	0.44	0.31
1992-93	0.55	0.54	0.49	0.54	0.25	0.16	0.07	0.16	0.22	0.34	0.74	0.33
1993-94	0.53	0.83	0.34	0.70	0.23	0.24	0.09	0.22	0.23	0.34	0.40	0.32
1994-95	0.45	0.99	0.80	0.83	0.20	0.25	0.12	0.23	0.22	0.39	0.66	0.37
1995-96	0.42	0.97	0.81	0.80	0.24	0.26	0.19	0.25	0.18	0.37	0.43	0.32
1996-97	0.36	1.12	0.96	0.89	0.19	0.29	0.25	0.27	0.19	0.39	0.38	0.33
1997-98	0.48	1.51	1.29	1.23	0.17	0.30	0.20	0.27	0.27	0.50	0.65	0.45
1998-99	0.59	2.87	1.46	2.13	0.20	0.62	0.25	0.51	0.29	0.46	0.57	0.42
1999-00	0.49	1.70	1.37	1.36	0.16	0.31	0.28	0.28	0.30	0.55	0.50	0.48
2000-01	0.38	1.34	1.36	1.16	0.11	0.27	0.25	0.25	0.33	0.50	0.55	0.47
2001-02	0.37	1.38	1.38	1.25	0.08	0.25	0.25	0.23	0.46	0.56	0.55	0.54
2002-03	0.42	1.08	1.41	0.98	0.12	0.17	0.25	0.17	0.34	0.62	0.55	0.56
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity												
1980-81-2002-03	0.25	5.62	3.36	4.82	-4.61	0.74	1.51	0.24	5.10	4.84	1.82	4.58
1980-81-1990-91	-3.96	-2.88	-11.74	-4.34	-4.75	-6.99	-10.33	-6.73	0.83	4.42	-1.58	2.57
1991-92-2002-03	-2.22	8.86	15.81	8.45	-8.55	2.80	14.96	2.32	6.93	5.89	0.74	5.99

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

The growth rates of total factor productivity are presented in table 6.3.45. Productivity for the group as a whole increases at a rate of 0.72 per cent per annum. An analysis of the sub periods reveals that the growth rate improves in the new policy regime. The decline in the growth rate of productivity at a rate of -2.92 per cent per annum in the pre-reform period is reversed by a positive and a rising trend rate of 1.71 per cent per annum in the post-reform period. The industries special purpose machinery (292) and domestic appliances, n.e.c. (293) show comparatively higher productivity growth in the post-reform period.

Table 6.3.45: Growth Rates of Total Factor Productivity in Machinery and Equipment N.E.C Sector

Year	Total Factor Productivity			
	Industry Code			
	291	292	293	29
1980-81	1.00	1.00	1.00	1.00
1981-82	1.06	1.13	1.03	1.09
1982-83	1.02	1.10	0.98	1.06
1983-84	1.08	0.80	1.21	0.87
1984-85	0.98	0.74	0.83	0.80
1985-86	1.02	1.01	0.88	0.99
1986-87	0.87	0.89	0.88	0.87
1987-88	0.92	0.78	0.99	0.81
1988-89	0.90	0.80	0.75	0.79
1989-90	0.87	0.84	0.89	0.81
1990-91	0.87	0.82	0.87	0.80
1991-92	0.98	0.86	1.19	0.86
1992-93	0.99	0.80	1.04	0.83
1993-94	0.97	0.99	1.11	0.95
1994-95	0.90	1.03	1.19	0.98
1995-96	0.93	1.04	0.69	1.01
1996-97	0.85	1.08	0.56	1.04
1997-98	0.89	1.13	0.70	1.08
1998-99	0.97	1.44	1.36	1.35
1999-00	0.88	1.14	1.32	1.10
2000-01	0.74	1.07	1.33	1.04
2001-02	0.66	1.05	1.50	1.03
2002-03	0.78	0.91	1.30	0.91
Growth Rates of Total Factor Productivity				
1980-81-2002-03	-1.22	0.93	1.04	0.72
1980-81-1990-91	-2.08	-2.72	-0.74	-2.92
1991-92-2002-03	-2.77	1.82	0.14	1.71

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

The overall analysis of this sector shows that value added which has a negative trend in the pre-reform period registers a rise and becomes positive in the new policy regime. Capital and labour inputs grew at a higher rate in the new policy regime. Labour productivity and capital productivity growth rates which were negative in the pre-reform period, become positive in the new policy regime. Capital intensity rate registers a rise in the new policy regime. The total factor productivity growth rate also shows a rising trend in the new policy regime. All this is indicative of the fact that this sector is a growing sector of the economy.

Office, Accounting and Computing Machinery Sector

Table 6.3.46: Growth Rates of Value Added, Capital and Labour in Office, Accounting and Computing Machinery Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
30	Office, Accounting and Computing Machinery	11.81	8.22	15.83	10.53	5.63	12.51	5.49	4.07	7.12

Computed

Value added in this group records a growth rate of 11.81 per cent per annum. There is an appreciable increase in the growth rate of value added and capital in the post-reform period. The rate of growth of value added is 15.83 per cent per annum in the post-reform period as against 8.22 per cent per annum in the pre-reform period. The rate of growth of capital is 12.51 per cent per annum in the post-reform period. The rate of growth of labour is also higher in the post-reform period, the rate being 7.12 per cent per annum in the post-reform period as against 4.07 per cent per annum in the pre-reform period.

The indices of partial productivities and capital intensity are shown in table 6.3.47. Labour productivity has increased at an annual rate of 6.90 per cent per annum for the sector as a whole. The performance of the sector as a whole has improved in the new policy regime. The growth rate of labour productivity is higher in the post-reform period as compared to pre-reform period. The rate of growth of capital productivity is 2.03 per cent per annum for the group as a whole. The growth rate registers a small increase in the post-reform period. Capital intensity in post-reform period registers an increase. It is 5.03 per cent per annum in the post-reform period as against 1.49 per cent per annum in the pre-reform period. The sector as a whole has performed better in terms of partial productivity, both labour as well as capital productivity, in the period associated with reforms.

Table 6.3.47: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Office, Accounting and Computing Machinery Sector

Year	Labour Productivity	Capital Productivity	Capital Intensity
	Industry Code	Industry Code	Industry Code
	30	30	30
1980-81	0.02	0.19	0.09
1981-82	0.23	0.28	0.08
1982-83	0.27	0.26	0.10
1983-84	0.26	0.30	0.09
1984-85	0.28	0.30	0.09
1985-86	0.29	0.23	0.13
1986-87	0.30	0.34	0.09
1987-88	0.29	0.30	0.10
1988-89	0.29	0.25	0.12
1989-90	0.29	0.24	0.12
1990-91	0.31	0.35	0.09
1991-92	0.32	0.35	0.09
1992-93	0.35	0.26	0.13
1993-94	0.45	0.33	0.14
1994-95	0.55	0.30	0.19
1995-96	0.57	0.25	0.22
1996-97	0.63	0.32	0.19
1997-98	0.73	0.30	0.24
1998-99	0.82	0.39	0.21
1999-00	0.93	0.34	0.27
2000-01	0.70	0.40	0.17
2001-02	0.70	0.39	0.18
2002-03	0.72	0.39	0.18
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity			
1980-81-2002-03	6.90	2.03	4.77
1980-81-1990-91	3.98	2.46	1.49
1991-92-2002-03	8.12	2.94	5.03

Computed
Note: Two digit industry code description: Appendix B

Table 6.3.48: Growth Rates of Total Factor Productivity in Office, Accounting and Computing Machinery Sector

Year	**Total Factor Productivity**
	Industry Code
	30
1980-81	1.00
1981-82	1.14
1982-83	1.15
1983-84	1.18
1984-85	1.19
1985-86	1.13
1986-87	1.25
1987-88	1.20
1988-89	1.16
1989-90	1.15
1990-91	1.27
1991-92	1.28
1992-93	1.21
1993-94	1.31
1994-95	1.31
1995-96	1.27
1996-97	1.36
1997-98	1.35
1998-99	1.44
1999-00	1.42
2000-01	1.43
2001-02	1.43
2002-03	1.43
Growth Rates of Total Factor Productivity	
1980-81-2002-03	1.32
1980-81-1990-91	1.24
1991-92-2002-03	1.47

Computed
Note: Two digit industry code description: Appendix B

An analysis of total factor productivity growth of this sector indicates an improvement in the post-reform period. The overall rate of growth for the group as a whole is 1.32 per cent per annum. The rise in total factor productivity from 1.24 per cent per annum in the pre-reform period to 1.47 per cent per annum in the post-reform period reflects an improvement in the performance of this sector.

An analysis of the sector shows that this is a progressing group. The post-reform period is marked by a significant acceleration in the growth of value added and capital. The growth rate of labour is also higher in the post-reform period. Labour productivity and capital intensity growth rates register an increase in the new policy regime. Capital productivity also improves in the new policy regime. Further, the translog index of total factor productivity is higher in the new policy regime. So the performance of this group is good in the new policy regime.

Electrical Machinery and Apparatus N.E.C. Sector

Table 6.3.49: Growth Rates of Value Added, Capital and Labour in Electrical Machinery and Apparatus N.E.C. Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
311	Electric motors, generators and transformers	7.29	1.22	8.15	5.98	3.50	5.70	3.04	3.21	2.40
313	Insulated wire and cable	-9.96	-5.79	-15.37	3.29	3.69	0.38	-1.77	-2.54	-5.51
314	Accumulators, primary cells and primary batteries	3.34	3.89	3.82	6.52	10.48	3.15	12.75	17.61	8.20
315	Electric lamps and lighting equipment	3.46	-2.13	12.58	6.69	9.16	4.96	-3.49	-4.70	3.46
319	Other electrical equipment n.e.c.	12.74	9.42	2.72	4.91	7.19	0.14	-1.75	14.62	-4.87
31	Electrical Machinery and Apparatus N.E.C.	4.36	-1.24	4.66	0.68	2.03	0.58	6.00	5.36	5.71

Computed

The growth rates of value added, capital and labour are presented in table 6.3.49. Value added depicts an annual growth rate of 4.36 per cent per annum for the entire period. The growth rate of value added, which is negative in the pre-reform period registers a positive growth rate of 4.66 per cent per annum in the post-reform period. Capital input growth rate is just 0.68 per cent per annum for the entire period, furthermore, the growth rate registers a fall in the post-reform period. Employment grows at a rate of 6.00 per cent per annum for the entire period. The rate of growth of employment is almost same for both the sub periods. Industry electric motors, generators and transformers (311) and electric lamps and lighting equipment (315) show marked improvement in growth of value added in the post-1991 period. Capital growth for all but electric motors, generators and transformers (311) industry is higher in the former period. Labour growth rate depicts a decline in all except electric lamps and lighting equipment (315) industry in the latter period, i.e., the post-liberalized phase.

An analysis of partial productivities highlights that the labour productivity has grown at the rate of 3.65 per cent per annum for the entire period. Growth of labour productivity has been 1.81 per cent per annum in the post-reform period as against 3.20 per cent per annum in the pre-reform period. Capital productivity registers a negative growth rate of 1.55 per cent per annum for the entire period. The growth rate is negative for both the periods, the decline in growth rate being more pronounced in the pre-reform era. Capital intensity rate of growth for the sector shows a rising trend in the post-reform period. The industry, other electrical equipment n.e.c. (319) has comparatively higher labour productivity and capital productivity growth for the entire period than others in the group. The industries electric motors, generators and transformers (311), electric lamps and lighting equipment (315) and other electrical equipment n.e.c. (319) show an increase in annual rate of labour productivity and capital productivity in the post-reform period as compared to that in the pre-reform period.

Table 6.3.50: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Electrical Machinery and Apparatus N.E.C. Sector

Year	Labour Productivity						Capital Productivity						Capital Intensity					
	Industry Code						Industry Code						Industry Code					
	311	313	314	315	319	31	311	313	314	315	319	31	311	313	314	315	319	31
1980-81	0.44	0.16	0.41	0.31	0.10	0.85	0.25	0.48	0.37	0.35	0.19	0.35	0.17	0.33	1.12	0.09	0.55	0.24
1981-82	0.53	0.10	0.36	0.36	0.10	0.68	0.32	0.27	0.34	0.33	0.18	0.27	0.16	0.38	1.07	0.11	0.56	0.26
1982-83	0.46	0.14	0.35	0.33	0.10	0.77	0.27	0.27	0.35	0.32	0.17	0.25	0.17	0.53	1.01	0.10	0.57	0.30
1983-84	0.53	0.18	0.34	0.70	0.08	0.96	0.31	0.32	0.36	0.67	0.08	0.30	0.17	0.56	0.95	0.11	1.10	0.32
1984-85	0.42	0.21	0.30	0.26	0.08	0.87	0.20	0.28	0.31	0.19	0.10	0.22	0.21	0.74	0.96	0.13	0.79	0.41
1985-86	0.31	0.15	0.27	0.30	0.06	0.58	0.16	0.18	0.30	0.22	0.13	0.17	0.19	0.88	0.91	0.14	0.46	0.35
1986-87	0.58	0.16	0.25	0.29	0.07	0.74	0.30	0.23	0.28	0.23	0.20	0.24	0.19	0.68	0.92	0.13	0.35	0.31
1987-88	0.27	0.14	0.20	0.57	0.09	0.70	0.17	0.25	0.26	0.21	0.25	0.23	0.16	0.54	0.76	0.27	0.35	0.31
1988-89	0.79	0.15	0.17	0.25	0.06	0.78	0.40	0.19	0.24	0.14	0.17	0.21	0.20	0.78	0.71	0.17	0.38	0.37
1989-90	0.38	0.11	0.14	0.44	0.07	0.58	0.25	0.16	0.22	0.17	0.18	0.18	0.15	0.66	0.64	0.26	0.40	0.32
1990-91	0.33	0.08	0.11	0.59	0.06	0.54	0.17	0.12	0.19	0.13	0.16	0.14	0.19	0.66	0.58	0.44	0.39	0.38
1991-92	0.53	0.10	0.13	1.24	0.13	0.89	0.28	0.13	0.20	0.28	0.25	0.21	0.19	0.71	0.63	0.44	0.52	0.42
1992-93	0.55	0.11	0.12	0.89	0.26	1.05	0.26	0.14	0.20	0.19	0.36	0.23	0.21	0.78	0.61	0.46	0.74	0.47
1993-94	0.65	0.30	0.12	1.28	0.53	1.95	0.31	0.31	0.20	0.20	0.47	0.33	0.21	0.98	0.61	0.64	1.14	0.58
1994-95	0.63	0.09	0.08	1.51	0.83	1.43	0.24	0.10	0.17	0.25	0.44	0.24	0.26	0.87	0.49	0.60	1.89	0.60
1995-96	0.57	0.08	0.08	0.05	0.91	1.11	0.20	0.10	0.19	0.01	0.52	0.21	0.28	0.80	0.41	0.57	1.74	0.54
1996-97	0.73	0.04	0.07	0.34	0.88	1.11	0.26	0.04	0.19	0.05	0.44	0.20	0.28	0.86	0.39	0.61	2.00	0.56
1997-98	1.14	0.02	0.07	0.61	0.82	1.25	0.45	0.01	0.20	0.06	0.48	0.21	0.25	1.16	0.38	1.08	1.73	0.58
1998-99	0.92	0.00	0.07	0.98	1.05	1.32	0.31	0.02	0.20	0.30	0.56	0.22	0.29	0.97	0.36	0.33	1.89	0.60
1999-00	0.82	0.01	0.07	1.33	0.62	1.23	0.29	0.01	0.17	0.32	0.51	0.19	0.28	1.28	0.38	0.41	1.22	0.66
2000-01	0.82	0.12	0.07	1.56	0.50	1.35	0.29	0.11	0.21	0.30	0.43	0.19	0.28	1.16	0.34	0.52	1.15	0.70
2001-02	0.94	0.06	0.08	2.78	1.11	1.43	0.34	0.06	0.22	0.43	0.42	0.19	0.28	1.05	0.39	0.64	2.62	0.75
2002-03	0.91	0.13	0.09	1.68	0.92	1.40	0.33	0.07	0.21	0.23	0.40	0.16	0.27	1.86	0.44	0.72	2.30	0.85
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity																		
1980-81-2002-03	4.12	-8.35	-8.34	7.20	16.39	3.65	1.23	-12.83	-2.98	-3.03	7.46	-1.55	2.86	5.14	-5.53	10.55	7.70	5.28
1980-81-1990-91	-1.92	-3.34	-11.66	2.69	-4.54	-3.20	-2.20	-9.14	-5.96	-10.34	2.08	-6.26	0.29	6.39	-6.06	14.54	-6.48	3.26
1991-92-2002-03	5.61	-10.43	-4.04	8.81	13.20	1.81	2.32	-15.69	0.65	7.26	2.58	-3.14	3.22	6.23	-4.66	1.45	10.35	5.10

Computed

Industry code description: Appendix B

Table 6.3.51: Growth Rates of Total Factor Productivity in Electrical Machinery and Apparatus N.E.C. Sector

Year	Total Factor Productivity					
	Industry Code					
	311	313	314	315	319	31
1980-81	1.00	1.00	1.00	1.00	1.00	1.00
1981-82	1.10	0.97	0.95	1.02	0.98	0.89
1982-83	1.03	0.89	0.94	0.99	0.97	0.89
1983-84	1.09	0.88	0.94	1.31	0.72	0.97
1984-85	0.94	0.84	0.88	0.83	0.81	0.85
1985-86	0.82	0.86	0.84	0.88	0.89	0.72
1986-87	1.09	0.81	0.81	0.88	1.04	0.86
1987-88	0.81	0.79	0.74	0.99	1.13	0.84
1988-89	1.22	0.79	0.69	0.74	0.97	0.83
1989-90	0.98	0.76	0.63	0.89	1.01	0.74
1990-91	0.86	0.72	0.54	0.87	0.96	0.66
1991-92	1.07	0.77	0.58	1.20	1.17	0.85
1992-93	1.05	0.82	0.57	1.04	1.35	0.88
1993-94	1.13	0.92	0.57	1.10	1.49	1.07
1994-95	1.05	0.90	0.44	1.19	1.48	0.93
1995-96	0.99	0.88	0.43	0.65	1.55	0.86
1996-97	1.10	0.85	0.41	0.56	1.48	0.85
1997-98	1.32	0.87	0.42	0.70	1.51	0.88
1998-99	1.19	1.35	0.41	1.26	1.59	0.89
1999-00	1.15	0.95	0.37	1.32	1.51	0.83
2000-01	1.15	0.93	0.43	1.33	1.43	0.86
2001-02	1.21	0.89	0.47	1.50	1.42	0.86
2002-03	1.20	0.87	0.48	1.25	1.40	0.81
Growth Rates of Total Factor Productivity						
1980-81-2002-03	0.97	0.35	-4.46	0.61	3.02	-0.13
1980-81-1990-91	-1.05	-2.91	-5.46	-2.36	-2.36	-2.93
1991-92-2002-03	1.35	1.34	-2.38	3.44	3.44	-0.97

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

This sector shows a poor performance on total factor productivity front. Total factor productivity growth for this sector shows a negative rate of 0.13 per cent per annum for the entire period. Furthermore the growth rate is negative for both the periods. A closer look at the industries covered under this group highlights the fact that electric motors, generators and transformers (311), insulated wire and cable (313), electric lamps and lighting equipment (315) and other electrical equipment n.e.c. (319) show positive rate of growth of total factor productivity for the entire period and rising productivity growth during the post liberalisation period. Only accumulators, primary cells and primary batteries (314) industry show negative growth rate for the entire period as well as for the sub period. But the performance of the sector as a whole is still not good.

The overall analysis of this group indicates that the output growth rate registers an increase in the post-reform period as compared to the pre-reform period. As compared to the pre-reform period the capital input registers a decline and the labour input growth registers a very small increase in the post-reform period. Labour productivity and capital intensity growth registers an increase in the post-reform period. Capital productivity growth rate shows a negative trend for the entire period as well as for both the sub periods. Total factor productivity growth rate also behaves in the similar manner. Overall the performance of this sector in the post-reform era is not satisfactory and the sector as a whole shows a negative rate of productivity, i.e., 0.13 percent for the total period under study.

Radio, Television and Communication Equipment and Apparatus Sector

This sector shows a rate of growth of 7.14 per cent per annum in value added for the entire period. The growth rate is 7.26 per cent per annum in the pre-reform period as against 4.66 per cent per annum in the post-reform period. The rate of growth of capital input is 5.52 per cent per annum for the entire period and the rate of growth is higher in the pre-reform period. Employment has grown at a rate of 6.65 per cent per annum, the rate being higher for the post-reform era. All the industries covered in this group depict a growth rate of more than five per cent for value added and labour for the total period of analysis. Capital input for all the industries grows at a higher rate in the post-reform period. Labour for two out of three industries also shows an increase in the latter period.

Table 6.3.52: Growth Rates of Value Added, Capital and Labour in Radio, Television and Communication Equipment and Apparatus Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
321	Electronic valves and tubes and other electronic components	5.07	7.74	4.08	4.32	1.07	4.15	5.62	2.75	7.69
322	Television and radio transmitters and apparatus for line telephony and line telegraphy	9.69	1.28	4.43	6.86	2.90	9.50	5.51	8.02	-5.80
323	Television and radio receivers, sound or video recording or reproducing apparatus, and associated goods	8.12	9.78	5.37	5.16	4.94	4.93	5.09	7.27	4.10
32	Radio, Television and Communication Equipment and Apparatus	7.14	7.26	4.66	5.52	6.67	1.80	6.65	4.97	7.26

Computed

Table 6.3.52 presents the growth rates of partial productivities and capital intensity. Labour productivity has increased at a higher rate in the post-reform period as compared to pre-reform period. For the group as a whole, the growth of labour productivity is 1.53 per cent per annum. Capital productivity for the group grows at a very low rate, i.e., 0.46 per cent per annum for the entire period of analysis. Furthermore the growth rate declines to -2.42 per cent per annum in the post-reform period from 2.19 per cent per annum in the pre-reform period. The growth rate of capital intensity recorded for the post-reform period is 5.36 per cent per annum as against 1.59 per cent per annum in the pre-reform period. Labour productivity of television and radio transmitters and apparatus for line telephony and line telegraphy (322) industry is above 10 per cent in the post-reform phase. Moreover capital productivity for all three digit industries shows a deceleration in the post-reform era.

Table 6.3.53: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Radio, Television and Communication Equipment and Apparatus Sector

Year	Labour Productivity				Capital Productivity				Capital Intensity			
	Industry Code				Industry Code				Industry Code			
	321	322	323	32	321	322	323	32	321	322	323	32
1980-81	0.46	0.24	0.15	0.24	0.15	0.12	0.14	0.18	0.31	0.21	0.10	0.13
1981-82	0.54	0.23	0.16	0.26	0.17	0.11	0.13	0.18	0.32	0.21	0.12	0.14
1982-83	0.58	0.21	0.16	0.27	0.19	0.10	0.14	0.19	0.30	0.21	0.12	0.14
1983-84	0.60	0.19	0.20	0.29	0.20	0.09	0.18	0.21	0.30	0.20	0.12	0.14
1984-85	0.72	0.18	0.25	0.33	0.24	0.09	0.21	0.23	0.30	0.20	0.12	0.15
1985-86	0.71	0.15	0.25	0.32	0.24	0.08	0.21	0.22	0.29	0.19	0.12	0.14
1986-87	0.70	0.12	0.21	0.28	0.25	0.07	0.21	0.22	0.28	0.17	0.10	0.13
1987-88	0.74	0.10	0.19	0.27	0.28	0.07	0.20	0.21	0.27	0.15	0.09	0.13
1988-89	0.76	0.13	0.21	0.29	0.28	0.09	0.22	0.23	0.28	0.15	0.10	0.13
1989-90	0.74	0.13	0.20	0.27	0.30	0.09	0.20	0.22	0.25	0.14	0.10	0.12
1990-91	0.80	0.17	0.19	0.27	0.27	0.12	0.20	0.22	0.29	0.14	0.10	0.12
1991-92	0.66	0.15	0.23	0.27	0.21	0.14	0.23	0.23	0.31	0.11	0.10	0.12
1992-93	0.68	0.14	0.26	0.26	0.24	0.20	0.26	0.26	0.29	0.07	0.10	0.10
1993-94	0.74	0.30	0.28	0.36	0.28	0.21	0.26	0.27	0.27	0.14	0.11	0.14
1994-95	0.68	0.21	0.27	0.31	0.28	0.20	0.26	0.26	0.24	0.10	0.11	0.12
1995-96	0.60	0.26	0.33	0.36	0.18	0.18	0.27	0.23	0.34	0.14	0.12	0.16
1996-97	0.87	0.16	0.30	0.30	0.21	0.18	0.28	0.24	0.42	0.09	0.11	0.13
1997-98	0.57	0.33	0.27	0.35	0.25	0.16	0.25	0.23	0.23	0.21	0.11	0.15
1998-99	0.51	0.18	0.31	0.29	0.20	0.16	0.26	0.22	0.25	0.11	0.12	0.13
1999-00	0.52	0.27	0.31	0.35	0.21	0.14	0.26	0.21	0.24	0.11	0.12	0.16
2000-01	0.48	0.51	0.27	0.37	0.23	0.13	0.25	0.21	0.21	0.12	0.11	0.18
2001-02	0.52	0.40	0.29	0.37	0.24	0.11	0.26	0.20	0.22	0.13	0.11	0.19
2002-03	0.54	0.61	0.29	0.40	0.25	0.11	0.27	0.20	0.22	0.15	0.11	0.21
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity												
1980-81-2002-03	-0.52	3.97	2.89	1.53	0.72	2.65	2.82	0.46	-1.24	-2.58	0.06	1.06
1980-81-1990-91	4.85	-6.24	2.34	0.56	6.59	-1.58	4.61	2.19	-1.64	-4.73	-2.17	-1.59
1991-92-2002-03	-3.36	10.87	1.22	2.81	-0.07	-4.62	0.42	-2.42	-3.29	3.07	0.80	5.36

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

Table 6.3.53 depicts the growth rates of total factor productivity of radio, television and communication equipment and apparatus sector. This group shows a growth rate of 0.23 per cent per annum for the entire period. The growth rate which is 0.82 per cent per annum in the pre-reform period has come down to - 0.74 per cent per annum in the post-reform period. Television and radio receivers, sound or video recording or reproducing apparatus, and associated goods (323) show a comparatively higher growth rate than other industries in the group for the entire period. Although this industry shows a deceleration of growth of total factor productivity in the post-reform period but the rate of growth is positive. The fact, however, is that all the individual industries covered in the group show a deceleration in the post-reform period.

Table 6.3.54: Growth Rates of Total Factor Productivity in Radio, Television and Communication Equipment and Apparatus Sector

Year	Total Factor Productivity			
	Industry Code			
	321	322	323	32
1980-81	1.00	1.00	1.00	1.00
1981-82	1.06	0.97	0.99	1.01
1982-83	1.11	0.95	1.00	1.03
1983-84	1.13	0.91	1.11	1.07
1984-85	1.20	0.89	1.18	1.11
1985-86	1.21	0.82	1.19	1.10
1986-87	1.23	0.75	1.18	1.08
1987-88	1.26	0.71	1.15	1.08
1988-89	1.26	0.83	1.19	1.10
1989-90	1.29	0.84	1.15	1.08
1990-91	1.26	0.95	1.14	1.09
1991-92	1.15	1.00	1.21	1.11
1992-93	1.19	1.11	1.26	1.15
1993-94	1.26	1.19	1.27	1.18
1994-95	1.27	1.13	1.26	1.15
1995-96	1.07	1.11	1.29	1.11
1996-97	1.15	1.09	1.29	1.12
1997-98	1.21	1.07	1.25	1.12
1998-99	1.13	1.05	1.28	1.09
1999-00	1.15	0.98	1.28	1.08
2000-01	1.18	0.96	1.25	1.08
2001-02	1.20	0.91	1.27	1.06
2002-03	1.21	0.90	1.28	1.06
Growth Rates of Total Factor Productivity				
1980-81-2002-03	0.26	0.70	1.05	0.23
1980-81-1990-91	2.37	-1.73	1.72	0.82
1991-92-2002-03	-0.06	-1.84	0.19	-0.74

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

An analysis of results of this sector shows a decline in value added and capital in the post-reform period. Labour and labour productivity rate is higher in the post-reform period. Capital productivity which is positive in the pre-reform period becomes negative in the period 1991-92 to 2002-03. Total factor productivity growth rate also registers a decline in the same period. On the whole, the performance of this sector is far from satisfactory in the new policy regime.

Medical, Precision and Optical Instruments, Watches and Clocks Sector

Table 6.3.55: Growth Rates of Value Added, Capital and Labour in Medical, Precision and Optical Instruments, Watches and Clocks Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
331	Medical appliances and instruments and appliances for measuring, checking, testing, navigating and other purposes except optical instruments	9.01	4.46	9.01	9.20	10.73	8.12	2.92	0.23	6.21
332	Optical instruments and photographic equipment	-3.20	-8.42	-1.35	1.99	3.61	0.84	3.77	3.80	3.31
33	Medical, Precision and Optical Instruments, Watches and Clocks	9.67	-0.86	7.44	8.22	5.79	8.12	3.25	-2.66	5.11

Computed

Value added in this sector grows at a rate of 9.67 per cent per annum. Value added performance has improved significantly in the post-reform period with the growth rate being 7.44 per cent per annum. The first period shows a negative trend with the growth rate of 0.86 per cent per annum. Capital grows at a rate of 8.22 per cent per annum for the entire period. An analysis of sub periods shows that the rate of growth of capital is higher during the period 1991-92 to 2002-03 than during the pre-reform period. Labour input grows at a rate of 3.25 per cent per annum for the whole period. The decline in labour input at the rate of 2.66 per cent per annum in the pre-reform period is reversed by a positive and rising trend rate of 5.11

per cent per annum in the post-reform period. Medical appliances and instruments and appliances for measuring, checking, testing, navigating and other purposes except optical instruments (331) industry shows a rapid growth in value added in the post-reform period. This industry is also marked by an improvement in labour input in the post-reform era.

Table 6.3.56: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Medical, Precision and Optical Instruments, Watches and Clocks Sector

Year	Labour Productivity			Capital Productivity			Capital Intensity		
	Industry Code			Industry Code			Industry Code		
	331	332	33	331	332	33	331	332	33
1980-81	0.24	0.35	0.36	0.25	0.26	0.28	0.11	0.13	0.13
1981-82	0.20	0.23	0.25	0.15	0.16	0.23	0.13	0.14	0.11
1982-83	0.26	0.31	0.28	0.15	0.15	0.22	0.17	0.21	0.13
1983-84	0.42	0.41	0.39	0.27	0.11	0.31	0.15	0.38	0.13
1984-85	0.26	0.30	0.38	0.13	0.18	0.21	0.20	0.17	0.18
1985-86	0.35	0.42	0.43	0.16	0.36	0.25	0.22	0.12	0.17
1986-87	0.27	0.24	0.29	0.13	0.09	0.14	0.21	0.27	0.21
1987-88	0.31	0.20	0.29	0.16	0.22	0.17	0.19	0.09	0.17
1988-89	0.30	0.11	0.33	0.15	0.06	0.16	0.21	0.19	0.21
1989-90	0.33	0.10	0.35	0.14	0.06	0.15	0.23	0.18	0.24
1990-91	0.42	0.11	0.45	0.09	0.06	0.16	0.46	0.18	0.27
1991-92	0.78	0.14	0.63	0.19	0.08	0.22	0.41	0.18	0.28
1992-93	0.68	0.13	0.67	0.27	0.08	0.25	0.25	0.17	0.26
1993-94	0.45	0.14	0.67	0.05	0.09	0.27	0.82	0.16	0.25
1994-95	0.78	0.14	0.97	0.31	0.10	0.39	0.26	0.15	0.25
1995-96	0.66	0.11	0.81	0.27	0.08	0.31	0.24	0.13	0.26
1996-97	0.46	0.08	0.75	0.20	0.07	0.31	0.23	0.13	0.24
1997-98	0.31	0.08	0.43	0.04	0.06	0.18	0.73	0.13	0.24
1998-99	0.51	0.08	2.00	0.12	0.06	0.50	0.43	0.14	0.40
1999-00	0.63	0.10	1.09	0.19	0.07	0.40	0.33	0.14	0.27
2000-01	0.79	0.10	0.55	0.15	0.07	0.16	0.53	0.13	0.35
2001-02	0.98	0.10	0.91	0.21	0.07	0.27	0.47	0.13	0.33
2002-03	0.97	0.09	0.76	0.28	0.07	0.23	0.35	0.13	0.34
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity									
1980-81-2002-03	5.91	-6.71	6.22	-0.17	-5.09	1.34	6.09	-1.71	4.81
1980-81-1990-91	4.22	-11.77	1.85	-5.66	-11.61	-6.28	10.47	-0.19	8.68
1991-92-2002-03	2.64	-4.51	2.22	0.82	-2.17	-0.62	1.81	-2.39	2.86

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

As per as the partial productivity performance [Table 6.3.56] is concerned the post-reform period presents a better picture. Labour productivity growth rate for the entire period is 6.22

per cent per annum. The growth rate recorded for the post-reform period is 2.22 per cent per annum as against 1.85 per cent per annum in the pre-1991 period. The growth rate of capital productivity is negative in the sub periods but the entire period exhibits an annual growth of 1.34 per cent per annum. There is a slowdown in the rate of growth of capital intensity in the post-reform period.

Table 6.3.57: Growth Rates of Total Factor Productivity in Medical, Precision and Optical Instruments, Watches and Clocks Sector

Year	Total Factor Productivity		
	Industry Code		
	331	**332**	**33**
1980-81	1.00	1.00	1.00
1981-82	0.88	0.91	0.88
1982-83	0.96	0.86	0.90
1983-84	1.18	0.84	1.04
1984-85	0.93	0.84	0.96
1985-86	1.03	1.05	1.01
1986-87	0.94	1.00	0.79
1987-88	1.02	0.98	0.85
1988-89	0.99	0.98	0.85
1989-90	0.99	0.96	0.84
1990-91	0.90	0.93	0.90
1991-92	1.21	0.89	1.04
1992-93	1.30	0.87	1.09
1993-94	0.84	0.83	1.11
1994-95	1.36	0.82	1.27
1995-96	1.31	0.80	1.17
1996-97	1.16	0.79	1.17
1997-98	0.44	0.78	0.93
1998-99	0.90	0.75	1.43
1999-00	1.06	0.75	1.31
2000-01	1.04	0.73	0.94
2001-02	1.16	0.72	1.17
2002-03	1.25	0.72	1.09
Growth Rates of Total Factor Productivity			
1980-81-2002-03	0.28	-1.34	1.36
1980-81-1990-91	-0.20	0.67	-1.31
1991-92-2002-03	-0.86	-1.92	0.18

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

A summary of total factor productivity growth of the sector is reported in table 6.3.57. Productivity grows at a rate of 1.36 per cent per annum for the sample period for this sector. Total factor productivity growth shows an improvement in the post-reform period. Total factor productivity growth accelerates and becomes positive in the post-reform period although the rate of growth is only 0.18 per cent per annum. The industrial growth of medical appliances and instruments and appliances for measuring, checking, testing, navigating and other purposes except optical instruments (331) shows positive rate of growth of total factor productivity and industry optical instruments and photographic equipment (332) shows a negative rate of growth of total factor productivity for the entire period.

An analysis of the group as a whole highlights the fact that value added which shows a negative trend in the pre-reform period registers a sharp increase in the post-reform period. The surge in value added is accompanied by further rise in the growth of intermediate inputs in the post-reform period. There is an increase in the growth of labour productivity in the new policy regime. Capital productivity remains negative for both the sub periods although the rate of growth is positive for the entire period. Total factor productivity growth shows an improvement in the new policy regime. So the group as a whole has performed better in terms of partial as well as total factor productivity in the new policy regime.

Motor Vehicles, Trailer and Semi-Trailers Sector

Table 6.3.58: Growth Rates of Value Added, Capital and Labour in Motor Vehicles, Trailer and Semi-Trailers Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
341+342 +343	Motor Vehicles, Trailer and Semi-Trailers	7.08	7.82	11.53	7.08	5.16	10.65	2.22	3.16	7.63

Computed

Trends for various summary statistics for this sector are depicted in table 6.3.58, 6.3.59 and 6.3.60. This sector shows a rate of growth of 7.08 per cent per annum in value added for the entire period, 1980-81 to 2002-03. The rate of growth in value added registers a sharp increase in the post-reform period. Capital grows at a rate of 7.08 per cent per annum for the entire period. The growth rate is 10.65 per cent per annum in the post-reform period as against 5.16 per cent per annum in the pre-reform period. Labour growth also registers an increase in the post-reform era.

Table 6.3.59: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Motor Vehicles, Trailer and Semi-Trailers Sector

Year	Labour Productivity	Capital Productivity	Capital Intensity
	Industry Code	Industry Code	Industry Code
	341+342+343	341+342+343	341+342+343
1980-81	0.39	0.23	0.17
1981-82	0.40	0.24	0.17
1982-83	0.39	0.22	0.18
1983-84	0.46	0.28	0.17
1984-85	0.39	0.22	0.17
1985-86	0.51	0.27	0.19
1986-87	0.48	0.27	0.18
1987-88	0.47	0.28	0.17
1988-89	0.53	0.27	0.19
1989-90	0.59	0.28	0.22
1990-91	0.59	0.30	0.20
1991-92	0.63	0.22	0.29
1992-93	0.85	0.30	0.28
1993-94	0.67	0.22	0.30
1994-95	0.63	0.19	0.33
1995-96	0.91	0.30	0.30
1996-97	0.58	0.16	0.37
1997-98	1.13	0.35	0.32
1998-99	0.95	0.24	0.40
1999-00	0.84	0.21	0.39
2000-01	0.82	0.23	0.36
2001-02	0.98	0.27	0.36
2002-03	1.02	0.27	0.37
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity			
1980-81-2002-03	4.75	-0.001	4.76
1980-81-1990-91	4.51	2.52	1.94
1991-92-2002-03	3.63	0.79	2.81

Computed
Note: Three digit industry code description: Appendix B

An analysis of partial productivities highlights that the labour productivity has grown at a rate of 4.75 per cent per annum for the entire period. Growth of labour productivity has been 3.63 per cent per annum in the post-reform period as against 4.51 per cent per annum in the pre-reform period. The growth rate of capital productivity shows a declining trend in post-reform period. The growth rate of capital intensity is 4.76 per cent per annum for the entire period and the rate of growth is higher in the new policy regime.

Table 6.3.60: Growth Rates of Total Factor Productivity in Motor Vehicles, Trailer and Semi-Trailers Sector

Year	Total Factor Productivity
	Industry Code
	341+342+343
1980-81	1.00
1981-82	1.01
1982-83	0.98
1983-84	1.07
1984-85	0.99
1985-86	1.08
1986-87	1.07
1987-88	1.09
1988-89	1.09
1989-90	1.11
1990-91	1.13
1991-92	1.06
1992-93	1.21
1993-94	1.08
1994-95	1.03
1995-96	1.22
1996-97	0.96
1997-98	1.29
1998-99	1.14
1999-00	1.10
2000-01	1.11
2001-02	1.19
2002-03	1.20
Growth Rates of Total Factor Productivity	
1980-81-2002-03	0.69
1980-81-1990-91	1.32
1991-92-2002-03	0.66

Computed
Note: Three digit industry code description: Appendix B

Table 5.2.60 depicts growth rates of total factor productivity in the group. The growth rate of total factor productivity is 0.69 per cent per annum for the entire period. The growth rate which is 1.32 per cent per annum in the pre-reform period came down to 0.66 per cent per annum in the post-reform period. Total factor productivity like that of partial productivities is better in the pre-reform era.

An increase in growth of value added in this sector has been accompanied by an increase in capital and labour. Overall analysis of results of this sector indicates that despite an increase in growth rates of value added, capital and labour over the period, this sector has not performed well on the productivity front. Both the labour productivity and capital productivity show deceleration in the post-reform period. Total factor productivity growth also decelerates in the new policy regime. This sector has performed better in the pre-reform era.

Other Transport Equipment Sector

Table 6.3.61: Growth Rates of Value Added, Capital and Labour in Other Transport Equipment Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
352	Railway and tramway locomotives and rolling stock	11.69	10.17	8.19	4.97	0.97	5.24	-7.25	-2.65	-10.10
359	Transport equipment n.e.c	8.53	13.31	3.74	9.27	9.17	9.33	4.43	7.79	3.44
35	Other Transport Equipment	8.82	12.70	4.28	3.56	6.38	2.82	9.06	8.69	9.16

Computed

This group, as a whole shows a high growth in value added in the pre-reform period, i.e., 12.70 per cent per annum but the growth rate is lower for the post-reform period, and is 4.28 per cent per annum. Capital for the sector as a whole, shows a growth rate of 3.56 per cent per annum with the rate being less for the post-reform period. Employment has a high growth rate of 9.06 per cent per annum for the entire period and the growth rate is higher in the post-reform period. Both railway and tramway locomotives and rolling stock (352) and transport equipment n.e.c. (359), three digit industries covered in this group show a deceleration in value added in the period associated with reforms.

Table 6.3.62: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Other Transport Equipment Sector

Year	Labour Productivity			Capital Productivity			Capital Intensity		
	Industry Code			Industry Code			Industry Code		
	352	359	35	352	359	35	352	359	35
1980-81	0.09	0.29	0.25	0.19	0.23	0.23	0.47	0.13	0.11
1981-82	0.09	0.35	0.30	0.18	0.24	0.23	0.51	0.15	0.13
1982-83	0.37	0.38	0.38	0.66	0.24	0.27	0.56	0.16	0.14
1983-84	0.60	0.29	0.34	1.04	0.19	0.24	0.58	0.15	0.14
1984-85	0.53	0.37	0.39	0.77	0.25	0.28	0.69	0.15	0.14
1985-86	0.48	0.31	0.33	0.63	0.22	0.24	0.76	0.14	0.13
1986-87	0.44	0.37	0.38	0.39	0.25	0.25	1.15	0.15	0.15
1987-88	0.38	0.45	0.44	0.37	0.31	0.31	1.03	0.14	0.14
1988-89	0.26	0.40	0.39	0.40	0.21	0.21	0.66	0.20	0.18
1989-90	0.41	0.43	0.43	0.61	0.32	0.34	0.67	0.13	0.13
1990-91	0.62	0.60	0.60	1.13	0.37	0.40	0.55	0.16	0.15
1991-92	0.37	0.55	0.53	0.59	0.32	0.33	0.63	0.17	0.16
1992-93	0.20	0.68	0.73	0.81	0.35	0.38	2.52	0.19	0.19
1993-94	0.37	0.75	0.87	1.47	0.32	0.37	2.50	0.24	0.24
1994-95	0.26	0.66	0.72	1.02	0.28	0.31	2.58	0.23	0.23
1995-96	0.19	0.69	0.75	0.90	0.27	0.30	2.07	0.26	0.25
1996-97	0.23	0.40	0.48	1.01	0.17	0.21	2.23	0.24	0.24
1997-98	0.40	0.59	0.72	1.37	0.20	0.24	1.92	0.30	0.30
1998-99	0.56	0.85	1.00	1.83	0.26	0.31	1.70	0.33	0.33
1999-00	1.06	0.58	0.68	1.14	0.20	0.23	1.75	0.29	0.30
2000-01	0.42	0.39	0.45	0.87	0.13	0.15	1.73	0.30	0.30
2001-02	0.86	0.87	0.97	0.83	0.27	0.30	2.60	0.32	0.33
2002-03	0.91	0.71	0.84	1.26	0.21	0.25	1.94	0.33	0.34
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity									
1980-81-2002-03	4.59	3.92	5.08	6.40	-0.68	-0.22	7.93	4.63	5.31
1980-81-1990-91	13.17	5.12	5.94	9.11	3.79	3.69	3.72	1.28	2.17
1991-92-2002-03	12.82	0.29	1.42	2.80	-5.11	-4.48	2.62	5.70	6.17

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

Table 6.3.62 presents the indices of labour productivity, capital productivity and capital intensity. Labour productivity for the entire period depicts a growth rate of 5.08 per cent per annum, the growth rate being less for the post-reform period. The slower growth in labour productivity in the post-reform period could be the consequence of slower growth of value added in the post-reform period. Capital productivity shows a negative trend for the entire period. The growth rate of capital productivity which is 3.69 per cent per annum in the pre-reform period came down to - 4.48 per cent per annum in the post-reform period. Capital intensity is higher in the post-reform period. As far as the performance of industries in this group is concerned, all the industries show deceleration in the growth rates of labour productivity and capital productivity in the post-reform period.

Table 6.3.63 depicts growth rates of total factor productivity in this sector. Total factor productivity growth is 0.57 per cent per annum for the entire period. The growth rate is higher during the pre-reform period. The estimate for the pre-reform period is 1.74 per cent per annum which came down to - 0.93 per cent per annum in the post-reform period. Railway and tramway locomotives and rolling stock (352) industry show comparatively higher total factor productivity growth for the entire period than the transport equipment n.e.c. (359) industry.

Table 6.3.63: Growth Rates of Total Factor Productivity in Other Transport Equipment Sector

Year	Total Factor Productivity		
	Industry Code		
	352	359	35
1980-81	1.00	1.00	1.00
1981-82	0.91	1.04	1.05
1982-83	0.96	1.06	1.13
1983-84	0.99	0.95	1.07
1984-85	1.03	1.06	1.14
1985-86	1.05	0.99	1.07
1986-87	1.19	1.06	1.11
1987-88	1.20	1.15	1.19
1988-89	1.25	1.03	1.07
1989-90	1.30	1.15	1.20
1990-91	1.41	1.24	1.30
1991-92	1.50	1.19	1.23
1992-93	1.56	1.24	1.32
1993-94	1.61	1.23	1.33
1994-95	1.66	1.18	1.26
1995-96	1.67	1.17	1.24
1996-97	1.68	0.95	1.07
1997-98	1.72	1.06	1.18
1998-99	1.78	1.20	1.29
1999-00	1.87	1.06	1.16
2000-01	1.89	0.88	0.98
2001-02	1.90	1.22	1.29
2002-03	1.95	1.12	1.21
Growth Rates of Total Factor Productivity			
1980-81-2002-03	3.74	0.34	0.57
1980-81-1990-91	4.16	1.65	1.74
1991-92-2002-03	2.35	-1.23	-0.93

Computed, Note: Two digit industry code description: Appendix B,
Three digit industry code description: Appendix C

An analysis of this industrial group highlights the fact that value added growth rate sharply declines in the post-reform period. Capital growth rate also decelerates in the post-reform period. Employment grows at a higher rate in the post-reform period. Both labour productivity and capital productivity decelerate in the new policy regime. Total factor productivity also behaves in the same manner. Overall, the sector shows sluggish performance in the new policy regime.

Furniture Sector

Table 6.3.64: Growth Rates of Value Added, Capital and Labour in Furniture Sector

Industry code	Industry Name	Value added			Capital			Labour		
		1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
36	Furniture	12.90	2.04	12.90	10.04	5.63	11.05	3.02	-4.99	6.86

Computed

This sector shows high growth rate of value added and capital as depicted in table 6.3.64 for the entire period. There is a strong acceleration in the growth rate of value added in the new policy regime, i.e., 12.90 per cent per annum as compared to 2.04 per cent per annum in the pre-reform period. The growth rate of capital is 11.04 per cent per annum in the new policy regime as against 5.63 per cent per annum in pre-reform period. The growth rate of labour which is - 4.99 per cent per annum in the pre-reform period increases to 6.86 per cent per annum in the new policy regime.

An analysis of partial productivities highlights that labour productivity has grown at a rate of 9.59 per cent per annum. The growth rate is 7.40 per cent per annum in the pre-reform period as compared to 5.65 per cent per annum in the post-reform period. A note-worthy development of this sector is that capital productivity growth rate which is negative for the pre-reform period registers a positive growth rate of 1.67 per cent per annum in the new policy regime. This sector shows a high growth rate of capital intensity in the pre-reform period.

Table 6.3.65: Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity in Furniture Sector

Year	Labour Productivity	Capital Productivity	Capital Intensity
	Industry Code	Industry Code	Industry Code
	36	36	36
1980-81	0.30	0.41	0.07
1981-82	0.19	0.28	0.07
1982-83	0.21	0.26	0.08
1983-84	0.23	0.27	0.09
1984-85	0.18	0.16	0.11
1985-86	0.29	0.22	0.13
1986-87	0.23	0.17	0.13
1987-88	0.31	0.30	0.10
1988-89	0.36	0.24	0.15
1989-90	0.36	0.21	0.17
1990-91	0.52	0.24	0.22
1991-92	0.59	0.22	0.26
1992-93	0.47	0.26	0.18
1993-94	0.67	0.33	0.20
1994-95	1.06	0.50	0.21
1995-96	0.81	0.37	0.22
1996-97	0.78	0.35	0.22
1997-98	0.88	0.56	0.16
1998-99	2.79	0.77	0.36
1999-00	1.36	0.55	0.25
2000-01	0.62	0.21	0.30
2001-02	1.07	0.38	0.29
2002-03	0.82	0.26	0.32
Growth Rates of Labour Productivity, Capital Productivity and Capital Intensity			
1980-81-2002-03	9.59	2.60	6.81
1980-81-1990-91	7.40	-3.39	11.17
1991-92-2002-03	5.65	1.67	3.92

Computed
Note: Two digit industry code description: Appendix B

Table 6.3.66 depicts growth rates of total factor productivity in this group. The group shows a growth rate of total factor productivity of 2.06 per cent per annum for the entire period. On splitting the entire period into sub periods, it is found that there is a slight rise in the growth rate in the new policy regime. The growth rate is 0.83 per cent per annum in the new policy regime as compared to 0.82 per cent per annum in the pre-reform period.

Table 6.3.66: Growth Rates of Total Factor Productivity in Furniture Sector

Year	Total Factor Productivity
	Industry Code
	36
1980-81	1.00
1981-82	0.82
1982-83	0.82
1983-84	0.85
1984-85	0.70
1985-86	0.87
1986-87	0.77
1987-88	0.96
1988-89	0.92
1989-90	0.89
1990-91	0.98
1991-92	0.98
1992-93	0.98
1993-94	1.10
1994-95	1.28
1995-96	1.15
1996-97	1.14
1997-98	1.30
1998-99	1.50
1999-00	1.33
2000-01	0.93
2001-02	1.18
2002-03	1.04
Growth Rates of Total Factor Productivity	
1980-81-2002-03	2.06
1980-81-1990-91	0.82
1991-92-2002-03	0.83

Computed
Note: Two digit industry code description: Appendix B

The picture that emerges for this sector is that value added and capital shows a sharp increase in the post-reform period. Employment which is negative in the pre-reform period increases and become positive in the post-reform period. The growth rates of labour productivity and capital intensity are higher in the pre-reform period. Capital productivity growth rate shows a rise in the post-reform period. Total factor productivity growth rate also rises slightly in the new policy regime. All these factors indicate that the performance of this sector has improved in the new policy regime.

6.4 Determinants of Productivity in Punjab Manufacturing

In this section an attempt has been made to trace the factors influencing productivity in Punjab manufacturing at aggregate and two digit level industries. Ordinary least square and stepwise regression models have been used for analyzing the factors affecting productivity. The time period for the analysis is 1980-81 to 2002-03. The purpose of the study is to find out the relationship between growth in total factor productivity and growth in variables like rate of growth of output, capital-labour ratio, rate of growth of investment, scale variable, rate of growth of factories and total emoluments. The dependent variable is total factor productivity growth.

6.4.1 Aggregative Analysis

Entire Manufacturing

Regression results of the entire manufacturing sector in Punjab are depicted by the equation:

$$
\begin{array}{lllllll}
y = 0.20x_1^{**} & -0.056x_2^{**} & +0.086x_3 & -0.077x_4 & -0.024x_5 & -0.046x_6 \\
t = \quad (6.00) & (3.83) & (0.67) & (1.36) & (0.05) & (0.99) \\
R^2 = 0.98 & (\overline{R}^2 = 0.97) & & & &
\end{array}
$$

Total factor productivity is positively related to output and investment and is negatively related to capital intensity, growth in the number of factories, scale variable and total emoluments. Output and capital intensity are statistically significant at 1 percent level. The model explains 97 percent of variations in total factor productivity.

Stepwise regression selects output, capital intensity and total emoluments as important determinants of productivity.

$$y = 0.15x_1^{**} - 0.044x_2^{**} - 0.032x_6^{**}$$
$$t = \quad (7.01) \quad (6.45) \quad (2.95)$$
$$R^2 = 0.97 \quad (\bar{R}^2 = 0.97)$$

The explanatory power of the model is 97 percent.

6.4.2 Sectorwise Analysis

Food Products and Beverages

The empirical results for the food products and beverages sector are:

$$y = 0.031x_1^{**} + 0.15x_2^{*} - 0.019x_3 + 0.064x_4^{*} - 0.012x_5 - 0.027x_6$$
$$t = \quad (3.19) \quad (2.51) \quad (0.28) \quad (2.57) \quad (1.51) \quad (0.065)$$
$$R^2 = 0.95 \quad (\bar{R}^2 = 0.93)$$

The model explains 93 percent of total variation in total factor productivity. Total factor productivity is positively related to output growth, capital intensity and growth in the number of factories. Total factor productivity is negatively related to investment, scale variable and total emoluments. Regression coefficient for output growth is significant at one percent level and regression coefficients for capital intensity and growth in the number of factories are significant at five percent level.

An analysis of stepwise regression depicts that output growth, capital intensity and growth in the number of factories are important determinants of total factor productivity. The value of adjusted R^2 is 0.93.

$$y = 0.029x_1^{**} + 0.068x_2^{**} + 0.053x_4^{**}$$
$$t = \quad (3.31) \quad (2.75) \quad (3.51)$$
$$R^2 = 0.94 \quad (\bar{R}^2 = 0.93)$$

Tobacco Products

The empirical results for this sector are:

$$y = 0.054x_1^{**} + 0.016x_2 - 0.023x_3^{**} - 0.022x_4^{**} + 0.061x_5^{**} + 0.077x_6^{**}$$
$$t = \quad (6.35) \quad (0.89) \quad (3.11) \quad (4.56) \quad (3.21) \quad (2.88)$$
$$R^2 = 0.92 \quad (\overline{R}^2 = 0.88)$$

Total factor productivity is positively related to output growth, capital-labour ratio, scale variable and total emoluments and is negatively related to investment and growth in the number of factories. Regression coefficients for output, investment, growth in the number of factories, scale variable and total emoluments are significant at one percent level. The model explains 88 percent variation in total factor productivity. Stepwise regression analysis failed to select the dominant independent variable.

Textiles

The results for textiles sector are:

$$y = 0.065x_1^{**} + 0.96x_2^{*} - 0.044x_3 + 0.077x_4^{**} - 0.012x_5^{**} + 0.026x_6^{*}$$
$$t = \quad (7.21) \quad (2.17) \quad (0.032) \quad (3.54) \quad (3.22) \quad (2.05)$$
$$R^2 = 0.93 \quad (\overline{R}^2 = 0.91)$$

Total factor productivity is positively related to output growth, capital-labour ratio, growth in the number of factories and total emoluments. It is negatively related to investment and scale variable. Regression coefficients for output, growth in the number of factories and scale variable are statistically significant at 1 percent level and regression coefficients for capital-labour ratio and total emoluments are statistically significant at 5 percent level. Out of total variation, 91 percent is explained by the model.

Stepwise regression has selected output growth, growth in the number of factories and scale variable to be significant determinants of productivity. Productivity is positively related to output and growth in the number of factories and is negatively related to scale variable.

$$y = 0.054x_1^{**} + 0.063x_4^{**} - 0.011x_5^{**}$$
$$t = \quad (4.71) \quad (3.26) \quad (7.61)$$
$$R^2 = 0.90 \quad (\overline{R}^2 = 0.89)$$

The model explains 89 percent variation in total factor productivity.

Wearing Apparel; Dressing and Dyeing of Fur

The regression equation for this sector is:

$$y = 0.049x_1^{**} + 0.024x_2 - 0.015x_3 + 0.075x_4 - 0.014x_5^{**} + 0.031x_6^{**}$$
$$t = \quad (5.23) \quad (1.08) \quad (1.49) \quad (1.42) \quad (4.73) \quad (2.89)$$
$$R^2 = 0.81 \quad (\overline{R}^2 = 0.73)$$

Output growth, capital-labour ratio and growth in the number of factories and total emoluments are positively related to total factor productivity. Investment and scale variable are negatively related to total factor productivity. Regression coefficients for output growth, scale variable and total emoluments are statistically significant at 1 percent level. Out of total variation, 73 percent is explained by the model.

Stepwise regression selects output growth, growth in the number of factories, scale variable and total emoluments as important determinants of productivity.

$$y = 0.040x_1^{**} - 0.11x_4^{*} - 0.011x_5^{**} - 0.023x_6^{**}$$
$$t = \quad (6.11) \quad (2.19) \quad (4.82) \quad (3.90)$$
$$R^2 = 0.77 \quad (\overline{R}^2 = 0.72)$$

The model explains 72 percent variations in total factor productivity.

Tanning and Dressing of Leather, Luggage, Handbags, Saddlery, Harness and Footwear

The regression equation for this sector is:

$$
\begin{aligned}
&y = 0.092x_1^{**} + 0.064x_2^{*} - 0.028x_3 - 0.014x_4 - 0.31x_5 + 0.85x_6 \\
&t = \quad (5.28) \quad (2.08) \quad (0.73) \quad (1.14) \quad (1.57) \quad (0.031) \\
&R^2 = 0.85 \quad (\overline{R}^2 = 0.80)
\end{aligned}
$$

Total factor productivity growth is positively related to output growth, capital-labour ratio and total emoluments and is negatively related to investment, growth in the number of factories and scale variable. Regression coefficient for output growth is statistically significant at 1 percent level and regression coefficient for capital-labour ratio is statistically significant at 5 per cent level. The model explains 80 percent of variations in total factor productivity.

Stepwise regression analysis proves that output growth and capital-labour ratio are significant determinants of total factor productivity. The explained variation of the model is 80 percent.

$$
\begin{aligned}
&y = 0.084x_1^{**} + 0.055x_2^{*} \\
&t = \quad (6.15) \quad (2.29) \\
&R^2 = 0.82 \quad (\overline{R}^2 = 0.80)
\end{aligned}
$$

Wood and Products of Wood and Cork, Except Furniture; Articles of Straw and Plating Materials

The explained variation of the model is 93 percent. The regression equation is:

$$y = 0.056x_1^{**} + 0.014x_2^{**} + 0.076x_3 - 0.010x_4^{**} - 0.20x_5^{**} + 0.85x_6^{*}$$
$$t = \quad (6.18) \quad (3.00) \quad (1.60) \quad (4.35) \quad (3.39) \quad (2.17)$$
$$R^2 = 0.95 \quad (\overline{R}^2 = 0.93)$$

The model depicts a positive relationship of total factor productivity with output growth, capital-labour ratio, investment and total emoluments. Growth in the number of factories and scale variable are negatively related to total factor productivity. Regression coefficients for output growth, capital-labour ratio, growth in the number of factories and scale variable are statistically significant at 1 percent level and regression coefficient for total emoluments is statistically significant at 5 percent level.

Stepwise regression selects output growth and growth in the number of factories as important determinants of productivity.

$$y = 0.049x_1^{**} + 0.015x_4^{**}$$
$$t = \quad (7.68 \quad (5.42)$$
$$R^2 = 0.90 \quad (\overline{R}^2 = 0.89)$$

The explained variation of the model is 89 percent.

Paper and Paper Products

Regression equation for paper and paper products sector is:

$$y = 0.023x_1^{*} - 0.031x_2 - 0.029x_3 - 0.015x_4 - 0.42x_5 - 0.010x_6$$
$$t = \quad (2.95) \quad (0.047) \quad (0.76) \quad (1.36) \quad (1.58) \quad (0.82)$$
$$R^2 = 0.76 \quad (\overline{R}^2 = 0.71)$$

Total factor productivity is positively related with output growth. All the other variables are negatively related with total factor productivity. Regression coefficient for output growth is statistically significant at 5 percent level. The model explains 71 percent of variations in total factor productivity.

Stepwise regression has picked out capital intensity as the determinant of total factor productivity. The value of adjusted R^2 is 0.59.

$$y = 0.033x_2^{**}$$
$$t = \quad (4.07)$$
$$R^2 = 0.66 \qquad (\overline{R}^2 = 0.59)$$

Publishing, Printing and Reproduction of Recorded Media

Regression equation for publishing, printing and reproduction of recorded media sector is:

$$y = 0.095x_1^{**} + 0.052x_2 + 0.46x_3 - 0.025x_4 + 0.065x_5 + 0.049x_6^{**}$$
$$t = \quad (3.65) \quad (1.35) \quad (0.48) \quad (1.38) \quad (0.25) \quad (3.92)$$
$$R^2 = 0.66 \qquad (\overline{R}^2 = 0.53)$$

The regression result indicates that total factor productivity is positively associated with all the independent variables except with the growth in the number of factories. The regression coefficients are statistically significant at 1 percent level for the output growth and total emoluments. The explained variation of the model is 53 percent.

Stepwise regression model depicts capital-labour ratio to be the most important and significant determinant of total factor productivity. The explained variation of the model is 40 percent.

$$y = 0.051x_2^{**}$$
$$t = \quad (2.66)$$
$$R^2 = 0.50 \qquad (\overline{R}^2 = 0.40)$$

Coke, Refined Petroleum Products and Nuclear Fuel

Regression equation for coke, refined petroleum products and nuclear fuel sector is:

$$y = 1.04x_1^{**} + 0.011x_2^{*} - 0.042x_3^{**} - 0.014x_4 - 0.036x_5 - 0.25x_6^{**}$$
$$t = \quad (6.15) \quad (2.44) \quad (3.49) \quad (1.49) \quad (1.29) \quad (2.79)$$
$$R^2 = 0.96 \quad (\overline{R}^2 = 0.94)$$

The model explains 94 percent of total variations in total factor productivity. Total factor productivity is positively related to output growth and capital intensity. It is negatively related to investment, growth in the number of factories, scale variable and total emoluments. Regression coefficients for output growth, investment and total emoluments are statistically significant at 1 percent level and regression coefficient for capital intensity is significant at 5 percent level.

Stepwise regression has selected output growth, investment and total emoluments to be significant determinants of productivity. The value of adjusted R^2 is 0.93.

$$y = 1.14x_1^{**} + 0.036x_3^{**} + 0.014x_6^{**}$$
$$t = \quad (5.11) \quad (3.46) \quad (2.98)$$
$$R^2 = 0.94 \quad (\overline{R}^2 = 0.93)$$

Chemicals and Chemical Products

Regression equation for chemicals and chemical products sector is:

$$y = 0.019x_1^{**} + 0.026x_2^{**} + 0.075x_3 - 0.012x_4 - 0.031x_5^{**} + 0.87x_6^{*}$$
$$t = \quad (4.37) \quad (3.52) \quad (1.01) \quad (1.52) \quad (3.89) \quad (2.14)$$
$$R^2 = 0.75 \quad (\overline{R}^2 = 0.66)$$

Ordinary least square regression model underscores the fact that total factor productivity is positively related to output growth, capital intensity, investment and total emoluments. Growth in the number of factories and scale variable shows a negative relationship with total factor productivity. Regression coefficients for output growth, capital intensity and scale variable are significant at 1 percent level and regression coefficient for total emoluments is significant at 5 percent level. The model explains 66 percent of variations in total factor productivity.

Output growth emerges to be the most important determinant of total factor productivity in the stepwise regression model. Explanatory power of total factor productivity variables comes to be 51 percent.

$$y = 0.15x_1^{**}$$
$$t = \quad (3.66)$$
$$R^2 = 0.62 \qquad (\overline{R}^2 = 0.51)$$

Rubber and Plastic Products

Regression results for the rubber and plastic products sector are as follows:

$$y = 0.045x_1^{**} + 0.026x_2^{**} - 0.031x_3 + 0.086x_4 - 0.075x_5 + 0.94x_6$$
$$t = \quad (2.71) \quad (4.56) \quad (0.12) \quad (0.084) \quad (1.14) \quad (0.24)$$
$$R^2 = 0.84 \qquad (\overline{R}^2 = 0.77)$$

Total factor productivity is directly related with all the variables except investment. Regression coefficients for output growth and capital intensity are statistically significant at 1 percent level. The explanatory variation of the model is 77 percent.

Significant determinants picked by stepwise regression are output growth and capital intensity. Explanatory power of total factor productivity variables comes to be 80 percent.

$$y = 0.049x_1^{**} + 0.024x_2^{**}$$
$$t = \quad (7.13) \quad (6.83)$$
$$R^2 = 0.81 \quad (\overline{R}^2 = 0.80)$$

Other Non-Metallic Mineral Products

Regression equation for other non-metallic mineral products sector is:

$$y = 0.052x_1^{*} + 0.015x_2 - 0.023x_3 - 0.046x_4 - 0.035x_5 + 0.077x_6$$
$$t = \quad (2.65) \quad (0.34) \quad (0.47) \quad (1.68) \quad (0.68 \quad (1.22)$$
$$R^2 = 0.68 \quad (\overline{R}^2 = 0.55)$$

Total factor productivity is positively related to output growth, capital-labour ratio and total emoluments. It is negatively associated with investment, growth in the number of factories and scale variable. Regression coefficient for output is statistically significant at 5 percent level. The model explains 55 percent of total variation in total factor productivity.

Stepwise regression has selected output growth and growth in the number of factories as the determinants of productivity. The value of adjusted R^2 is 0.54.

$$y = 0.065x_1^{**} - 0.032x_4^{**}$$
$$t = \quad (4.52) \quad (2.31)$$
$$R^2 = 0.58 \quad (\overline{R}^2 = 0.54)$$

Basic Metals

The regression equation for this sector is:

$$y = 0.076x_1^{**} + 0.020x_2 - 0.015x_3 + 0.013x_4^{**} - 0.029x_5^{**} + 1.52x_6$$
$$t = \quad (5.85) \quad (1.08) \quad (0.096) \quad (3.75) \quad (4.36) \quad (0.23)$$
$$R^2 = 0.94 \quad (\overline{R}^2 = 0.92)$$

In the basic metals sector, total factor productivity is positively associated with output growth, capital intensity and total emoluments. It is negatively associated with investment, growth in the number of factories and scale variable. Regression coefficients are statistically significant at 1 percent level for output, growth in the number of factories and scale variable. The model explains 92 percent of the total variations in total factor productivity.

Stepwise regression has selected output growth, growth of the number of factories and scale variable as the determinants of productivity. Total factor productivity is negatively associated with growth of the number of factories and scale variable. The explanatory variation of the model is 93 percent.

$$y = 0.068x_1^{**} - 0.010x_4^{**} - 0.014x_5^{**}$$
$$t = \quad (4.24) \quad (2.79) \quad (3.68)$$
$$R^2 = 0.94 \quad (\overline{R}^2 = 0.93)$$

Fabricated Metal Products, Except Machinery and Equipments

The regression equation for this sector is:

$$y = 0.041x_1^{**} + 0.046x_2 - 0.053x_3 + 0.062x_4 - 0.037x_5 + 1.52x_6$$
$$t = \quad (3.54) \quad (0.21 \;\; (0.57) \quad (0.52) \quad (0.51) \quad (0.16)$$
$$R^2 = 0.81 \quad (\overline{R}^2 = 0.73)$$

The results of regression depict a positive relationship of total factor productivity with output growth, capital intensity, growth in the number of factories and total emoluments. Investment and scale variable are negatively related to total factor productivity. The model explains 73 percent of the variations in the dependent variable. The regression coefficient is statistically significant for the output growth.

The results of stepwise regression indicate a positive and significant relation between total factor productivity and output growth.

$$y = 0.046x_1^{**}$$
$$t = \quad (4.51)$$
$$R^2 = 0.78 \qquad (\overline{R}^2 = 0.77)$$

In the finally selected model, 77 percent of variation in total factor productivity is explained by output growth alone.

Machinery and Equipment N.E.C.

The regression equation for this sector is:

$$y = 1.71x_1^{**} + 0.092x_2 - 0.053x_3 - 0.015x_4^{**} - 0.046x_5^{**} + 0.069x_6^{**}$$
$$t = \quad (5.05) \qquad (2.03) \qquad (0.31) \qquad (4.49) \qquad (3.74) \qquad (2.79)$$
$$R^2 = 0.92 \qquad (\overline{R}^2 = 0.89)$$

Output, capital-labour ratio and total emoluments are positively related to total factor productivity. Investment, growth in the number of factories and scale variable are negatively related to total factor productivity. Regression coefficients for output, growth in the number of factories, scale variable and total emoluments are statistically significant at 1 percent level.

Stepwise regression analysis has selected output, growth in the number of factories and scale variable to be significant determinants of total factor productivity. Productivity is positively related to output and is negatively related to growth in the number of factories and scale variable.

$$y = 1.24x_1^{**} - 0.011x_4^{**} - 0.027x_5^{**}$$
$$t = \quad (4.74) \qquad (4.20) \qquad (3.09)$$
$$R^2 = 0.87 \qquad (\overline{R}^2 = 0.85)$$

The model explains 85 percent variations in total factor productivity.

Office, Accounting and Computer Machinery

Regression equation for this sector is:

$$y = 0.075x_1^{*} + 0.042x_2 - 0.038x_3^{*} - 0.014x_4 + 0.054x_5 - 0.026x_6$$
$$t = \quad (2.57) \quad (1.24) \quad (2.18) \quad (0.66) \quad (0.44) \quad (1.73)$$
$$R^2 = 0.90 \quad (\overline{R}^2 = 0.86)$$

Total factor productivity is positively associated with output, capital-labour ratio and scale variable. The variables investment, growth in the number of factories and total emoluments enter with a negative sign in the regression. The regression coefficients for output and investment are statistically significant at 5 percent level.

Stepwise regression has picked out output and total emoluments as the determinants of total factor productivity. The value of adjusted R^2 is 0.84.

$$y = 0.068x_1^{**} - 0.014x_6^{**}$$
$$t = \quad (4.71) \quad (2.61)$$
$$R^2 = 0.85 \quad (\overline{R}^2 = 0.84)$$

Electrical Machinery and Apparatus N.E.C.

The regression equation for this sector is:

$$y = 0.062x_1^{**} + 0.046x_2^{*} - 0.054x_3 - 0.048x_4^{**} - 0.016x_5^{**} + 0.081x_6$$
$$t = \quad (7.23) \quad (2.35) \quad (0.55) \quad (5.53) \quad (5.32) \quad (1.38)$$
$$R^2 = 0.89 \quad (\overline{R}^2 = 0.85)$$

The model depicts a positive relationship of total factor productivity with output, capital intensity and total emoluments. Investment, growth in the number of factories and scale variable are negatively related to total factor productivity. The regression coefficients for output, growth in the number of factories and scale variable are significant at 1 percent level. Regression coefficient for capital intensity is significant at 5 percent level. The model explains 85 percent of the variations in the dependent variable.

Stepwise regression has picked up output and capital intensity as the determinants of total factor productivity. The value of adjusted R^2 is 0.60.

$$y = 0.057x_1^{**} - 0.041x_2^{**}$$
$$t = \quad (5.85) \quad (4.53)$$
$$R^2 = 0.63 \quad (\overline{R}^2 = 0.60)$$

Radio, Television and Communication Equipment and Apparatus

Regression equation for this sector is:

$$y = 0.052x_1^{**} + 0.068x_2 - 0.047x_3^{*} - 0.013x_4^{**} - 0.057x_5^{**} - 0.015x_6$$
$$t = \quad (6.75) \quad (1.76) \quad (2.04) \quad (5.12) \quad (4.31) \quad (0.79)$$
$$R^2 = 0.87 \quad (\overline{R}^2 = 0.82)$$

Total factor productivity is positively related to output and capital intensity. It is negatively associated with investment, growth in the number of factories, scale variable and total emoluments. Regression coefficients for output, growth in the number of factories and scale variable are statistically significant at 1 percent level. Regression coefficient for investment is statistically significant at 5 percent level. The model explains 82 percent of the variations in total factor productivity. No variable has been selected by stepwise regression for radio, television and communication equipment and apparatus sector.

Medical, Precision and Optical Instruments, Watches and Clocks

Regression results for this sector are as follows:

$$y = 0.047x_1^{**} + 0.057x_2 - 0.036x_3 - 0.015x_4^{*} - 0.023x_5^{**} + 0.025x_6$$
$$t = \quad (6.08) \quad (1.36) \quad (0.12) \quad (2.48) \quad (3.02) \quad (1.90)$$
$$R^2 = 0.89 \quad (\overline{R}^2 = 0.85)$$

The result of regression depicts a positive relationship of total factor productivity with output, capital intensity and total emoluments. Investment, growth in the number of factories and scale variable are negatively related to total factor productivity. Regression coefficients for output and scale variable are significant at 1 percent level. Regression coefficient for growth in the number of factories is significant at 5 percent level. The model explains 85 percent of the variations in total factor productivity.

Stepwise regression selects output and scale variable as important determinants of productivity.

$$y = 0.045x_1^{**} - 0.016x_5^{*}$$
$$t = \quad (6.05) \quad (2.47)$$
$$R^2 = 0.85 \quad (\overline{R}^2 = 0.83)$$

The model explains 83 percent variations in total factor productivity.

Motor Vehicles, Trailers and Semi-trailers

Regression equation for motor vehicles, trailers and semi-trailers sector is:

$$y = 0.096x_1^{**} + 0.065x_2 - 0.048x_3^{*} - 0.016x_4^{**} - 0.077x_5^{**} + 0.081x_6$$
$$t = \quad (6.23) \quad (0.40) \quad (2.13) \quad (4.26) \quad (7.14) \quad (1.88)$$
$$R^2 = 0.93 \quad (\overline{R}^2 = 0.91)$$

Total factor productivity is positively related to output, capital intensity and total emoluments. It is negatively associated with investment, growth in the number of factories, and scale variable. Regression coefficients for output, growth in the number of factories and scale variable are statistically significant at 1 percent level. Regression coefficient for investment is statistically significant at 5 percent level. The model explains 91 percent of the variations in total factor productivity.

Stepwise regression analysis has selected output, investment, growth in the number of factories, scale variable and total emoluments to be significant determinants of total factor productivity. Total factor productivity is positively related to output and total emoluments.

$$y = 0.092x_1^{**} - 0.049x_3^{*} - 0.011x_4^{**} - 0.065x_5^{**} + 0.091x_6^{*}$$
$$t = \quad (6.76) \quad (3.16) \quad (4.56) \quad (7.74) \quad (2.23)$$
$$R^2 = 0.93 \quad (\overline{R}^2 = 0.91)$$

The model explains 91 percent of the variations in total factor productivity.

Other Transport Equipment

The regression equation for this sector is:

$$y = 0.036x_1^{**} - 0.024x_2 - 0.048x_3 + 0.55x_4 - 0.072x_5 + 0.017x_6$$
$$t = \quad (7.60) \quad (1.29) \quad (1.43) \quad (0.59) \quad (0.60) \quad (1.02)$$
$$R^2 = 0.89 \quad (\overline{R}^2 = 0.84)$$

In the other transport equipment sector total factor productivity is positively associated with output, growth in the number of factories and total emoluments. It is negatively associated with capital intensity, investment and scale variable. Regression coefficient for output is statistically significant at 1 percent level. The model explains 84 percent of the total variations in total factor productivity.

Stepwise regression selects output and scale variable as important determinants of productivity.

$$y = 0.025x_1^{**} - 0.054x_5^{**}$$
$$t = \quad (7.35) \quad (6.99)$$
$$R^2 = 0.85 \quad (\overline{R}^2 = 0.84)$$

The model explains 84 percent of the variations in total factor productivity.

Furniture

The regression equation for this sector is:

$$y = 0.026x_1^{**} + 0.075x_2 + 0.036x_3 + 0.011x_4 + 0.084x_5 - 0.041x_6$$
$$t = \quad (5.69) \quad (1.35) \quad (1.67) \quad (0.28) \quad (0.05) \quad (1.36)$$
$$R^2 = 0.89 \quad (\overline{R}^2 = 0.85)$$

Total factor productivity has a positive association with all the independent variables except with that of total emoluments. Regression coefficient for output is statistically significant at 1 percent level. The model explains 85 percent of the variations in total factor productivity.

Stepwise regression analysis highlights the fact that output is the most important determinant of total factor productivity. The explanatory variation of the model is 84 percent.

$$y = 0.022x_1^{**}$$
$$t = \quad (6.05)$$
$$R^2 = 0.84 \quad (\overline{R}^2 = 0.84)$$

6.5 Chapter Summary

At aggregate level, the picture that emerges for the Punjab manufacturing sector is that the overall long term growth of 7.91 per cent per annum in output during 1980-81 to 2002-03 is associated with a rapid growth of capital (5.21 per cent per annum) and an average growth of employment (3.01 per cent per annum). Comparing the annual growth rates during 1980-81 to 1990-91 with those of 1991-92 to 2002-03, the post-reform period, it is found that there is a decline in growth rate of value added from 9.65 per cent per annum in period I to 3.04 per cent per annum in period II. Both capital and labour also decelerate in the post-reform period.

Labour productivity for the whole period increases at an annual rate of 4.76 per cent per annum while capital productivity increases at a rate of 2.57 per cent per annum. Capital intensity for the entire period is 2.14 per cent per annum. Estimates for the sub periods reveal differences in the growth rates. Labour productivity increases at a higher rate, i.e., at 3.98 per cent per annum in the pre-reform period as against 1.72 per cent per annum in the post-reform period. Capital productivity shows a rising trend in the first period of the analysis and it decreases in the second period. Capital intensity which is negative in the pre-reform period improves and becomes positive in the post-reform period.

The estimates of total factor productivity growth of Punjab manufacturing are 1.25 per cent per annum over the total period, 1980-81 to 2002-03. Total factor productivity growth decelerates during the post-reform period. Estimates of pre-reform phase are 1.71, while in the post-reform phase total factor productivity decreases to 0.46 per cent per annum. So the aggregative analysis demonstrates that in the new policy regime there is a deceleration in partial productivity and total factor productivity in the manufacturing sector in Punjab.

Sector wise analysis depicts that in terms of value added the growth rate for manufacturing sector is higher for thirteen industrial groups in the pre-reform phase while nine groups depict higher growth in the post-reform phase. The highest growth rate of value added is recorded for wearing apparel, dressing and dyeing of fur (18), followed by other non-metallic mineral products (26) and food products and beverages (15). The lowest performance is reported by:

coke, refined petroleum products and nuclear fuel (23), which depict a negative rate (-1.57) for the entire period of the analysis.

The highest growth rate of capital is recorded for other non-metallic mineral products (26) followed by tobacco products (16) and wearing apparel, dressing and dyeing of fur (18). Capital growth is the lowest for the machinery and equipment n.e.c (29) during the entire period of the analysis. Eleven sectors depict higher growth of capital for the second period of the analysis. Despite higher growth in capital in the second period, the performance on the productivity front as seen in subsequent part of the research does not show much improvement and is rather a cause of concern.

Rate of growth of labour is highest for the industry group other transport equipment (35) followed by wearing apparel, dressing and dyeing of fur (18) and radio, television and communication equipment and apparatus (32) for the entire period of analysis. Labour growth is the lowest for the basic metals (27), i.e., (-0.67) for the entire period. The manufacturing sector depicts a slow down of labour growth in the second period of the analysis for ten out of twenty two sectors.

The picture is better for the labour productivity for the entire period as nine sectors depict growth rate higher than 7.5 per cent per annum although in case of labour productivity also there is a decline in many sectors in the period associated with reforms. Labour productivity is higher in fifteen sectors in the first period of analysis i.e. the pre-reform phase. Labour productivity shows improvement in only seven sectors in the post-reform phase. So manufacturing sector of Punjab has not performed well in terms of labour productivity in the post-reform era.

The future is not very bright on the capital productivity front. A look at capital productivity trend depicts that for eleven manufacturing industries capital productivity is negative for the entire period and only three industrial groups depict growth rate more than four percent. Industries having rate of growth above four percent are food products and beverages (15), tanning and dressing of leather, luggage, handbags saddlery, harness and footwear (19) and rubber and plastic products (25). Trends in capital productivity for the two sub-periods depict that capital productivity is higher for most of the sectors in the first period of analysis, i.e., the pre-reform era and in the post-reform era only seven out of twenty two sectors depict an improvement in capital productivity. So the trend depicts a lower growth of both capital productivity and labour productivity for most of the industrial groups in the second period of analysis, i.e., the post-reform period.

The analysis of total factor productivity shows a deceleration in productivity in sixteen sectors in the nineties onwards era-the period associated with reform. Out of twenty two sectors, only six sectors depict higher productivity in the post-1991 phase. Industry group wood and products of wood and cork, except furniture, articles of straw and plating materials (20), depicts the highest growth in total factor productivity for the entire period, being followed by industrial groups food products and beverages (15) and furniture (36). All these three industries depict a higher growth in labour productivity. Moreover the growth rate is good as it is between 7.5–10 percent. In terms of capital productivity also, the growth rate is between 2-3 percent in these three industries. Paper and paper products (21), chemicals and chemical products (23), basic metals (27) and electrical machinery and apparatus n.e.c. (31) depict a negative growth rate in the entire period. These sectors have not performed well on productivity front. Overall analysis depicts that total factor productivity decelerates for most of the sectors in Punjab manufacturing in the new policy regime. So the hypothesis is rejected as productivity has not improved in the post-1991 period, the period of new policy regime for Punjab Manufacturing.

Analyzing the determinants of productivity growth in Punjab manufacturing, the regression results show that coefficients for output growth variable are positive and statistically significant in all the industries. The rate of output growth is an important determinant of productivity. So the hypothesis is accepted.

A significant positive relationship between output growth and total factor productivity growth has been observed in a number of earlier studies. Kendrick (1961, 1973) and others have pointed out that productivity growth and output growth are interrelated. Just as productivity growth can be seen as an effect of output growth because of differential scale economies and technological progress that it creates, output growth may also be seen as a consequence of productivity growth because of lowering of costs and prices that the latter leads to and the increase in demand that fall in prices themselves lead to.

A significant and positive relationship has also been observed between capital intensity and total factor productivity in eight industries. The regression coefficients of total emoluments are positive for most of the industries. Motivation is basic to all human behavior and it leads to productivity improvement. Productivity depends on financial incentives provided to workers and other employees. This includes the methods of paying wages and salaries, rewards and incentive plans. The regression coefficients of total emoluments are significant for eight industries.

The regression coefficients of investment are positively related to total factor productivity for the entire manufacturing and for wood and products of wood and cork, except furniture, articles of straw and plating materials (20), printing and reproduction of recorded media (22), chemicals and chemical products (23), electrical machinery and apparatus n.e.c. (31) and furniture (36). In most of the sectors investment coefficients are negatively related with total factor productivity. The growth of factories is positively related to total factor productivity in seven industries. The results of regression depict a significant relationship between total factor productivity and growth in the number of factories in ten industries. Scale variable enters in many industries with a negative sign. This could be due to its relationship with other variables included in the model.

Chapter 7

NEW POLICY REGIME AND PRODUCTIVITY OF MANUFACTURING SECTOR: A COMPARISON OF INDIA AND PUNJAB

7.1 Introduction

In this chapter a comparison has been made between productivity of Indian manufacturing and Punjab manufacturing. The study analyses the trends in output (value added), inputs (capital, labour) as well as trends in labour productivity, capital productivity, capital intensity and total factor productivity for the entire period as well as for the pre-reform period and post-reform period. On the basis of this analysis, a comparison has been made between the Indian manufacturing and Punjab manufacturing to examine in which sector the productivity growth is high. The analysis has been done at aggregate level as well as for twenty two industrial sectors for the organized manufacturing sector in India and Punjab for the entire period as well as for the two sub periods.

Hypothesis

The impact of new policy regime on the adjustment process of Punjab manufacturing sector is significantly different from that of India.

7.2 Analysis: Comparison of Indian Manufacturing and Punjab Manufacturing at Aggregate Level

A comparison of Indian and Punjab manufacturing at aggregate level in terms of value added, inputs (capital, labour), partial productivity and total factor productivity is depicted in the table 7.2.

In terms of output growth rate, a similar trend has been observed for both Indian as well as Punjab manufacturing. The growth rate of output for all India manufacturing is 7.78 per cent per annum and for Punjab manufacturing, it is 7.91 per cent per annum for the entire period of analysis i.e. 1980-81 to 2002-03. Output growth rate in the post-reform period decelerates for both the Indian and Punjab manufacturing sector, but for Punjab manufacturing the decline is sharper. The rate of growth of capital is 6.05 per cent per annum for Indian manufacturing and 5.21 per cent per annum for Punjab manufacturing for the entire period. The rate of growth of capital for Indian manufacturing slightly increases in the post-reform period. But for Punjab manufacturing, this growth rate decelerates in the post-reform period. On employment growth front, Punjab manufacturing grows at a higher rate as compared to Indian manufacturing. For Indian manufacturing this rate of growth is 0.65 per cent per annum and for Punjab manufacturing, it is 3.01 per cent per annum for the entire period of analysis.

Table 7.2: Growth Rates of Value Added, Capital, Employment and Productivity Trends in Indian Manufacturing and Punjab Manufacturing

	India			**Punjab**		
	1980-81-2002-03	**1980-81-1990-91**	**1991-92-2002-03**	**1980-81-2002-03**	**1980-81-1990-91**	**1991-92-2002-03**
Value Added	7.78	6.67	4.38	7.91	9.65	3.04
Capital	6.05	4.34	4.63	5.21	4.91	1.92
Employment	0.65	0.23	-0.81	3.01	5.46	1.29
Labour Productivity	7.09	6.43	5.24	4.76	3.98	1.72
Capital Productivity	1.64	2.23	-0.23	2.57	4.52	1.1
Capital Intensity	5.36	4.11	5.48	2.14	-0.52	0.62
Total Factor Productivity	1.24	1.53	0.44	1.25	1.71	0.46

Computed

Having had an idea about the output and input growth, let us observe the productivity trends in Indian and Punjab manufacturing. The growth rate of labour productivity is higher for manufacturing sector of India as compared to that of Punjab. On the other hand, capital productivity is higher for Punjab manufacturing. For Indian manufacturing, capital productivity declines and become negative in the new policy regime. The growth rate of capital intensity is higher for Indian manufacturing as compared to Punjab manufacturing. This rate of growth of capital intensity shows an increase in the new policy regime for both the Indian manufacturing as well as Punjab manufacturing. The results for the total factor productivity are almost similar for Indian and Punjab manufacturing. Furthermore, when we split the whole period into sub periods, both Indian manufacturing and Punjab manufacturing show a deceleration of total factor productivity in the post-reform period. Thus the results highlights that the performance of Indian manufacturing and Punjab manufacturing for the time period 1980-81 to 2002-03 is almost similar.

In terms of value added, input growth, partial productivity and total factor productivity Punjab manufacturing depicts a deceleration in the new policy regime. For Indian manufacturing also, the new policy regime is associated with lesser growth of output, labour productivity, capital productivity and total factor productivity. There is a deceleration in the growth of labour also while capital growth rate shows small rise for the Indian manufacturing in the new policy regime. Only in case of capital intensity both the Punjab manufacturing and Indian manufacturing shows some improvement. Overall, the aggregative analysis depicts that the performance of Indian manufacturing and Punjab manufacturing in terms of productivity is almost similar and both show deceleration in period associated with reforms.

7.3 Sectorwise Analysis: Comparison of Indian and Punjab Manufacturing

After making a comparison of Indian and Punjab manufacturing at aggregate level, the comparison has been done at disaggregative level. At the disaggregate level, the analysis has been done for 22 two digit manufacturing industries of India and Punjab.

Trends in Value Added

The table (7.3.1) shows the comparative rate of growth of value added for Indian manufacturing and for Punjab manufacturing. For the total period of analysis, growth rates of value added are higher for nine sectors in the manufacturing sector of India as compared with that of Punjab. For thirteen other sectors, growth rates of value added are higher in Punjab manufacturing. For six sectors, the growth rate of value added for the entire period is more than ten per cent per annum for both Indian and Punjab manufacturing. These sectors are food products and beverages (15), tobacco products (16), wearing apparel, dressing and dyeing of fur (18), wood and products of wood and cork, except furniture, articles of straw and plating materials (20), fabricated metal products, except machinery and equipments (28) and furniture (36). The growth rate of output for Indian manufacturing is the highest for wearing apparel, dressing and dyeing of fur (18) followed by furniture (36) and coke, refined petroleum products and nuclear fuel (24). On the other hand, for Punjab manufacturing, the rate of growth of output is the highest for wearing apparel, dressing and dyeing of fur (18) followed by other non-metallic mineral products (26) and food products and beverages (15).

Table 7.3.1: Growth Rates of Value Added in Manufacturing Sector in India and Punjab

Industry code	India			Punjab		
	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
15	11.12	12.76	8.76	13.53	14.51	12.62
16	11.29	21.22	3.98	10.85	14.40	6.29
17	5.74	7.54	5.86	7.64	14.93	-0.59
18	16.01	10.72	9.61	17.49	20.52	9.83
19	12.58	11.03	3.24	6.60	3.53	2.89
20	11.66	6.13	14.86	11.00	8.50	16.53
21	7.01	7.15	3.41	7.66	11.70	3.71
22	6.03	3.65	2.21	2.83	9.12	1.45
23	7.89	4.99	7.05	-1.57	0.92	0.60
24	13.26	15.33	8.35	8.79	5.49	7.77
25	1.88	1.75	5.56	13.17	7.62	6.61
26	8.20	9.25	2.80	14.12	15.11	17.63
27	7.59	8.40	5.53	3.47	8.63	-3.04
28	10.67	8.28	5.62	12.76	11.08	3.83
29	2.36	-1.56	2.96	5.40	-3.42	10.00
30	3.37	1.88	-1.58	11.81	8.22	15.83
31	1.99	-0.81	-2.49	4.36	-1.24	4.66
32	6.29	4.95	2.64	7.14	7.26	4.66
33	11.57	1.59	10.78	9.67	-0.86	7.44
34	6.89	6.09	5.90	7.08	7.82	11.53
35	5.91	4.62	3.70	8.82	12.70	4.28
36	13.63	3.51	14.98	12.90	2.04	12.90

Computed, Note: Two digit industry code description: Appendix B

Comparing period I with period II, six out of twenty two sectors show higher output growth in the new policy regime for Indian manufacturing and nine out of twenty two sectors show higher output growth for Punjab manufacturing for the same period. So the growth rate of output of most of the sectors is higher in the pre-1991 period. On the whole the performance in terms of output for Punjab manufacturing is somewhat better than that for the manufacturing sector of India.

Table 7.3.2: Growth Rates of Capital in Manufacturing Sector in India and Punjab

Industry code	India			Punjab		
	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
15	7.25	4.97	7.23	7.77	6.96	6.51
16	6.35	4.82	6.06	11.59	7.97	11.73
17	6.79	3.37	6.81	9.41	9.24	6.70
18	13.74	7.14	13.40	11.28	6.90	10.20
19	9.94	4.43	8.27	1.73	-1.19	3.59
20	5.98	3.52	7.07	7.87	7.11	10.76
21	6.55	3.78	6.76	9.61	13.84	7.14
22	6.38	3.52	7.02	2.35	1.31	3.55
23	10.28	7.08	11.33	1.90	7.15	4.32
24	10.63	10.86	8.59	7.55	12.14	4.23
25	7.68	3.24	10.57	7.79	4.33	3.62
26	9.66	9.65	8.94	15.47	15.38	21.77
27	6.33	3.91	4.73	6.12	4.42	3.75
28	7.48	3.80	6.86	9.57	4.47	11.08
29	4.75	3.86	5.67	0.55	0.96	1.43
30	7.28	8.17	3.88	10.53	5.63	12.51
31	5.41	3.09	5.02	0.68	2.03	0.58
32	13.51	12.93	8.46	5.52	6.67	1.80
33	9.88	5.25	10.37	8.22	5.79	8.12
34	8.42	5.06	10.75	7.08	5.16	10.65
35	3.39	1.30	3.63	3.56	6.38	2.82
36	10.30	3.89	13.86	10.04	5.63	11.05

Computed, Note: Two digit industry code description: Appendix B

Trends in Capital

A comparison between Indian and Punjab manufacturing in terms of growth rate of capital is depicted in table 7.3.2. Growth rates of capital are higher in twelve sectors for Indian manufacturing as compared to Punjab manufacturing for the entire period. For Indian manufacturing, the highest growth rate of capital is recorded for wearing apparel, dressing and dyeing of fur (18) followed by radio, television and communication equipment and apparatus (32) and coke, refined petroleum products and nuclear fuel (24); and for Punjab manufacturing growth rate is the highest for other non-metallic mineral products (26) followed by tobacco products (16) and wearing apparel, dressing and dyeing of fur (18). The sectors which depict almost similar growth rate for Indian and Punjab manufacturing are: food products and beverages (15), rubber and plastic products (25), other transport equipment (35) and furniture (36).

Sub sectoral analysis reveals that eighteen sectors show higher growth in capital in the post-reform period for Indian manufacturing and twelve sectors show higher capital growth for Punjab manufacturing for the same period. The performance of most of the sectors of both Indian and Punjab manufacturing in terms of capital growth is better in the post-reform period.

Trends in Labour

The table 7.3.3 depicts that for the entire period, growth rate of labour is higher in fifteen sectors of Punjab manufacturing as compared with Indian manufacturing. Seven out of twenty two sectors of Indian manufacturing show negative growth rate of labour for the whole period of the analysis. Comparing pre-reform period with post-reform period, eight sectors show increase in rate of growth of labour in the latter period of analysis for the Indian manufacturing. Three sectors, namely, publishing, printing and reproduction of recorded media of India (22), machinery and equipment n.e.c (29) and other transport equipment (35) shows negative trend in both the sub-periods for Indian manufacturing.

For Punjab manufacturing, twelve sectors show an improvement in rate of growth of labour in the post-reform era. The growth rate of labour for Punjab manufacturing is the highest for other transport equipment (35) followed by wearing apparel, dressing and dyeing of fur (18) and radio, television and communication equipment and apparatus (32). Only one sector, namely, basic metals (27) depicts negative rate of growth of labour for Punjab manufacturing for the entire period of the analysis. So the performance in terms of labour growth is better for Punjab manufacturing as compared to Indian manufacturing.

Table 7.3.3: Growth Rates of Labour in Manufacturing Sector in India and Punjab

Industry code	India			Punjab		
	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
15	0.77	-2.06	0.74	3.73	6.12	5.39
16	1.77	1.39	0.23	4.30	6.54	3.96
17	-1.46	-1.96	-2.48	0.03	3.79	-3.17
18	9.25	5.54	9.46	7.43	12.46	8.00
19	5.77	9.81	2.26	0.40	0.38	3.27
20	-0.07	-1.54	1.23	1.49	-6.56	9.51
21	1.63	-0.004	1.46	4.62	13.62	1.03
22	-1.20	-1.16	-3.32	5.05	2.27	8.77
23	0.55	0.90	0.62	5.31	6.33	4.45
24	3.09	3.15	2.58	4.60	12.34	3.01
25	0.86	-1.36	3.65	6.10	8.89	6.52
26	2.11	4.80	1.07	2.28	6.68	4.97
27	0.95	3.54	-1.43	-0.67	0.36	-2.00
28	3.50	4.98	2.17	2.98	0.24	2.32
29	-0.95	-0.86	-0.82	5.15	3.55	7.51
30	-2.44	0.03	-4.86	5.49	4.07	7.12
31	-0.97	0.14	-3.97	6.00	5.36	5.71
32	5.19	12.33	-1.41	6.65	4.97	7.26
33	6.36	6.65	5.32	3.25	-2.66	5.11
34	4.96	0.64	13.62	2.22	3.16	7.63
35	-0.20	-1.02	-1.33	9.06	8.69	9.16
36	5.41	1.75	6.99	3.02	-4.99	6.86

Computed, Note: Two digit industry code description: Appendix B

An analysis of productivity is essential to have a complete picture of manufacturing sector.

Analysis: Partial Productivity

Labour Productivity

In the table below the trends in labour productivity in Indian manufacturing and Punjab manufacturing sector have been depicted. For the total period, growth rate of labour productivity is higher in twelve sectors in the manufacturing sector of Punjab than in the manufacturing sector of India. Three sectors, namely, textiles (17), tanning and dressing of leather, luggage, handbags saddlery, harness and footwear (19) and coke, refined petroleum products and nuclear fuel (24) depict almost similar rate of growth of labour productivity, for both Indian as well as Punjab manufacturing.

Table 7.3.4: Growth Rates of Labour Productivity in Manufacturing Sector in India and Punjab

Industry code	India			Punjab		
	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
15	10.27	15.13	7.96	9.44	7.90	6.86
16	9.36	19.56	3.75	6.27	7.37	2.25
17	7.31	9.69	8.55	7.61	10.73	2.66
18	6.19	4.90	0.13	8.50	4.23	1.69
19	6.44	1.12	0.95	6.17	3.14	-0.37
20	11.74	7.80	13.47	9.37	16.11	6.41
21	5.30	7.15	1.93	9.19	12.14	2.66
22	7.32	4.87	5.71	0.47	7.71	-2.03
23	7.30	4.06	6.39	0.47	-5.81	-3.57
24	8.91	4.91	5.62	8.07	5.98	4.62
25	1.00	3.15	1.84	4.99	3.16	2.89
26	5.96	4.24	1.71	11.57	7.90	11.81
27	6.57	4.70	7.06	4.17	8.24	-1.07
28	6.93	3.14	3.38	9.50	10.81	1.48
29	3.35	-0.71	3.81	4.82	-4.34	8.45
30	5.95	1.85	3.45	6.90	3.98	8.12
31	2.99	-0.95	1.55	3.65	-3.20	1.81
32	1.04	-6.56	4.11	1.53	0.56	2.81
33	4.90	-4.75	5.19	6.22	1.85	2.22
34	1.84	5.41	-6.80	4.75	4.51	3.63
35	6.13	5.70	5.09	5.08	5.94	1.42
36	7.80	1.72	7.46	9.59	7.40	5.65

Computed, Note: Two digit industry code description: Appendix B

Growth rate of labour productivity for Indian manufacturing is the highest for wood and products of wood and cork, except furniture, articles of straw and plating materials (20) followed by food products and beverages (15) and tobacco products (16). For Punjab manufacturing, the rate of growth of labour productivity is the highest for other non-metallic mineral products (26) followed by furniture (36) and fabricated metal products, except machinery and equipments (28). The sector motor vehicles, trailer and semi-trailers (34) shows negative rate of growth of labour productivity in the post-reform period for manufacturing sector of India. In Punjab manufacturing, the sectors: tanning and dressing of leather, luggage, handbags saddlery, harness and footwear (19), publishing, printing and reproduction of recorded media (22), chemicals and chemical products (23) and basic metals (27) shows negative growth rate in the post-1991 period. Sub-periods analysis reveals that twelve sectors show higher growth in labour productivity in the post-reform period for Indian manufacturing and seven sectors for Punjab manufacturing in the same period. So the performance in terms of labour productivity is better for Indian manufacturing sector as compared to Punjab manufacturing sector in the new policy regime.

Capital Productivity

In terms of capital productivity, twelve out of twenty two sectors of Indian manufacturing depict higher growth rate as compared to manufacturing sector of Punjab for the entire period. Only seven sectors show higher growth in capital productivity in the post-reform period for Indian manufacturing and nine sectors for Punjab manufacturing. Ten sectors of Indian manufacturing and ten sectors of Punjab manufacturing depict negative growth rate of capital productivity for the entire period of the analysis. Again, negative rate of growth of capital productivity has been seen for both the Indian and Punjab manufacturing in the new policy regime. On the whole, the performance in terms of capital productivity is not good for Indian manufacturing as well as for Punjab manufacturing in the new policy regime.

Table 7.3.5: Growth Rates of Capital Productivity in Manufacturing Sector in India and Punjab

Industry code	India			Punjab		
	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
15	3.61	7.43	1.42	5.34	7.06	5.73
16	1.61	8.37	-1.96	-0.67	5.96	-4.87
17	-0.98	4.03	-0.89	-1.61	5.20	-6.84
18	1.99	3.34	-3.35	1.06	2.12	-2.10
19	2.41	6.32	-4.64	4.79	4.77	-0.68
20	5.36	2.53	7.27	2.91	1.30	5.22
21	0.43	3.24	-3.14	-1.78	-1.87	-3.20
22	-0.33	0.13	-4.50	-2.12	6.70	-6.73
23	-2.17	-1.95	-3.84	-6.53	-5.09	-3.69
24	1.49	-2.39	-0.23	3.11	0.92	3.39
25	-5.39	-1.44	-4.53	6.67	-1.17	0.09
26	-1.33	-0.37	-5.64	-3.48	-0.24	-9.06
27	1.19	4.32	0.76	-2.50	4.03	-6.55
28	2.97	4.31	-1.17	3.68	5.89	-4.13
29	-2.28	-5.22	-2.56	0.24	-6.73	2.32
30	-3.65	-5.81	-5.26	2.03	2.46	2.94
31	-3.25	-3.78	-7.15	-1.55	-6.26	-3.14
32	-6.36	-7.07	-5.36	0.46	2.19	-2.42
33	1.54	-3.48	0.37	1.34	-6.28	-0.62
34	-1.41	0.98	-4.38	-0.001	2.52	0.79
35	2.44	3.28	0.06	-0.22	3.69	-4.48
36	3.02	-0.37	0.98	2.60	-3.39	1.67

Computed, Note: Two digit industry code description: Appendix B

Capital Intensity

Comparative growth rate of capital intensity in the manufacturing sector of India and Punjab is presented in the table 7.3.6. For the total period of analysis, growth rate of capital intensity is higher for twelve sectors in the manufacturing sector of India as compared to the manufacturing sector in Punjab. The growth rate of capital intensity is above 5 per cent per annum for the entire period for five sectors of both India and Punjab manufacturing. These are textiles (17), wood and products of wood and cork, except furniture, articles of straw and plating materials (20), other non-metallic mineral products (26), basic metals (27) and electrical machinery and apparatus n.e.c. (31).

Table 7.3.6: Growth Rates of Capital Intensity in Manufacturing Sector in India and Punjab

Industry code	India			Punjab		
	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
15	6.43	7.17	6.45	3.90	0.79	1.06
16	4.51	3.38	5.82	6.99	1.34	7.48
17	8.37	5.44	9.53	9.38	5.26	10.20
18	4.11	1.51	3.60	3.58	-4.94	2.04
19	3.94	-4.89	5.87	1.32	-1.56	0.31
20	6.06	5.14	5.77	6.28	14.62	1.14
21	4.84	3.79	5.23	4.78	0.19	6.05
22	7.67	4.74	10.69	2.64	0.95	5.04
23	9.67	6.12	10.64	3.35	-0.76	0.12
24	7.31	7.48	5.86	2.82	-0.18	1.19
25	6.75	4.66	6.67	-1.57	4.37	2.80
26	7.39	4.63	7.79	12.89	8.15	16.00
27	5.33	0.36	6.25	6.84	4.05	5.86
28	3.84	-1.12	4.60	5.61	4.65	5.85
29	5.76	4.76	6.54	4.58	2.57	5.99
30	9.96	8.14	12.99	4.77	1.49	5.03
31	6.44	2.94	9.37	5.28	3.26	5.10
32	7.90	0.54	10.01	1.06	-1.59	5.36
33	3.31	-1.31	4.80	4.81	8.68	2.86
34	3.29	4.39	-2.53	4.76	1.94	2.81
35	3.60	2.35	5.03	5.31	2.17	6.17
36	4.64	2.10	6.42	6.81	11.17	3.92

Computed, Note: Two digit industry code description: Appendix B

The growth rate of capital intensity for Indian manufacturing is the highest for office, accounting and computing machinery (30) followed by coke, refined petroleum products and nuclear fuel (23), and textiles (17). Next, for Punjab manufacturing, the growth rate of capital intensity is the highest for other non-metallic mineral products (26) followed by textiles (17) and tobacco products (16). Comparison at sub sectoral level depicts that nineteen out of twenty two sectors show higher capital intensity growth in the new policy regime for Indian manufacturing and eighteen out of twenty two sectors show higher capital intensity growth for Punjab manufacturing in the same period. Almost all the sectors which have negative growth rate of capital intensity in the pre-reform period experience positive growth rate of capital intensity in the post-reform period for both the Indian and Punjab manufacturing. So the growth rate of capital intensity for most of the sectors is higher in the new policy regime.

On the whole, the performance in terms of capital intensity is better for both the Indian and Punjab manufacturing in the new policy regime.

Trends in Total Factor Productivity

Table 7.3.7: Growth Rates of Total Factor Productivity in Manufacturing Sector in India and Punjab

Industry code	India			Punjab		
	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03	1980-81-2002-03	1980-81-1990-91	1991-92-2002-03
15	1.88	3.58	0.96	2.10	2.65	1.83
16	2.06	5.68	-0.07	0.15	2.27	-1.21
17	1.16	2.79	1.85	0.42	2.69	-1.56
18	1.09	1.40	-0.82	0.78	0.48	-0.86
19	1.15	1.68	-1.28	1.95	1.75	-0.54
20	2.86	2.07	3.01	2.51	3.92	2.26
21	0.88	2.00	-0.60	-0.93	-1.01	-1.42
22	1.16	1.10	-0.14	0.36	3.00	0.22
23	-0.41	-0.37	-1.23	-1.01	-2.74	1.84
24	1.39	-0.53	0.35	1.34	0.57	1.19
25	-1.93	-0.02	-1.88	1.63	2.87	0.31
26	0.16	0.63	-1.73	1.33	1.78	0.25
27	0.88	1.60	0.69	-0.33	2.22	-2.35
28	1.51	1.45	0.16	1.93	2.80	-0.73
29	-0.06	-1.43	-0.18	0.72	-2.92	1.71
30	-0.42	-1.31	-1.38	1.32	1.24	1.47
31	-0.63	-1.22	-2.28	-0.13	-2.93	-0.97
32	-2.21	-3.36	-1.63	0.23	0.82	-0.74
33	1.06	-1.64	0.64	1.36	-1.31	0.18
34	-0.08	1.21	-2.15	0.69	1.32	0.66
35	1.48	1.89	0.46	0.57	1.74	-0.93
36	1.97	0.39	1.11	2.06	0.82	0.83

Computed, Note: Two digit industry code description: Appendix B

A view of total factor productivity is necessary to have a clear picture of manufacturing sector. A comparison has been made between Indian and Punjab manufacturing in terms of growth rate of total factor productivity in table 7.3.7. For the entire period, thirteen out of twenty two sectors depict higher growth rate of total factor productivity for Punjab manufacturing as compared to manufacturing sector of India. Wood and products of wood and cork, except furniture, articles of straw and plating materials (20), food products and beverages (15) and furniture (36) depict better performance of total factor productivity for both Indian and Punjab manufacturing. The performance of coke, refined petroleum products and nuclear fuel (23) and electrical machinery and apparatus n.e.c. (31) industrial sectors is sluggish for both Indian manufacturing and Punjab manufacturing. Seven sectors of Indian manufacturing and four sectors of Punjab manufacturing show negative growth rate of total factor productivity for the entire period of the analysis. Only two sectors of India and three sectors of Punjab manufacturing depict more than two per cent per annum growth rate of total factor productivity for the entire period.

At sub sector level, sixteen sectors of Indian manufacturing and fifteen sectors of Punjab manufacturing depict declining rate of growth of total factor productivity during the new policy regime. So overall analysis of total factor productivity depict a deceleration in productivity for Indian manufacturing as well as for Punjab manufacturing in the nineties onwards era-the period associated with reforms.

Table 7.3.8: A comparison of R^2 and Adjusted R^2 in ordinary least square regression and stepwise regression in Indian and Punjab manufacturing

Industry Code	Industry Name	India		Punjab	
		Ordinary least square regression	Stepwise regression	Ordinary least square regression	Stepwise regression
Aggregative Results		$R^2 = 0.93$ ($\bar{R}^2$=0.90)	$R^2 = 0.92$ ($\bar{R}^2$=0.92)	$R^2 = 0.98$ ($\bar{R}^2$=0.97)	$R^2 = 0.97$ ($\bar{R}^2$=0.97)
15	Food Products and Beverages	$R^2 = 0.95$ ($\bar{R}^2$=0.93)	$R^2 = 0.80$ ($\bar{R}^2$=0.79)	$R^2 = 0.95$ ($\bar{R}^2$=0.93)	$R^2 = 0.94$ ($\bar{R}^2$=0.93)
16	Tobacco Products	$R^2 = 0.92$ ($\bar{R}^2$=0.86)	$R^2 = 0.80$ ($\bar{R}^2$=0.79)	$R^2 = 0.92$ ($\bar{R}^2$=0.88)	*-
17	Textiles	$R^2 = 0.98$ ($\bar{R}^2$=0.97)	$R^2 = 0.97$ ($\bar{R}^2$=0.97)	$R^2 = 0.93$ ($\bar{R}^2$=0.91)	$R^2 = 0.90$ ($\bar{R}^2$=0.89)
18	Wearing Apparel, Dressing & Dyeing of Fur	$R^2 = 0.79$ ($\bar{R}^2$=0.71)	$R^2 = 0.73$ ($\bar{R}^2$=0.70)	$R^2 = 0.81$ ($\bar{R}^2$=0.73)	$R^2 = 0.77$ ($\bar{R}^2$=0.72)
19	Tanning and Dressing of Leather, Luggage, Handbags Saddlery, Harness & Footwear	$R^2 = 0.92$ ($\bar{R}^2$=0.88)	$R^2 = 0.78$ ($\bar{R}^2$=0.77)	$R^2 = 0.85$ ($\bar{R}^2$=0.80)	$R^2 = 0.82$ ($\bar{R}^2$=0.80)
20	Wood and Products of Wood and Cork, Except Furniture,Articles of Straw and Plating Materials	$R^2 = 0.95$ ($\bar{R}^2$=0.94)	$R^2 = 0.92$ ($\bar{R}^2$=0.91)	$R^2 = 0.95$ ($\bar{R}^2$=0.93)	$R^2 = 0.90$ ($\bar{R}^2$=0.89)
21	Paper and Paper Products	$R^2 = 0.88$ ($\bar{R}^2$=0.84)	$R^2 = 0.84$ ($\bar{R}^2$=0.82)	$R^2 = 0.76$ ($\bar{R}^2$=0.71)	$R^2 = 0.66$ ($\bar{R}^2$=0.59)
22	Publishing, Printing and Reproduction of Recorded Media	$R^2 = 0.97$ ($\bar{R}^2$=0.96)	$R^2 = 0.97$ ($\bar{R}^2$=0.96)	$R^2 = 0.66$ ($\bar{R}^2$=0.53)	$R^2 = 0.50$ ($\bar{R}^2$=0.40)
23	Coke, refined petroleum products & nuclear fuel	$R^2 = 0.89$ ($\bar{R}^2$=0.85)	$R^2 = 0.84$ ($\bar{R}^2$=0.82)	$R^2 = 0.96$ ($\bar{R}^2$=0.94)	$R^2 = 0.94$ ($\bar{R}^2$=0.93)
24	Chemicals and Chemical Products	$R^2 = 0.88$ ($\bar{R}^2$=0.84)	*-	$R^2 = 0.75$ ($\bar{R}^2$=0.66)	$R^2 = 0.62$ ($\bar{R}^2$=0.51)
25	Rubber and Plastic Products	$R^2 = 0.98$ ($\bar{R}^2$=0.97)	$R^2 = 0.98$ ($\bar{R}^2$=0.97)	$R^2 = 0.84$ ($\bar{R}^2$=0.77)	$R^2 = 0.81$ ($\bar{R}^2$=0.80)
26	Other Non-Metallic Mineral Products	$R^2 = 0.94$ ($\bar{R}^2$=0.91)	$R^2 = 0.92$ ($\bar{R}^2$=0.90)	$R^2 = 0.68$ ($\bar{R}^2$=0.55)	$R^2 = 0.58$ ($\bar{R}^2$=0.54)
27	Basic Metals	$R^2 = 0.92$ ($\bar{R}^2$=0.88)	$R^2 = 0.83$ ($\bar{R}^2$=0.83)	$R^2 = 0.94$ ($\bar{R}^2$=0.92)	$R^2 = 0.94$ ($\bar{R}^2$=0.93)
28	Fabricated Metal Products, Except Machinery and Equipments	$R^2 = 0.91$ ($\bar{R}^2$=0.88)	$R^2 = 0.90$ ($\bar{R}^2$=0.89)	$R^2 = 0.81$ ($\bar{R}^2$=0.73)	$R^2 = 0.78$ ($\bar{R}^2$=0.77)
29	Machinery and Equipment N.E.C,	$R^2 = 0.97$ ($\bar{R}^2$=0.95)	$R^2 = 0.96$ ($\bar{R}^2$=0.95)	$R^2 = 0.92$ ($\bar{R}^2$=0.89)	$R^2 = 0.87$ ($\bar{R}^2$=0.85)
30	Office, Accounting and Computing Machinery	$R^2 = 0.86$ ($\bar{R}^2$=0.81)	$R^2 = 0.81$ ($\bar{R}^2$=0.79)	$R^2 = 0.90$ ($\bar{R}^2$=0.86)	$R^2 = 0.85$ ($\bar{R}^2$=0.84)
31	Electrical Machinery &Apparatus N.E.C.	$R^2 = 0.98$ ($\bar{R}^2$=0.97)	$R^2 = 0.98$ ($\bar{R}^2$=0.97)	$R^2 = 0.89$ ($\bar{R}^2$=0.85)	$R^2 = 0.63$ ($\bar{R}^2$=0.60)
32	Radio, Television and Communication Equipment and Apparatus	$R^2 = 0.98$ ($\bar{R}^2$=0.98)	$R^2 = 0.98$ ($\bar{R}^2$=0.98)	$R^2 = 0.87$ ($\bar{R}^2$=0.82)	*-
33	Medical, Precision and Optical Instruments, Watches & Clocks	$R^2 = 0.79$ ($\bar{R}^2$=0.71)	$R^2 = 0.76$ ($\bar{R}^2$=0.72)	$R^2 = 0.89$ ($\bar{R}^2$=0.85)	$R^2 = 0.85$ ($\bar{R}^2$=0.83)
34	Motor Vehicles, Trailer and Semi-Trailers	$R^2 = 0.56$ ($\bar{R}^2$=0.39)	$R^2 = 0.55$ ($\bar{R}^2$=0.50)	$R^2 = 0.93$ ($\bar{R}^2$=0.91)	$R^2 = 0.93$ ($\bar{R}^2$=0.91)
35	Other Transport Equipment	$R^2 = 0.97$ ($\bar{R}^2$=0.96)	$R^2 = 0.95$ ($\bar{R}^2$=0.95)	$R^2 = 0.89$ ($\bar{R}^2$=0.84)	$R^2 = 0.85$ ($\bar{R}^2$=0.84)
36	Furniture	$R^2 = 0.79$ ($\bar{R}^2$=0.71)	$R^2 = 0.62$ ($\bar{R}^2$=0.60)	$R^2 = 0.89$ ($\bar{R}^2$=0.85)	$R^2 = 0.84$ ($\bar{R}^2$=0.84)

*No variable selected by stepwise regression for Tobacco Products of Punjab (16), Radio, Television and Communication Equipment and Apparatus of Punjab (32) and Chemicals and Chemical Products of India (24)

A comparison of R^2 and $\bar{R}^2$ in ordinary least square regression and stepwise regression in Indian and Punjab manufacturing has been depicted in table 7.3.8. The analysis shows that $\bar{R}^2$ is more than 0.80 for nineteen industrial sectors in ordinary least square regression and for eleven industrial sectors in Stepwise regression out of a total of twenty two industrial sectors for India. For Punjab manufacturing $\bar{R}^2$ is more than 0.80 for sixteen industrial sectors in ordinary least square regression and for fourteen industrial sectors in Stepwise regression out of a total of twenty two industrial sectors. The value of $\bar{R}^2$ is less than 0.80 for three industrial sectors in ordinary least square regression and for eleven industrial sectors in Stepwise regression out of a total of twenty two industrial sectors for India. The value of $\bar{R}^2$ is less than 0.80 for six industrial sectors in ordinary least square regression and for eight industrial sectors in Stepwise regression out of a total of twenty two industrial sectors for Punjab. Thus the above results clearly highlight that the model used in the study is of good fit.

7.5 Chapter Summary

The present chapter is a comparative study of productivity in Indian manufacturing and Punjab manufacturing. The analysis at aggregative level depicts that the total manufacturing of India grows at a higher rate in terms of capital, labour productivity and capital intensity. On the other hand, the rate of growth of labour and capital productivity is higher for Punjab manufacturing. The growth rate of value added and total factor productivity depict similar trends for both Indian manufacturing and Punjab manufacturing.

Output growth rates decline in the post-reform period both for the Indian manufacturing as well as for Punjab, but for Punjab manufacturing the decline is sharper. The rate of growth of capital for all India manufacturing increases slightly in the post-reform period. But for Punjab manufacturing, this growth rate decelerates in the post-reform period. Employment growth rate decelerates for both Indian manufacturing and Punjab manufacturing in the post-reform period. For Indian manufacturing, capital productivity declines and becomes negative in the post-reform period. For Punjab manufacturing, capital productivity also decelerates in the post-reform period. Labour productivity decelerates in the new policy regime both for the

Indian manufacturing and Punjab manufacturing. On the other hand, capital intensity increases in the new policy regime for Indian manufacturing as well as for Punjab manufacturing. The results for the total factor productivity are almost similar for Indian and Punjab manufacturing. Furthermore, on splitting the whole period into two sub periods, i.e., the pre-1991 and post-1991 period, both Indian and Punjab manufacturing depict a deceleration of total factor productivity in the post-1991 period.

At disaggregative level, growth rates of value added, labour, labour productivity and total factor productivity are higher in the manufacturing sector of Punjab as compared to that of India for the entire period. The growth rates of capital, capital productivity and capital intensity are higher in the manufacturing sector of India as compared to manufacturing sector of Punjab for the same period. Comparing pre-reform period with post-reform period, it is seen that six out of twenty two sectors show higher output growth in the post-reform period for Indian manufacturing and nine sectors for Punjab manufacturing depict higher output growth in the same period. Eighteen sectors show growth in capital in the post-reform period for Indian manufacturing and twelve sectors show higher capital growth for Punjab manufacturing in the same period. Growth rate of labour shows deceleration in fourteen sectors during the post-reform era in case of Indian manufacturing. On the other hand, ten sectors show deceleration in the rate of growth of labour in the manufacturing sector of Punjab for the same period.

Further sub-periods analysis reveals that twelve sectors show growth in labour productivity in the post-reform period for Indian manufacturing and seven sectors show higher labour productivity growth for Punjab manufacturing in the same period. Seven sectors for Indian manufacturing and nine sectors for Punjab manufacturing depict growth in capital productivity in the post-reform period. In case of capital intensity, nineteen sectors of Indian manufacturing and eighteen sectors of Punjab manufacturing show higher growth rate in the new policy regime. The highest growth rate of total factor productivity is recorded for wood and products of wood and cork, except furniture, articles of straw and plating materials (20) for both Indian and Punjab manufacturing. Sixteen sectors of Indian manufacturing and fifteen sectors of Punjab manufacturing show declining rate of growth of total factor productivity during the post-reform period. Overall aggregative and disaggregative analysis depict that there is a deceleration in productivity in both Indian manufacturing and Punjab manufacturing in the new policy regime. So the hypothesis is rejected as the results depicts that the impact of new policy regime on the adjustment process of Punjab manufacturing sector is not significantly different from that of India. A comparison of R^2 and $\bar{R}^2$ in ordinary least square regression and stepwise regression in Indian and Punjab manufacturing highlight that the model used in the study is of good fit.

Chapter 8

NEW POLICY REGIME AND ADJUSTMENT PROCESS OF MANUFACTURING SECTOR IN PUNJAB: SURVEY RESULTS

8.1 Introduction

One of the main objectives of the present study is to analyse the adjustment process of manufacturing sector in Punjab in response to the new policy regime. For analysis of this part of the problem the primary data has been used. The data has been collected from two hundred manufacturing firms of the Punjab state. Various aspects that have been analysed in the adjustment process of manufacturing sector are (a) adjustment of output (b) adjustment of labour, (c) adjustment of capital, (d) adjustment of technology and (e) adjustment of research and development. This chapter gives a snap-shot of the adjustment process in manufacturing sector in Punjab in the new policy regime.

The industries which have been covered are engineering goods, bicycle and bicycle parts, steel rerolling, hosiery, sewing machine and sports industry. These industries have been chosen on the basis of their importance and contribution to the manufacturing sector. A structured questionnaire has been administrated to collect data from the manufacturing sector. Before using the questionnaire, it has been tested in a pilot study to increase its validity and to note the level of difficulty for each question. As a result, some questions have been improved by the recommendations and evaluations by the respondents. The reliability of the questionnaire has been tested according to Cronbach's Coefficient Alpha (α), which indicated the reliability of the questionnaire to be high.

Starting with the organisational profile, the questionnaire has been divided into four sections. The first section covers the overall performance of the firms. In the second section the performance of the employees has been analysed. The third section explains the impact of globalisation on technology adoption and adaptation and the last section deals with research and development of Punjab manufacturing. The data has been analysed by using the statistical tools viz. chi square test, overall mean, average rank and tabular analysis. Along with this, factor analysis also has been used to find out the factors which influence the performance of Punjab manufacturing firms.

Hypothesis

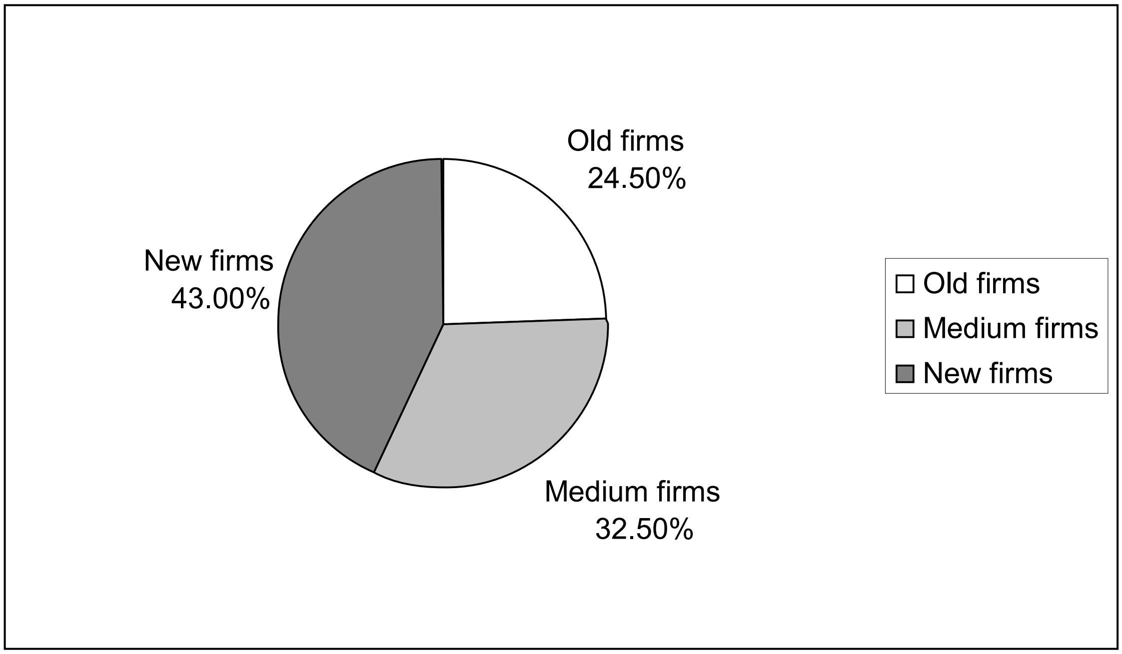
- Large scale firms have performed better in the post-reform period.
- Old firms have responded positively to the liberalisation, privatisation and globalisation.

8.1.1 Broad Distribution of the Sample

In the study, analysis has been done on the basis of three different categories namely age, size and organization type. Age is one of the determinants of performance. Age can be positively related to performance of manufacturing sector. It can be treated as managerial experience, which is a part of the learning-by-doing concept. The older the firm, the greater the experience of its management. Firms, as they grow older, are more accurate in their productivity prediction.

In the sample size, age wise, firms are divided into three parts on the basis of the year of establishment. The firms which are established up to 1970 are considered as the old aged firms. The firms whose establishment year is between 1971 and 1990 are taken as medium aged firms. The firms with establishment year above 1990 are considered new firms. Size wise the firms are divided into large sized, medium sized and small sized. Type of organization wise the firms are divided into four parts; single proprietary, partnership, public limited and private limited.

Figure 1: Percentage of Old Aged, Medium Aged and New Firms in Total Sample



The figure 1 indicates that in the total sample of 200 firms, 24.50 percent are old aged firms, 32.50 percent are medium aged firms and 43 percent are new firms.

In the total sample of 200 firms, 29.50 percent are large scale, 19.50 percent are medium scale and 51 percent are small scale firms.

Figure 2: Percentage of Large Scale, Medium Scale and Small Scale Firms in Total Sample

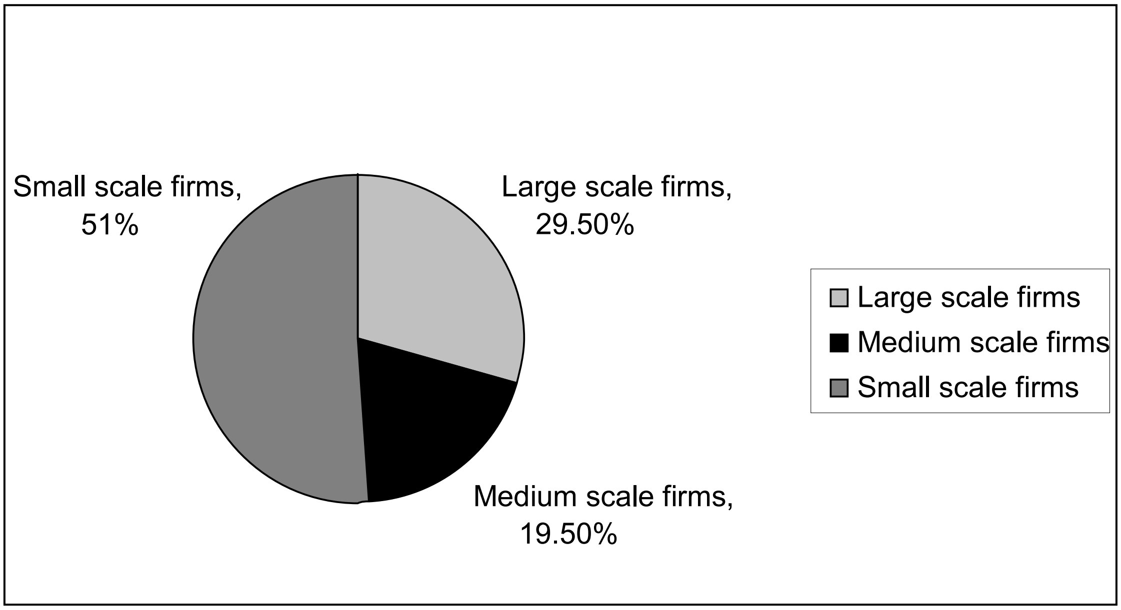
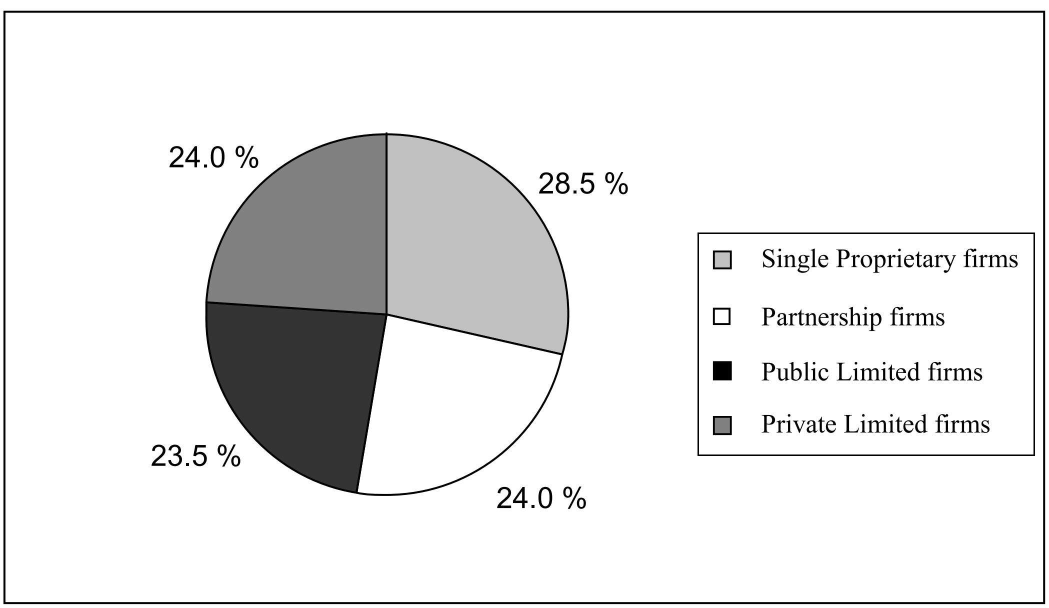


Figure 3: Percentage of Single Proprietary, Partnership, Public Limited and Private Limited Firms in Total Sample



The figure 3 shows that in the total sample, 28.5 percent firms are single proprietary, 24 percent are partnership, 24 percent are public limited and 23.5 percent are private limited firms.

8.2 Results of the Survey

The results of the four sections of the questionnaire namely, Section A: Overall Performance, Section B: Employees, Section C: Impact of Globalisation on Technology Adoption and Adaptation, and Section D: Research and Development are listed below.

8.2.1 Section A: Overall Performance

(1) Selling

Table 8.1: Selling

Group/Sub Group	Selling in Punjab	Selling in Rest of Punjab	Selling in Abroad
	Mean	Mean	Mean
Age Structure			
1. Old	21.69	40.31	38.00
2. Medium	34.35	45.43	20.22
3. New	59.01	30.41	10.58
Size of firm			
1. Large Scale	17.56	45.80	36.54
2. Medium Scale	51.15	26.80	22.05
3. Small Scale	52.35	37.16	10.49
Type of Organisation			
1. Single Proprietary	53.42	40.61	5.97
2. Partnership	43.96	28.13	27.92
3. Public Limited	24.96	48.19	26.85
4. Private Limited	42.56	33.71	23.83
All Data	41.86	37.72	20.43

Computed

The above table depicts the mean for selling in Punjab, in rest of Punjab and abroad. At aggregate level the table depicts that selling is higher in Punjab. The age structural analysis depicts that mean is the highest for new firms as far selling in Punjab is concerned. For selling outside Punjab the medium firms are followed by old firms. For selling abroad, the mean value is the highest for the old firms.

Size wise analysis depicts that most of the small sized firms are selling in Punjab. For selling outside Punjab the large firms are followed by the small ones. In selling abroad the large firms have the highest mean value. Type of organization analysis depicts that single proprietary firms sell in Punjab as they possess the highest mean value. In case of selling outside Punjab, the highest mean score is by public limited firms. Overall the table depicts that most of the old and large sized firms are selling more abroad as well as outside Punjab. Most of the new, small sized firms and single proprietary firms are selling mostly in Punjab.

(2) Present Turnover

Table 8.2 gives present turnover categories according to different classifying criteria. For the total sample it depicts that the majority of units fall in the less than 10 crores category. The percentage share of such units is 47.50 percent. Percentage share of units in the 11-50 crores category is 11.50 percent, in the category 51-100 crores it is 12 percent and in 101-250 it is 9.50 percent. Big units with more than 250 crores turnover are 19.50 percent. This shows that manufacturing sector in Punjab is dominated basically by small scale units.

Age structural analysis of present turnover depicts that most of the old and medium aged units belong to more than 51 crores category of the present turnover but most of the new units (73.26 percent) belong to less than 10 crores category. This implies old units are big units and new units are basically smaller units in terms of the present turnover. The chi square test for independence depicts that the present turnover and age of firm are not independent. [χ^2 = 61.56, degree of freedom (df) = 8].

Table 8.2: Present Turnover (in crores)

Group/Sub Group	<10 Cr.		11-50 Cr.		51-100 Cr.		101-250 Cr.		>250 Cr.		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	20	40.82	3	6.12	4	8.16	7	14.29	15	30.61	
2. Medium	12	18.46	10	15.38	17	26.15	6	9.23	20	30.77	Chi^2=61.56**
3. New	63	73.26	10	11.63	3	3.49	6	6.98	4	4.65	(df : 8)
Size of Firm											
1. Large Scale	4	6.78	4	6.78	3	5.08	13	22.03	35	59.32	
2. Medium Scale	9	23.08	9	23.08	11	28.21	6	15.38	4	10.26	Chi^2=156.41**
3. Small Scale	82	80.39	10	9.80	10	9.80		12.75			(df : 8)
Type of Organisation											
1. Single Proprietary	44	77.19	3	5.26	10	17.54					
2. Partnership	39	81.25	3	6.25	6	12.50					
3. Public Limited	6	12.77	7	14.89	4	8.51	3	6.38	27	57.45	Chi^2=151.16**
4. Private Limited	6	12.50	10	20.83	4	8.33	16	33.33	12	25.00	(df : 12)
All Data	95	47.50	23	11.50	24	12.00	19	9.50	39	19.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

The size wise analysis of the present turnover is indicative of the fact that higher turnover is associated with large and medium sized units. This is what is normally expected. The chi square test for the present turnover and size of the firm is significant at 1 percent level of significance (χ^2 =156.41, df = 8). It also shows that the variables are not independent. Analysis on the basis of type of organization depicts that smaller turnover is identified by single proprietary and partnership kind of firms. Present turnover of the range more than 250 crores is found in public limited and private limited firms only. Chi Square test depicts that the present turnover and the type of organisation are not independent. (χ^2 =151.16, df = 12).

On the whole, this table depicts that the turnover for most of the firms in sample is less than 50 crores. Large turnover is basically limited to large sized, private limited and public limited firms. 73.26 percent of new and 80.39 percent of small sized firms have less than 10 crore turnover. There is a need for a systematic policy intervention by which joint stock companies with large turnover and wider linkage effects could be brought to the state.

(3) Market Share

Table 8.3: Market Share

Group/Sub Group	<10%		11-25%		26-50%		51-75		>75%	
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms		
Age Structure										
1. Old	10	20.41	12	24.49	27	55.10				
2. Medium	28	43.08	14	21.54	23	35.38				Chi^2=46.81**
3. New	63	73.26	3	3.49	17	19.77	3	3.49		(df : 6)
Size of Firm										
1. Large Scale	13	22.03	15	25.42	28	47.46	3	5.08		
2. Medium Scale	25	64.10	4	10.26	10	25.64				Chi^2=32.45**
3. Small Scale	63	61.76	10	9.80	29	28.43				(df : 6)
Type of Organisation										
1. Single Proprietary	31	54.39	7	12.28	19	33.33				
2. Partnership	31	64.58			17	35.42				
3. Public Limited	20	42.55	14	29.79	13	27.66				Chi^2=28.92**
4. Private Limited	19	39.58	8	16.67	18	37.50	3	6.25		(df : 9)
All Data	101	50.50	29	14.50	67	33.50	3	1.50		

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Market share of the manufacturing sector of Punjab is explained in table 8.3. At aggregate level the table depicts that 50.50 percent firms have market share less than ten percent. Out of the remaining firms, approximately fifteen percent firms have a market share between 11-25 percent and 33.50 percent firms have market share 26-50 percent. So this shows that the market share for fifty percent of the sample firms is less than 10 percent.

Analysis at disaggregate level depicts that most of the old firms have 26-50 percent market share but new firms (73.26 percent) have less than 10 percent market share. The chi square test for independence shows that market share and age of firm are not independent. (χ^2 = 46.81, df = 6). Size wise analysis indicates that large sized firms have higher market share. 64.10 percent of medium and 61.76 percent of small sized firms have comparatively less than 10 percent of market share. Chi square test for market share and size of firm is significant at

1 percent level ($\chi^2 = 32.45$, df = 6). It also shows that the variables are dependent. Analysis of the type of organization level gives a mixed result. 54.39 percent single proprietary firms have less than 10 percent market share and 33.33 percent single proprietary firms have 26-50 percent market share. Partnership firms generally dominate amongst the firms having less than 10 percent market share. Only 6.25 percent of the firms have higher market share i.e. 51-75 percent and these firms are private limited firms. Chi Square test shows that market share and type of organisation are not independent ($\chi^2 = 28.92$, df = 9).

Evidence of Punjab manufacturing on the basis of market share analysis depicts that for most of the firms in Punjab the market share falls in the category of 0-50 percent. Only 6.25 percent of private limited and 5.08 percent of large scale firms have high market share i.e. 51-75 percent. Analysis on the basis of age structure depicts higher market share of older firms.

(4) Investment made as Percentage of Total Expenditure during Last Ten Years

Investment made as percentage of total expenditure during the last ten years is depicted in table 8.4. Analysis at aggregate level depicts that only 7 percent firms have invested more than 80 percent of total expenditure during the last ten years. 28 percent firms have invested below 20 percent, another 28 percent have invested between 21-40 percent of their expenditure. 27 percent firms have invested between 41-60 percent of their expenditure. Analysis at age structure level depicts that old and medium firms have invested higher percentage of total expenditure than the new firms. The chi square test for independence depicts that investment made as percentage of total expenditure and age of firm are not independent ($\chi^2 = 14.58$, df = 8).

Size wise analysis reveals that large sized firms invest more as compared to medium and small sized firms. The chi square test for investment made as percentage of total expenditure and size of firm is significant at 1 percent level ($\chi^2 = 45.37$, df =8). It also shows that the variables are dependent. Approximately 40 percent single proprietary firms have invested less than 20 percent of the total expenditure during the last ten years. Public limited and private limited firms have higher investment as percentage of total expenditure during the last ten years as compared to single proprietary and partnership firms. The chi square test depicts that investment made as percentage of total expenditure and type of organisation are not independent (χ^2 = 57.55, df = 6).

Table 8.4: Investment made as Percentage of Total Expenditure during Last Ten Years

Group/Sub Group	1-20%		21-40%		41-60%		61-80%		>80%		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	12	24.49	19	38.78	12	24.49	3	6.12	3	6.12	
2. Medium	12	18.46	17	26.15	18	27.69	11	16.92	7	10.77	Chi^2=14.58
3. New	32	37.21	20	23.26	24	27.91	6	6.98	4	4.65	(df : 8)
Size of Firm											
1. Large Scale			18	30.51	24	40.68	7	11.86	10	16.95	
2. Medium Scale	12	30.77	14	35.90	9	23.08	4	10.26			Chi^2=45.37**
3. Small Scale	44	43.14	24	23.53	21	20.59	9	8.82	4	3.92	(df : 8)
Type of Organisation											
1. Single Proprietary	22	38.60	17	29.82	12	21.05	6	10.53			
2. Partnership	12	25.00	13	27.08	19	39.58			4	8.33	
3. Public Limited	9	19.15	16	34.04	12	25.53			10	21.28	Chi^2=57.55**
4. Private Limited	13	27.08	10	20.83	11	22.92	14	29.17			(df : 12)
All Data	56	28.00	56	28.00	54	27.00	20	10.00	14	7.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Overall analysis depicts that smaller, new, single proprietary and partnership firms have invested less percentage of total expenditure during last ten years as compared to medium and large sized firms. Investment as a percentage of total expenditure is higher in large sized, older, public limited and private limited firms.

(5) Gross Value of Plant and Machinery as at the End of Accounting Year (Rs. in lakhs)

Gross value of plant and machinery as at the end of the accounting year of the manufacturing sector in Punjab is depicted in table 8.5. Column wise, this table gives gross value of plant and machinery at the end of accounting year and row wise, it gives classifiers like age structure, size of firm and type of organization. At aggregate level, the analysis depicts that in the new policy regime, Punjab manufacturing sector has responded well in terms of gross value of plant and machinery as at the end of accounting year. Gross value of plant and machinery at the end of accounting year is higher for 57.50 percent of the units surveyed. Twenty percent units have gross value of plant and machinery between 21 to 30 lakhs. Only 6.50 percent units have gross value of plant and machinery below 5 lakhs.

Table 8.5: Gross Value of Plant and Machinery as at the End of Accounting Year (Rs. in lakhs)

Group/Sub Group	<5 lakhs		6-10 lakhs		11-20 lakhs		21-30 lakhs		>30 lakhs		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	6	12.24			4	8.16	11	22.45	28	57.14	
2. Medium			9	13.85	3	4.62	16	24.62	37	56.92	Chi^2=15.90*
3. New	7	8.14	10	11.63	6	6.98	13	15.12	50	58.14	(df : 8)
Size of Firm											
1. Large Scale					4	6.78	14	23.73	41	69.49	
2. Medium Scale	3	7.69			6	15.38	6	15.38	24	61.54	Chi^2=34.31**
3. Small Scale	10	9.80	19	18.63	3	2.94	20	19.61	50	49.02	(df : 8)
Type of Organisation											
1. Single Proprietary	3	5.26	16	28.07	6	10.53	7	12.28	25	43.86	
2. Partnership	3	6.25			4	8.33	10	20.83	31	64.58	
3. Public Limited	3	6.38	3	6.38	3	6.38	10	21.28	28	59.57	Chi^2=41.15**
4. Private Limited	4	8.33					13	27.08	31	64.58	(df : 12)
All Data	13	6.50	19	9.50	13	6.50	40	20.00	115	57.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

At disaggregative level, analysis on the basis of age structure is indicative of the fact that more than 55 percent of old, medium and new firms have gross value of plant and machinery more than 30 lakhs. More than 15 percent of the old, medium and new firms have gross value of plant and machinery between 21 to 30 lakhs. Chi square test for gross value of plant and machinery as at the end of accounting year and age of firm is significant at 5 percent level of significance (χ^2 = 15.90, df = 8). It also shows that the variables are not independent. Size wise analysis depicts that large and medium sized firms have higher gross value of plant and machinery. Chi square test depicts gross value of plant and machinery as at the end of accounting year and size of firm are dependent (χ^2 = 34.31, df = 8). 64.58 percent partnership and 64.58 percent private limited firms have the gross value of plant and machinery above 30 lakhs. Approximately 60 percent public limited firms have more than 30 lakhs of the gross value of plant and machinery at the end of the accounting year. The Chi Square test for independence depicts that gross value of plant and machinery as at the end of accounting year and type of organisation are dependent (χ^2 = 41.15, df = 12). Overall the gross value of plant and machinery as at the end of the accounting year is higher for the manufacturing sector of Punjab. Thus according to this trend the impact of new policy regime on the manufacturing sector of Punjab is positive.

(6) Percentage of Investment by Foreign Companies in the Firms

Table 8.6: Percentage of Investment by Foreign Companies in the Firms

Group/Sub Group	<5%		6-10%		11-15%		16-20%		>21%		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	7	50.00					3	21.43	4	28.57	
2. Medium	12	54.55	7	31.82			3	13.64			Chi^2=19.86*
3. New	10	50.00	3	15.00	3	15.00			4	20.00	(df : 8)
Size of Firm											
1. Large Scale	3	17.65	7	41.18			3	17.65	4	23.53	
2. Medium Scale	10	50.00	3	15.00	3	15.00			4	20.00	Chi^2=29.31**
3. Small Scale	16	84.21					3	15.79			(df : 8)
Type of Organisation											
1. Single Proprietary	7	53.85			3	23.08	3	23.08			
2. Partnership	6	66.67	3	33.33							
3. Public Limited	7	50.00	7	50.00							Chi^2=44.77**
4. Private Limited	9	45.00					3	15.00	8	40.00	(df : 12)
All Data	29	51.79	10	17.86	3	5.36	6	10.71	8	14.29	N.A:144(72.00%)

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

In the new policy regime, a large number of foreign companies started investing in India. In table 8.6, the percentage of investment by foreign companies in the Punjab manufacturing industries is shown according to the age structure, size of firm and type of organization. Out of the sample of 200 firms, 144 firms have no investment by foreign companies. At aggregate level the table depicts that the percentage of investment by foreign companies in Punjab manufacturing sector is very low. Moving to the disaggregate level, in all categories most of the responding firms have less than 5 percent investment by foreign companies.

On the whole the analysis depicts that investment of more than 21 percent is by a few old, large sized, medium sized, private limited as well as by 20 percent of new firms. So in the new policy regime, percentage of investment by foreign companies in Punjab Manufacturing is low. This needs the attention of researchers and policy planners to increase this investment by foreign companies in manufacturing sector of Punjab.

(7) Investment made in New Machinery and Equipment as Percentage of Total Expenditure

One of the objectives of this study is to analyse the adjustment process of capital, labour and technology in response to the changed policy regime. How the new machinery and equipment has adjusted, is given in table 8.7. Column wise, this table gives the investment made in new machinery and equipment and row wise, it gives classifiers like age structure, size of firm and type of organization. In aggregate the table depicts that in the new policy regime a major chunk of the industry has not responded with higher investment on new machinery and equipment. Higher investment on new machinery and equipment is identified by only 21 percent of the units surveyed. About 39.50 percent of the units lie in the below 20 percent investment as in new machinery and equipment. Next 15.50 percent lie in the range of 21 to 40 percent investment in new machinery and equipment. So taking these together, about 55 percent of the industry falls below the average level as far as investment in new machinery and equipment is concerned.

Table 8.7: Investment made in New Machinery and Equipment as Percentage of Total Expenditure

Group/Sub Group	1-20%		21-40%		41-60%		61-80%		>80%		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	18	36.73	9	18.37					22	44.90	
2. Medium	15	23.08	4	6.15	23	35.38	12	18.46	11	16.92	Chi^2=72.05**
3. New	46	53.49	18	20.93	9	10.47	3	3.49	10	11.63	(df : 8)
Size of Firm											
1. Large Scale	11	18.64	3	5.08	10	16.95	6	10.17	29	49.15	
2. Medium Scale	10	25.64	7	17.95	9	23.08	6	15.38	7	17.95	Chi^2=62.09**
3. Small Scale	58	56.86	21	20.59	13	12.75	3	2.94	7	6.86	(df : 8)
Type of Organisation											
1. Single Proprietary	35	61.40	6	10.53	13	22.81			3	5.26	
2. Partnership	27	56.25	12	25.00	3	6,25	3	6.25	3	6.25	
3. Public Limited	7	14.89	3	6.38	13	27.66	6	12.77	18	38.30	Chi^2=73.59**
4. Private Limited	10	20.83	10	20.83	3	6.25	6	12.50	19	39.58	(df : 12)
All Data	79	39.50	31	15.50	32	16.00	15	7.50	43	21.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

At the disaggregate level, age structure is indicative of the fact that larger investment in new machinery and equipment is associated with old firms. The same is indicated by the chi square (72.05), which is significant at 1 percent. Furthermore investment in new machinery and equipment as an adjustment media is identified by large sized firms. Small sized firms have almost been deprived of this change. The chi square test depicts that investment made in new machinery and equipment as a percentage of total expenditure and size of firm are not independent (χ^2 = 62.09, df = 8).

Analysis of the type of organization depicts that public and private limited firms have resorted to higher investment in new machinery and equipment and small firms like single proprietary or partnership firms have been unable to catch up with the process of modernization of technology. The chi square test for investment made in new machinery and equipment as a percentage of total expenditure and type of organisation is significant at 1 percent level (χ^2 is 73.59, df = 12). It also shows that the variables are not independent.

On the whole, the table shows that industry in Punjab has responded weakly to the new policy regime in terms of upgradation of machinery and equipment. Whatever upgradation of machinery and equipment has been done is basically associated with old, big and public or private limited companies. Thus, to conclude, Punjab industry has not responded properly to the emerging new structure. This needs the attention of researchers and policy planners.

(8) Investment in Computer Hardware and Software as Percentage of Total Expenditure

Table 8.8: Investment in Computer Hardware and Software as Percentage of Total Expenditure

Group/Sub Group	1-10%		11-20%		21-30%		31-40%		>40%		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	26	53.06	8	16.33			4	8.16	11	22.45	
2. Medium	38	58.46	15	23.08			4	6.15	8	12.31	Chi^2=29.13**
3. New	73	84.88	7	8.14			6	6.98			(df : 6)
Size of Firm											
1. Large Scale	10	16.95	19	32.20			11	18.64	19	32.20	
2. Medium Scale	33	84.62	3	7.69			3	7.69			Chi^2=113.22**
3. Small Scale	94	92.16	8	7.84							(df : 6)
Type of Organisation											
1. Single Proprietary	54	94.74	3	5.26							
2. Partnership	44	91.67	4	8.33							
3. Public Limited	13	27.66	19	40.43			4	8.51	11	23.40	Chi^2=91.84**
4. Private Limited	26	54.17	4	8.33			10	20.83	8	16.67	(df : 9)
All Data	137	68.50	30	15.00			14	7.00	19	9.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Investment in computer hardware and software as percentage of total expenditure in the manufacturing sector of Punjab is depicted in table 8.8. The table depicts that at aggregate level, 68.50 percent firms out of the total sample invest less than 10 percent in computer hardware and software as percentage of total expenditure. Only 9 percent firms invest more than 40 percent of total expenditure in computer hardware and software.

Analysis at the disaggregate level depicts that 84.88 percent new firms, 58.46 percent medium firms and 53.06 percent of old firms invest between 1 to 10 percent of total expenditure in computer hardware and software. More than 40 percent of investment in computer hardware and software is associated with only 22.45 percent old firms and 12.31 percent medium aged firms. The chi square test depicts that investment in computer hardware and software as a percentage of total expenditure and the age of firm are not independent (χ^2 = 29.13, df = 6).

Large sized firms have higher investment in computer hardware and software, and medium as well as small sized firms have less investment as percentage of their total expenditure in computer hardware and software. The chi square test for investment in computer hardware and software as a percentage of total expenditure and size of firm is significant at 1 percent level (χ^2 = 113.22, df = 6). It also shows that the variables are not independent. Approximately all the single proprietary and partnership firms invest less than 10 percent of total expenditure in computer hardware and software. Public limited and private limited firms have higher investment in computer hardware and software. The chi square test for independence shows that investment in computer hardware and software as a percentage of total expenditure and type of organisation are also dependent (χ^2 is 91.84, df = 9).

To conclude, the investment made in computer hardware and software as a percentage of total expenditure by new, medium sized and small sized firms is less. Old and large firms invest more in computer hardware and software. The organizational structural analysis of the firms depicts that public as well as private limited firms invest more in computer hardware and software as compared to single proprietary or partnership firms. Overall the investment in computer hardware and software still falls mostly in 1 to 10 percent of total expenditure. There is a need for higher investment to be made by Punjab manufacturing firms on computer hardware and software.

(9) Accreditation/Certification of the Firm

Table 8.9: Accreditation/Certification of the Firm

Group/Sub Group	yes		no		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure					
1. Old	34	69.39	15	30.61	
2. Medium	40	61.54	25	38.46	Chi^2=2.88
3. New	47	54.65	39	45.35	(df : 2)
Size of Firm					
1. Large Scale	43	72.88	16	27.12	
2. Medium Scale	20	51.28	19	48.72	Chi^2=5.74
3. Small Scale	58	56.86	44	43.14	(df : 2)
Type of Organisation					
1. Single Proprietary	26	45.61	31	54.39	
2. Partnership	29	60.42	19	39.58	
3. Public Limited	28	59.57	19	40.43	Chi^2=12.30**
4. Private Limited	38	79.17	10	20.83	(df : 3)
All Data	121	60.50	79	39.50	

Computed
Note: ** = Significant at 1 per cent, * = Significant at 5 per cent

Table 8.9 depicts the accreditation/certification of the firms in Punjab. Out of the total sample of 200 firms, approximately 60 percent firms have accreditation/certification of their firms. Analysis at disaggregtive level depicts that approximately 70 percent old and large sized firms have certification of their firms. About 55 percent new and small sized firms have certification of their firms. The chi square for independence depicts that accreditation/certification of the firm and the age of firm are independent (χ^2 = 2.88, df = 2). The chi square test shows that accreditation/certification of the firm and the size of firm are independent (χ^2 = 5.74, df = 2).

About 60 percent partnership and public limited firms have certification. Approximately 80 percent private limited firms have certification of their firm. The chi square test shows that accreditation/certification of the firm and type of organisation is significant at 1 percent level (χ^2 =12.30, df =3). It also shows that the variables are not independent. Overall the table shows that the accreditation/certification of the manufacturing sector of Punjab is less but there seems to be a realization even the smaller and new firms now to go in for accreditation/certification.

(10) Total Sales (last ten years)

Table 8.10: Total Sales (last ten years)

Group/Sub Group	substantially decreased	marginally decreased		remained the same		marginally increased		substantially increased		
		No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure										
1. Old				3	6.12	21	42.86	25	51.02	
2. Medium		3	4.62			16	24.62	46	70.77	Chi^2=22.10**
3. New						22	25.58	64	74.42	(df : 6)
Size of Firm										
1. Large Scale		3	5.08			18	30.51	38	64.41	
2. Medium Scale						19	48.72	20	51.28	Chi^2=19.70**
3. Small Scale				3	2.94	22	21.57	77	75.49	(df : 6)
Type of Organisation										
1. Single Proprietary						16	28.07	41	71.93	
2. Partnership						9	18.75	39	81.25	
3. Public Limited		3	6.38	3	6.38	14	29.79	27	57.45	Chi^2=26.67**
4. Private Limited						20	41.67	28	58.33	(df : 9)
All Data		3	1.50	3	1.50	59	29.50	135	67.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

The adjustment in total sales of the manufacturing sector of Punjab in the new policy regime is depicted in table 8.10. The table depicts that almost all the firms out of the sample size of 200 firms have responded with an increase in total sales in the new policy regime. Out of 200 firms 67.50 percent firms experience a substantial increase in total sales and 29.50 percent firms experience a marginal increase in total sales in last ten years.

Disaggregative analysis depicts that the total sales of old, medium and new firms increased during last ten years. The chi square test for independence shows that the total sales in last ten years and the age of firm are dependent (χ^2 = 22.10, df = 6). Size wise analysis shows that the total sales of large sized, medium sized and small sized firms have increased during the last ten years. The chi square test depicts a relationship between total sales and size of firm (χ^2 = 19.70, df = 6). Analysis on the basis of the type of organization also depicts an increase in total sales. The chi square test for total sales in the last ten years and the type of organisation is significant at 1 percent level (χ^2 = 26.67, df =9). It also shows that the variables are not independent. On the whole, in the new policy regime, the manufacturing sector of Punjab has witnessed an increase in total sales.

(11) Net Profit Rate (over the past ten years)

Increase in sales and increase in profits are accepted as indices of growth. After analyzing the status of Punjab manufacturing in terms of sales the analyses has been done to find out the status of net profit rate over the past ten years (Table 8.11). Out of the sample of 200 firms, 110 firms (55 percent) respond with substantial increase in the net profit rate over the past ten years. 58 firms (29 percent) show the marginal increase in the profit rate. Only 19 firms (9.50 percent) experience decline in the net profit rate during the last ten years. Age wise analysis reveals that approximately all the old, medium and new firms have experienced increase in net profit rate over the past ten years. Size wise analysis depicts the similar trend, i.e., a substantial increase in net profit rate. The chi square for independence shows that the net profit rate over the past ten years and the size of firm are independent (χ^2 = 8.57, df = 8).

Table 8.11: Net Profit Rate (over the past ten years)

Group/Sub Group	substantially decreased		marginally decreased		remained the same		marginally increased		substantially increased		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old			3	6.12	4	8.16	17	34.69	25	51.02	
2. Medium			3	4.62	3	4.62	19	29.23	40	61.54	Chi^2=8.79
3. New	3	3.49	10	11.63	6	6.98	22	25.58	45	52.33	(df : 8)
Size of Firm											
1. Large Scale			3	5.08	4	6.78	14	23.73	38	64.41	
2. Medium Scale			3	7.69	3	7.69	16	41.03	17	43.59	Chi^2=8.57
3. Small Scale	3	2.94	10	9.80	6	5.88	28	27.45	55	53.92	(df : 8)
Type of Organisation											
1. Single Proprietary	3	5.26	10	17.54	6	10.53	12	21.05	26	45.61	
2. Partnership					3	6.25	12	25.00	33	68.75	
3. Public Limited							17	36.17	30	63.83	Chi^2=34.92**
4. Private Limited			6	12.50	4	8.33	17	35.42	21	43.75	(df : 12)
All Data	3	1.50	16	8.00	13	6.50	58	29.00	110	55.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Analysis on the basis of organizational structure depicts that about 90 percent of partnership and public limited firms experience an increase in the net profit rate over the past ten years. Single proprietary and partnership firms also depict a rise in net profit rate over the past ten years. 17.54 percent single proprietary and 12.50 percent partnership firms have experienced a marginal decline in the net profit rate. The chi square test depicts that net profit rate over the past ten years and type of organization are dependent (χ^2 = 34.92, df =12). Thus on the whole, the analysis throws light on the fact that the manufacturing sector has experienced an increase in net profit rate in the new policy regime.

8.2.2 Section B: Employees

(1) Number of Employees

Group/sub group wise number of employees in the manufacturing sector of Punjab is depicted in table 8.12. At aggregate level, 35.50 percent firms have less than 50 employees and 37.50 percent firms have more than 400 employees. In terms of age structure, most of the old and medium firms have more than 400 employees and new firms have less than 100 employees. The chi square test for independence depicts that number of employees and age of firm are not independent (χ^2 = 64.51, df = 8). Size wise analysis depicts that approximately 80 percent of small sized firms have less than 100 employees. About 88 percent large sized firms have more than 400 employees. The chi square test for the number of employees and the age of firm is significant at 1 percent level (χ^2 =121.88, df = 8). It also shows that the variables are not independent.

Table 8.12: Number of Employees

Group/Sub Group	0-50		50-100		100-200		200-400		>400		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	12	24.49	4	8.16	4	8.16			29	59.18	
2. Medium	12	18.46	3	4.62	4	6.15	10	15.38	36	55.38	Chi^2=64.51**
3. New	47	54.65	18	20.93	8	9.30	3	3.49	10	11.63	(df : 8)
Size of Firm											
1. Large Scale					4	6.78	3	5.08	52	88.14	
2. Medium Scale	12	30.77	3	7.69	8	20.51	3	7.69	13	33.33	Chi^2=121.88**
3. Small Scale	59	57.84	22	21.57	4	3.92	7	6.86	10	9.80	(df : 8)
Type of Organisation											
1. Single Proprietary	35	61.40	15	26.32			4	7.02	3	5.26	
2. Partnership	24	50.00	7	14.58	8	16.67	3	6.25	6	12.50	
3. Public Limited	6	12.77					6	12.77	35	74.47	Chi^2=117.49**
4. Private Limited	6	12.50	3	6.25	8	16.67			31	64.58	(df : 12)
All Data	71	35.50	25	12.50	16	8.00	13	6.50	75	37.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Analysis of the type of organization depicts the trend that the single proprietary and partnership firms have less than 100 employees and public limited and private limited firms have more than 400 employees. The chi square test shows that number of employees and type of organization are not independent (χ^2 = 117.49, df = 12). The picture which emerges from the table is that old, medium and large sized firms have more employees. New and small sized firms have fewer employees. Public limited and private limited firms have more employees as compared to single proprietary and partnership firms.

(2) Technically Skilled Employees as Percentage of Total Employees

Table 8.13 depicts the technically skilled employees as percentage of total employees in the manufacturing sector of Punjab. At aggregate level, the table depicts that for 25.5 percent of the firms, 5-10 percent of the total employees constitute technically skilled employees. For 22.5 percent firms technically skilled employees are between 11 to 20 percent, for another 18 percent technically skilled employees are between 20-40 percent. Only for 14 percent of the total firms technically skilled employees are more than 60 percent.

Old and large sized firms have comparatively large percentage of technically skilled employees. The chi square test depicts that technically skilled employees as percentage of total employees and age of firm are not independent (χ^2 = 74.90, df = 8). The chi square test for independence depicts that technically skilled employees as percentage of total employees and size of firm are dependent (χ^2 = 41.92, df = 8).

Public limited firms have higher percentage of technically skilled employees as compared to single proprietary, partnership and private limited firms. The chi square test for technically skilled employees as percentage of total employees and type of organization is significant at 1 percent level (χ^2 is 80.91, df =12). It also shows that the variables are not independent.

Table 8.13: Technically Skilled Employees as Percentage of Total Employees

Group/Sub Group	5-10%		1-20%		20-40%		40-60%		>60%		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old			10	20.41	3	6.12	25	51.02	11	22.45	
2. Medium	16	24.62	10	15.38	22	33.85	6	9.23	11	16.92	Chi^2=74.90**
3. New	35	40.70	25	29.07	11	12.79	9	10.47	6	6.98	(df : 8)
Size of Firm											
1. Large Scale	3	5.08	7	11.86	16	27.12	18	30.51	15	25.42	
2. Medium Scale	13	33.33	16	41.03	3	7.69	3	7.69	4	10.26	Chi^2=41.92**
3. Small Scale	35	34.31	22	21.57	17	16.67	19	18.63	9	8.82	(df : 8)
Type of Organization											
1. Single Proprietary	16	28.07	16	28.07	10	17.54	9	15.79	6	10.53	
2. Partnership	18	37.50	16	33.33	7	14.58	7	14.58			
3. Public Limited			3	6.38	12	25.53	10	21.28	22	46.81	Chi^2=80.91**
4. Private Limited	17	35.42	10	20.83	7	14.58	14	29.17			(df : 12)
All Data	51	25.50	45	22.50	36	18.00	40	20.00	28	14.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

The firm level analysis of Punjab manufacturing depicts that the percentage of technically skilled employees as percentage of total employees is higher in old and large sized firms. In case of public limited firms, technically skilled employees as percentage of total employees are the highest. In the new policy regime, there is a need of technically skilled employees to compete in the market. But for Punjab manufacturing sector, technically skilled employees are limited to a few firms. To enhance productivity and performance the percentage of technically skilled employees has to be increased and it should constitute a major percentage of employees.

(3) Training Programme Organized for Employees in Last Ten Years

Table 8.14 depicts the training programme organized for the employees in the last ten years in the manufacturing industries of Punjab. Analysis at the aggregate level depicts that out of the sample of 200 firms, 35 percent firms have organized 1 to 2 training programmes, 13 percent firms have organized 3 to 5 training programmes, and another 13 percent have organized 6 to 8 training programmes. 34 percent firms have organized above 10 training programmes in the last ten years. Disaggregative analysis indicates that old and medium aged firms have organized more training programmes and new firms have organized less training programmes for employees in the last ten years. The chi square test for independence depicts that training programme organized for employees in last ten years and age of firm are not independent (χ^2 = 43.68, df = 8).

Table 8.14: Training Programme Organized for Employees in Last Ten Years

Group/Sub Group	1-2		3-5		6-8		9-10		Above		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	15	30.61			7	14.29			27	55.10	
2. Medium	12	18.46	13	20.00	6	9.23	7	10.77	27	41.54	Chi^2=43.68**
3. New	43	50.00	13	15.12	13	15.12	3	3.49	14	16.28	(df : 8)
Size of Firm											
1. Large Scale			3	5.08	10	16.95	4	6.78	42	71.19	
2. Medium Scale	12	30.77	10	25.64	6	15.38	3	7.69	8	20.51	Chi^2=80.01**
3. Small Scale	58	56.86	13	12.75	10	9.80	3	2.94	18	17.65	(df : 8)
Type of Organisation											
1. Single Proprietary	37	64.91	10	17.54	6	10.53			4	7.02	
2. Partnership	24	50.00	9	18.75	8	16.67			7	14.58	
3. Public Limited	6	12.77	3	6.38	3	6.38	4	8.51	31	65.96	Chi^2=92.91**
4. Private Limited	3	6.25	4	8.33	9	18.75	6	12.50	26	54.17	(df : 12)
All Data	70	35.00	26	13.00	26	13.00	10	5.00	68	34.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

About 71 percent of large sized firms have organized more than ten training programmes for the employees in the last ten years. Medium and small sized firms have organized comparatively fewer training programmes for the employees. The chi square test depicts that training programmes organized for employees in the last ten years and the size of firm are dependent (χ^2 is 80.01, df = 8). Analysis on the basis of organizational structure depicts that both public limited as well as private limited firms have organized more number of training programmes as compared to single proprietary and partnership firms. The chi square test for training programmes organized for employees in the last ten years and the type of organization is significant at 1 percent level (χ^2 is 92.91, df = 12). It also shows that the variables are not independent.

On the whole the analysis depicts that old, medium and large sized firms have organized more training programmes for the employees. Public limited and private limited firms have organized more number of training programmes for the employees in the last ten years. One of the ways to enhance the competitiveness is to organize more training programmes to equip the workers with the latest technology and skills needed in the wake of liberalisation and globalisation. Here the older, larger, public and private limited firms responded better to such a change.

(4) Percentage of Male in Total Employees

Percentage of males in total employees is explained in the table 8.15. Out of the sample of 200 firms, 83 percent firms have 80 to 100 percent male employees. About 15 percent firms have 60 to 80 percent male employees. This shows that the female employees are very less in the Punjab manufacturing sector.

Age structure analysis depicts that about 80 percent of old, medium and news firms have 80 to 100 percent male employees. The chi square test for independence shows that the percentage of male employees in total employees and age of firm are independent (χ^2 = 5.79, df = 4). Size wise analysis depicts that approximately 75 percent large sized firms have above 80 percent male employees and 25 percent large sized firms have 60 to 80 percent male employees among total number of employees. Approximately 85 percent medium sized and 90 percent small sized firms have more than 80 percent male employees. The chi square test depicts that the percentage of male employees in total employees and the size of firm are dependent (χ^2 = 9.5, df = 4).

Table 8.15: Percentage of Male in Total Employees

Group/Sub Group	20-30%		30-40%	40-60%	60-80%		80-100%		
	No. of Firms	%age of Firms			No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure									
1. Old					8	16.33	41	83.67	
2. Medium					13	20.00	52	80.00	Chi^2=5.79
3. New	3	3.49			10	11.63	73	84.88	(df : 4)
Size of Firm									
1. Large Scale					15	25.42	44	74.58	
2. Medium Scale					6	15.38	33	84.62	Chi^2=9.51*
3. Small Scale	3	2.94			10	9.80	89	87.25	(df : 4)
Type of Organisation									
1. Single Proprietary					7	12.28	50	87.72	
2. Partnership	3	6.25					45	93.75	
3. Public Limited					7	14.89	40	85.11	Chi^2=32.42**
4. Private Limited					17	35.42	31	64.58	(df : 6)
All Data	3	1.50			31	15.50	166	83.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Analysis of the type of organization depicts that about 90 percent of single proprietary and partnership firms have more than 80 percent male employees. In private limited firms, about 65 percent firms have 80 to 100 percent male employees in total employees. The chi square test for percentage of male in total employees and type of organization is significant at 1 percent level (χ^2 = 32.42, df = 6). It also shows that the variables are not independent. Thus overall, analysis depicts that male employees constitute a major percentage of total employees in the manufacturing sector of Punjab, irrespective of the fact that the firms are new or old, large or small, private limited or public limited.

(5) Other Benefits to Employees

Table 8.16 depicts the other benefits to employees, i.e., employees contribution to old age benefits and employees contribution to other social security charges in the manufacturing sector of Punjab. The analysis depicts that in 13 percent firms, these benefits to employees have substantially increased. In 41.50 percent firms these benefits to employees have marginally increased and 40 percent firms depict no change in this connection. Analysis at disaggregate level depicts that old, medium aged and large sized firms have reported greater increase in benefits to employees as compared to new, medium sized and small sized firms. Even 10.26 percent medium sized firms show a marginal decline in the benefits of employees. Analysis on the basis of type of organization depicts that the increase in other benefits to employees is greater for the public limited and private limited firms as compared to single proprietary and partnership firms. The results of the sample depict that old, medium aged and large sized firms depict an increase in the other benefits to the employees. Again the public limited and private limited firms show higher increase in the benefits to employees.

(5) Table 8.16: Other Benefits to Employees

Group/Sub Group	substantially decreased	marginally decreased		remained the same		marginally increased		substantially increased		
		No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure										
1. Old		4	8.16	14	28.57	19	38.78	12	24.49	
2. Medium				22	33.85	32	49.23	11	16.92	Chi^2=23.33**
3. New		7	8.14	44	51.16	32	37.21	3	3.49	(df : 6)
Size of Firm										
1. Large Scale		4	6.78	11	18.64	21	35.59	23	38.98	
2. Medium Scale		4	10.26	15	38.46	20	51.28			Chi^2=59.06**
3. Small Scale		3	2.94	54	52.94	42	41.18	3	2.94	(df : 6)
Type of Organisation										
1. Single Proprietary		3	5.26	31	54.39	23	40.35			
2. Partnership				26	54.17	18	37.50	4	8.33	
3. Public Limited				13	27.66	19	40.43	15	31.91	Chi^2=49.60**
4. Private Limited		8	16.67	10	20.83	23	47.92	7	14.58	(df : 9)
All Data		11	5.50	80	40.00	83	41.50	26	13.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

(6) Percentage of Labourers after 1991 Reforms

The table (8.17) depicting the change in percentage of labourers after 1991 reforms, at aggregate shows that approximately 70 percent firms responded with an increase in the percentage of labourers after 1991 reforms. Analysis of age structure depicts that about 87 percent old firms and 70 percent medium firms show an increase in the percentage of labourers after 1991 reforms. 52.33 percent of new firms show that the percentage of labourers after 1991 reforms is almost the same while 10.47 percent of new firms show substantial increase in percentage labourers after 1991 reforms. The chi square test for independence shows that percentage of labourers after 1991 reforms and age of firm are not independent (χ^2 = 37.04, df = 4).

Table 8.17: Percentage of Labourers after 1991 Reforms

Group/Sub Group	substantially decreased	marginally decreased	remained the same		marginally increased		substantially increased		
			No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure									
1. Old			6	12.24	35	71.43	8	16.33	
2. Medium			13	20.00	31	47.69	21	32.31	Chi^2=37.04**
3. New			45	52.33	32	37.21	9	10.47	(df : 4)
Size of Firm									
1. Large Scale			3	5.08	35	59.32	21	35.59	
2. Medium Scale			13	33.33	26	66.67			Chi^2=44.00**
3. Small Scale			48	47.06	37	36.27	17	16.67	(df : 4)
Type of Organisation									
1. Single Proprietary			25	43.86	22	38.60	10	17.54	
2. Partnership			19	39.58	25	52.08	4	8.33	
3. Public Limited			3	6.38	27	57.45	17	36.17	
4. Private Limited			17	35.42	24	50.00	7	14.58	Chi^2=25.95**
									(df :6)
All Data			64	32.00	98	49.00	38	19.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Analysis done on the basis of the size of firm highlights that approximately 95 percent of large scale firms have responded to the reforms with an increase in number of employees after 1991. Out of these, 35 percent of responding firms report a substantial increase in the percentage of labourers in the post 1991 era. 66.67 percent medium scale and 52.94 percent small scale firms have also experienced an increase in the percentage of labourers after the reforms initiated in 1991. The chi square test shows that the percentage of labourers after 1991 reforms and the size of firm are dependent ($\chi^2 = 44.00$, df = 4).

In case of public limited firms, almost all the firms report a rise in the percentage of labourers after 1991 reforms. Approximately 60 percent of single proprietary, partnership and private limited firms have also experienced an increase in the percentage of labourers after 1991 reforms. The chi square test for percentage of labourers after 1991 reforms and type of organisation is significant at 1 percent level ($\chi^2 = 25.95$, df = 6). This shows that the variables are related.

To conclude, the analysis depicts that almost all the old, large scale and public limited firms have experienced an increase in the percentage of labourers after 1991 reforms. In case of new and small scale firms, the firms which experience rise in the percentage of labourers after 1991 reforms are about 50 percent. Overall it can be said that Punjab manufacturing has responded to the reforms with an increase in the percentage of labourers in the post-reform era.

(7) Work Orientation and Attitude of the Workers

In table 8.18, work orientation and attitude of the workers of the firms is depicted. At aggregate level most of the firms respond that work orientation and attitude of the workers of their firms is good.

Analysis at the level of age structure depicts that about 80 percent of old, medium and new firms respond that the work orientation and attitude of the workers is either good or very good. The chi square test shows that work orientation and attitude of the workers of the firm and age of firm are independent ($\chi^2 = 6.87$, df = 6). Size wise analysis depicts that work orientation and attitude of the workers in almost all the large sized firms is good. 75 percent of large sized firms depict good attitude of workers and 18.64 percent depict 'very good' orientation and attitude of workers. Approximately 77 percent medium sized and 71 percent small sized firms rate work orientation and attitude of the workers of their firms as either 'good' or 'very good'. The chi square test for independence shows a relation between work orientation and attitude of the workers of the firm and size of firm (χ^2 = 14.85, df = 6).

Table 8.18: Work Orientation and Attitude of the Workers

Group/Sub Group	very poor	poor		moderate		good		very good		
		No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure										
1. Old				9	18.37	32	65.31	8	16.33	
2. Medium		3	4.62	11	16.92	41	63.08	10	15.38	Chi^2=6.87
3. New				19	22.09	53	61.63	14	16.28	(df : 6)
Size of Firm										
1. Large Scale				4	6.78	44	74.58	11	18.64	
2. Medium Scale				9	23.08	27	69.23	3	7.69	Chi^2=14.85*
3. Small Scale		3	2.94	26	25.49	55	53.92	18	17.65	(df : 6)
Type of Organisation										
1. Single Proprietary		3	5.26	20	35.09	24	42.11	10	17.54	
2. Partnership				3	6.25	33	68.75	12	25.00	
3. Public Limited				3	6.38	40	85.11	4	8.51	Chi^2=36.94**
4. Private Limited				13	27.08	29	60.42	6	12.50	(df :9)
All Data		3	1.50	39	19.50	126	63.00	32	16.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Partnership and public limited firms accept the work orientation and attitude of workers to be good. 85.11 percent of public limited firms report a good work orientation and attitude. The chi square test for the work orientation and attitude of the workers of the firm and type of organisation is significant at 1 percent level (χ^2 = 36.94, df = 9). Organisational structure is related to work orientation and attitude of workers. To conclude it can be said that the work orientation and attitude of the workers is good for almost all the old, medium and new firms in the manufacturing sector of Punjab. Again size wise analysis and organisational analysis also depicts the similar trend. There seems to be a change in the organisation with workers having a good orientation and attitude, i.e., eagerness to learn and to adapt to the changing environment.

8.2.3 Section C: Impact of Globalisation on Technology Adoption and Adaptation

(1) Impact of Globalisation

(i) Technology Availability and its Adoption

Table 8.19 depicts the response to the question whether availability of better technology due to globalisation stimulated the firms to adopt new technology. At aggregate level, the analysis depicts that approximately 40 percent firms strongly agree with that the availability of better technology due to globalisation stimulated them to go for it and 44.50 percent firms ‘agree’ with this observation. Only 4.50 percent firms disagree with this observation.

Table 8.19: Technology Availability and its Adoption

Group/Sub Group	strongly disagree	disagree		neutral		agree		strongly agree		
		No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure										
1. Old		3	6.12	3	6.12	14	28.57	29	59.18	
2. Medium				6	9.23	34	52.31	25	38.46	Chi^2=21.51**
3. New		6	6.98	16	18.60	41	47.67	23	26.74	(df : 6)
Size of Firm										
1. Large Scale				6	10.17	21	35.59	32	54.24	
2. Medium Scale		3	7.69	3	7.69	23	58.97	10	25.64	Chi^2=14.60*
3. Small Scale		6	5.88	16	15.69	45	44.12	35	34.31	(df : 6)
Type of Organisation										
1. Single Proprietary		6	10.53	10	17.54	23	40.35	18	31.58	
2. Partnership		3	6.25	6	12.50	25	52.08	14	29.17	
3. Public Limited				6	12.77	15	31.91	26	55.32	Chi^2=20.65*
4. Private Limited				3	6.25	26	54.17	19	39.58	(df :9)
All Data		9	4.50	25	12.50	89	44.50	77	38.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Most of the old, medium and new firms agree that the availability of better technology due to globalisation has stimulated them to go for it. Approximately 90 percent of large sized firms agree that availability of better technology due to globalisation has stimulated them to go for it. About 84 percent medium sized and 78 percent small sized firms also accepted this. The chi square test for independence depicts that the availability of better technology due to globalisation stimulating the firms to go for it and the size of firm are not independent (χ^2 = 14.60, df =6). The result of the type of organization depicts that all types of firms agree that the availability of better technology due to globalisation stimulated the firms to go for new technology. The chi square test for availability of better technology due to globalisation stimulating the firms to go for it and the type of organisation is significant at 5 percent level. This shows that the variables are not independent (χ^2 = 20.65, df =9).

So overall the analysis depicts that the availability of better technology due to globalisation stimulated the firms to go for it. New globalized scenario brought with it new technology and this new technology is available to Punjab manufacturing too. Thus in the new policy regime, the manufacturing sector of Punjab started adopting new technology at a higher rate due to its better availability.

(ii) Opportunities for New Technology Adoption

Globalisation brings with it new opportunities as well as new threats. One of such opportunities is in the form of vast market potential which induces the firms to shift to new technology to gain competitive advantage. An attempt is made to study the response of Punjab manufacturing to switchover to new technology because of this opportunity and the aggregate analysis does depict that most of the firms agree with this view.

Analysis at the disaggregative level depicts that almost all the large firms and 90 percent of medium and new firms agree that opportunities created by globalisation have encouraged them to move over to new technology. The chi square test shows that opportunities created due to globalisation encouraged the firms to go for new technology and age of firm are not independent (χ^2 = 20.71, df =6).

Size wise analysis depicts that the size does not act as a hindrance to the view that the opportunities of enhanced markets have encouraged the firms to adopt new technology. The chi square test for independence depicts that opportunities created due to globalisation encouraging the firms to go for new technology and the size of firm are related (χ^2 = 28.76, df = 6). Organisational analysis depicts that all the firms accept the viewpoint that opportunities created due to globalisation have encouraged them to go for new technology. Only 14 percent single proprietary firms disagree with it. The chi square test for opportunities created due to globalisation encouraging the firms to go for new technology and type of organization, significant at 1 percent level shows that the variables are dependent (χ^2 = 37.74, df = 9).

Table 8.20: Opportunities for New Technology Adoption

Group/Sub Group	strongly disagree	disagree		neutral		agree		strongly agree		
		No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure										
1. Old						19	38.78	30	61.22	
2. Medium		4	6.15	3	4.62	30	46.15	28	43.08	Chi^2=20.71**
3. New		4	4.65	9	10.47	50	58.14	23	26.74	(df : 6)
Size of Firm										
1. Large Scale						21	35.59	38	64.41	
2. Medium Scale				3	7.69	25	64.10	11	28.21	Chi^2=28.76**
3. Small Scale		8	7.84	9	8.82	53	51.96	32	31.37	(df : 6)
Type of Organisation										
1. Single Proprietary		8	14.04	3	5.26	25	43.86	21	36.84	
2. Partnership				3	6.25	31	64.58	14	29.17	
3. Public Limited						28	59.57	19	40.43	Chi^2=37.74**
4. Private Limited				6	12.50	15	31.25	27	56.25	(df :9)
All Data		8	4.00	12	6.00	99	49.50	81	40.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

So in the new policy regime almost all the firms have been encouraged to go for new technology due to the opportunity of increased markets. This is a healthy trend as Punjab manufacturing is responding to the new opportunities created by globalisation.

(iii) Threats: Competition Induced New Technology Adoption

Opportunities and threats exist side by side. A shift to new technology could be the result of an opportunity of a new expanding market or a threat of losing to your competitors as globalisation brings with it competition and only the fittest firms are able to survive in the end. Table 8.21 depicts whether the threats in the form of competitions in the markets have induced firms to adopt new technology. 80 percent firms agree with this and only 12 percent firms disagree that the threat of losing market to their competitors have induced them to shift to new technology.

Table 8.21: Threats: Competition Induced New Technology Adoption

Group/Sub Group	strongly disagree	disagree		neutral		agree		strongly agree		
		No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure										
1. Old				7	14.29	16	32.65	26	53.06	
2. Medium		3	4.62	3	4.62	25	38.46	34	52.31	Chi^2=35.23**
3. New		21	24.42	9	10.47	37	43.02	19	22.09	(df : 6)
Size of Firm										
1. Large Scale				3	5.08	19	32.20	37	62.71	
2. Medium Scale		3	7.69	10	25.64	19	48.72	7	17.95	Chi^2=42.24**
3. Small Scale		21	20.59	6	5.88	40	39.22	35	34.31	(df : 6)
Type of Organisation										
1. Single Proprietary		6	10.53	3	5.26	27	47.37	21	36.84	
2. Partnership		12	25.00	6	12.50	12	25.00	18	37.50	
3. Public Limited				7	14.89	21	44.68	19	40.43	Chi^2=20.25**
4. Private Limited		6	12.50	3	6.25	18	37.50	21	43.75	(df :9)
All Data		24	12.00	19	9.50	78	39.00	79	39.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Age wise analysis depicts that almost all the old and medium firms accept this viewpoint. In case of new firms also, 65 percent agree and only 24 percent disagree. The chi square test shows that threats in form of competitions in the markets inducing the firms to go for new technology and the age of firm are not independent (χ^2 = 35.23, df =6).

Size wise analysis depicts that 62.71 percent large sized firms strongly agree and 32.20 percent large sized firms agree with this observation. In the case of medium sized firms, approximately 70 percent agree and 20 percent disagree. About 73 percent small sized firms also agree with this observation. The chi square test for independence shows that threats in the form of competitions in the markets inducing the firms to adopt new technology and the size of firm are dependent (χ^2 = 42.24, df = 6). The chi square test for threats in form of competitions in the markets inducing the firms to adopt for new technology and the type of organisation is significant at 5 percent level (χ^2 = 20.25, df =9). This shows that the variables are not independent. The responses on the basis of organizational structure also depict a similar trend. This highlights that one of the reasons of Punjab manufacturing for switching over to the new technology is the threat perceived due to increased competitiveness.

(2) Expectations of the Firms after New Technology Adoption

Table 8.22: Ranking of Expectations of the Firms after New Technology Adoption

	Expectation	**Average Rank**
(i)	Increased Sales	3.04
(ii)	Increased Net Profits	5.61
(iii)	Improved Product Quality	4.91
(iv)	Increased Market Share	3.75
(v)	Improved Productivity	3.15
(vi)	Reduced Product Cost	5.30

Computed

The above table depicts that the highest average rating is for the increased sales. This shows that after adopting the new technology, the firms accept that the sales have increased maximally. The second highest improvement is in productivity. On the other hand, after adopting the new technology, there is least rise in the net profit and the reduction in production cost is also less.

(3) Technology Adoption

(i) Adoption of New Technology for the First Time

Regarding the adoption of new technology for the first time, there is a mixed response (Table 8.23). The highest percentage i.e. 34 percent firms responded that they had adopted new technology for the first time five to ten years ago and 29.50 percent responded that they had adopted it 1-5 years ago. Age structure analysis depicts that 36.76 percent old firms responded that they had adopted new technology for the first time five to ten years ago and 26.53 percent responded that they had adopted it one to five years ago. Most of the medium firms opted for adoption of new technology five to ten years ago while for the new firms the maximum responses are for one to five years ago. The chi square test shows that adoption of new technology for the first time by the firms and age of firm are not independent (χ^2 = 27.23, df = 8).

Size wise analysis depicts that most of the large sized firms had adopted new technology for the first time 5 to 10 years ago or 10 to 15 years ago. 43.59 percent of medium sized firms responded that they had adopted new technology for the first time 1-5 years ago. 36 of 102 small sized firms adopted new technology for the first time 5-10 years ago and 33 of 102 small sized firms adopted new technology for the first time 1-5 years ago. The chi square test for adoption of new technology for the first time by the firms and the size of firm is significant at 1 percent level (χ^2 = 43.13, df =8). This shows that the variables are not independent. Analysis on the basis of organizational structure depicts that most of the firms responded of having adopted new technology either one to five or five to ten years ago. In case of partnership firms there are 33.33 firms, which have also adopted it a year ago. The chi square test for independence shows that adoption of new technology for the first time by the firms and the type of organisation are not independent (χ^2 =64.36, df =12).

Table 8.23: Adoption of New Technology for the First Time

Group/Sub Group	<1 yr		1-5 yr ago		5-10 yr ago		10-15 yr ago		more 15 yr		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old			13	26.53	18	36.73	7	14.29	11	22.45	
2. Medium	9	13.85	12	18.46	31	47.69	9	13.85	4	6.15	Chi^2=27.23**
3. New	14	16.28	34	39.53	19	22.09	9	10.47	10	11.63	(df :8)
Size of Firm											
1. Large Scale			9	15.25	22	37.29	16	27.12	12	20.34	
2. Medium Scale	3	7.69	17	43.59	10	25.64	6	15.38	3	7.69	Chi^2=43.13**
3. Small Scale	20	19.61	33	32.35	36	35.29	3	2.94	10	9.80	(df : 8)
Type of Organisation											
1. Single Proprietary	7	12.28	21	36.84	20	35.09	6	10.53	3	5.26	
2. Partnership	16	33.33	15	31.25	14	29.17	3	6.25			
3. Public Limited			13	27.66	21	44.68	3	6.38	10	21.28	Chi^2=64.36**
4. Private Limited			10	20.83	13	27.08	13	27.08	12	25.00	(df : 12)
All Data	23	11.50	59	29.50	68	34.00	25	12.50	25	12.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Overall analysis depicts that 68 out of 200 firms responded of having adopting new technology 5 to 10 years ago. 59 adopted it for the first time 1 to 5 years ago. In case of old, large sized, public limited and private firms, more than 20% firms have responded that they had adopted new technology more than 15 years ago. So this shows that in the new policy regime, due to the availability of new technology, the firms started adopting new technology.

(ii) Present Technology

After enquiring about the adoption of new technology, the study focus has been on the present technology. Table 8.24 depicts the status of present technology used by the firms. At the aggregate level the table depicts that 46.50 percent firms are using advanced technology, another 46.50 percent responding firms are using intermediate technology. The respondents are not using the conventional or old technology. Analysis at age structural level depicts that about 40 percent old firms are using advanced technology and 51.02 percent old firms are using intermediate technology. For medium firms 61.54 percent of them are using advanced technology and 33.85 are using intermediate technology. 38.37 percent new firms are using advanced technology and 53.49 percent new firms are using intermediate technology. The chi square test depicts a relationship between technology being used presently by the firms and the age of firm (χ^2 = 19.61, df = 6).

Size wise analysis highlights that large sized firms use more of advanced technology. The small firms use more of intermediate technology. The chi square test for independence depicts that the technology used by the firms and the size of firm are related (χ^2 = 46.50, df =6). Analysis on the basis of organizational structure depicts that most of the single proprietary and partnership firms are using intermediate technology. On the other hand most of the public and private limited firms are using advanced technology. The chi square test for present state of technology used by the firms and type of organisation is significant at 1 percent level (χ^2 = 54.83, df = 9). This shows that the variables are not independent.

Table 8.24: Technology used by the Firms

Group/Sub Group	quite old		Conventional		intermediate		advanced		
	No. of Firms	**%age of Firms**	**No. of Firms**	**%age of Firms**	**No. of Firms**	**%age of Firms**	**No. of Firms**	**%age of Firms**	
Age Structure									
1. Old			4	8.16	25	51.02	20	40.82	
2. Medium	3	4.62			22	33.85	40	61.54	Chi^2=19.61**
3. New			7	8.14	46	53.49	33	38.37	(df : 6)
Size of Firm									
1. Large Scale					15	25.42	44	74.58	
2. Medium Scale			8	20.51	18	46.15	13	33.33	Chi^2=46.50**
3. Small Scale	3	2.94	3	2.94	60	58.52	36	35.29	(df : 6)
Type of Organisation									
1. Single Proprietary	3	5.26	3	5.26	41	71.93	10	17.54	
2. Partnership					29	60.42	19	39.58	
3. Public Limited			4	8.51	7	14.89	36	76.60	Chi^2=54.83**
4. Private Limited			4	8.33	16	33.33	28	58.33	(df : 9)
All Data	3	1.50	11	5.50	93	46.50	93	46.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

The above analysis is indicative of the fact that most of the medium aged, large sized, public limited and private limited firms are presently using advanced technology. So the above trends depict that with the increase in size and with a shift towards private and public limited, the use of advanced technology by the firms increases.

(iii) Basis for Adoption of New Technology

Table 8.25 depicts the basis for adoption of new technology by the firms. Technology adoption trends depict that there are 14.5 percent firms which are early adopters who adopt new technology immediately when it arrives. 53 percent firms decide to adopt new technology after its performance has been proved.

Table 8.25: Basis for Adoption of New Technology

Group/Sub Group	in dire need		after performance proved		when getting popular		immediately on availability		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure									
1. Old			32	65.31	7	14.29	10	20.41	
2. Medium	7	10.77	39	60.00	10	15.38	9	13.85	Chi^2=20.28**
3. New	16	18.60	35	40.70	25	29.07	10	11.63	(df : 6)
Size of Firm									
1. Large Scale	3	5.08	39	66.10	4	6.78	13	22.03	
2. Medium Scale	3	7.69	23	58.97	10	25.64	3	7.69	Chi^2=20.89**
3. Small Scale	17	16.67	44	43.14	28	27.45	13	12.75	(df : 6)
Type of Organisation									
1. Single Proprietary	17	29.82	22	38.60	12	21.05	6	10.53	
2. Partnership	3	6.25	25	52.08	10	20.83	10	20.83	
3. Public Limited			38	80.85	3	6.38	6	12.77	Chi^2=45.82**
4. Private Limited	3	6.25	21	43.75	17	35.42	7	14.58	(df : 9)
All Data	23	11.50	106	53.00	42	21.00	29	14.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Similar trends are visible when analysis is done on the basis of age structure. Most of the old and medium firms adopt new technology after it has been tested. 40 percent new firms adopt the new technology after its performance has been proved and approximately 30 percent new firms adopt it when it is getting popular. About 20 percent old firms adopt the new technology immediately on availability. The chi square test for ‘basis for adoption of new technology by the firms’ and age of firm is significant at 1 percent level (χ^2 = 20.28, df =6). This shows that the variables are related.

Size wise analysis depicts that most of the large, medium and small sized firms adopt new technology after its performance has been proved. The chi square test for independence shows that the basis for the adoption of new technology by the firms and size of firm are related (χ^2 = 20.89, df =6). The maximum number of public limited firms, infact 80.85 percent adopts new technology after the performance has been proved. For all other firms the adoption of new technology is either when it is becoming popular or when the performance has been proved. Early adopters in all the categories are less. The chi square test shows that basis for adoption of new technology by the firms and type of organisation are not independent (χ^2 = 45.82, df = 9). The technology adoption cycle depicts that there will be few firms who are early adopters. The similar trend is visible for Punjab manufacturing where most of the firms adopt new technology either after its performance has been proved or when it is getting popular.

(4) Role of Government

(i) Government Agencies and Technology Adoption

After having a view of technology adoption in Punjab manufacturing, let us see the role played by the government to motivate the manufacturing sector for adopting new technology. The analysis depicts that only 25.50 percent firms agree that the govt. agencies motivate them for the new technology adoption and 38 percent firms disagree and are of the view that the govt. agencies do not motivate them for technology adoption.

Age structure analysis depicts that 42.26 percent old firms agree that the govt. agencies motivate new technology adoption. In case of new firms the respondents results depict that they mostly disagree with the view that the govt. agencies help in technology adoption. The responses of medium firms are either neutral or they also disagree with the view. The chi square test for independence shows that govt. agencies motivate new technology adoption to the firms and age of firm are related (χ^2 = 28.44, df = 8).

In case of large scale firms there are still 37 percent who feel that the govt. agencies motivate technology adoption but small scale firms are of the contrary viewpoint with 43 percent disagreeing that govt. agencies motivate technology adoption. The chi square test shows that the variables are to be related (χ^2 = 23.22, df =8). Analysis on the basis of organizational structure also highlights that there are many firms at all levels which feel that govt. agencies do not motivate new technology adoption. The chi square test shows that govt. agencies motivating new technology adoption to the firms and the type of organisation are not independent (χ^2 = 29.01, df = 12).

Table 8.26: Government Agencies Motivation for New Technology Adoption

Group/Sub Group	**strongly disagree**		**disagree**		**neutral**		**agree**		**strongly agree**		
	No. of Firms	**%age of Firms**	**No. of Firms**	**%age of Firms**	**No. of Firms**	**%age of Firms**	**No. of Firms**	**%age of Firms**	**No. of Firms**	**%age of Firms**	
Age Structure											
1. Old	3	6.12	7	14.29	18	36.73	21	42.86			
2. Medium	15	23.08	11	16.92	29	44.62	10	15.38			Chi^2=28.44**
3. New	13	15.12	27	31.40	22	25.58	20	23.26	4	4.65	(df : 8)
Size of Firm											
1. Large Scale	6	10.17	11	18.64	20	33.90	22	37.29			
2. Medium Scale	12	30.77	3	7.69	15	38.46	9	23.08			Chi^2=23.22**
3. Small Scale	13	12.75	31	30.39	34	33.33	20	19.61	4	3.92	(df : 8)
Type of Organisation											
1. Single Proprietary	13	22.81	16	28.07	15	26.32	9	15.79	4	7.02	
2. Partnership	3	6.25	9	18.75	19	39.58	17	35.42			
3. Public Limited	12	25.53	7	14.89	17	36.17	11	23.40			Chi^2=29.01**
4. Private Limited	3	6.25	13	27.08	18	37.50	14	29.17			(df :12)
All Data	31	15.50	45	22.50	69	34.50	51	25.50	4	2.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Overall the results show that there is no strong evidence to prove that the govt. agencies motivate new technology adoption in Punjab manufacturing sector. Only for a few old and large manufacturing firms there is some supportive evidence of motivation of govt. agencies for new technology adoption. Thus the results highlight that govt. has to take some steps to facilitate the adoption of new technology by Punjab manufacturing industries.

ii) Govt. Regulations and New Technology Adoption

Table 8.27: Govt. Regulations and New Technology Adoption

Group/Sub Group	strongly disagree		disagree		neutral		agree		strongly agree		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	3	6.12	8	16.33	10	20.41	25	51.02	3	6.12	
2. Medium	6	9.23	13	20.00	20	30.77	23	35.38	3	4.62	Chi^2=38.27**
3. New	16	18.60	32	37.21	25	29.07	6	6.98	7	8.14	(df : 8)
Size of Firm											
1. Large Scale	3	5.08	11	18.64	13	22.03	29	49.15	3	5.08	
2. Medium Scale	6	15.38	13	33.33	17	43.59	3	7.69			Chi^2=32.18**
3. Small Scale	16	15.69	29	28.43	25	24.51	22	21.57	10	9.80	(df :8)
Type of Organisation											
1. Single Proprietary	13	22.81	10	17.54	12	21.05	15	26.32	7	12.28	
2. Partnership			12	25.00	19	39.58	17	35.42			
3. Public Limited	9	19.15	11	23.40	14	29.79	10	21.28	3	6.38	Chi^2=32.35**
4. Private Limited	3	6.25	20	41.67	10	20.83	12	25.00	3	6.25	(df :12)
All Data	25	12.50	53	26.50	55	27.50	54	27.00	13	6.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Table 8.27 depicts the responses to the question whether the govt. regulations are a basis for new technology adoption. The analysis here depicts that only 33.50 percent of firms agree that the govt. regulations are a basis for technology adoption and 40 percent firms disagree with this viewpoint. Age structural analysis depicts that old and medium firms agree to this viewpoint while new firms almost disagree with the view that the govt. regulations are a basis for new technology adoption. The chi square test shows that the govt. regulations as a basis for new technology adoption and age of firm are not independent (χ^2 = 38.27, df =8). Similarly many large sized firms agree with this viewpoint. Only 30 percent small sized firms agree and 44.12 percent small sized firms disagree with it. The chi square test for govt. regulations as a basis for new technology adoption and size of firm is significant at 1 percent level. This shows that the variables are dependent (χ^2 = 32.18, df =8).

Analysis on the basis of organization structure also depicts that there are still many firms in each category who do not accept that the govt. regulations are a basis for the adoption of new technology. The chi square test for independence shows that govt. regulations as a basis for new technology adoption and type of organisation are dependent (χ^2 = 32.35, df = 12). On the whole the analysis depicts that the most of the old and large firms agree that the govt. regulations are a basis for new technology adoption whereas new and small sized firms disagree with this viewpoint. Most of the single proprietary, partnership, public limited and private limited firms disagree that the govt. regulations are a basis for new technology adoption. So all these are pointers to the fact that govt. regulations are not implemented effectively. The govt. needs to focus more on these aspects.

(iii) Industrial Policy and New Technology Adoption

Table 8.28 depicts the response of the manufacturing sector of Punjab whether the industrial policy induces new technology adoption by giving incentives. The table at aggregate level depicts that 22 percent firms agree that the industrial policy induces new technology adoption by giving incentives while 35 percent feel that it does not give incentives for new technology adoption. Most of the old firms approximately 36.73 percent agree that the industrial policy induces new technology adoption by giving incentives while most of the new firms disagree with it. The chi square test for independence shows that there is a relation between incentives provided by the industrial policy for new technology adoption to the firms and the age of firm (χ^2 = 24.65, df =8).

Similarly large sized firms still feel that the industrial policy induces new technology adoption by giving incentives while small sized firms feel otherwise. The chi square test shows that incentives provided by the industrial policy for new technology adoption to the firms and size of firm are not independent (χ^2 = 49.88, df = 8). Similarly on the basis of organizational structure there are single proprietary firms which do not accept that the industrial policy has encouraged new technology adoption. The chi square test depicts that incentives provided by the industrial policy for new technology adoption to the firms and type of organisation is significant at 1 percent level (χ^2 = 70.71, df =2. This shows that the variables are not independent.

Table 8.28: Industrial Policy and New Technology Adoption

Group/Sub Group	strongly disagree		disagree		neutral		agree		strongly agree		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	3	6.12	10	20.41	18	36.73	18	36.73			
2. Medium	6	9.23	13	20.00	31	47.69	15	23.08			Chi^2=24.65**
3. New	16	18.60	22	25.58	37	43.02	7	8.14	4	4.65	(df : 8)
Size of Firm											
1. Large Scale	3	5.08	16	27.12	13	22.03	27	45.76			
2. Medium Scale	6	15.38	7	17.95	26	66.67					Chi^2=49.88**
3. Small Scale	16	15.69	22	21.57	47	46.08	13	12.75	4	3.92	(df : 8)
Type of Organisation											
1. Single Proprietary	13	22.81	19	33.33	18	31.58	3	5.26	4	7.02	
2. Partnership			6	12.50	38	79.17	4	8.33			
3. Public Limited	9	19.15	7	14.89	13	27.66	18	38.30			Chi^2=70.71*
4. Private Limited	3	6.25	13	27.08	17	35.42	15	31.25			(df :12)
All Data	25	12.50	45	22.50	86	43.00	40	20.00	4	2.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Overall analysis depicts that there are just a few firms which agree that the industrial policy induces new technology adoption by giving incentives. These are mostly old, large sized, public limited and private limited firms. So there has not been much evidence to show that the new industrial policy has provided sufficient incentives for new technology adoption in the Punjab manufacturing sector.

(5) Barriers to New Technology Adoption

(i) Cost of Acquisition of New Technology

Due to import liberalisation in the new policy regime, the import of technology increased in India. But there are a lot of barriers to this new technology adoption; one such barriers exists in the form of cost of new technology acquisition. New technology is often costly and to assess whether the cost of new technology acts as a barrier, the responses of Punjab manufacturing sector were taken and table 8.29 gives details of these responses. A majority of firms infact 75 percent of the total firms consider cost as an important barrier for technology adoption.

Table 8.29: Cost of Acquisition as a Barrier to New Technology Adoption

Group/Sub Group	not important		not at all important		neutral		important		highly important		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	7	14.29					25	51.02	17	34.69	
2. Medium	6	9.23	4	6.15	12	18.46	26	40.00	17	26.15	Chi^2=16.72*
3. New	9	10.47	6	6.98	6	6.98	38	44.19	27	31.40	(df : 8)
Size of Firm											
1. Large Scale	7	11.86	4	6.78	6	10.17	28	47.46	14	23.73	
2. Medium Scale	3	7.69			3	7.69	16	41.03	17	43.59	Chi^2=6.47
3. Small Scale	12	11.76	6	5.88	9	8.82	45	44.12	30	29.4	(df : 8)
Type of Organisation											
1. Single Proprietary	3	5.26	3	5.26	3	5.26	29	50.88	19	33.33	
2. Partnership	9	18.75			9	18.75	13	27.08	17	35.42	
3. Public Limited	3	6.38	4	8.51	6	12.77	21	44.68	13	27.66	Chi^2=26.46**
4. Private Limited	7	14.58	3	6.25			26	54.17	12	25.00	(df :12)
All Data	22	11.00	10	5.00	18	9.00	89	44.50	61	30.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Analysis at disaggregative level depicts that most of the old, medium and new firms consider that cost constitutes an important barrier. The chi square test depicts that the cost of acquisition of new technology as a barrier to new technology adoption and the age of firm are not independent (χ^2 = 16.72, df =8). For a majority of large sized, medium sized and small sized firms, cost constitutes an important barrier. The chi square test for independence shows that the cost of new technology acquisition as a barrier to new technology adoption and the size of firm are not dependent (χ^2 = 6.47, df = 8). The similar trend is visible for the organizational analysis as well. The chi square test for cost of new technology acquisition as a barrier to new technology adoption and type of organization is significant at 1 percent level. This shows that the variables are related (χ^2 = 26.46, df =12).

To conclude it can be said that a majority of the firms consider the cost of acquisition of new technology as an important barrier to new technology adoption. Steps can be taken to provide certain schemes like providing loans or providing new machines on installment, or charging low interest rates for technology adoption.

(ii) Cost of Training and Education

New technology is not only available at a high cost but also involves a lot of expenditure which has to be incurred for training and educating the workforce to use the new machines, new methods etc. The table 8.30 depicts whether the cost incurred on training and education acts as a barrier to new technology adoption. Most of the responding firms consider cost of training and education as another important barrier to new technology adoption.

Age structural analysis reveals that 78 percent of old firms consider cost of training and education as an important barrier to new technology adoption. About 51 percent medium firms also consider it as an important barrier. Not only the old and medium firms but the new firms also consider the cost of training and education as an important barrier to new technology adoption. The chi square test for the cost of training and education as a barrier to new technology adoption and the age of firm is significant at 1 percent level (χ^2 = 49.14, df =8). This shows that the variables are not independent.

Table 8.30: Cost of Training and Education as a Barrier to New Technology Adoption

Group/Sub Group	not important		not at all important		neutral		important		highly important		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	8	16.33	3	6.12			14	28.57	24	48.98	
2. Medium	10	15.38	3	4.62	18	27.69	14	21.54	20	30.77	Chi^2=49.14**
3. New	6	6.98	15	17.44	9	10.47	43	50.00	13	15.12	(df : 8)
Size of Firm											
1. Large Scale	8	13.56			12	20.34	15	25.42	24	40.68	
2. Medium Scale	4	10.26	3	7.69	9	23.08	13	33.33	10	25.64	Chi^2=28.21**
3. Small Scale	12	11.76	18	17.65	6	5.88	43	42.16	23	22.55	(df : 8)
Type of Organisation											
1. Single Proprietary	3	5.26	6	10.53	3	5.26	29	50.88	16	28.07	
2. Partnership	6	12.50	9	18.75	9	18.75	17	35.42	7	14.58	
3. Public Limited	8	17.02			12	25.53	8	17.02	19	40.43	Chi^2=36.46**
4. Private Limited	7	14.58	6	12.50	3	6.25	17	35.42	15	31.25	(df :12)
All Data	24	12.00	21	10.50	27	13.50	71	35.50	57	28.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Size wise analysis also depicts the similar results with 66 percent of large, 59 percent of medium and 67 percent of small firms considering it as an important barrier in technology adoption. Infact 40.68 percent of large firms consider it an highly important barrier. The chi square test for independence shows that the cost of training and education as a barrier to new technology adoption and size of firm are dependent (χ^2 = 28.21, df = 8). The same trend is visible in the analysis at organizational level. The chi square test shows that cost of training and education as a barrier to new technology adoption and type of organization are not independent (χ^2 =36.46, df =12). Thus on the whole, the cost of training and education is another important barrier to new technology adoption.

(iii) Workers Resistance

Workers generally resist change. Trying to find an answer to this, the respondents were asked whether the workers resistance acts as a barrier to technology adoption or not. Workers resistance as a barrier to new technology adoption is depicted in table 8.31. The responses depict that workers resistance is not received as that important a barrier as the cost of new technology or cost incurred on training and educating employees.

Table 8.31: Workers Resistance as a Barrier to New Technology Adoption

Group/Sub Group	not important		not at all important		neutral		important		highly important		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	7	14.29	16	32.65	6	12.24	10	20.41	10	20.41	
2. Medium	14	21.54	13	20.00	3	4.62	24	36.92	11	16.92	Chi^2=17.01*
3. New	17	19.77	16	18.60	20	23.26	21	24.42	12	13.95	(df : 8)
Size of Firm											
1. Large Scale	11	18.64	18	30.51			19	32.20	11	18.64	
2. Medium Scale	4	10.26	7	17.95	6	15.38	12	30.77	10	25.64	Chi^2=22.54**
3. Small Scale	23	22.55	20	19.61	23	22.55	24	23.53	12	11.76	(df : 8)
Type of Organisation											
1. Single Proprietary	7	12.28	10	17.54	10	17.54	18	31.58	12	21.05	
2. Partnership	6	12.50	14	29.17	16	33.33	12	25.00			
3. Public Limited	7	14.89	11	23.40			12	25.53	17	36.17	Chi^2=56.43**
4. Private Limited	18	37.50	10	20.83	3	6.25	13	27.08	4	8.33	(df :12)
All Data	38	19.00	45	22.50	29	14.50	55	27.50	33	16.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Disaggregative analysis reveals that 20.41 percent old firms consider the workers resistance as highly important barrier to new technology adoption and 20.41 percent old firms accept it as an important barrier. 14.29 percent old firms do not consider it as an important barrier and 32.65 percent old firms accept it as not at all important barrier. 50.84 percent of medium scale and approximately 40 percent new firms consider workers resistance as an important barrier to new technology adoption. The chi square test for independence shows that workers resistance as a barrier to new technology adoption and age of firm are dependent (χ^2 = 17.01, df = 8). The results of the analysis are indicative of the fact that about 50 percent of large sized firms consider workers resistance an important barrier to new technology adoption. 56.41 percent medium and 35.29 percent small sized firms accept it as an important barrier.

The chi square test shows that the variables are dependent (χ^2 = 22.54, df =8). Most of the single proprietary and public limited firms show that workers resistance is a highly important barrier to new technology adoption. Most of the private limited firms also consider it as an important barrier to new technology adoption. The chi square test for workers resistance as a barrier to new technology adoption and type of organization is significant at 1 percent level (χ^2 = 56.43, df =12). This shows that the variables are not independent.

Thus the overall analysis depicts that most of the medium, large sized, medium sized, single proprietary, public limited and private limited firms consider the workers resistance as an important barrier to new technology adoption. So it can be said that workers resistance is also an important barrier but the responses here are less intense as compared with responses cost of machinery and cost of training and education being barriers to adoption of new technology.

(iv) Lack of Qualified Personnel

The results of the lack of qualified personnel as a barrier to new technology adoption in Punjab manufacturing sector are depicted in the table 8.32. On the whole the table shows that 12.50 percent firms consider lack of qualified personnel as a highly important barrier to new technology adoption, while 33 percent firms consider it as an important barrier to new technology adoption. 38.50 percent firms do not consider it as an important barrier. Disaggregative analysis depicts that most of the old firms consider lack of qualified personnel not an important barrier and most of the medium and new firms consider it as an important barrier. The older firms may be having highly qualified staff. So they do not accept it as an important barrier. The chi square test shows that lack of qualified personnel as a barrier to new technology adoption and the age of firm are not independent (χ^2 = 27.09, df = 8).

Size wise analysis depicts that large sized firms do not consider it an important barrier and medium sized and small sized firms accept it as an important barrier to new technology adoption. The chi square test for independence shows that the lack of qualified personnel as a barrier to new technology adoption and size of firm are dependent (χ^2 = 14.90, df =8).

Approximately 63 percent single proprietary firms accept it as an important barrier to new technology adoption. 46 percent of public limited firms and 55 percent of private limited firms also consider it as an important barrier to new technology adoption. Thus most of the single proprietary, public and private limited do consider it as an important barrier. The chi square test for lack of qualified personnel as a barrier to new technology adoption and type of organization is significant at 1 percent level (χ^2 =66.82, df =12). This shows that the variables are dependent.

Table 8.32: Lack of Qualified Personnel as a Barrier to New Technology Adoption

Group/Sub Group	not important		not at all important		neutral		important		highly important		
	No. of Firms	**%age of Firms**	**No. of Firms**	**%age of Firms**	**No. of Firms**	**%age of Firms**	**No. of Firms**	**%age of Firms**	**No. of Firms**	**%age of Firms**	
Age Structure											
1. Old	11	22.45	16	32.65	6	12.24	13	26.53	3	6.12	
2. Medium	13	20.00	3	4.62	19	29.23	20	30.77	10	15.38	Chi^2=27.09**
3. New	16	18.60	18	20.93	7	8.14	33	38.37	12	13.95	(df : 8)
Size of Firm											
1. Large Scale	11	18.64	15	25.42	9	15.25	1`7	28.81	7	11.86	
2. Medium Scale	11	28.21			10	25.64	12	30.77	6	15.38	Chi^2=14.90
3. Small Scale	18	17.65	22	21.57	13	12.75	37	36.27	12	11.76	(df : 8)
Type of Organisation											
1. Single Proprietary	6	10.53	9	15.79	6	10.53	27	47.37	9	15.79	
2. Partnership	9	18.75	20	41.67	13	27.08	6	12.50			
3. Public Limited	8	17.02	8	17.02	9	19.15	10	21.28	12	25.53	Chi^2=66.82**
4. Private Limited	17	35.42			4	8.33	23	47.92	4	8.33	(df :12)
All Data	40	20.00	37	18.50	32	16.00	66	33.00	25	12.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

So from the above analysis it can be concluded that old, large and partnership firms do not consider the lack of qualified personnel as an important barrier. The large sized firms and old firms are at an advantage here as due to size or experience they might be able to attract professionally skilled persons to the organization while small sized and sole proprietorship firms are at a loss on this front.

(v) Obsolescence of Technology

Globalization and competition bring with it new technology which renders the existing technology obsolete. Moreover the rate of change is very fast. Hence to observe these trends, obsolescence of technology is taken as another barrier to new technology adoption [Table 8.33]. The results depict that 47 percent firms do not consider it as an important barrier to new technology adoption. 29 percent firms accept it as an important barrier to new technology adoption.

Table 8.33: Obsolescence of Technology as a Barrier to New Technology Adoption

Group/Sub Group	not important		not at all important		neutral		important		highly important		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	11	22.45	20	40.82	6	12.24	12	24.49			
2. Medium	20	30.77	7	10.77	17	26.15	15	23.09	6	9.23	Chi^2=24.02**
3. New	17	19.77	19	22.09	16	18.60	31	36.05	3	3.49	(df : 8)
Size of Firm											
1. Large Scale	14	23.73	23	38.98	13	22.03	6	10.17	3	5.08	
2. Medium Scale	11	28.21			13	33.33	12	30.77	3	7.69	Chi^2=34.72**
3. Small Scale	23	22.55	23	22.55	13	12.75	40	39.22	3	2.94	(df : 8)
Type of Organisation											
1. Single Proprietary	14	24.56	13	22.81	6	10.53	24	42.11			
2. Partnership	9	18.75	14	29.17	10	20.83	15	31.25			
3. Public Limited	11	23.40	8	17.02	13	27.66	6	12.77	9	19.15	Chi^2=43.76**
4. Private Limited	14	29.17	11	22.92	10	20.83	13	27.08			(df :12)
All Data	48	24.00	46	23.00	39	19.50	58	29.00	9	4.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Age structural analysis depicts that old firms do not consider it as an important barrier while new firms do consider it as an important barrier. The chi square test for independence shows that obsolescence of technology as a barrier to new technology adoption and the age of firm are dependent. (χ^2 = 30.62, df =8). Size wise analysis depicts that most of the large sized firms do not consider it as an important barrier while small sized firms do consider it as an important barrier to new technology adoption. The chi square test for obsolescence of technology as a barrier to new technology adoption and size of firm is significant at 1 percent level (χ^2 = 17.92, df =8). This shows that the variables are dependent.

42.11 percent single proprietary and 31.25 percent partnership firms consider it as an important barrier. 19.15 percent public limited firms accept obsolescence of technology as a highly important barrier to new technology adoption. Approximately 30 percent private limited firms take this barrier to be not important and about 27 percent private limited firms take it as a important barrier. The chi square test shows that obsolescence of technology as a barrier to new technology adoption and type of organization are not independent (χ^2 = 31.66, df =12).

So on the whole the analysis depict that most of the old and large sized firms do not consider obsolescence of technology to be an important barrier to new technology. But the new, medium sized and small sized firms do accept it as a big barrier to new technology adoption. Again most of the partnership and private limited firms also do not consider it be a big barrier to new technology adoption.

(6) Technology Adaptation: Preparedness of the Firm for New Technology Adaptation

(i) Redesign of Organizational Structure

Table 8.34 depicts the extent to which the firms redesign the organizational structure for adapting new technology. At aggregate level, the table depicts that 47.50 percent firms redesign the organizational structure to some extent. 16 percent firms redesign the organizational structure at considerable extent while only 5 percent firms redesign the organizational structure to large extent.

Analysis at disaggregative level depicts that most of the old, medium and new firms redesign the organizational structure to ‘some extent’ for adapting new technology. The chi square test for independence shows that redesigning of organizational structure for adapting new technology and age of firm are not independent (χ^2 = 32.96, df = 8). Size wise analysis depicts that approximately 60 percent of large sized firms and 43.14 percent small sized firms redesign the organizational structure to some extent. The chi square test shows that redesigning of organizational structure for adapting new technology and the size of firm are independent (χ^2 = 15.13, df =8).

Table 8.34: Redesign of Organizational Structure for Technology Adaptation

Group/Sub Group	not at all		to some extent		moderate extent		considerable extent		to a large extent		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old			22	44.90	9	18.37	14	28.57	4	8.16	
2. Medium	7	10.77	29	44.62	16	24.62	7	10.77	6	9.23	Chi^2=32.96**
3. New			44	51.16	31	36.05	11	12.79			(df : 8)
Size of Firm											
1. Large Scale	4	6.78	35	59.32	9	15.25	7	11.86	4	6.78	
2. Medium Scale			16	41.03	16	41.03	7	17.95			Chi^2=15.13**
3. Small Scale	3	2.94	44	43.14	31	30.39	18	17.65	6	5.88	(df : 8)
Type of Organisation											
1. Single Proprietary	3	5.26	32	56.14	12	21.05	7	12.28	3	5.26	
2. Partnership			12	25.00	18	37.50	18	37.50			
3. Public Limited			28	59.57	9	19.15	3	6.38	7	14.89	Chi^2=52.13**
4. Private Limited	4	8.33	23	47.92	17	35.42	4	8.33			(df :12)
All Data	7	3.50	95	47.50	56	28.00	32	16.00	10	5.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Again most of the single proprietary and public limited firms redesign the organizational structure 'to some extent' for adapting new technology. 37.50 percent partnership firms redesign the organizational structure to a considerable extent for adapting new technology. The chi square test for redesigning of organizational structure for adapting new technology and the type of organization is significant at 1 percent level (χ^2 = 52.13, df =12). This shows that the variables are not independent. Thus, on the whole the table depicts that most of the firms redesign the organizational structure to some extent for adapting new technology.

(ii) Transferring People within Firm

Table 8.35 depicts the extent to which the firms transfer people within the firm for adapting new technology. At aggregate level the table depicts that 22 percent firms transfer people within firm for adapting new technology to a considerable extent and another 10 percent firms transfer people within firm at a large extent. 33.50 percent firms transfer people within the firm to some extent.

Table 8.35: Transferring People within Firm for Technology Adaptation

Group/Sub Group	not at all		to some extent		moderate extent		considerable extent		to a large extent		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	3	6.12	15	30.61	17	34.69	7	14.29	7	14.29	
2. Medium	6	9.23	20	30.77	16	24.62	10	15.38	13	20.00	Chi^2=24.53**
3. New	6	6.98	32	37.21	21	24.42	27	31.40			(df : 8)
Size of Firm											
1. Large Scale			28	47.46	16	27.12	4	6.78	11	18.64	
2. Medium Scale	3	7.69	14	35.90	9	23.08	13	33.33			Chi^2=31.03**
3. Small Scale	12	11.76	25	24.51	29	28.43	27	26.47	9	8.82	(df : 8)
Type of Organisation											
1. Single Proprietary	6	10.53	12	21.05	16	28.07	17	29.82	6	10.53	
2. Partnership	3	6.25	6	12.50	19	39.58	17	35.42	3	6.25	
3. Public Limited			21	44.68	13	27.66	6	12.77	7	14.89	Chi^2=45.41**
4. Private Limited	6	12.50	28	58.33	6	12.50	4	8.33	4	8.33	(df :12)
All Data	15	7.50	67	33.50	54	27.00	44	22.00	20	10.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Disaggregative analysis depicts that 34.69 percent old firms and 24.62 percent medium firms transfer people within firm for adapting new technology to a moderate extent only. 37.2 percent new firms transfer people within the firm to some extent and 31.40 percent new firms transfer people within firm to a considerable extent. The chi square test shows that transferring people within the firm for adapting new technology and the age of firm are not independent (χ^2 = 24.53, df = 8). Size wise analysis depicts that 47.46 percent large sized firms and 35.20 percent medium sized firms resort to transferring to 'some extent'. Only 26.43 percent small sized firms transfer people within the firm to a 'considerable extent'. The chi square test for independence shows that transferring people within the firm for adapting new technology and the size of firm are dependent ($\chi^2 = 31.03$, df =8).

The type of organization analysis depicts that approximately 30 percent single proprietary firms and 35.42 percent partnership firms transfer people within firm to a considerable extent. Most of the private limited firms transfer people within the firm to 'some extent'. The chi square test for transferring people within the firm for adapting new technology and the type of organization is significant at 1 percent level ($\chi^2 = 45.41$, df =12). This shows that the variables are not independent. On the whole the analysis shows that comparatively large number of old and medium firms transfer people within the organization from moderate to a large extent. Most of the large sized, medium sized and private limited firms transfer people within the firm to 'some extent' only.

(iii) New Recruitment of Skilled Personnel

To what scale the firms recruit skilled personnel is depicted in the table 8.36. The table at aggregate level shows that 10 percent firms recruit skilled personnel at a large extent while 35 percent firms recruit at considerable extent. 33.50 percent recruit skilled personnel to some extent. On the basis of age structure analysis, 40.82 percent of old firms and 30 percent medium firms recruited skilled personnel at a considerable extent while approximately 47 percent new firms make recruitments in their firms to 'some extent' only. The chi square test for independence shows that recruiting skilled persons for adapting new technology and age of firm are dependent ($\chi^2 = 27.45$, df = 8).

33.90 percent large sized firms make recruitments at a 'considerable extent'. Next about 40 percent small sized firms recruit skilled personnel at considerable extent and 36.27 percent small size firms recruit to some extent. The chi square test shows that recruiting skilled persons for adapting new technology and the size of firm are not independent ($\chi^2 = 24.83$, df =8). About 50 percent single proprietary firms recruit personnel at a considerable extent. About 36 percent of public limited and 40 percent private limited firms recruit the personnel to ‘some extent’ for adapting new technology. The chi square test for recruiting skilled persons for adapting new technology and type of organisation is significant at 1 percent level ($\chi^2 = 45.96$, df =12). This shows that the variables are not independent.

Table 8.36: New Recruitment of Skilled Personnel for Technology Adaptation

Group/Sub Group	not at all		to some extent		moderate extent		considerable extent		to a large extent		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old			14	28.57	11	22.45	20	40.82	4	8.16	
2. Medium	3	4.62	13	20.00	16	24.62	20	30.77	13	20.00	Chi^2=27.45**
3. New			40	46.51	13	15.12	30	34.88	3	3.49	(df : 8)
Size of Firm											
1. Large Scale			17	28.81	11	18.64	20	33.90	11	18.64	
2. Medium Scale			13	33.33	16	41.03	10	25.64			Chi^2=24.83**
3. Small Scale	3	2.94	37	36.27	13	12.75	40	39.22	7	8.82	(df : 8)
Type of Organisation											
1. Single Proprietary	3	5.26	19	33.33			29	50.88	6	10.53	
2. Partnership			12	25.00	22	45.83	11	22.92	3	6.25	
3. Public Limited			17	36.17	7	14.89	16	34.04	7	14.89	Chi^2=45.96**
4. Private Limited			19	39.58	11	22.92	14	29.17	4	8.33	(df :12)
All Data	3	1.50	67	33.50	40	20.00	70	35.00	20	10.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

To conclude the table shows that the recruitments of skilled personnel have been made in order to adopt new technology in the Punjab manufacturing sector. The firms which recruit skilled personnel at a considerable extent, are old, large sized, small sized and single proprietary firms.

(iv) Imparting Training to Personnel

For adapting new technology, the level to which the firms impart training to personnel is explained in table 8.37. Aggregative analysis shows that 25.50 percent firms impart training to personnel to some extent and 36.50 percent firms impart training to personnel at considerable extent.

Table 8.37: Imparting Training to Personnel for Technology Adaptation

Group/Sub Group	not at all		to some extent		moderate extent		considerable extent		to a large extent		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	3	6.12	11	22.45	7	14.29	18	36.73	10	20.41	
2. Medium	3	4.62	15	23.08	6	9.23	23	35.38	18	27.69	Chi^2=13.63**
3. New	3	3.49	25	29.07	19	22.09	32	37.21	7	8.14	(df : 8)
Size of Firm											
1. Large Scale			10	16.95	4	6.78	27	45.76	18	30.51	
2. Medium Scale			22	56.41	6	15.38	7	17.95	4	10.26	Chi^2=45.30**
3. Small Scale	9	8.82	19	18.63	22	21.57	39	38.24	13	12.75	(df : 8)
Type of Organisation											
1. Single Proprietary	6	10.53	13	22.81			32	56.14	6	10.53	
2. Partnership			12	25.00	15	31.25	14	29.17	7	14.58	
3. Public Limited	3	6.38	13	27.66	4	8.51	13	27.66	14	29.78	Chi^2=45.36**
4. Private Limited			13	27.08	13	27.08	14	29.17	8	16.67	(df :12)
All Data	9	4.50	51	25.50	32	16.00	73	36.50	35	17.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

In considering the age of firm, the table shows that most of the old and medium firms impart training to personnel to a considerable extent or to a large extent. 37.21 percent new firms impart training to personnel at considerable extent. Very few new firms impart training to personnel at large extent for adapting new technology. The chi square test shows that imparting training to personnel for adapting new technology in the firm and the age of firm are independent. (χ^2 = 13.63, df = 8). Size wise analysis depicts that approximately 46 percent large sized firms and 38.24 percent small sized firms impart training to personnel at considerable extent. Most of the medium sized firms impart training to personnel to 'some extent'. The chi square test for independence shows that imparting training to personnel for adapting new technology in the firm and size of firm are not independent (χ^2 = 45.30, df =8).

Most of the single proprietary firms impart training to personnel to a considerable extent. 29.79 percent public limited firms impart training to personnel to a large extent. The chi square test for imparting training to personnel for adapting new technology in the firm and type of organization is significant at 1 percent level (χ^2 is 45.36, df =12). This shows that the variables are not independent.

On the whole the analysis reveals that the manufacturing industries of Punjab impart training to personnel to a 'considerable extent' for adopting new technology. Any new technology that a firm adopts is also associated with new skills that might have to be imparted to the personnel. Training these personnel with the requisite skills can make a difference in the firms productivity and competitiveness. The conclusion that can be drawn from the above table is that Punjab manufacturing sector has responded by imparting training to the personnel to a considerable extent and there are very few firms which admit to not imparting any training to the personnel.

(v) Encouraging and Inducing the Employees to Accept New Technology

People in an organization generally resist change, so the management has to encourage and induce the employees to accept new technology. The table 8.38 shows level to which manufacturing firms encourage and induce their employees to accept new technology. Aggregative analysis depicts that 27 percent firms responded that they had encouraged and induced the employees to a moderate extent, next 43.50 percent firms to a considerable extent and 21 percent firms encourage the employees to a 'large extent' to make new technology acceptable.

Age wise analysis reveals that most of the old, medium and new firms encourage and induce the employees to 'moderate' to 'large' extent to make new technology acceptable. The chi square test for independence shows that encouragement and inducement to the employees to accept new technology and age of firm are not independent (χ^2 = 30.62, df = 8).

Table 8.38: Encouraging and Inducing the Employees to Accept New Technology

Group/Sub Group	not at all		to some extent		moderate extent		considerable extent		to a large extent		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	4	8.16			23	46.94	22	44.90			
2. Medium	3	4.62	4	6.15	9	13.85	28	43.08	21	32.31	Chi^2=30.62**
3. New	3	3.49	3	3.49	22	25.58	37	43.02	21	24.42	(df : 8)
Size of Firm											
1. Large Scale			4	6.78	8	13.56	30	50.85	17	28.81	
2. Medium Scale	4	10.26			12	30.77	15	38.46	8	20.51	Chi^2=17.92*
3. Small Scale	6	5.88	3	2.94	34	33.33	42	41.81	17	16.67	(df : 8)
Type of Organisation											
1. Single Proprietary	3	5.26			19	33.33	29	50.88	6	10.53	
2. Partnership			3	6.25	18	37.50	20	41.67	7	14.58	
3. Public Limited	4	8.51	4	8.51	7	14.89	22	46.81	10	21.28	Chi^2=31.66**
4. Private Limited	3	6.25			10	20.83	16	33.33	19	39.58	(df :12)
All Data	10	5.00	7	3.50	54	27.00	87	43.50	42	21.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Size wise analysis indicates that about 50 percent of large sized firms had responded that they had encouraged the employees to a considerable extent. Again most of the medium sized and small sized firms had encouraged the employees from 'moderate' to 'large extent' to make new technology acceptable. The chi square test for encouragement and inducement to the employees to accept new technology and size of firm is significant at 5 percent level (χ^2 = 17.92, df =8). This shows that the variables are dependent.

The same trend is visible in the type of organizational analysis i.e. most of the firms encourage and induce the employees from moderate to a large extent to make new technology acceptable. The chi square test shows that encouraging and inducing the employees to accept new technology and the type of organization are not independent (χ^2 = 31.66, df =12). To conclude it can be said that the manufacturing firms had encouraged and induced the employees to make new technology acceptable.

8.2.4 Section D: Research and Development (R&D)

(1) Investment in R&D (percentage of expenditure)

Time and again this issue of investing more in research and development is raised. A high investment in research and development is very essential for enhancing competitiveness in the new globalized scenario. From the responses received it can be inferred that the investment in R&D as percentage of total expenditure is very low in the manufacturing sector of Punjab. 56.50 percent of firms are investing less than 1 percent of expenditure in R&D and only 2 percent firms have invested more than 10 percent of expenditure in R&D.

Table 8.39: Investment in R&D (percentage of expenditure)

Group/Sub Group	1%		1-2%		2-5%		5-10%		>10%		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	24	48.98	8	16.33	7	14.29	10	20.41			
2. Medium	29	44.62	12	16.46	13	20.00	7	10.77	4	6.15	Chi^2=21.46**
3. New	60	69.77	7	6.98	11	12.79	9	10.47			(df : 8)
Size of Firm											
1. Large Scale	21	35.59	7	11.86	23	38.98	4	6.78	4	6.78	
2. Medium Scale	15	38.46	10	25.64	4	10.26	10	25.64			Chi^2=66.28**
3. Small Scale	77	75.49	9	8.82	4	3.92	12	11.76			(df : 8)
Type of Organisation											
1. Single Proprietary	45	78.95	6	10.53			6	10.53			
2. Partnership	35	72.92	3	6.25	4	8.33	6	12.50			
3. Public Limited	17	36.17	17	36.17	9	19.15			4	8.51	Chi^2=97.85**
4. Private Limited	16	33.33			18	37.50	14	29.17			(df :12)
All Data	113	56.50	26	13.00	31	15.50	26	13.00	4	2.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

On the basis of the age structure analysis, approximately 50 percent old firms invest less than 1 percent of expenditure in R&D and 20.41 percent invest 5 to 10 percent. 44.62 percent of medium firms invest less than 1 percent of the expenditure in R&D. Only 6.15 percent medium firms invest more than 10 percent of expenditure in research and development. Most of the new firms invest less than 1 percent of the expenditure in research and development. The chi square test for investment in R&D as percentage of expenditure and the age of firm shows that the variables are dependent (χ^2 = 21.46, df =8).

38.98 percent large sized firms invest between 2 to 5 percent of expenditure in R&D. Only 5.78 percent of large sized firms invest more than 10 percent of the expenditure in R&D. 38.46 percent medium sized firms invest less than 1 percent of total expenditure in R&D. More than 75 percent of small sized firms invest less than 1 percent of expenditure in R&D. The chi square test for independence shows that investment in R&D as percentage of expenditure and the size of firm are not independent (χ^2 = 66.28, df =8).

Most of the single proprietary and partnership firms invest less than 1 percent of expenditure in R&D, only 8.51 percent public limited firms invest more than 10 percent. 37.50 percent private limited firms invest 2 to 5 percent and approximately 30 percent private limited firms invest 5 to 10 percent of the expenditure in R&D. The chi square test shows that investment in R&D as percentage of expenditure and the type of organization are not independent (χ^2 = 97.85, df = 12).

On the whole, the analysis shows that the investment in R&D as percentage of expenditure is very low in the manufacturing sector of Punjab. To compete in this globalized world, the investment in R&D must be increased.

(2) Impact of Innovation Activity undertaken by the Firm

(i) Increase in Range of Goods and Services

Table 8.40 depicts the level to which the range of goods and services increased due to innovation activity undertaken by the firms. The analysis at aggregate level depicts that 10.50 percent firms responded that the impact of innovation activity on increasing the range of goods and services is ‘very high’. 60 percent firms show that the impact of innovation activity on increasing the range of goods and services is ‘high’.

Table 8.40: Impact of Innovation Activity on Increase in Range of Goods and Services

Group/Sub Group	very low		low		neutral		high		very high		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	3	6.12					35	71.43	11	22.45	
2. Medium	3	4.62	3	4.62	16	24.62	33	50.77	10	15.38	Chi^2=40.91**
3. New	9	10.47			25	29.07	52	60.47			(df : 8)
Size of Firm											
1. Large Scale					10	16.95	31	52.54	18	30.51	
2. Medium Scale	6	15.38			7	17.95	26	66.67			Chi^2=44.75**
3. Small Scale	9	8.82	3	2.94	24	23.53	63	61.76	3	2.94	(df : 8)
Type of Organisation											
1. Single Proprietary	9	15.79	3	5.26	12	21.05	30	52.63	3	5.26	
2. Partnership					6	12.50	39	81.25	3	6.25	
3. Public Limited	6	12.77			10	21.28	24	51.06	7	14.89	Chi^2=34.01**
4. Private Limited					13	27.08	27	56.25	8	16.67	(df :12)
All Data	15	7.50	3	1.50	41	20.50	120	60.00	21	10.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

At disaggregative level, 71.43 percent old firms show ‘high impact’ of innovation activity and 22.45 percent old firms show ‘very high’ impact. 50 percent medium firms show ‘high impact’ and 15.38 percent medium firms show ‘very high’ impact of innovation activity on increasing the range of goods and services. Most of the new firms also show high impact of innovation activity on increasing the range of goods and services. Thus, old, medium and new firms, all accept that there is high impact of innovation. The chi square test shows that the impact of innovation activity undertaken by the firm on the increased range of goods and services and age of firm are not independent (χ^2 = 40.91, df =8).

Size wise analysis depicts that most of the large sized, medium sized and small sized firms respond with having 'high' impact of innovation activity on increasing the range of goods and services. Size wise analysis also depicts that size is not a constraint here, almost all firms of all sizes agree that innovation activity has lead to increased range of goods and services. The chi square test for independence shows that the impact of innovation activity undertaken by firm on the increased range of goods and services and size of firm are dependent (χ^2 = 44.75, df = 8).

Maximum percentage of sole proprietorship, partnership, private and public limited firms accept that the impact of innovation activity on increasing the range of goods and services is high. The percentage of private and public limited firms showing 'very high' impact is almost 15 percent which is almost double that of the sole proprietorship and partnership firms. The chi square test for the impact of innovation activity undertaken by firms on the increased range of goods and services and type of organization is significant at 1 percent level (χ^2 = 34.01, df =12). This shows that the variables are dependent.

(ii) Increase in Market/Market Share

The degree of impact of innovation activity, undertaken by the firms, on market share is depicted in the table 8.41. Aggregative analysis depicts that approximately 60 percent firms responded that there is high impact of innovation activity in increasing the market share.

Coming to the disaggregative analysis, many old as well as new firms have responded that there is high impact of innovation activity undertaken by the firms in increasing market share. The chi square test for independence shows that the impact of innovation activity undertaken by the firm on the increased market or market share and age of firm are not independent (χ^2 = 26.82, df = 8). Similarly the large sized as well as small sized firms have also responded positively to the degree of impact that innovation has on market or market share. The chi square test shows that the impact of innovation activity undertaken by the firm on the increased market or market share and size of firm are not independent (χ^2 = 48.48, df =8).

Table 8.41: Impact of Innovation Activity on Increase in Market/Market Share

Group/Sub Group	very low		low		neutral		high		very high		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old			7	14.29	7	14.29	27	55.10	8	16.33	Chi^2=26.82**
2. Medium			6	9.23	29	44.62	20	30.77	10	15.38	(df : 8)
3. New	3	3.49	6	6.98	26	30.23	48	55.81	3	3.49	
Size of Firm											
1. Large Scale					21	35.59	20	33.90	18	30.51	
2. Medium Scale			7	17.95	13	33.33	19	48.72			Chi^2=48.48**
3. Small Scale	3	2.94	12	11.76	28	27.45	56	54.90	3	2.94	(df : 8)
Type of Organisation											
1. Single Proprietary	3	5.26	6	10.53	16	28.07	29	50.88	3	5.26	
2. Partnership			3	6.25	10	20.83	32	66.67	3	6.25	
3. Public Limited			10	21.28	20	42.55	10	21.28	7	14.89	Chi^2=39.04**
4. Private Limited					16	33.33	24	50.00	8	16.67	(df :12)
All Data	3	1.50	19	9.50	62	31.00	95	47.50	21	10.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

The type of organization analysis shows that about 50 percent single proprietary and 50 percent private limited firms have shown that there is high impact of innovation activity on increasing market share. 66.67 percent partnership firms also depict that there is high impact of innovation activity. The chi square test for impact of innovation activity undertaken by the firm on the increased market or market share and the type of organization is significant at 1 percent level (χ^2 = 39.04, df =12). This shows that the variables are dependent. Overall the analysis shows that there is high impact of innovation activity undertaken by the firms on the increasing market or market share. By concentrating more on the R&D, this market share can be further increased.

(iii) Improvement in Quality of Goods and Services

Table 8.42: Impact of Innovation Activity on Improvement in Quality in Goods and Services

Group/Sub Group	very low		low		neutral		high		very high		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old					6	12.24	31	63.27	12	24.49	
2. Medium	3	4.62			3	4.62	38	58.46	21	32.31	Chi^2=27.08**
3. New	3	3.49	3	3.49	9	10.47	67	77.91	4	4.65	(df : 8)
Size of Firm											
1. Large Scale					3	5.08	27	45.76	29	49.15	Chi^2=69.36**
2. Medium Scale			3	7.69	3	7.69	29	74.36	4	10.26	(df : 8)
3. Small Scale	6	5.88			12	11.76	80	78.43	4	3.92	
Type of Organisation											
1. Single Proprietary	6	10.53			9	15.79	42	73.68			
2. Partnership							41	85.42	7	14.58	
3. Public Limited			3	6.38	3	6.38	27	57.45	14	29.79	Chi^2=57.49**
4. Private Limited					6	12.50	26	54.17	16	33.33	(df :12)
All Data	6	3.00	3	1.50	18	9.00	136	68.00	37	18.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

The impact of innovation activity undertaken by the firms on the improvement of quality of goods and services is indicated in table 8.42. At aggregate, the table depicts that 68 percent firms responded that the innovation activity has high impact on the improvement in quality of goods and services and about 20 percent firms feel that there is ‘very high’ impact of innovation activity on the improvement in quality of goods and services.

On the basis of disaggregative analysis almost all the old, medium and new firms agree that the innovation activity has either high or very high impact on improving the quality of goods and services. The chi square test for impact of innovation activity on the improved quality in goods and services and the age of firm is significant at 1 percent level (χ^2 = 27.08, df =8).

This shows that the variables are not independent. Size wise analysis also depicts that approximately all the large sized, medium sized and small sized firms show that innovation activity has high impact on improving the quality of goods and services. The chi square test for independence shows that the impact of innovation activity undertaken by firm on the improved quality in goods and services and the size of firm are not independent (χ^2 = 69.36, df = 8).

The type of organization analysis depicts the same trend. Only in the case of single proprietary firms, about 11 percent firms have responded that innovation activity has very low impact on improving the quality of goods and services. The chi square test shows that the impact of innovation activity undertaken by the firm on the improved quality in goods and services and type of organization are not independent (χ^2 = 57.49, df =12). The above analysis depicts that the manufacturing sector of Punjab accept that there is a strong impact of innovation activity undertaken by the firm on improvement in the quality of the goods and services. An increase in innovation activity will lead to improvement in product quality.

(iv) Improvement in Production/Flexibility

Table 8.43 depicts the degree of impact of innovation activity undertaken by the firms on the improvement in production and flexibility. Aggregative analysis depicts that 64 percent firms accept that there is high impact of innovation activity on improving the production and flexibility. 21 percent firms feel that the impact of innovation activity on improving the production and flexibility is very high. So most of the firms accept that the impact of the innovation activity on improving production and flexibility is quite high.

Disaggregative analysis depicts that approximately all the old, medium and new firms accept that there is a ‘high’ impact of innovation activity undertaken by their firms on improving production and flexibility. The chi square test shows that impact of innovation activity undertaken by firms on the improved production as well as flexibility and age of firm are dependent (χ^2 = 23.48, df = 8). Size wise analysis also depicts that most of the large sized, medium sized and small sized firms accept that the impact of innovation activity on the improvement in production and flexibility is high. The chi square test for independence shows that the impact of innovation activity undertaken by the firm on the improved production as well as flexibility and the size of firm are dependent (χ^2 = 59.37, df =8).

Table 8.43: Innovation Activity and Improvement in Production/Flexibility

Group/Sub Group	very low		low		neutral		high		very high		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old			3	6.12	3	6.12	32	65.31	11	22.45	
2. Medium			3	4.62	6	9.23	32	49.23	24	36.92	Chi^2=23.48**
3. New	3	3.49	3	3.49	9	10.47	64	74.42	7	8.14	(df : 8)
Size of Firm											
1. Large Scale			3	5.08			25	42.37	31	52.54	
2. Medium Scale			3	7.69	3	7.69	29	74.36	4	10.26	Chi^2=59.37**
3. Small Scale	3	2.94	3	2.94	15	14.71	74	72.55	7	6.86	(df : 8)
Type of Organisation											
1. Single Proprietary	3	5.26	3	5.26	15	26.32	33	57.89	3	5.26	
2. Partnership							41	85.42	7	14.58	
3. Public Limited			6	12.77	3	6.38	21	44.68	17	36.17	Chi^2=68.94**
4. Private Limited							33	68.75	15	31.25	(df :12)
All Data	3	1.50	9	4.50	18	9.00	128	64.00	42	21.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

The type of organization analysis depicts that about 58 percent single proprietary firms accept 'high impact' of innovation activity on the improvement in production and flexibility. Approximately all the partnership, public limited and private limited firms respond that the impact of innovation activity undertaken by their firms on improving production and flexibility is quite high. The chi square test for impact of innovation activity undertaken by firm on the improved production as well as flexibility and type of organization is significant at 1 percent level (χ^2 = 68.94, df =12). This shows that the variables are dependent.

In the end it can be concluded that the impact of innovation activity undertaken by the firms on improving production and flexibility is high. This shows that manufacturing firms accept that research and development has a positive impact on improving production and flexibility in Punjab manufacturing.

(v) Reduction in Labour Costs

The impact of innovation activity undertaken by the firms on reducing labour costs per produced unit is shown in the table 8.44. Aggregative analysis depicts that 51.50 percent firms accept that the degree of impact of innovation activity on reducing labour costs per produced unit is high. Another 14 percent responded that the degree of impact is very high.

Age wise analysis depicts that most of the old firms accept that the degree of impact of innovation activity on reducing labour costs per produced unit is high. 50 percent medium firms report the degree of impact as high and 17 percent responded that it is ‘very high’. Almost similar trend is reported by new firms as well with 45.35 percent accepting the degree of impact to be ‘high’ and another 10.47 percent reporting it to be ‘very high’. The chi square test shows that impact of innovation activity undertaken by firm on reducing labour costs per produced unit/transaction and age of firm are not independent (χ^2 = 23.16, df = 8). Most of the large sized and small sized firms accept that there is high impact of innovation activity on reducing the labour costs per produced unit. About 51 percent medium sized firms also show that the degree of impact of innovation activity on reducing the labour costs per produced unit is high. The chi square test for independence shows that impact of innovation activity undertaken by firm on reducing labour costs per produced unit/transaction and the size of firm are dependent (χ^2 = 31.05, df =8).

Most of the partnership, public limited and private limited firms report that the degree of impact of innovation activity on the reduced labour costs produced per unit is ‘high’. About 50 percent of single proprietary firms also accept that the degree of impact is ‘high’. The chi square test for impact of innovation activity undertaken by firm on reducing labour costs per produced unit/transaction and the type of organization is significant at 1 percent level (χ^2 = 33.44, df =12). This shows that the variables are not independent. Analysis on the basis of age structure, size and type of organization depicts that Punjab manufacturing firms accept that there is a 'high' impact of innovation on reduced labour costs per produced unit/transaction.

Table 8.44: Impact of Innovation Activity on Reduction in Labour Costs per Produced Unit/Transaction

Group/Sub Group	very low		low		neutral		high		very high		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old					9	18.37	32	65.31	8	16.33	
2. Medium			3	4.62	19	29.23	32	49.23	11	16.92	Chi^2=23.16**
3. New	3	3.49	16	18.60	19	22.09	39	45.35	9	10.47	(df : 8)
Size of Firm											
1. Large Scale			3	5.08	10	16.95	27	45.76	19	32.20	
2. Medium Scale			7	17.95	12	30.77	20	51.28			Chi^2=31.05**
3. Small Scale	3	2.94	9	8.82	25	24.51	56	54.90	9	8.82	(df : 8)
Type of Organisation											
1. Single Proprietary	3	5.26	6	10.53	19	33.33	29	50.88			
2. Partnership					9	18.75	27	56.25	12	25.00	
3. Public Limited			6	12.77	13	27.66	20	42.55	8	17.02	Chi^2=33.44**
4. Private Limited			7	14.58	6	12.50	27	56.25	8	16.67	(df :12)
All Data	3	1.50	19	9.50	47	23.50	103	51.50	28	14.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

(vi) Reduction in Material and Energy per Produced Unit/Transaction

Innovations are generally accepted to lead to either increase in production or reduction in costs. Production cost could be reduced by minimizing the wastage in the use of material and energy per unit. After analyzing the degree of impact of innovation activity on reduced labour cost, the present research tries to view the degree of impact on reducing material and energy (Table 8.45). The analysis at aggregate level depicts that approximately 60 percent firms report 'high impact' of innovation activity in reducing the material and energy per produced unit. Next 9 percent firms accept that it is 'very high'. 8 percent firms have responded that the impact of innovation activity in reducing material and energy per produced unit is low.

Table 8.45: Impact of Innovation Activity on Reduction in Material and Energy per Produced Unit/Transaction

Group/Sub Group	very low		low		neutral		high		very high		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old			3	6.12	10	20.41	28	57.14	8	16.33	
2. Medium			3	4.62	22	33.85	33	50.77	7	10.77	Chi^2=26.83**
3. New	6	6.98	10	11.63	10	11.63	57	66.28	3	3.49	(df : 8)
Size of Firm											
1. Large Scale					14	23.73	30	50.85	15	25.42	
2. Medium Scale			10	25.64	6	15.38	23	58.97			Chi^2=53.44**
3. Small Scale	6	5.88	6	5.88	22	21.57	65	63.73	3	2.94	(df : 8)
Type of Organisation											
1. Single Proprietary	3	5.26	3	5.26	13	22.81	38	66.67			
2. Partnership					9	18.75	33	68.75	6	12.50	
3. Public Limited			6	12.77	13	27.66	24	51.06	4	8.51	Chi^2=27.73**
4. Private Limited	3	6.25	7	14.58	7	14.58	23	47.92	8	16.67	(df :12)
All Data	6	3.00	16	8.00	42	21.00	118	59.00	18	9.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Age structure analysis depicts that most of the old, medium and new firms respond that there is ‘high’ or ‘very high’ impact of innovation activity on reducing the material and energy per produced unit. The chi square test shows that the impact of innovation activity undertaken by firm on reducing material and energy per produced unit/transaction and the age of firm are not independent (χ^2 = 26.83, df = 8). Size wise as well as organizational structure analysis also depict similar trend with most of the firms responding that there is a high impact of innovation activity on reducing material and energy in the production process. The chi square test for independence shows that the impact of innovation activity undertaken by firm on reducing labour costs per produced unit/transaction and the size of firm are not independent (χ^2 = 53.44, df =8). The chi square test for impact of innovation activity undertaken by firm on reducing labour costs per produced unit/transaction and type of organization also shows a relationship between the two variables ($\chi^2 = 27.73$, df =12).

To conclude, the analysis depicts that most of the firms show that the degree of impact of innovation activity in reducing material and energy per produced unit/transaction is high. A very small portion of the firms accept that there is ‘low impact’ of innovation activity on reducing the material and energy per produced unit/transaction. Innovations by means of using less of material and energy would lead to reduction in production costs.

(vii) Improvement in Environmental Impact or Health Safety Aspects

Investment in research and development should improve environmental impact and health safety aspects. The researcher tries to analyse the degree of impact of innovation activity, undertaken by the manufacturing firms, on improving environmental or health safety aspects. Analysis at the aggregate level shows that the degree of impact of innovation activity, undertaken by the firms, on improving environmental or health safety aspects is high.

At disaggregate level, age structure analysis depicts that maximum number of old, medium and new firms accept that there is ‘high impact’ of innovation activity on improving environmental or health safety aspects. The chi square test shows that the impact of innovation activity undertaken by firm on improving environmental impact or health safety aspects and the age of firm are not independent ($\chi^2 = 16.37$, df = 8). Size wise analysis depicts that approximately 90 percent of large sized firms show the impact to be high. Again, maximum number of medium sized and small sized firms report ‘high impact’ of innovation activity on the improvement in environmental and health safety aspects. The chi square test for independence shows that the variables are dependent ($\chi^2 = 29.31$, df =8).

Analysis of the type of organization shows that most of the single proprietary, partnership, public limited and private limited firms report that the degree of impact of innovation activity on improving the environmental or health safety aspects is high. The chi square test for impact of innovation activity undertaken by firm on improving environmental impact or health safety aspects and the type of organization is significant at 1 percent level (χ^2 =56.49, df =12). Analysis on the basis of age, size and organizational structure depicts that the manufacturing firms of Punjab accept that there is ‘high’ impact of innovation activity on improvement in environmental aspects or on the health safety aspects.

Table 8.46: Impact of Innovation Activity on Improvement in Environmental Impact or Health Safety Aspects

Group/Sub Group	very low		low		neutral		high		very high		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old			3	6.12	6	12.24	29	59.18	11	22.45	
2. Medium	3	4.62			16	24.62	26	40.00	20	30.77	Chi^2=16.37*
3. New	6	6.98	6	6.98	16	18.60	45	52.33	13	15.12	(df : 8)
Size of Firm											
1. Large Scale					7	11.86	28	47.46	24	40.68	
2. Medium Scale			3	7.69	9	23.08	19	48.72	8	20.51	Chi^2=29.31**
3. Small Scale	9	8.82	6	5.88	22	21.57	53	51.96	12	11.76	(df : 8)
Type of Organisation											
1. Single Proprietary	9	15.79			16	28.07	29	50.88	3	5.26	
2. Partnership					6	12.50	30	62.50	12	25.00	
3. Public Limited			6	12.77	7	14.89	24	51.06	10	21.28	Chi^2=56.49**
4. Private Limited			3	6.25	9	18.75	17	35.42	19	39.58	(df :12)
All Data	9	4.50	9	4.50	38	19.00	100	50.00	44	22.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

(viii) Regulations and Standards

The study tries to analyse whether the Punjab manufacturing sector meet regulations and standards as set by the government. The table at aggregate shows that most of the firms generally agree that innovation activity has enabled them to meet the regulations and standards set by the government. Disaggregative analysis reveals that most of the old, medium and new firms agree that innovation activity helps in meeting regulations and standards. The chi square test for the impact of innovation activity undertaken by the firm to meet regulations and standards and the age of firm shows that the variables are dependent (χ^2 = 21.27, df =8).

Table 8.47: Impact of Innovation Activity to Meet Regulations and Standards

Group/Sub Group	very low		low		neutral		high		very high		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old			3	6.12	6	12.24	32	65.31	8	16.33	
2. Medium	3	4.62			16	24.62	29	44.62	17	26.15	Chi^2=21.27**
3. New	6	6.98	10	11.63	19	22.09	42	48.84	9	10.47	(df : 8)
Size of Firm											
1. Large Scale					4	6.78	30	50.85	25	42.37	
2. Medium Scale			7	17.95	9	23.08	23	58.97			Chi^2=61.89**
3. Small Scale	9	8.82	6	5.88	28	27.45	50	49.02	9	8.82	(df : 8)
Type of Organisation											
1. Single Proprietary	9	15.79			19	33.33	26	45.61	3	5.26	
2. Partnership					9	18.75	30	62.50	9	18.75	
3. Public Limited			6	12.77	4	8.51	23	48.94	14	29.79	Chi^2=55.91**
4. Private Limited			7	14.58	9	18.75	24	50.00	8	16.67	(df :12)
All Data	9	4.50	13	6.50	41	20.50	103	51.50	34	17.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Almost 90 percent of large sized and most of medium and small sized firms agree that innovations have in helped meeting the regulations and standards set by the government. The chi square test shows that the impact of innovation activity undertaken by the firm to meet regulations and standards and the size of firm are not independent (χ^2 = 61.89, df = 8). Analysis of the type of organization also shows a similar trend. The chi square test for independence shows that impact of innovation activity undertaken by firm to meet regulations and standards and the type of organisation are not independent (χ^2 = 55.91, df =12). Overall the aggregative as well as disaggregative analysis shows that the innovation activity undertaken by the firms have helped in meeting the regulations and standards set by the government.

(3) Number of Trademarks of the Firm

Table 8.48: Number of Trademarks of the Firm

Group/Sub Group	<5		6-10		11-15		16-20		>21		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	20	40.82	3	6.12	22	44.90			4	8.16	
2. Medium	38	58.46			21	32.31	3	4.62	3	4.62	Chi^2=15.05
3. New	48	55.81	3	3.49	32	37.21	3	3.49			(df : 8)
Size of Firm											
1. Large Scale	17	28.81	3	5.08	29	49.15	3	5.08	7	11.86	
2. Medium Scale	27	69.23	3	7.69	6	15.38	3	7.69			Chi^2=47.20**
3. Small Scale	62	60.78			40	39.22					(df : 8)
Type of Organisation											
1. Single Proprietary	34	59.65			20	35.09	3	5.26			
2. Partnership	28	58.33			20	41.67					
3. Public Limited	17	36.17	6	12.77	18	38.30	3	6.38	3	6.38	Chi^2=36.89**
4. Private Limited	27	56.25			17	35.42			4	8.33	(df :12)
All Data	106	53.00	6	3.00	75	37.50	6	3.00	7	3.50	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

The amount of innovation activity undertaken by the firm can be judged from the number of patents and trademarks a firm has. In case of patenting, the Punjab manufacturing still has to go a long way but many respondents have trademarks to their credit. The total number of trademarks of the manufacturing firms of Punjab are given in the table 8.48. The table at aggregate level shows that the firms have fewer number of trademarks. 53 percent firms have fewer than 5 trademarks, next 37.50 percent firms have between 11 to 15 trademarks and 3.50 percent firms have more than 21 trademarks.

Age wise the table depicts that 40.82 percent old firms have fewer than 5 trademarks and 44.90 percent old firms have between 11 to 15 trademarks. Most of the medium and new firms have fewer than 5 trademarks. The chi square test shows that the number of trademarks of the firm and the age of firm are independent (χ^2 = 15.05, df = 8). Size wise analysis highlights that about 50 percent of large sized firms have 11-15 trademarks and 28.81 percent have fewer than 5 trademarks and only a small percentage of firms (11.86) has more than 21 trademarks. Approximately 70 percent medium sized firms and about 60 percent small sized firms have fewer than 5 trademarks. The chi square test for independence shows that the number of trademarks of the firm and the size of firm are dependent (χ^2 = 47.20, df =8).

Type of organization analysis reveals that most of the firms fall in the category of fewer than 5 trademarks. The chi square test for number of trade marks of the firm and the type of organization shows that the variables are not independent (χ^2 = 36.89, df =12). Overall the analysis indicates that the most of the firms have fewer 5 trademarks. The firms which have more than 21 trademarks are very few and are old, large sized and private limited firms. So the number of trademarks is less in the manufacturing sector of Punjab.

(4) Percentage of Staff Employed in R&D Activities

The percentage of staff employed in research and development activities in the manufacturing sector of Punjab is depicted in the table 8.49. Analysis at aggregate level shows that approximately 70 percent firms have less than 5 percent staff employed in R&D. 21 percent firms have between 6 to 11 percent staff employed in R&D. Only 6.50 percent firms have between 16 to 20 percent staff employed in R&D. Disaggregative analysis depicts that most of old, medium and new firms have less than 5 percent staff employed in R&D. The chi square test shows that percentage of staff employed in R&D activities and age of firm are independent (χ^2 = 12.00, df = 6).

Size wise analysis depicts that most of the large sized and small sized firms have less than 5 percent staff employed in R&D. 46.15 percent medium sized firms have less than 5 percent staff employees in R&D and 38.46 percent firms have between 6 to 11 percent. 11.86 percent large sized and 15.38 percent medium sized firms have between 16 to 20 percent staff employed in R&D. The chi square test for percentage of staff employed in R&D activities and size of firm is significant at 1 percent level and shows that the variables are dependent (χ^2 = 26.36, df =6). Most of the single proprietary, partnership, public limited and private limited firms have less than 5 percent staff employed in R&D. Only 14.89 percent public limited firms have between 16 to 20 percent staff employed in R&D. The chi square test for independence shows that percentage of staff employed in R&D activities and type of organization are not independent (χ^2 = 20.02, df =9).

Table 8.49: Percentage of Staff Employed in R&D Activities

Group/Sub Group	<5%		6-10%		11-15%		16-20%		>21%	
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms		
Age Structure										
1. Old	34	69.39	11	22.45	4	8.16				
2. Medium	41	63.08	14	21.54	3	4.62	7	10.77		Chi^2=12.00
3. New	63	73.26	17	19.77			6	6.98		(df : 6)
Size of Firm										
1. Large Scale	41	69.49	7	11.86	4	6.78	7	11.86		
2. Medium Scale	18	46.15	15	38.46			6	15.38		Chi^2=29.36**
3. Small Scale	79	77.45	20	19.61	3	2.94				(df : 6)
Type of Organization										
1. Single Proprietary	44	77.19	7	12.28	3	5.26	3	5.26		
2. Partnership	35	72.92	13	27.08						
3. Public Limited	30	63.83	10	21.28			7	14.89		Chi^2=20.02*
4. Private Limited	29	60.42	12	25.00	4	8.33	3	6.25		(df :9)
All Data	138	69.00	42	21.00	7	3.50	13	6.50		

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

On the whole the results highlight that most of the firms have less than 5 percent staff employed in R&D. Only a fewer medium aged, large sized, medium sized and public limited firms have larger percentage of staff employed in R&D. Overall analysis throws light on the fact that in case of Punjab manufacturing still fewer number of people are employed in the research and development activity.

(5) Performance of R&D Activities in the Firms

The table 8.50 depicts the performance of R&D activities in the manufacturing sector of Punjab. At aggregate level, the table depicts that 21 percent firms show that the performance of R&D activity is ‘very low’, next 21 percent firms also report the performance of R&D activity to be low. 37.50 percent firms show that the performance of R&D activity is moderate in their firms and only 16.50 percent firms show that the performance of R&D activity is high in their firms.

Table 8.50: Performance of R&D Activities in the Firms

Group/Sub Group	very low		low		moderate		high		very high		
	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	No. of Firms	%age of Firms	
Age Structure											
1. Old	6	12.24	9	18.37	30	61.22	4	8.16			
2. Medium	9	13.85	7	10.77	25	38.46	16	24.62	8	12.31	Chi^2=48.09**
3. New	27	31.40	26	30.23	20	23.26	13	15.12			(df : 8)
Size of Firm											
1. Large Scale			10	16.95	28	47.46	13	22.03	8	13.56	
2. Medium Scale	6	15.38	9	23.08	15	38.46	9	23.08			Chi^2=49.40**
3. Small Scale	36	35.29	23	22.55	32	31.37	11	10.78			(df : 8)
Type of Organisation											
1. Single Proprietary	18	31.50	17	29.82	15	26.32	7	12.28			
2. Partnership	12	25.00	12	25.00	18	37.50	6	12.50			
3. Public Limited	3	6.38	10	21.28	24	51.06	6	12.77	4	8.51	Chi^2=34.95**
4. Private Limited	9	18.75	3	6.25	18	37.50	14	29.17	4	8.33	(df :12)
All Data	42	21.00	42	21.00	75	37.50	33	16.50	8	4.00	

Note: ** = Significant at 1 per cent and * = Significant at 5 per cent
Computed

Age structural analysis depicts that most of the old firms show moderate rate of performance of R&D activity in their firms, while about 60 percent new firms report that performance of R&D activity in their firms is ‘low’ or ‘very low’. The chi square test for independence shows that the performance of R&D activities in the firm and the age of firm are not independent (χ^2 = 48.09, df = 8). Size wise analysis depicts that approximately 48 percent large sized firms show moderate rate, about 22 percent large sized firms show high rate of performance in R&D activity in their firms and 13.56 percent large sized firms show 'very high' rate of performance of R&D activity. 38.46 percent medium sized firms show moderate rate and 23.08 percent medium sized firms show high rate of performance of R&D activity in their firms. Most of the small firms report performance of R&D activity in their firms to be low. The chi square test shows that the performance of R&D activities in the firm and size of firm are dependent (χ^2 = 49.40, df =8).

None of the single proprietorship or partnership firms reports the rate of performance of research and development to be 'very high'. Maximum number of public limited firms report moderate performance. In private limited firms also, a large number of firms report the rate of performance of R&D activity to be either moderate or high. The chi square test for the performance of R&D activities in the firm and type of organization is significant at 1 percent level (χ^2 = 34.95, df = 12). This shows that the variables are not independent. To conclude, the analysis highlights that most of the firms show moderate rate of performance of R&D activity in their firms. New, small sized, single proprietary and partnership firms report low rate of performance of R&D activity in their firms. Thus steps should be taken to improve the performance of R&D activity in the manufacturing sector of Punjab to make it more competitive in this new policy regime.

8.3 Factor Analysis

The factor analysis has been conducted for finding the factors influencing the a) Overall Performance and Employees Performance, b) Technology Adoption and c) Impact of Research and Development. Since there are many factors therefore principal component analysis with Varimax rotation and Kaiser normalization has been applied.

Table 8.51: Factors influencing Overall Performance and Employees Performance of Punjab Manufacturing

Factor No.	Factor Name	Eigen Value	% of Variance	Items	Item Loading	Mean	Std. Deviation
1	**Size, Training and Accreditation of Firm**	7.398	32.165	i) Present Turnover	.847	2.22	.803
				ii) No. of Employees	.825	2.98	1.77
				iii) Investment made as % of total expenditure during last ten year in new machinery and equipment	.762	2.56	1.58
				iv) Type of organization	.745	2.43	1.14
				v) Accreditation/certification of the firm	.740	1.40	.490
				vi) Training programme organized for employees in last ten years	.725	2.75	1.40
Overall Mean of Size, Training and Accreditation of Firm					2.39		
2	**Employee Compensation**	3.127	13.594	i) Total benefits to employees	.934	3.62	.780
				ii) Employees contribution to other social security charges	.917	3.54	.838
				iii) Employees contribution to old age benefits	.847	3.55	.775
				iv) Other Benefits	.845	3.63	.746
Overall Mean of Employee Compensation					3.59		
3	**Market share and Skill of the employee**	2.000	8.695	i) Technically skilled employees as %age of total employees	.739	2.75	1.40
				ii) Market share	.718	1.86	.941
				iii) Percentage of Labourers after 1991 reforms	.560	3.87	.704
Overall Mean of Market share and Skill of the employee					2.83		
4	**Work orientation and Attitude of worker**	1.402	6.094	i) Workers attitude	.822	3.94	.643
				ii) Net Profit rate (over the past ten years)	.720	4.28	.999
				iii) Investment made as percentage of total expenditure during last ten years	.520	2.40	1.20
Overall Mean of Work orientation and Attitude of worker					3.54		
5	**Sales and Investment**	1.144	4.975	i) Percentage of investment by foreign companies in the firm	.644	3.48	1.59
				ii) Total sales (last ten years)	.501	4.63	.596
Overall Mean of Sales and Investment					4.06		
6	**Composition of employees**	1.068	4.643	i) Percentage of male employees in total employees.	.916	4.79	.592
Overall Mean of Composition of employees					4.79		
Overall Mean of all six factors					3.53		

Computed

The factor analysis resulted in six factors influence overall performance and employees performance of Punjab manufacturing namely, i) Size, Training and Accreditation of Firm ii) Employee Compensation iii) Market Share and Skill of the Employee, iv) Work Orientation and Attitude of worker v) Sales and Investment and vi) Composition of Employees. These six factors explain 70.167 percent of total variance. These factors are explained below:

1. **Size, Training and Accreditation of Firm:** This factor has emerged as the most important factor of the research with a total variance of 32.165. The major elements consisting this factor include: i) present turnover (.847), ii) no. of employees (.825), iii) investment as percentage of total expenditure (last ten year) in new machinery and equipment (.762), iv) type of organization (.745), v) accreditation/certification of the firm (.740) and vi) training programmes organized for employees in last ten years (.725).
2. **Employee Compensation:** This factor has emerged as the second important determinant of research with a total variance of 13.594. The major elements consisting this factor include: i) total benefits to employees (.934), ii) employees contribution to other social security charges (.917) and iii) employees contribution to old age benefits (.847) and other benefits (.845).

3. **Market Share and Skill of the Employee:** Another important factor has been market share and skill of the employee with a total variance of 8.695. The major elements consisting this factor include: i) technically skilled employees as percentage of total employees (.739) ii) market share (.718) and iii) percentage of labourers after 1991 reforms (.560).

4. **Work Orientation and Attitude of Worker:** The fourth factor influencing overall performance and employees performance of Punjab manufacturing has been work orientation and attitude of worker, explains 6.094 of total variance. The major elements consisting this factor include: i) workers attitude (.822). ii) net profit rate (over the past ten years) (.720) and iii) investment made as percentage of total expenditure during last ten years (.520).

5. **Sales and Investment:** Sales and investment factor explains a total variance of 4.975. The major elements consisting this factor include: i) percentage of investment by foreign companies in the firm (.644) and ii) total sales (last ten years) (.501).

6. **Composition of Employees:** The last factor has been composition of employees with an item loading of .916. This explained a total variance of 4.643.

The results of the mean score of the factors help in understanding the importance of the factors. The important factors influencing overall performance and employees performance of Punjab manufacturing are: i) composition of employees, ii) sales and investment, iii) employee compensation and iv) work orientation and attitude of worker. The mean of these four factors is greater than the overall mean score of 3.53.

The important variables in the category, size, training and accreditation of firm are: no. of employees, investment made in new machinery and equipment as percentage of total expenditure during the last ten year, type of organization, and training programmes organized for employees in the last ten years. In employee compensation the most important variable has been other benefits and total benefits to employees. Percentage of labourers after 1991 reforms emerged as a most important variable in the market share and skill of the employee factor. The important variables in work orientation and attitude of worker have been past net profit rate and workers attitude. In sales and investment, the important variable having more mean than the overall factor mean has been past sales.

Table 8.52: Factors influencing Technology Adoption in Punjab Manufacturing

Factor No	Factor Name	Eigen Value	% of Variance	Items	Item Loading	Mean	Std. Deviation
1	**Barriers to New Technology Adoption**	4.407	23.194	i) Cost of acquisition of new technology	.786	3.79	1.24
				ii) Cost of training and education	.763	3.58	1.32
				iii) Encouraging and inducing the employees to accept new technology	.754	3.72	.998
				iv) New recruitment of skilled personnel	.662	3.19	1.06
Overall Mean of Barriers to New Technology Adoption					3.57		
2	**Role of Government and Technology Adoption**	3.096	16.297	i) Industrial Policy induces new technology adoption by giving incentives	.870	2.77	.977
				ii) Govt. agencies motivate adoption of new technology	.826	2.76	1.06
				ii) Govt. regulations are a basis of new technology adoption	.801	2.89	1.14
Overall Mean of Role of Government and Technology Adoption					2.81		
3	**Globalisation and Technology Adoption**	2.044	10.759	i) Threats: competition in market induced new technology adoption	.806	4.06	.986
				ii) Opportunities: international markets encouraged firms for adopting new technology	.769	4.27	.747
				iii) Availability of better technology stimulated new technology adoption	.732	4.17	.815
Overall Mean of Globalisation and Technology Adoption					4.17		
4	**Technology Adaptation: Level of Preparedness**	1.540	8.107	i) Obsolescence of technology	.733	2.67	1.24
				ii) Lack of qualified personnel	.678	2.99	1.35
				iii) Workers resistance	.674	3.00	1.39
				iv) Transferring people within the firm	.663	3.14	.935
Overall Mean of Technology Adaptation: Level of Preparedness					2.95		
5	**Adjustment within the Firm**	1.263	6.647	i) Redesigning organizational structure	.752	2.13	.824
				ii) Imparting training to personnel	.550	3.37	1.17
Overall Mean of Adjustment within the Firm					2.75		
6	**Type of Technology Used**	1.074	5.655	i) Basis for adoption of new technology	.782	2.39	.872
				ii) Present technology being used	.729	3.38	.662
Overall Mean of Type of Technology Used					2.89		
Overall Mean of all six factors					3.19		

Computed

Factors influencing Technology Adoption in Punjab Manufacturing: The factor analysis resulted in six factors influencing technology adoption in Punjab manufacturing. These are: i) Barriers to New Technology Adoption ii) Role of Government and Technology Adoption iii) Globalisation and Technology Adoption iv) Technology Adaptation: Cost and Level of Preparedness v) Adjustment within the Firm and vi) Type of Technology Used. These six factors explained 70.659 per cent of total variance. These factors are explained below:

1. **Barriers to New Technology Adoption:** The most important factor influencing the technology adoption in Punjab has been barriers to new technology adoption explains a total variance of 23.194 percent. Major elements consisting this factor include: i) cost of acquisition of new technology (.786), ii) cost of training and education (.763), iii) encouraging and inducing the employees to accept new technology (.754) and iv) new recruitment of skilled personnel (.662).

2. **Role of Government and Technology Adoption:** This factor explains a total variance of 16.297 percent. Major elements consisting this factor include: i) industrial policy induces new technology adoption by giving incentives (.870), ii) govt. agencies motivate adoption of new technology (.826) and iii) govt. regulations are a basis of new technology adoption (.801).

3. **Globalisation and Technology Adoption:** This factor has also emerged as another important factor with a total variance of 10.759 percent. The major elements consisting this factor include: i) threats: competition in market induced new technology adoption (.806), ii) opportunities: international markets encouraged firms for adopting new technology (.769) and iii) availability of better technology stimulated new technology adoption (.732).

4. **Technology Adaptation: Cost and Level of Preparedness:** This factor has emerged as another important determinant with a total variance of 8.107 percent. i) obsolescence of technology (.733), ii) lack of qualified personnel (.678) iii), workers

resistance (.674) and iv) transferring people within the firm (.663) are the major elements within this factor.

5. **Adjustment within the Firm:** Adjustment within the firm explains a total variance of 6.647 percent. Major elements consisting this factor include: i) redesigning organizational structure (.752) and ii) imparting training to personnel (.550).

6. **Type of Technology Used:** Type of technology used explains a total variance of 5.655 percent. This factor includes: i) basis for adoption of new technology (.782) and ii) present technology being used (.729)

The results of the mean score highlighted that two factors had higher mean than overall average. Thus important factors influencing technology adoption in Punjab manufacturing are: i) barriers to new technology adoption and ii) globalisation and technology adoption. The mean of both these factors is greater than overall mean score of 3.19.

The most important variables emerged in barriers to new technology adoption are: cost of acquisition of new technology, cost of training and education, and encouraging and inducing the employees to accept new technology. The least important variable is new recruitment of skilled personnel. The important variable in role of government and technology adoption is govt. regulations are a basis of new technology adoption and the least important variable is govt. agencies motivate adoption of new technology. In globalisation and technology adoption, opportunities in the form of international markets encouraged firms for adopting new technology emerged as an important variable. The most important variables in technology adaptation: level of preparedness are lack of qualified personnel, workers resistance and transferring people within the firm. The least important variable is obsolescence of technology. The important variable in adjustment within the firm is imparting training to personnel. Present technology being used emerged as important variable having higher than the factor mean in type of technology used.

Table 8.53: Factors determining Impact of Research and Development in Punjab Manufacturing

Factor No	Factor Name	Eigen Value	% of Variance	Items	Item Loading	Mean	Std. Deviation
1	**Innovation Activity and IPRs**	5.838	48.651	i) Increased range of goods and services	.888	3.65	.961
				ii) Improved quality in goods and services	.857	3.98	.779
				iii) Improved production, flexibility	.797	3.99	.786
				iv) Met regulations and standards	.788	3.70	.977
				v) Improved environmental impact or health safety aspects	.786	3.81	.981
				vi) Reduced labour costs per produced unit/transaction	.719	3.67	.886
				vii) Reduced material and energy per produced unit/transaction	.719	3.63	.870
Overall Mean of Innovation Activity and IPRs						3.78	
2	**Investment and Employee %age in R&D**	1.947	16.222	i) Investment in R&D	.897	1.91	1.19
				ii) Percentage of staff employed in R&D activities	.776	1.48	.844
				iii) Performance of R&D activities	.646	2.62	1.11
Overall Mean of Investment and Employee %age in R&D						2.00	
3	**Trademarks**	1.122	9.350	No. of Trade marks of the firm	.878	2.01	1.16
Overall Mean of Trademarks						2.01	
Overall Mean of all three factors						2.60	

Computed

Factors determining Impact of Research and Development in Punjab Manufacturing: Factor analysis of impact of R&D in Punjab manufacturing resulted in three factors namely Innovation Activity and IPRs, Investment and Employee percentage in R&D, and Trademarks. These three factors explained 74.223 percent of total variance.

1. **Innovation Activity and IPRs** emerged as a dominant factor with a total variance of 48.651 percent. This factor includes: i) increased range of goods and services (.888), ii) improved quality in goods and services (.857), iii) improved production, flexibility (.797), iv) meet regulations and standards (.788), v) improved environmental impact or health safety aspects (.786), vi) reduced labour costs per produced unit/transaction (.719) and vii) reduced material and energy per produced unit/transaction (.719).
2. **Investment and Employee percentage in R&D:** The second important factor has been investment and employee percentage in R&D. 16.222 percent variation has been

explained by this factor. This factor includes: i) investment in R&D (.897), ii) percentage of staff employed in R&D activities (.776) and iii) performance of R&D activities (.646).

3. **Trademarks:** This is the third factor with a total variance of 9.350. This includes: number of trademarks of the firm (.878).

The results of the mean score highlights that the most important factor influencing impact of research and development in Punjab manufacturing is innovation activity and IPRs. The mean of this factor is greater than overall mean score of 2.60. Investment and employee percentage in R&D and trademarks had lower average score than overall mean score. Important variables in innovation activity and IPRs are improved quality in goods and services, improved production, flexibility and improved environmental impact or health safety aspects. In investment and employee percentage in R&D, the most important factor is performance of R&D activities.

8.4 Chapter Summary

Different factors identified for primary data analysis are output, labour, capital, technology and R&D. All the factors have adjusted in response to changed policy regime but there is a difference in nature and quantum of this adjustment. The analysis depicts that the turnover of most of the firms of Punjab is less than 50 crores. The results highlight that investment as a percentage of total expenditure is higher in large sized and older firms. Gross value of plant and machinery at the end of accounting year in most of the firms is more than 30 lakhs. Investment in new machinery and equipment has been done mostly by the old, big, public limited and private limited firms. In case of investment in computer hardware and software, the dominant players have been old and large sized firms. Survey results for total sales and net profit rate in the last ten years shows that total sales and net profit rate of all the firms has increased.

The analysis depicts that most of the firms have responded with an increase in percentage of labourers after 1991 reforms. Technically skilled employees as percentage of total employees are fewer in the new and small sized firms. Old, medium aged, large sized, public limited and private limited firms have organized more training programmes for the employees during the last ten years. As far as benefits to employees are concerned, the results show an increase in the benefits to the employees by old, medium, large sized, public limited and private limited firms. Most of the firms have responded with good work orientation and attitude of the workers.

All firms agree that the availability of better technology due to globalisation stimulate them to go for it. Analysis based on the opportunities created due to globalisation in the form of international markets encouraged most of the firms for adopting new technology. The analysis depicts that threats in form of competition in the markets have induced the firms to go in for new technology. The analysis of the expectations of the firms after successfully adopting and adapting the new technology reveals that the highest average rating given by the firms is to increased sales. The lowest rating is given to the increased net profits.

About 50 percent firms reported using advanced technology presently. The technology adoption cycle depicts that only a few firms are early adopters. Most of the Punjab manufacturing firms decided to adopt new technology after its performance has been proved or after it has become popular. There isn't strong evidence to prove that the govt. agencies motivate new technology adoption in Punjab manufacturing sector. The analysis also reveals that new technology adoption is not the result of government regulations. A few old, large sized, public limited and private limited firms agree that industrial policy induces new technology adoption by giving incentives. Analysis on the basis of barriers to new technology adoption depicts that most of the firms consider cost of acquisition of new technology, cost of training and education, workers resistance and obsolescence of technology as important barriers to new technology adoption.

Investment in R&D as percentage of expenditure is very low in the manufacturing sector of Punjab. The analysis based on the impact of innovation activity undertaken by the firms shows that maximum number of firms felt there is high impact of innovation activity on increasing range of goods and services, increasing market share, improving production and flexibility, improving environmental impact or health safety aspects, meeting regulations and standards and improving quality of goods and services. The manufacturing firms report a high impact of innovation activity in reducing labour costs and reducing material and energy. A majority of the firms have fewer than 5 trademarks. Percentage of staff employed in R&D activities is less than 5 percent for most of the firms. On the whole the results depict that large scale firms have performed better in the post-reform period. So the null hypothesis is accepted. The old firms have responded positively to the liberalisation, privatisation and globalisation and the concerned hypothesis is also accepted.

The factor analysis depicts that there are six factors which influence the overall performance and employees performance in Punjab manufacturing sector. These are: i) size, training and accreditation of firm ii) employee compensation iii) market share and skill of the employee, iv) work orientation and attitude of worker v) sales and investment and vi) composition of employees. These six factors explain 70.167 percent of total variance. Factors influencing technology adoption are: i) barriers to new technology adoption ii) role of government and technology adoption iii) globalisation and technology adoption iv) technology adaptation: cost and level of preparedness v) adjustment within the firm and vi) type of technology used. These six factors explain 70.659 percent of total variance. Three factors emerged as a result of factor analysis determining the impact of research and development in Punjab manufacturing: These are: innovation activity and IPRs, investment and percentage of employees in R&D and number of trademarks. These three factors explain 74.223 percent of total variance.

Analysis of the mean score of these factors highlights that the important factors influencing overall performance and employees performance of Punjab manufacturing are: composition of employees, sales and investment, employee compensation, and work orientation and attitude of worker. The mean of these four factors is greater than overall mean score of 3.53. The important factors influencing technology adoption in Punjab manufacturing are: barriers to new technology adoption, and globalisation and technology adoption. The mean of these two factors is greater than overall mean score of 3.19. Only one factor, i.e., innovation activity and IPRs, has a higher mean than overall mean of 2.60. So this factor is an important factor in impact of research and development.

Chapter 9

CONCLUSIONS

The basic purpose of this study has been to investigate the impact of new policy regime on the adjustment process of manufacturing sector in Punjab. This chapter discusses the conclusions, policy implications, limitations of the study and finally gives recommendations for future work.

The present study uses both primary and secondary data. The study analyses the trends in labour productivity, capital productivity, capital intensity and total factor productivity at aggregate level and at two digit level for Indian and Punjab manufacturing. For Punjab manufacturing, analysis has also been done for three digit level as well. An attempt has been made to examine the growth rates of output (value added) and inputs (labour and capital). The analysis has been done for the time period 1980-81 to 2002-03. To compare the pre-reform period with post-reform period, the entire period has been divided into two sub periods, period I, 1980-81 to 1990-91 and period II, 1991-92 to 2002-03. An attempt has also been made to isolate the determinants of productivity growth in Indian manufacturing and in Punjab manufacturing. A comparison has been made between the Indian and Punjab manufacturing for aggregate level and for twenty two industrial groups for the entire period as well as for both the sub periods to examine the better performer in the new policy regime.

Primary data has been collected through a structured questionnaire from two hundred manufacturing firms of Punjab covering the industries: engineering goods, bicycle and bicycle parts, hosiery, steel rerolling, sewing machine, and sports goods. The data has been collected from the six major industrial centers of Punjab, i.e., Ludhiana, Jalandhar, Amritsar, Gobindgarh, Patiala, and Mohali. The questionnaire has four sections. Section A covers the overall performance, section B deals with employees, section C relates to impact of globalisation on technology adoption and adaptation, and section D concerns itself with research and development. The primary data analysis has been done on the basis of age, size and type of organization to trace the adjustment of manufacturing in response to the new policy regime. The statistical tools used to analyse the data are tabular analysis, chi square test and factor analysis.

9.1 Major Findings of the Study

For Indian manufacturing the aggregative analysis depicts an overall long term growth of 7.78 per cent per annum in value added during 1980-81 to 2002-03. This has been associated with a rapid growth of capital (6.05 percent per annum) and a low growth of employment (0.65 percent per annum). Labour productivity for the entire period shows an increase of 7.09 per cent per annum while capital productivity increases at a rate of 1.64 per cent per annum. Capital intensity for the entire period increases at a rate of 5.36 per cent per annum. The estimate of total factor productivity growth for Indian manufacturing is 1.24 per cent per annum over the entire period, 1980-81 to 2002-03. Total factor productivity growth decelerates during the post-reform period. The TFP for pre-reform phase is 1.53 per cent per annum, while in the post-reform phase it decreases to 0.44 per cent per annum.

The growth rate of value added and labour decelerate in the post-reform period. Capital grows at a higher rate in the post-reform period but it has not transformed into higher productivity growth. This increase in capital may lead to higher growth in productivity in the coming years. Labour productivity declines in the post-reform period. Capital productivity also declines and becomes negative in the post-reform period. For total manufacturing sector partial productivity as well as total factor productivity decelerate in the post-reform period. Thus the aggregative analysis depicts a deceleration in productivity in Indian manufacturing in the new policy regime.

The results of disaggregative analysis depict that value added has been the highest for the wearing apparel, dressing and dyeing of fur industry (18). Growth rates of value added have been higher for sixteen industrial groups in the pre-reform phase. Growth rates of labour are higher for fourteen industrial groups in the pre-reform phase. Growth rates of capital depict acceleration in eighteen industrial groups in the post-reform phase. Thus the post-1991 period has been associated with lower growth in value added and labour and higher growth in capital. Analysis of the partial productivities depicts a higher growth of labour productivity in the second period of analysis, in twelve out of twenty-two sectors, while capital productivity has been higher in the first period of analysis, in fifteen out of twenty-two sectors. Capital intensity grows at a higher rate for nineteen industrial groups in the post-reform phase.

Growth rate of total factor productivity has been the highest for wood and products of wood and cork, except furniture, articles of straw and plating materials (20). This is followed by tobacco products (16) and furniture (36). These sectors report higher growth in labour productivity and capital productivity. Lower growth rate of total factor productivity are recorded for: radio, television and communication equipment and apparatus (32) and rubber and plastic products (25). Growth rates of total factor productivity have been higher for the sixteen industrial groups in the pre-reform phase. Partial productivity and total factor productivity decelerate for most of the industrial sectors in the manufacturing sector of India in the new policy regime. The results of this study are corroborated by several studies covering the period of 1991 reforms [Balakrishnan et al. (2000), Srivastava (2000), Trivedi et al. (2000), Das (2003), and Goldar and Kumari (2003)]. Thus in the near future there is need for greater impetus on productivity for the sustainability of growth of the manufacturing sector as productivity growth is still far from satisfactory.

For Indian manufacturing the regression results show that the coefficients for output growth variable are positive and statistically significant for almost all the industries. A positive and significant relationship has been observed between capital intensity and total factor productivity in ten out of twenty two industries. The result of regression depicts a significant and positive relationship between total factor productivity and growth in the number of factories in eight industries. Regression coefficients of investment are significant in wood and products of wood and cork, except furniture, articles of straw and plating materials (20), coke, refined petroleum products and nuclear fuel (24), rubber and plastic products (25) and other non-metallic mineral products (26). Investment is positively related to total factor productivity for twelve industries. The regression coefficients of total emoluments are positive and significant for tobacco products (16), tanning and dressing of leather, luggage, handbags saddlery, harness and footwear (19), other non-metallic mineral products (26) and furniture (36). Scale variable enters in many industries with a negative sign.

Although there have been some studies covering Indian aspect, there is no study covering productivity aspects in Punjab manufacturing. For the Punjab manufacturing sector at aggregate level the overall long term growth of 7.91 per cent per annum in output during 1980-81 to 2002-03 has been associated with a rapid growth of capital (5.21 percent per annum) and an average growth of employment (3.01 percent per annum). Comparing the annual growth rates during 1980-81 to 1990-91 with those of 1991-92 to 2002-03, it has been found that there is a decline in growth rate of value added from 9.65 per cent per annum in period I to 3.04 per cent per annum in period II. Both capital and labour also show deceleration in the post-reform period.

Labour productivity for the whole period has shown an increase of 4.76 per cent per annum while capital productivity increases at a rate of 2.57 per cent per annum. Capital intensity for the entire period increases at a rate of 2.14 per cent per annum. Estimates for the sub-periods reveal differences in the growth rates. Labour productivity increases at a higher rate, i.e., at 3.98 per cent per annum in the pre-reform period as against 1.72 per cent per annum in the post-reform period. Capital productivity also shows a rising trend in the first period of the analysis and it decreases in the second period. Capital intensity which is negative in the pre-reform period becomes positive and is higher in the post-reform period.

The estimate of total factor productivity growth of Punjab manufacturing is 1.25 per cent per annum for the total period, i.e., from 1980-81 to 2002-03. Total factor productivity growth decelerates during the post-reform period. Estimates of pre-reform phase are 1.71, while in the post-reform phase total factor productivity decreases to 0.46 per cent per annum. So the aggregative analysis demonstrates that in the new policy regime there is a deceleration in labour productivity, capital productivity and total factor productivity in the manufacturing sector in Punjab.

Sector wise analysis depicts that in terms of value added, the growth rate for manufacturing sector has been higher for thirteen industrial groups in the pre-reform phase, while nine groups depict higher growth in the post-reform phase. The highest growth rate of value added is recorded for wearing apparel, dressing and dyeing of fur (18), followed by other non-metallic mineral products (26) and food products and beverages (15). The lowest performance is reported by: coke, refined petroleum products and nuclear fuel (23) sector, which depicts a negative rate (-1.57) for the entire period of the analysis. The highest growth rate of capital is recorded for other non-metallic mineral products (26) followed by tobacco products (16) and wearing apparel, dressing and dyeing of fur (18). Capital growth is the lowest for the machinery and equipment n.e.c (29) sector during the entire period of the analysis. Eleven sectors depict higher growth of capital in the post-reform period.

Rate of growth of labour is the highest for other transport equipment (35), industry followed by wearing apparel, dressing and dyeing of fur (18), and radio, television and communication equipment and apparatus (32). Labour growth is the lowest for the basic metals (27), i.e., (-0.67) for the entire period. The manufacturing sector depicts a slow down of labour growth in the post-reform period for ten out of twenty two sectors. The picture is slightly better for the labour productivity for the entire period as nine sectors depict growth rate of more than 7.5 per cent per annum but even in this case labour productivity is higher in fifteen sectors in the first period of analysis. Labour productivity shows improvement in only seven sectors in the post-reform phase.

A look at capital productivity trends depict that for eleven manufacturing industries, capital productivity is negative for the entire period of analysis and there are only three industrial groups depict growth rate more than four percent. These are: food products and beverages (15), tanning and dressing of leather, luggage, handbags saddlery, harness and footwear (19) and rubber and plastic products (25). The picture is not very bright on the capital productivity front also. Trends in capital productivity for the two sub-periods depict that capital productivity is higher for most of the sectors in the first period of analysis, i.e., the pre-reform era and in the post-reform era only seven out of twenty two sectors depict an improvement in capital productivity. So the trends depict a lower growth of both capital productivity and labour productivity for most of the industrial groups in the post-reform period.

An analysis of total factor productivity shows a deceleration in productivity in sixteen sectors in the nineties onwards era, i.e., the period associated with liberalisation and reforms. Out of twenty two sectors, only six sectors depict higher productivity in the post-1991 phase. Wood and products of wood and cork, except furniture, articles of straw and plating materials (20), depicts the highest growth in total factor productivity for the entire period, followed by food products and beverages (15) and furniture (36). All these three industries depict a higher growth in labour productivity, comparatively higher than in other sectors, the growth rate being 7.5-10 percent. In terms of capital productivity also the growth rate is between 2-3 percent in these three industries. Paper and paper products (21), chemicals and chemical products (23), basic metals (27), and electrical machinery and apparatus n.e.c. (31) sectors depict a negative growth for the entire period. These sectors have not performed well on productivity front. Overall analysis is indicative of the fact that total factor productivity decelerates for most of the industrial groups in Punjab manufacturing in the new policy regime.

The present study has been undertaken with the view that productivity has improved in the post-1991 period, the period of new policy regime for Indian as well as Punjab Manufacturing. However the results of the study highlight that the productivity has not improved in the post-1991 period, the period of new policy regime for India and Punjab. Thus the first hypothesis is rejected.

The regression results on the basis of analysis of the determinants of productivity for Punjab manufacturing depict that coefficients for output growth variable are positive and statistically significant in all the industries. A significant positive relationship between output growth and total factor productivity growth has been observed in a number of earlier studies. Kendrick (1961, 1973) and others have pointed out that productivity growth and output growth are interrelated. Just as productivity growth can be seen as an effect of output growth because of differential scale economies and technological progress that it creates, output growth may also be seen as a consequence of productivity growth because of lowering of costs and prices that the latter leads to and the increase in demand that fall in prices themselves lead to.

A significant and positive relationship has also been observed between capital intensity and total factor productivity in eight industries. The regression coefficients of total emoluments are positive for most of the industries. Motivation is basic to all human behavior and it leads to improvement in productivity. Productivity depends on financial incentives provided to workers and other employees. This includes the methods of paying wages and salaries, rewards and other incentive plans. The regression coefficients of total emoluments are significant for eight industries. The regression coefficients of investment are positively related with total factor productivity for the entire manufacturing and for wood and products of wood and cork, except furniture, articles of straw and plating materials (20), printing and reproduction of recorded media (22), chemicals and chemical products (23), electrical machinery and apparatus n.e.c. (31), and furniture (36). In most of the sectors investment coefficients are negatively related to total factor productivity. Scale variable enters in many industries with a negative sign. This could be due to its relationship with other variables included in the model.

The regression results show that the coefficients for output growth variable are positive and statistically significant for almost all the industries. The results are true for Indian as well as Punjab Manufacturing. Thus the results highlight that the hypothesis is accepted as the rate of output growth emerges as an important determinant of productivity.

A comparison of the Indian manufacturing and Punjab manufacturing at aggregative level depicts that the India manufacturing grows at a higher rate in terms of capital, labour productivity and capital intensity. On the other hand, the rate of growth of labour and capital productivity is higher for Punjab manufacturing. The growth rate of value added and total factor productivity depicts similar trends for both the Indian and Punjab manufacturing. Analysis of sub-period analysis reveals that output growth rate declines in the post-reform period both for the Indian and Punjab manufacturing sector with the decline being sharper for Punjab manufacturing. The rate of growth of capital for India manufacturing increases slightly in the post-reform period. For Punjab manufacturing, this growth rate decelerates in the post-reform period. The post-reform period is associated with a deceleration in employment for both Indian and Punjab manufacturing.

For Indian manufacturing, capital productivity declines and becomes negative in the post-reform period. Punjab manufacturing depicts a similar trend and also shows a deceleration in capital productivity in the post-reform period. Labour productivity also decelerates in the new policy regime both for the Indian manufacturing as well as for Punjab manufacturing. On the other hand, capital intensity registers an increase for Indian as well as for Punjab manufacturing. The results for the total factor productivity for the entire period are almost similar for Indian and Punjab manufacturing. Both Indian manufacturing and Punjab manufacturing depict a deceleration of total factor productivity in the post-reform period.

Comparing pre-reform period with post-reform period, six out of twenty two sectors depict higher output growth in the post-reform period for Indian manufacturing and nine sectors depict higher output growth for Punjab manufacturing in the same period. Eighteen sectors depict growth in capital in the post-reform period for Indian manufacturing and twelve sectors depict higher capital growth for Punjab manufacturing in the same period. Growth rate of labour depicts deceleration in fourteen sectors during the post-reform era in case of Indian manufacturing. On the other hand ten sectors depict deceleration in rate of growth of labour in the manufacturing sector of Punjab for the same period. Further sectoral analysis reveals that twelve sectors of Indian manufacturing and seven sectors of Punjab manufacturing depict higher labour productivity growth in the post-reform era. Seven sectors of Indian manufacturing and nine sectors of Punjab manufacturing depict growth in capital productivity in the new policy regime. In case of capital intensity, nineteen sectors of India and eighteen sectors of Punjab manufacturing depict higher growth in post-1991 era.

The highest growth rate of total factor productivity is recorded for wood and products of wood and cork, except furniture, articles of straw and plating materials (20) for both Indian and Punjab manufacturing. Sixteen sectors of Indian manufacturing and fifteen sectors of Punjab manufacturing depict declining rate of growth of total factor productivity during the post-1991 period. A deceleration is recorded in partial productivity and total factor productivity for most of the industrial sectors in both the Indian manufacturing and Punjab manufacturing in the new policy regime. The performance of Indian and Punjab manufacturing decelerates in the new policy regime. The next hypothesis was to test whether the impact of new policy regime on the adjustment process of Punjab manufacturing sector is significantly different from that of India. As the results depicts that the impact of new policy regime on the adjustment process of Punjab manufacturing sector is not significantly different from that of India. So the above hypothesis is rejected

Different sectors have adjusted differently in the new policy regime. Different factors identified for primary data analysis are: output, labour, capital, technology and research and development. The results of the survey depict that the turnover is less than 50 crores for the new and small firms as well as for large and old firms. Public limited firms with large turnover are less in number. Market share of older firms is much higher than the new firms. Only a few private limited firms have higher market share.

Investment as a percentage of total expenditure is higher in large sized and older firms. But the percentage of investment by foreign companies in Punjab is less. Old, big, public limited and private limited firms have gone for the upgradation of new machinery and equipment. Similar results are evident from the investment in computer hardware and software. Large and old firms have also gone for accreditation/certification. Total sales and net profit rate of all the firms have increased during the last ten years. Technically skilled employees as percentage of total employees are fewer in the new, small sized firms, single proprietary, partnership and private limited firms. Punjab manufacturing has a dominance of male employees.

Majority of the firms responded with an increase in percentage of labourers after 1991 reforms. Old, medium aged and large sized firms have organized more training programmes for the employees during the last ten years. Public and private limited firms have organized more training programmes for the employees but the number is still low and should be enhanced. As far as benefits to employees are concerned, the survey results depict an increase in the benefits to the employees in old, medium and large sized firms. The public limited and private limited firms report an increase in the benefits to employees. Old, medium aged and new firms have responded with good work orientation and attitude of the workers. Size wise analysis and organizational structural analysis also highlight similar trends.

Almost all firms agree that the availability of better technology after the globalisation stimulated new technology adoption. Thus in the new policy regime, the manufacturing sector of Punjab started adopting new technology at a higher rate due to its better availability. Opportunities created due to globalisation in the form of international markets encouraged almost all the firms to switch over to new technology. This is a healthy trend as Punjab manufacturing is responding to reforms by encouraging new technology adoption. Threats in the form of competition in the markets have also induced the firms to go in for new technology adoption.

The highest average rating given by the firms is to increased sales. The second highest average rating is given to improved productivity. The lowest rating is given to the increased net profits. Most of the manufacturing firms reported of having adopting new technology 1 to 5 years ago. 50 percent of the respondent firms are using advanced technology. Only a few firms are early adopters of new technology, i.e., adopting it immediately. Most of the Punjab manufacturing firms decided to adopt new technology after its performance has been proved or after it became popular.

Effort has also been made to understand the role the government agencies play in motivating new technology adoption. The analysis reveals that there is no strong evidence to prove that the govt. agencies motivate new technology adoption in Punjab manufacturing sector. Only in case of a few old and large manufacturing firms there is some supportive evidence of motivation by the govt. agencies to help them adopt new technology. Hence all this highlights that the govt. has to initiate strong steps to facilitate the adoption of new technology. A few old, large sized, public limited and private limited firms agree that industrial policy induces new technology adoption. Cost of acquisition of new technology and cost of training and education are considered as important barriers to new technology adoption. Schemes like providing loans or getting new machinery etc. on installments where low interest rates could be charged would help to overcome these barriers.

An analysis of research and development highlights that investment in R&D as percentage of expenditure is very low in the manufacturing sector of Punjab. In an industry which is fast changing, firms must continually revise their design and range of products. To compete in this globalized world, the investment in R&D must be increased. The firms felt that there is high impact of innovation activity on increasing range of goods and services, market share, improving quality of goods and services, improving production and flexibility, improving environmental impact or health safety aspects, and meeting regulations and standards. Firms perceive that innovation activity helps in reducing labour costs. A majority of the firms have fewer than 5 trademarks. Percentage of staff employed in R&D activities is less than 5 percent for most of the firms. Performance of R&D activities is moderate in most of the firms. Steps have to be taken to improve the performance of R&D activity in the manufacturing sector to make it more competitive.

On the whole the results depict that large scale firms have performed better in the post-reform period. So the null hypothesis that large scale firms have performed better in the post-reform period is accepted. The old firms have responded positively to the liberalisation, privatisation and globalisation and the concerned hypothesis that old firms have responded positively to the liberalisation, privatisation and globalisation is also accepted.

Factor analysis was also conducted to find out the factors influencing a) overall performance and employees performance, b) technology adoption, and c) research and development. The factor analysis shows that there are six factors which influence the overall performance and employees performance of Punjab manufacturing sector. These are: i) size, training and accreditation of firm ii) employee compensation iii) market share and skill of the employee, iv) work orientation and attitude of worker v) sales and investment and vi) composition of employees. These six factors explain 70.167 percent of total variance.

There are six factors influencing technology adoption: i) barriers to new technology adoption ii) role of government and technology adoption iii) globalisation and technology adoption iv) technology adaptation: cost and level of preparedness v) adjustment within the firm and vi) type of technology used. These six factors explain 70.659 per cent of total variance. Three factors determining the impact of research and development on Punjab manufacturing are: innovation activity and IPRs, investment and percentage of employees in R&D, and number of trademarks. These three factors explain 74.223 per cent of total variance.

The mean score of the above factors has been calculated to find out the important factors. The result of the mean score of the factor overall performance and employees performance factor highlights that the mean score of (i) composition of employees, (ii) sales and investment, (iii) employee compensation, and (iv) workers orientation and attitude of worker is greater than overall mean score of 3.53. The mean of barriers to new technology adoption, and globalisation and technology adoption factors is greater than overall mean score of 3.19. These two factors are considered important factors influencing technology adoption in Punjab manufacturing. The most important factor influencing impact of research and development in Punjab manufacturing is innovation activity and IPRs. The mean of this factor is greater than overall mean score of 2.60.

9.2 Policy Implications

The findings of this study have significant policy implications for the Punjab manufacturing firms and other related firms. Based on the study findings, the following policy implications can be offered.

The Punjab manufacturing sector is using higher inputs but still the performance in terms of productivity is low and needs to be improved. Most of the industries use more of capital input. Focus has to be concentrated on efficient use of capital. The higher growth of capital in the production, suggests that many manufacturing industries are moving towards more capital intensive production. This calls for steps to use capital judicially along with labour. The efficient usage of capital could make important productive contribution to the industrial sector of Punjab.

The study suggests that specific guidelines are required to increase productivity in industries in Punjab. Industries with low TFP require the introduction of new frontier technology.

Government policy should encourage investments which can lead to the introduction of new production technology. The cost and quality of products has to be considered as essential factors for increasing productivity. Policy formulation and implementation in infrastructure and competition have also to be considered crucial. TFP can increase as a result of the interaction between policymakers and the resilience and adaptability of the Indian/Punjab manufacturing sector in a highly competitive era.

Highly productive manufacturing sector requires highly skilled labour. The manufacturing sector of Punjab has a small proportion of skilled labour. The lack of skilled labour is an obstacle to the development of the manufacturing sector of Punjab. The immediate task for the government is to increase the number of skilled workers and also to improve labour skills by establishing more vocational training centres, improving the quality of the education, and having more science and technology degree programmes offered by the universities and also by conducting such programmes within the firms. The government can also augment skilled labour by putting schemes in place to encourage private firms to train their own employees. Besides this the incidence of employee training is very low in Punjab manufacturing. Large firms conduct more training than small firms and most training goes to skilled workers and managerial level officers. Focus should be laid on organizing suitable training programmes for all levels of workers to help the use of the new technology efficiently. Training has a substantial effect upon TFP and increased training results in higher productivity. The firms can take steps to improve productivity by imparting proper training to labour to equip them with new technical skills.

Punjab manufacturing is dominated by small scale enterprises. Small firms are constrained by available resources that can be allocated for adoption of new technologies. In fact, the level of technology used in these industries is quite low, which results in low productivity and poor quality of products, thus leading to competitive disadvantage both in domestic and global markets. These small scale firms have to be supported by the government to acquire new technology. These firms need to realize the benefits of new technologies for surviving the competition. Thus upgradation of technology is essential for most of the small scale industrial units. Credit facilities made available to the firms at low rates of interest will help solve this problem. Need based financing for technology upgradation, and meeting standards etc. should be allowed at low term deposit rates.

The research and development facilities available in the Punjab manufacturing are inadequate and investment in R&D is very low. The firms have to realize that R&D is the drive towards higher productivity. Investment in R&D should be increased to enhance productivity. Besides this, new innovations can keep the countries on edge. The firms have to realize that R&D is necessary for survival as it creates and differentiates the products from competitors. The firms are not able to compete with low skilled products and higher labour cost. To survive, the firms have to compete in capital-intensive products, in which new R&D and skills are needed. Investment in R&D will result in improved quality of goods and increased range of goods. Hence the number of research centers, expenditure on R&D and percentage of employees in R&D activities should be increased.

The use of advanced information and communication technology (ICT) has to be increased in the Punjab manufacturing. Investment in computer hardware and software has to be inceased by the firms. Internet helps to reduce cost and time of communication, and hence is a powerful tool for manufacturers to market their products by presenting their firm's profiles on the global market. This improves competitiveness of the firms. The internet can also helps manufacturers to become retailers of their own goods by directly reaching target consumers. Further, the ICT is an important tool to access global market information any time, anywhere.

Industrial policy should help provide incentives for new technology adoption. Acquiring new and latest technology can significantly raise firm productivity. The study suggests that there should be ample role for the government sponsored efforts to encourage plant modernization. The services related with such policies may be provided by public, non-profit, or private organizations. One approach is to directly provide technology assistance to the manufacturing firms. As training is important for technology adoption, there is a need for public support and effort on the part of the firms to stimulate training. This is especially likely to be useful where training can be improved for existing workers, for example through apprenticeship and skill upgrading.

The government should take effective measures to market Punjab as an investment destination, especially for foreign direct investment. Foreign direct investment brings productivity spillovers and higher wages. The government should create a steady political environment in the state to attract investment. Incentives have to be provided by the state for investment. Foreign direct investment gives opportunities to Indian and Punjab industry for technological upgradation, for gaining access to global managerial skill and practices, optimizing and utilizing human and capital resources and competing internationally with higher efficiency. FDI is essential for India's integration into global production chains, which involves production by multinational corporations spread across locations all over the world. The FDI in India/Punjab is still quite restrictive and foreign ownership of between 51 and 100 percent of equity still requires a long procedure of governmental approval. There should be automatic approval for 100 percent foreign ownership except on a small list of sectors that may continue to require government authorization. Further deregulation of FDI in industry and simplification of FDI procedures is called for.

Labour is a life line of the manufacturing sector. For the development of the industry, investment in human capital is important to maximize the benefits of new technologies and to improve methods of developing customer relations. For this knowledge, skills and education levels should be promoted. Labour welfare and productive employment generation in the manufacturing sector will have to be ensured. Moreover for the protection of interests of workers in the manufacturing sector, strengthening of existing legislation and introduction of new legislation is required. These laws should aim at regulating employment and conditions of service as safety, health and welfare measures for the workers in the manufacturing sector. Adequate levels of earnings, access to minimum social security benefits, and safe and humane conditions of work are the major qualitative dimensions of employment which enhance quality of life of workers and their productivity. This calls for increased emphasis on labour welfare schemes viz. old age benefits, housing, medical facilities etc.

Thus for the development of the Punjab economy due care has to be taken of the manufacturing sector development of Punjab for which a strong industrial support system and conducive economic environment is needed. There is a need for greater impetus to be given on productivity in the Punjab manufacturing sector for the sustainability of growth of the manufacturing sector. Focus has to be laid on technological innovation, which can be the prime enhancer of productivity. In this changing environment of greater openness and competitiveness there is an urgent need for the industries to became more productive and thus help the economy achieve a higher growth. A package of well formulated policies needs to be introduced which can help increase productivity, technological development and reform process in Punjab manufacturing.

9.3 Limitations of the Study

The limitation of the present study originate mainly from the database and the methodology used. Estimates of output and input in the present study are not free from certain biases. There are conceptual problems in the measurement of capital and these are very difficult to overcome. The standard methodology used in this study also has certain limitations. The measure of total factor productivity growth used in this study is derived from a Translog production function under the assumption of competitive equilibrium (where the factors are paid the value of their respective marginal products) and constant returns to scale. These assumptions have been frequently questioned in literature. In case of primary data the respondents often do not give the truthful and reliable feedback. There are always chances of sampling errors as well.

9.4 Recommendations for Further Research

The present study deals with organized manufacturing sector and can be extended over to the unorganized manufacturing sector. Detailed analysis can be undertaken to see the impact of technology, especially technology adoption and technology adaptation on Punjab manufacturing. Investigations of impact of technology adoption along with the findings in this study will not only deepen the understanding of motivators and facilitators of technology adoption but also provide more detailed directions for future research. By including extensive factors, a comprehensive framework of technology adoption and its rigor can be built. It would be useful to concentrate future research on determining the contribution of foreign capital and technology to the productive performance of the Punjab manufacturing industries. The firm level analysis can be taken up to see the impact of reforms especially by taking into account R&D intensity, investment climate and foreign direct investment. At firm level further study aiming at the level of investment by each firm may be needed to address the effect of investment variations on firm productivity. For a more comprehensive study, the effect of level of technology application by each firm, the work methods employed, and the work ethics of employees on the productivity of these firms needs further investigation.

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APPENDIX A

QUESTIONNAIRE

QUESTIONNAIRE ON NEW POLICY REGIME AND ADJUSTMENT PROCESS OF MANUFACTURING SECTOR IN PUNJAB

ORGANIZATION PROFILE

Organization Name	
Organization Address	
Survey Respondent's Name and Designation	
Respondent's E-mail/Address	
Please return the completed questionnaire to:	Ms Manpreet Kaur, Research Scholar, School of Management and Social Sciences, Thapar University, Patiala, Punjab, India. E mail-manpreet.smss@gmail.com Ph. No. 0175-2393080 (O), Mobile-09417467232

SECTION A: OVERALL PERFORMANCE (Please tick the appropriate option)

1.	Type of firm	Large Scale		Medium Scale	Small Scale	
2.	Year of Establishment					
3.	Selling in (Percentage)	Punjab		Rest of Punjab	Abroad	
4.	Type of Organization	Single Proprietary	Partnership	Public Limited	Private Limited	
5.	Present Turnover (In Crores)	<10	11-50	51-100	101-250	>250
6.	Market share	<10%	11-25%	26-50%	51-75%	>75%
7.	Investment made as percentage of total expenditure during last ten years	1-20	21-40	41-60	61-80	>80
8.	Gross Value of plant and machinery as at the end of accounting yr(Rs.in lakhs	<5	6-10	11-20	21-30	>30
9.	Percentage of Investment by Foreign Companies in your firm	<5	6-10	11-15	16-20	>21
10.	Investment made in the following areas as %age of total expenditure					
(i)	New Machinery and Equipment	1-20	21-40	41-60	61-80	>80
(ii)	Computer Hardware and Software	1 to 10	11 to 20	21 to 30	31 to 40	>40
10	Accreditation/Certification of the firm	Yes ☐	No ☐			

11	Total Sales (last ten years)	Substantially Decreased	Marginally decreased	Remained the same	Marginally Increased	Substantially Increased
12	Net Profit rate (over the past ten years)	Substantially Decreased (>-10%)	Marginally Decreased (upto-10%)	Remained the same	Marginally Increased (upto-10%)	Substantially Increased (>+10%)

SECTION B: EMPLOYEES (Please tick the appropriate option)

1.	No. of Employees	0-50	50-100	100-200	200-400	>400
2.	Technically Skilled Employees as percentage of total employees	5-10%	1-20%	20-40%	40-60%	>60%
3.	Training Programme organized for Employees in last ten years	1-2	3-5	6-8	9-10	Above
4.	Percentage of Male in Total Employees	20-30%	30-40%	40-60%	60-80%	80-100%

5.	Other benefits to employees:						
			Substantially Decreased 1	Marginally Decreased 2	Remained the same 3	Marginally Increased 4	Substantially Increased 5
	(i)	Employees Contribution to old age benefits in (Rs.)					
	(ii)	Employees Contribution to other social security charges (Rs.)					
	(iii)	Other benefits					
	(iv)	Total (i) to (iii)					
6		Percentage of Labourers after 1991 reforms					
7		How do you rate the work orientation and attitude of the workers of your firm?	Very Poor	Poor	Moderate	Good	Very Good

SECTION C: IMPACT OF GLOBALISATION ON TECHNOLOGY ADOPTION & ADAPTATION

(Please tick the appropriate option)

1. Impact of Globalisation

(i)	Availability of better technology stimulated new technology adoption	Strongly Disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5
(ii)	Opportunities: International markets encouraged firms for adopting new technology					
(iii)	Threats: competition in market induced new technology adoption					

2. Prioritize the expectations of your firm after adoption and adaptation of new technology. (Highest Priority 1)

	Expectation	**Priority (1 to 5)**
(i)	Increase in Sales	
(ii)	Increase in Net Profits	
(iii)	Increase in Product Quality	
(iv)	Increase in Market Share	
(v)	Increase in Productivity	
(vi)	Decreased Product Cost	

3. Technology Adoption

(i)	Adoption of new technology for the first time	< 1 year	1-5 years ago	5-10 years ago	10 -15 years ago	More than 15 years ago
(ii)	Present technology being used	Quite old	Conventional	Intermediate	Advanced	
(iii)	Basis for adoption of new technology	In dire need	After its performance is proved	When it is getting popular	Immediately on availability	

4. Role of Government

		Strongly Disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5
(i)	Govt. Agencies motivate adoption of new technology					
(ii)	Govt. regulations are a basis of new technology adoption					
(iii)	Industrial Policy induces new technology adoption by giving incentives					

5. Important barriers to new technology adoption.

	Barriers to New Technology Adoption	Not Important 1	Not at all Important 2	Neutral 3	Important 4	Highly Important 5
(i)	Cost of Acquisition of new Technology					
(ii)	Cost of Training and Education					
(iii)	Workers Resistance					
(iv)	Lack of Qualified Personnel					
(v)	Obsolescence of Technology					

6. Technology Adaptation: Preparedness of your firm for new technology adaptation

(i)	Redesigning organizational structure	Not at all 1	To some extent 2	Moderate extent 3	Considerable extent 4	To a large extent 5
(ii)	Transferring people within the firm					
(iii)	New recruitment of skilled personnel					
(iv)	Imparting training to personnel					
(v)	Encouraging and inducing the employees to accept new technology					

SECTION D: RESEARCH AND DEVELOPMENT (R&D) (Please tick the appropriate option)

1.	Investment in R&D(%age of expenditure)	<1%	1-2	2-5	5-10	>10%
2.	Please Indicate the degree of impact of innovation activity undertaken by your firm.					
	INNOVATION ACTIVITY	**DEGREE OF IMPACT**				
		Very Low	Low	Neutral	High	Very High
(i)	Increased range of goods and services					

(ii)	Increased market or market share					
(iii)	Improved quality in goods and services					
(iv)	Improved production, flexibility					
(v)	Reduced Labour Costs per produced unit/transaction					
(vi)	Reduced material and energy per produced unit/transaction					
(vii)	Improved Environmental impact or Health Safety aspects					
(viii)	Meet regulations and Standards					
3	Number of Trademarks of your firm	<5	6-10	11-15	16-20	>21
4	Percentage of Staff Employed in R&D Activities	<5	6-10	11-15	16-20	>21
5	How do you rate the Performance of R&D activities in your firm	Very Low	Low	Moderate	High	Very high

Thank you for your cooperation

APPENDIX B

Two-Digit Industry Code Description

Industry Code (National Industrial Classification – 1998)	Two-Digit Industry Description
15	Food Products and Beverages
16	Tobacco Products
17	Textiles
18	Wearing Apparel; Dressing and Dyeing of Fur
19	Tanning and Dressing of Leather, Luggage, Handbags Saddlery, Harness and Footwear
20	Wood and Products of Wood and Cork, Except Furniture; Articles of Straw and Plating Materials
21	Paper and Paper Products
22	Publishing, Printing and Reproduction of Recorded Media of India
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, Trailer and Semi-Trailers
35	Other Transport Equipment
36	Furniture

APPENDIX C - Three-Digit Industry Code Description

Industry Code (National Industrial Classification -1998)	Three-Digit Industry Description
151	Production, Processing and Preservation of Meat, Fish, Fruit Vegetables, Oils and Fats
152	Dairy Product
153	Grain Mill Products, Starches and Starch Products, and Prepared Animal Feeds
154	Other Food Products
155	Beverages
160	Tobacco Products
171	Spinning, Weaving and Finishing of Textiles
172	Other Textiles
173	Knitted and Crocheted Fabrics and Articles
181	Wearing Apparel, Except Fur Apparel
191	Tanning and Dressing of Leather, Manufacture of Luggage Handbags, Saddlery & Harness
192	Footwear
201	Saw Milling and Planing of Wood
202	Products of Wood, Cork, Straw and Plaiting Materials
210	Paper and Paper Product
221	Publishing
222	Printing and Service Activities related to Printing
231	Coke Oven Products
232	Refined Petroleum Products
241	Basic Chemicals
242	Other Chemical Products
251	Rubber Products
252	Plastic Products
269	Non-Metallic Mineral Products N.E.C.
271	Basic Iron and Steel
272	Basic Precious and Non-Ferrous Metals
273	Casting of Metals
281	Structural Metal Products, Tanks, Reservoirs and Steam Generators
289	Other Fabricated Metal Products; Metal Working Service Activities
291	General Purpose Machinery
292	Special Purpose Machinery
293	Domestic Appliances, N.E.C.
300	Office, Accounting and Computing Machinery
311	Electric Motors, Generators and Transformers
313	Insulated Wire and Cable
314	Accumulators, Primary Cells and Primary Batteries
315	Electric Lamps and Lighting Equipment
319	Other Electrical Equipment N.E.C.
321	Electronic Valves and Tubes and Other Electronic Components
322	Television and Radio Transmitters and Apparatus for Line Telephony and Line Telegraphy
323	Television and Radio Receivers, Sound or Video Recording or Reproducing Apparatus, and associated Goods
331	Medical Appliances and Instruments and Appliances for Measuring, Checking, Testing, Navigating and Other Purposes Except Optical Instruments
332	Optical Instruments and Photographic Equipment
341	Motor Vehicles
342	Bodies (Coach Work) for Motor Vehicles; Manufacture of Trailers and Semi-Trailers
343	Parts and Accessories for Motor Vehicles and Their Engines
352	Railway and Tramway Locomotives and Rolling Stock
359	Transport Equipment N.E.C.